Sida Evaluation 98/17

Environment-friendly District Heating in China

Five Investment Projects Supported by Concessionary Credits from Sweden

Karlis Goppers

Department for Infrastructure and Economic Cooperation

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Map of China


HEILONGJIANG
Harbin
Changchun
JILIN
NEI MONGOL
Shenyang
LIAONING
Urumqi
XINJIANG
Lop Nor
Huang He
(Yellow River)
Huhhot
Qinhuangdao
BEIJING
HEBEI
TIANJIN
Dalian
Yantai
Yellow Sea
Shijiazhuang
Yinchuan
Taiyuan
NINGXIA
SHANXI
Jinan
SHANDONG
Qingdao
Lianyungang
QINGHAI
Xining
Huang He
(Yellow River)
Lanzhou
GANSU
Xian
SHAANXI
Zhengzhou
HENAN
JIANGSU
Nantong
SHANGHAI
XIZANG
Hefei
Nanjing
ANHUI
Chang Jiang
(Yangtse River)
HUBEI
Wuhan
Ningbo
Hangzhou
ZHEJIANG
East China Sea
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EXECUTIVE SUMMARY

BACKGROUND

The projects evaluated are the five *district heating* investments, part-financed by Swedish concessionary credits, in China during 1993-1995. Their purpose was to introduce and expand district heating systems in the following five Chinese cities: Dalian, Taiyuan, Shijiazhuang, Jiamusi, and Fushun.

The overall objectives on part of the donor BITS were *environmental protection* and *energy conservation.,* and the purpose of the projects was to connect additional building area to the central heat network thus replacing many smaller scattered boilers. The expected effects of the projects were:

- savings in coal consumption when one large, highly efficient, boiler replaces a multitude of stoves and small, inefficient boilers
- savings in gasoline due to less transportation of coal and ashes being needed
- dramatic reductions in polluting particulate emissions, and
- a more reliable supply of heat to the city´s inhabitants.

The cities, where the projects are located belong to the most polluted cities in China, and a direct correlation had been found between air pollution levels and hospitalization for respiratory and other diseases. The Swedish financing covered the import of district heating equipment. The composition of different type of equipment varied between the different projects but covered mainly heat exchangers for sub-stations, shut-off valves, regulating valves, circulation pumps, flow metres, prefabricated insulated pipes, hardware and software products for a computer monitoring system, installations supervision, documentation and training.

Energy and District Heating in China

Coal accounts for 75 % of all energy consumption. Alternative sources of energy cannot significantly reduce the country´s dependence on coal in the foreseeable future as they are too expensive. Improving the country´s energy efficiency today stands out as the government´s main environmental protection strategy in its fight to reduce air pollution and stop increases in green houses gas emissions. Enormous potential for cost effective improvements in energy efficiency remains untapped in China.

About 50 of the 150 cities in northern China are today estimated to have introduced some kind of district heating system, of which only 10 have a modern -*indirect* system. The first DH systems in China were installed around 1950, built according to the *eastern* model developed in the Soviet Union and adopted by Eastern Europe. The Government has today an explicit policy of promoting district heating, and conserve energy by replacing inefficient heating sources with cogeneration plants with an efficiency of 95%, and to improve the country´s living standards by providing more stable and reliable heating and eliminating the need for local transport and handling of coal and ashes.

The Environment

China´s air and water, particularly in urban areas, are among the most polluted in the world. According to estimates of the World Bank as many as 289, 000 deaths a year can be ascribed to air pollution alone not reaching up to Chinese government standards. Overall, the economic *cost* of China´s air and water pollution has been estimated at 3 to 8 % of GDP per year. A major factor in environmental pollution is Chinas extreme dependence on coal for its use of energy, and in particular due to the many small individual boilers and stoves used in industry as well as in households. Environmental problems occur at every stage of the coal chain: mining and disposal of mine waste, coal washing, transport and handling, processing and combustion, and ultimately ash disposal. The World Bank has shown that investments in air pollution abatement can yield benefits of several 100 % higher than the investment cost.

Swedish aid in the field of energy and district Heating
The total Swedish support to the energy sector, outside Eastern Europe, in 1995 amounted to almost 1000 MSEK, but of 100 concessionary credits granted, the five in China, are the only ones in the field of district heating. In the last few years Sweden´s aid program to the Eastern Europe has been very active in aid to energy and environmental projects in general, including support to district heating.

Sweden´s development cooperation with China started in 1979, and by 1985 China had become the biggest recipient of BITS´ aid regarding technical assistance and one of the largest regarding concessionary credits. An area of special interest is environment. Sweden´s experience from development cooperation with China is quite good. Planned objectives were achieved in nearly all projects. The Chinese authorities have in general been found to be competent partners in the dialogue as well as in negotiations.
Sweden´s **concessionary credits** to China started in 1982, and since then credits amounting to more than 5,500 MSEK have been approved. As much as 65 % of the credits have been in the area of telecommunications. During later years there has been a focusing on *district heating* (totaling 145 MSEK) and on municipal sewage treatment and water purification. Of the credits, so far only the telecommunication projects have been evaluated. The current volume of total Swedish concessionary credits to *all* countries is about MSEK 1,500 a year, with a total grant element of about SEK 400 million. Of the total x accumulated amount of credits since the start of the program in 1980, about **X** % has gone to China, making it the y largest recipient of this type of aid from Sweden.

THE EVALUATION AND METHODOLOGY
Two of the district heating projects were seen as important *demonstration cases* and large expectations were raised with respect to their outcomes.

This is a *comprehensive* ex post evaluation, and covers not only all levels of the projects´ goal hierarchies - inputs, activities, outputs, effects and impacts - but also all the usual aspects and criteria which are important for Swedish aid, among them the six main objectives of Sweden´s development cooperation. The *assignment* was for 35 person-days, of which 20 were spent in the field, visiting the five different cities in four different provinces by plane and by road.
Methodology: *Firstly,* all project information was systematically arranged in a *logical framework* schedule, on the basis of which a *goal hierarchy* model was created for each of the five projects. *Secondly,* project outcomes were analyzed and assessed against *planned* targets at the following five levels:- planning stage, - implementation, - outputs, - effects, and - impacts.

Availability of information: In none of the projects was there anyone at all of the responsible officers who spoke English, so all interviews had to be conducted through an interpreter. This implies an important restriction on the possibility to gather information and insights. There were no reports made available by the Chinese end-users even in Chinese. Availability of documentation for this evaluation was very uneven also in the BITS´ and Sida´s files: regarding the project preparation stage it was adequate, but for the post-decision period there was virtually nothing. This being a *summary* evaluation of five separate investment projects, to be carried out in a limited time, has implications both w.r.t. depth of analysis and availability of data.

FINDINGS

Procurement
In virtually all projects there has been at least some degree of controversy surrounding the procurement process with many claims from the bidding Swedish companies that sound procurement rules had been violated. My impression is that none of the alleged faults were of a very serious nature.

Competitive prices. Even if the procurement procedures used by the Chinese importing agencies is not fully in accordance, at least not in a formal sense, with standard requirements of competitive bidding, the imported goods have been purchased at *competitive prices*.. There seems to have been a keen competition between the half dozen Swedish companies that are considered to be internationally competitive suppliers in the field of district heating. One reason for the keen competition is no doubt the very skillful negotiating techniques of the Chinese importers. Not only are the prospective suppliers tapped for a considerable amount of expert advice which in the pre-contract period, but they are also squeezed hard in price negotiations.

Implementation

In all of the projects the Swedish equipment has generally been delivered according to contract and overall found to be of expected quality and function. Some of the client companies stated that the Swedish suppliers had completed the project to full satisfaction. All companies have, however, a list of, mainly minor, complaints.

All of the projects are experiencing *delays* of between one and two years. In a few cases part of the delay was due to the hesitation on part of the Bank of China to act as intermediary for the credit, because it had a suspicion regarding the solvency of end-user. In other cases it had to do with the parallel construction of a power plant outside of the control of the end-user. As of May 1998 about two thirds or more of the equipment has been installed. Most of the equipment was put into operation on schedule and, after test runs, found to perform basically as per specified requirements, however with some exceptions.

Results

….overall Swedish equipment is performing well….

Test runs show the performance of the imported equipment basically to meet the specified requirements, a major part running very smoothly and efficiently. Some clients emphasized the benefits created by the Swedish delivery: *"it changed our heating methods, the way we provide heat to the consumer;.....The Swedish technology is very advanced, more so than our own equipment in this field; Judging from the test tuns made we think that the equipment is very good;.....The output and the benefits of the system we think will be the ones as planned"*

….but there are some problems…

All of the end-users, however, also points out a number of, mainly, minor problems. Among them: noise level of pumps; lack of spare parts for the frequency converters; problems with the computerized monitoring system; malfunctions in the foaming machine; still inadequate training. Some of the end-user's staff harbor considerable discontent about the Swedish equipment and their functioning. The most serious points noted by this evaluation are the following:

- In a few projects some of the pumps vibrate and shake and make too much noise
- An acute lack of original spare parts is a problem experienced by technicians in all the projects and w.r.t. most of the Swedish equipment. This is not surprising for management preferred to use the available credit funds for hardware at the expense of spare parts.
- There are many indications that the amount of *training and supervision* in the contracts was insufficient. There was a temptation for the end-users to use money, potentially destined for training and supervision purposes, to import additional equipment in stead. Today many wish that more had been included.
- In one project four computers were delivered two years ahead of their intended installation, making them obsolete already at the time they were put in operation.
- In one of the projects too small valves were delivered, and they can today not satisfy their regulatory function.

- At least one of the end-users is not satisfied with the after-delivery service provided by the Swedish supplier, feeling that they have not received prompt response and help when needed. One reason for this could however be that the Swedish supplier believes that its obligations as per contract have already been used up.
- In one project the control system of the boilers is not functioning due to lack of spare parts.

There are varied reasons for the malcontent with different equipment. It has not been possible to determine exactly who, in each particular case, is in the right and who is wrong. All things having been said and considered, I tend to believe that the shortcomings as exposed, are marginal phenomena, and that basically the equipment is appropriate and functions without problems, and that the critical points, that have been raised, largely belong to what are normal occurrences in commercial life.

However there are some points which seem to be more serious than the others, and which raise questions not only about the competence of the Chinese importing agency, but also about the efficiency and meaningfulness of the donor agency´s planning and negotiating systems. A case in point is when large amounts of equipment were shipped several years before their intended use. In the case of the computers shipped to China two years ahead of their planned installation the supplier´s, and perhaps BITS´, passiveness w.r.t. this faulty delivery can be described as careless or even irresponsible.

Domestic versus imported equipment

Some of the equipment purchased from Sweden could have been bought locally from the Chinese market. Generally one must assume that the local quality is considerably lower, but it would seem likely that if the company had received an untied credit in many cases it would have purchased domestic equipment instead of importing it from Sweden. In a few cases the domestic equipment is actually manufactured by a foreign joint ventures. A case in point is the Alfa-Laval joint venture in Shanghai which produces virtually the same heat exchangers that are imported from Sweden. In general one may perhaps conclude that the reason for choosing the Swedish equipment was twofold: *Firstly,* quality and price were competitive. *Secondly,* Sweden offered the best credit.

Conclusion: Even though, with some exceptions, the Swedish equipment is basically functioning according to plan - the respective clients are not satisfied with all their purchases. There are several reasons for this. *Firstly,* in some cases the equipment may not have had the exact *correct specification* to suit the client´s needs. *Secondly,* there may be a mal function which needs to be adjusted or repaired, but where lack of close relations or disagreements between supplier and client has prevented this from happening in a prompt fashion. *Thirdly,* it would seem that some of the equipment, probably of lower quality, could have been bought in the domestic market at maybe less than half the price. And the only reason for not doing so was because the credit was tied to purchases in Sweden.

In most cases I tend to believe that the quality and durability of the imported equipment may be so superior that it becomes economical even if it costs twice or thrice the price of domestic equipment. But surely we can expect that in some of the cases it would really have been much more economical to buy locally produced goods. However, it is possible that individual products in the complete DH-packages delivered from Sweden are not competitive. It may be difficult for the client to have the expert knowledge to extract some of the equipment and have it delivered from other sources.

Effects

The effects of the projects are:

- a considerable energy conservation, in the order of around 50 %, because of the coal that is saved when one large, highly efficient boiler replaces a multitude of stoves and small, inefficient boilers
- savings in gasoline due to less transportation of coal and ashes being needed
- dramatic reductions in polluting particulate emissions, primarily SO2, CO2 and NOx
- a more reliable supply of heat to the city´s inhabitants

- increased possibility for future expansion
- reduced need of make-up water due to installation of heat exchangers.
- control of water will decrease corrosion inside the pipes, which will lead to longer network technical lifetime
- installation of control valves at the substations will make it easier to balance the system and give better temperature control.

Since none of the projects is yet completed, only a smaller part of the expected effects have yet started to manifest themselves. There is however nothing at present which would indicate that the effects as planned would not be forthcoming once the projects are completed.

Financial analysis

No financial data was available to this evaluation which would permit calculation of *ex post* financial profitability. However, it will suffice with general reasoning to indicate that, most probably, *none* of the projects will be able to achieve its financial target. This is simply due to the fact that all of the project are experiencing delays of between one and two years, and it is clear from the financial analyses carried out during the appraisal that such a long delay in the projects revenues to start materializing would make financial profitability impossible to achieve. Another, contributing factor is that in some of the projects a promised raise in heating tariffs has not materialized. As a result the cost of producing heat has increased more than the revenues collected.

Fallacies of financial analysis

Analysis of the financial rate of return for a state firm operating in a regulated economy is of limited interest, when taxes, subsidies, tariffs etc., can be changed at any moment by a mere administrative or political decision on part of the government. In such an environment, the financial rate of return becomes unreliable as a measure of the strength and quality of a company´s operation. One should then be more concerned with the *economic* analysis of the project, because it is the project´s *economic* profitability which is the correct criterium whether or not a project is worth while and desirable.

The financial rate of return in these projects is important mainly because it will decide whether or not the project can be financed in the commercial market, or whether it needs subsidies by way of e. g. domestic or foreign concessionary credits. The donor agencies today devote a considerable effort to financial analysis because of the demands posed by the OECD. In order to determine that the Helsinki accord rules are being followed, and to make a concessionary credit legitimate the donor is obliged to carry out comprehensive analysis of a project´s financial viability and of its cash flow.

An interesting difference between the *World Bank* and the Swedish DH projects is that the Bank will only support projects which are commercially viable, while bilaterals like Sweden, because concessionary financing is restricted by the OECD "Helsinki rules", are *not allowed* to choose commercially viable projects. This difference has a significant effect on the way projects are managed and analyzed. While the Bank must insist that financial targets are achieved, a bilateral donor can accept a much wider "margin of inefficiency", for his main concern is that the project is economically viable. There has been no cooperation whatsoever, nor any exchange of information, between the Bank and Sida in the area of district heating. This is clearly unsatisfactory

Highly profitable economically

All the projects are highly profitable from an economic point of view. Intuitively this is easy to understand because, by generating heat in large efficient boilers that replace a multitude of smaller inefficient boilers, very large savings can be realized in coal consumption, and in reduced gasoline consumption because of reduced need for transportation of coal and ashes through the city .

Furthermore, in the case of an already existing power-plant which is converted to a co-generation plant, the DH-system in effect makes use of a free resource, namely waste energy, which in the absence of a DH solution would be just emitted unused into the air. As a result there are dramatic reductions achieved in emissions of pollutants, and the economic savings of the projects can be expected to be enormous. These economic benefits are of such magnitude that their economic profitability can not be threatened by the projects suffering this or that technological set-back or because it is implemented with one or even a few years delay. In a recent World Bank DH-project in Weihai and Yantai districts, the economic rate of return from the savings in energy alone, was calculated to between 24 and 66 % depending on assumption made. The dramatic reductions in pollution can also be expected to have a considerable effect on peoples´ *healths*. Judging by various World Bank studies, the economic rate of return could be in the order of a few hundred per cent when health and mortality effects are included in the analysis.

It deserves to be pointed out that the bulk of the benefits from introducing imported DH technology, would be reaped also in projects relying exclusively on Chinese technology. Imported , advanced technology can make these gains bigger, but are not a condition.

Environment

All five project are experiencing considerable delays in their implementation, and consequently most of the environmental gains have not yet materialized as many of the old local boilers are still in operation.

This however does not change the fact that, when completed, the reductions in emissions of pollutants due to these five projects will be dramatic, and there can be no doubt that the benefits to the environment as well as to Peoples´ healths will be equally dramatic. In two recent projects supported by the World Bank the reduction in SO2 emissions was estimated to be 97 %, ad the reduction of TSP 96 %. From what be seen today there will be no problem to reach the environmental targets of the Project. The only environmental problem which at present does not have a ready solution is the noise level in some of the pump stations located in residential areas.

Equality/ Poverty orientation

None of the projects are seen as especially favoring any particular group in society, and it is basically assumed that they will uniformly benefit all the inhabitants in the respective cities.

It is conceivable that, on average, a smaller proportion of poorer groups live in buildings that are possible to connect to district heating than richer groups. If this is the case we one could claim that the introduction of district heating is biased against poorer groups, and that introducing district heating in the cities will favor (richer) city inhabitants at the expense of the(poorer) country dwellers.

In a recent study on China´s environment, however, the World Bank found that as wages rise the pollution density of suspended particles falls, and that poor cities have higher emissions of sulfur dioxide than rich cities. The following explanations were given: *Firstly,* environmental regulations are stricter in richer areas because they contain better educated citizens, who are more concerned and better informed about the environment, and also ready and capable of defending their interests. *Secondly,* production in low-wage communities generates more pollution because industrial facilities with unskilled workers are generally less efficient and produce more waste, and *Thirdly,* demand in high-income markets tend to favor products whose production generates less pollution.

Gender, Democracy and Independence

It does not appear possible to detect any particular effects, direct nor indirect, on *gender, democracy* or *independence* emanating form the DH projects.

Demonstration effect

An explicit objective of the first two district heating projects supported by BITS (Dalian and Taiyuan) was that the project should become a *demonstration case,* which would show those other Chinese cities contemplating the introduction of a modern DH-system, the feasibility of mixing advanced technology

imported from abroad with Chinese produced equipments accounting for the bulk of the investment. Given the delays experienced by the projects, and given the uncertainty that seems to exist regarding the possibility of cheaper domestic equipment replacing some of the Swedish equipment, I do not believe that one can say that this objective has been achieved. At least not yet.

Sida´s interventive and controlling role

Sida in all of the DH heating projects in China held a rather high profile in analyzing the projects, and recommending, or even requesting, the loan-takers´ compliance on various points. In many instances it seems that the end-users heeded the advice given. BITS´s project decision documents were generally of high quality. The reasons for Sida´s active role were:

- The municipal heating companies in China, were not seen to be capable to negotiate successfully a technologically complicated contract with a foreign supplier.
- Nor was the ministry in Beijing seen as competent in assessing technologically advanced projects or to guarantee a successful implementation in the case of new and inexperienced end-users, like the municipal DH companies.
- Sida could not expect the Swedish suppliers to take responsibility for the projects to be well balanced in terms of needs for import, and that "appropriate technology" would be imported rather than just the latest technology.
- The clients were not seen as able to prepare appraisal reports of sufficiently high standard.
- Because the Chinese DH-companies were seen as overly focusing on the hard-ware part of a contract and hesitant to use the funds to pay for soft-ware by way of supervision and training, Sida found itself obliged to actively control that such items were always present in the contract and in sufficient amounts.

Sida´s interventive role in the project can be seen as a balance act between being a contract financier and a regular project financier. There was a debate within BITS on whether or not, in China, they should modify their traditional role which is to leave all planning as well as implementation to the contracting parties and generally to abstain from any involvement in the design of a project. In the opinion of this evaluation Sida has managed this balance act very well.

Possible system failure

In spite of its active control, in at least one of the projects Sida can be criticized for failing to detect major shortcomings, namely the Swedish equipment which was shipped two years before its intended use. In the case of the computers, they were grossly outdated - and overpriced ! - by the time they were finally installed in the project. One gets the impression that the client was rushed into accepting an immediate delivery in order not to loose the opportunity of Swedish concessionary financing. Could it be a system-failure of the Swedish credit scheme, in the sense that it does not contain an easy mechanism for part deliveries to be postponed to a later date? The Swedish supplier also comes out as a victim. There was obviously no gain for him to deliver a system which is out of date by the time it is installed. But this is what happened, and as a result also the Swedish supplier may suffer commercially when the client becomes aware that his computer system is outdated already from the start.

Violation of Sida´s energy policy

The decision on part of Sweden to finance district heating projects in China does not comply with one fundamental requirement of Sida´s policy on aid in the field of energy, namely that no aid should be given to countries that increase its coal dependency. Improving the country´s energy efficiency today stands out as the government´s main environmental protection strategy in its fight to reduce air pollution and stop increases in green houses gas emissions. However, for compelling economic reasons, coal will remain the only economical option for most of China´s cities. Since this evaluation has found the district heating projects to be highly beneficial for the country, our conclusion is that there is something wrong with Sida´s energy policy, at least in the form that it is today written.

Reporting requirement
In none of the five projects has any of the contracting parties - neither the seller nor the buyer - complied with the contractual obligation to provide BITS with a completion report six months after commissioning of the project.

GENERAL SUMMARY OF EACH OF THE 5 PROJECTS:

DALIAN
Claims were made that sound procurement rules had been violated, but none of the alleged faults seem to have been of a serious nature.

All equipment has been installed and the company states that quality and functions are in accordance with the contract. However there is discontent among some of the client´s engineers, about some of the Swedish equipment and its functioning:- the magnetic fluviographs attached to the heat exchangers are not functioning, - oil gauge of the water circulation pump is leaking, - the pumps vibrate and shake and make too much noise, - the training of the Chinese technicians in Sweden did not get the effects expected, as they are not able to independently take responsibility for maintenance and commission, and - there is a lack of spares for parts that break or wear down fast. There are also indications that the amount of *training and supervision* in the contract was insufficient.

An important reason for buying the Swedish equipment was that the company was offered a Swedish concessionary credit, but one must consider that if these companies were completely autonomous w..r.t. long run profits and losses perhaps they would be more quality oriented - and willing to pay a higher price for higher quality, knowing that this strategy would in the end turn out to be the most economic one.

Although it was not possible to have access to **financial** data which permit calculation of ex post profitability, it is entirely clear that financial targets in this project can <u>not</u> have been met. This is because the project is experiencing a two year delay, and also that an expected tariff change still has not materialized. The financial deficit in heat delivery can today be compensated by profits realized in electricity sales which is the company´s other branch of business. The **economic** savings to society because of this district heating project are very large as are the beneficial effects on environment. An inclusion of health factors in the economic analysis would increase economic profitability considerably over the already high level found in the appraisal study. Because the project is experiencing a considerable delay, most of the **environmental effects** have not yet materialized. This however does not change the fact that the environmental benefits of this project - which will manifest themselves as implementation progresses - are enormous. Because of several (minor) problems that have afflicted the project, but mainly because of the delay experienced it would be hard to claim that the objective of the project becoming a demonstration project has been attained. But perhaps it is not too late yet.

TAIYUAN
One of the Swedish bidders withdrew from the race due to a difference in opinion with the Chinese client regarding the appropriateness of turn-key delivery, taking the position that if it could not influenced the design of the project it was not logical for the supplier to shoulder a turn-key responsibility for the outcome of the project.

Since the project has not yet reached its design capacity, the performance of some of the Swedish equipment can not yet be tested. So far 28 of the 44 substations have been equipped. None of the stations have yet been connected to the computer system. At the end of 1997, with a heated floor area of about 4,3 million sqm, and 174 boiler houses dismounted, it is calculated that 240,000 tons of coal are saved annually, as well as 600 tons of gasoline.

Even though all of the Swedish equipment is basically functioning according to plan - the client is not satisfied with all purchases: Four computers, which according to plan were to be installed at the end of 1996, were delivered at the end of 1994, i.e two years ahead of planned installation. When they were installed in November 1997 they were completely outdated. According to original plan the project would have used a cable as connection between the control station and the sub stations, but for cost reasons it was decided in 1996 to use the public telephone system instead. This, at least partly, explains the delay in installing the control system. In the company´s opinion the problem with the too small valves is a serious one, as the valves can not satisfy its regulatory function. The valves are today not performing their intended function, and it is the same situation in all the substations. The company is not satisfied with the after-delivery service provided by the Swedish supplier. On several occasions there have been a difference of opinion between the client and the supplier.

In a storage room today there are 30 heat exchangers, 28 pumps, 9 control cabinets, transmitters, valves, flow metres etc.- equipment, enough for nine complete substations. They were delivered from Sweden at the end of 1994, to be installed by 1996, but due to lack of funds they were not. The company says that the goods are kept in the perfect condition, with no risk of corrosion. However, due to the great amount of sulphur in the air, the corrosion of steel products is much faster in China than in, say, Scandinavia..

The knowledge and awareness of financial information by the company´s officers leaves much to be desired. Discussions revealed that there is no clear price information regarding several central cost items, among them for the items imported from Sweden. The profit calculations carried out by the company today, i.e. when about half of the total building area has been covered, indicate that it will be difficult to achieve the profit as planned. This is partly due to the fact that the cost of producing heat has increased more then the tariffs received from consumers, but more importantly, because of the long delay in implementation of the project. The project is highly profitable from an **economic** point of view. The reductions in different types of pollutive emissions largely correspond to the degree to which the project has been implemented, i.e. the share of the building space connected. Several people that I spoke to remarked that they could feel by eyes and nose that air quality has become much better in recent years. Given the delays experienced by the project, and because of the uncertainties that exist in peoples´ minds w.r.t. importing equipment of instead of buying some of it much cheaper in the domestic market, it is not possible to say that the project has become a positive *demonstration case* for others to follow. At least not yet.. BITS´s project decision document was of high professional quality, as were in deed also those of the other four district heating projects. BITS played an active and dynamic role in trying to assist the end-user to improve the projects, both from a technological and economic point of view, sometimes with a positive result, sometimes not.

SHIJIAZHUANG

Most of the imported equipment has been put in operation on schedule, and their performance basically meet specified requirements. The company is satisfied with the training services offered by Sida, all three conveyor belt systems are running very well and, and in the company´s opinion, clearly better than similar systems produced in China. - The electricity distribution center is working very well, and the experience of the eight rough water pumps so far is very good. But there are also problems: Because the ignition system of the plant was changed to use charcoal instead of oil the two type oil pumps became useless and have never been used. The boiler control system has not been put to use, because there is a difference between the design of the system and the actual operation. Test runs failed and the computer system has therefore never been used. There is a lack of *spare parts.* Some cannot be found in China. Other parts, among them some that wear down quickly, are unknown to the Chinese, because no drawings were made available by the Swedish supplier. Due to the big seasonal change the *boilers* are not functioning well. The load factor must be made more even in order for the boilers to perform better. The control system of the boilers is not functioning due to lack of spare parts. The whole *control system* is out of order since February 1998, a possible reason being that the software is

not able to handle unannounced electricity cuts. But it may also be due to the fact that fact that some designs of the plant were changed in relation to the original plans on the basis of which the computer program was procured.

It is not yet possible to assess whether or not pollution targets have been reached, because the project has not yet reached a full load. From what we can see today there will be no problem to reach the environmental targets of the project. The only environmental problem which at present does not have a ready solution is the noise level. Also in this project there are examples of how BITS, mainly through its appraisal, was in a position to offer positive advice to the client regarding technical modifications in order to improve the project. After the BITS decision to grant financing was taken, the parties agreed to change the contents of the import order of a magnitude of app. 20 % of the total order. Strangely enough there is no documentation at all of this dramatic change in the contract in the Sida file, except for a short letter where Sida accepts the change.

JIAMUSI

There were several controversies with some bidding Swedish companies claiming that sound procurement rules had been violated. My impression is that none of the alleged faults were of a very serious nature.

Because the construction of the co-generation plant has not been finished according to plan, the project is currently running at least one year behind schedule. The responsibility for the cogeneration plant rests with another state company, and the work can not be speeded up by the Jiamusi District Heating Company. Because of errors committed in planning the shipment - apparently by the supplier and/or the shipping agency - the company incurred a considerable extra cost of transportation.

The prefabricated pipes, the computerized control equipment, as well as the various kinds of equipment for the sub-stations, have all been successfully installed, and according to the company, operating well and according to expectation. The company is specially content with the Alfa Laval heat exchangers - 41 were imported. The foaming machine has however not been functioning properly. At present it is out of order and the company lacks spare parts to put it in operation.

Most of the people interviewed seemed convinced that the main, if not the only, reason that the company had imported the equipment instead of buying it from the local market, was the difficulty to raise finance in the local Chinese market. However, they are aware of the quality difference. In summary, one may perhaps conclude that the reason for choosing the Swedish equipment was two-fold: *Firstly,* quality and price were competitive; *secondly,* Sweden offered the best credit.

Since the project is not yet finished, very few of the expected - highly beneficial - effects have yet started to manifest themselves. There is however nothing at present which would indicate that the effects as planned would not be forthcoming once the project is completed. There are no data to calculate a revised ex post financial rate of return, but by general reasoning we can see that the one-year delay, which now seems likely, is quite enough to upset the rates of return estimated in the appraisal. The BITS decision document makes a very big understatement when it says that the project can be deemed to have "an acceptable" economic rate of return. Judging from the indications we have the economic benefits of this project are enormous, notwithstanding the delays in the project´s implementation. The reductions in emissions of pollutants due to this project are expected to be dramatic. But the co-generation plant has not yet been opened, and the old local boilers are still in operation. Therefore the environmental gains have not yet materialized. BITS has held a rather high profile when it comes to carrying out its own analysis and forming its own opinion about the project. In all important aspects it seems that the end-user has heeded advice given by BITS

FUSHUN

One of the Swedish bidders claimed that the tender procedure applied by the Chinese government discriminated against small bidders. Sida, having looked into this, as well as other critique directed at the procurement process, found nothing that would constitute a serious breach against generally accepted procurement rules.

Overall, the delay in the project, as compared to original plans, is between one and two years. At first, the Bank of China hesitated to act as intermediary for this credit, as it had a suspicion regarding the solvency of the Fushun District Heating Company. Then, there was, in the company´s opinion, a delay caused by the shipping company retained by the Swedish exporter. At a later stage, a further delay was caused by the slow pace of construction of the new power plant, whose boiler the company wanted to use for heat water.

At present about 70% of the heating station equipment has been installed in 33 substations and about 30 % of the pipes. The entire job is expected to be finished by 1999. Test runs have shown the equipment generally to run smoothly and efficiently. The company is quite satisfied with the performance of the Swedish heat exchangers, but has also tested the heat exchangers manufactured in Chine and was quite satisfied with them too. If the Swedish credit had not been tied to Swedish goods, it would have preferred to purchase the heat exchangers in China.

The problems are: - noise level of pumps, - lack of spare parts for the frequency converters, - problems with the computerized monitoring system, - malfunctions in the foaming machine, and- still inadequate training.

No data are available to try to calculate the ex post financial profitability of the project. But even without data it is clear that due to the current two-year delay in the implementation of the project, there is no way that the financial target can be met. There are important effects, e.g. on health, which have not been included in the economic analysis carried out at the appraisal. A full inclusion of all economic effects, whether quantifiable or not, would yield a very high economic rate of return. There is no doubt that the benefits to the environment as well as to peoples´ healths will be dramatic when the project is completed.

Still today the communist party has a political secretary in this, as in all state companies, who in many peoples opinion, has more power than the General manager. According to one of the company officers, sometimes the political secretary respects the expert opinions of the company´s staff, sometimes not. According to the Company´s Chief engineer, however, there are no cases where the Political secretary has had an opinion which differs from that of the management.

SUSTAINABILITY

Technologically. Even though there are problems with spare parts, essentially the Chinese end-users are well familiar with the advanced equipment imported from Sweden. Some of the equipment is even started to be produced in China. I therefore believe that, while technological sustainability is not guaranteed in the short or medium term, there is little reason to worry about it in the long term.

Financially. Financial profitability of the projects stands and falls with administrative decisions regarding subsidies, tax payments and most of all tariff policy. Due to delays and, mainly, minor shortcomings it would seem that none of the five projects is able to achieve planned financial profitability. But the reason for the shortcomings were rather connected to circumstances outside the control of the mangers rather than reflecting incompetence or lack of knowledge on part of the companies. From an administrative efficiency point of view all of the companies seemed at least reasonably proficient and dynamic. There is therefore nothing indicating that, given proper legislation regarding prices and tariffs and a competitive structure in the industry, the district heating companies could not develop into financially viable and sustainable enterprises.

Environmentally. Introduction of district heating to replace a multitude of scattered boilers, or a modern, *indirect* DH system introduced to replace an old soviet style, *direct* system will lead to very substantial improvements in the environment. This is a truth which is not overturned by the fact that the fuel source for the heating will remain to be coal. We can therefore categorically state that the projects are clearly environmentally sustainable.

Economically. The elements explaining the very large economic profitability of introducing district heating are well defined and obvious. Because district heating replaces many smaller inefficient boilers with a much more efficient big heat producing plant, the savings in fuel consumption and the reductions in pollutive emissions realized in the short run will be there also in the long run. Therefore it is clear that the projects are economically sustainable.

Policy-wise. It is obvious that China´s government is well aware of the large improvements in terms of environment, energy conservation as well as economic benefits for the country associated with district heating. There is therefore little reason to imagine that something would happen on the policy level which could put in question the sustainability of district heating projects.

Socio-culturally. There is no circumstance of socio-cultural nature in Chinese cities which would in any way be incompatible with the sustainabilty of the DH projects.

LESSONS LEARNED

Importance of spare parts, training and supervision

The analysis confirms an old lesson, namely that it is not wise to try to economize too much on the amount of spare parts to include in a delivery. The same holds true for the amount of *training* and *supervision* that should be included in the contract so as to ensure successful installation and operation of modern equipment hitherto unknown.

Choice between imported versus domestic equipment

Even if it is today possible to equip and operate a DH substations relying exclusively on Chinese equipment, this does not necessarily mean that - from a Chinese point of view - it is always wiser to buy only domestic equipment. *Firstly*, chances are that the quality, both in terms of functionality and durability, of imported equipment could turn out to be so superior that even at double the price it would be a more economical. *Secondly,* it must be good for the development of a domestic industry to have a few show case projects where alternative technology can be demonstrated, and against which the domestically manufactured equipment can measure its performance, quality and price.

Limited role of financial analysis

In countries where the outcome of the financial analysis can at any moment be changed by the government making a political or administrative decision which changes a tax, a subsidy or modifies a tariff, the financial analysis is important mainly for deciding if a project can be financed in the commercial market. In today´s China, even though important steps have been taken towards a market economy, there are enough remaining regulations and subsidies both on the cost and revenue sides, and with enough distortions, due to hidden subsidies and tax payments structure to invalidate the financial rate of returns a true measure of entrepreneurial efficiency. It is then the project´s *economic* profitability which should serve as the main criterium whether or not a project is worth while and desirable.

Financial and institutional viability of district heating company

Studying the different approaches to district heating of the World Bank and Sida one may learn the following lesson: If a donor engages in financial analysis only, or mainly, in order to satisfy the requirements posed by the OECD Helsinki rules, which forbid concessionary financing to be given to commercially viable projects but which requires the project to be economically viable, a fairly modest level of ambition will suffice. If however the donor is genuinely interested in the financial viability of the district heating company in order to help develop it into an independent entrepreneur, mere financial and cash flow analysis will not be enough. Then the donor also needs to carry out a considerable amount of institutional analysis.

Economic profitability of district heating investments

Introducing district heating in urban areas, where none existed before, is highly profitable for the country´s economy. This is intuitively easy to understand: by generating heat in large efficient boilers that replace a multitude of smaller inefficient boilers, very large savings can be realized in coal consumption, and in reduced gasoline consumption because of reduced need for transportation of coal and ashes through the city . Furthermore, in the case where an already existing power-plant is converted to a co-generation plant, the DH-system in effect makes use of a free resource, namely waste energy, which in the absence of a DH solution would be just emitted unused into the air. As a result there are dramatic reductions achieved in emissions of pollutants, and the economic savings of the projects can be expected to be enormous. These economic benefits are of such magnitude that their economic profitability can not be threatened by the projects suffering a technological set-back or because it is implemented with one or even a few years delay.

The importation of advanced technology from the West is <u>not</u> a pre-condition for achieving high economic profitability, as is sometimes implied by some donor agencies. The bulk of the dramatic environmental improvements as well as the large savings in energy consumption, would be reaped also in project relying exclusively on Chinese technology. Imported, advanced technology can make these gains bigger, but are not a condition.

Importance of follow-up contacts and cooperation

A close collaboration between the client and supplier is essential to avoid many instances of discontent and misunderstandings. Even though the Swedish equipment performs basically according to plan, there is today a large amount of uncertainty and speculation going on regarding the quality of the Swedish equipment, and about the relevance of importing instead of buying from the local market. It seems as if a considerable potential gain of good-will for Swedish aid and for Swedish export industry may be lost unnecessarily. The lesson to learn is this: In the case of Sida´s concessionary credits, where normally the donor participates actively only up until the financing decision, it could sometimes be a good idea to have a more active follow-up activity, starting already at the time of implementation, and not waiting several years until evaluation is due. This would seem to be especially true in cases like the present one, when there is a whole series of similar investments.

RECOMMENDATIONS.

Modification of Sida´s energy policy

It was found above that Sweden´s decision to finance district heating projects in China is incompatible with Sida´s policy requirement that no aid should be given to countries that increase its coal dependency. Given the finding by this evaluation that these district heating projects are highly beneficial for the country, and given the fact that, for compelling economic reasons, coal will remain the only economical option for most of China´s cities, it is recommended that Sida modify the text of its energy policy so as to make it compatible with future Swedish aid to district heating development in China.

Wrap-up seminar

Sida should consider the idea of arranging and financing a ”wrap-up” seminar with the participation of the responsible managers and chief engineers from all the five DH projects, representatives from the suppliers, relevant consultants, and key persons from Sida as well as from the Chinese government. Given the misconceptions and (small) controversies that still surround the projects, such a seminar would seem to be a very timely forum for airing outstanding issues, to follow up and exchange the various experiences and insights, and thus close the book on this first generation of cooperation between Sweden and China in the field of district Heating.

Cooperation with the World Bank

If Sida decides to support district heating projects also in the future it is imperative that cooperation, or at least exchange of information, be taken up with similar projects supported by the World Bank.

Today´s situation, where the two donors are apparently barely aware of the existence of the other, is clearly unsatisfactory.

Reporting obligation

Given the fact that in none of the five projects any of the contracting parties have complied with their contractual obligation to provide Sida with a completion report six months after commissioning of the project, and given the fact that this seems to be the normal state of affairs in virtually every concessionary credit granted by BITS, it is recommended that Sida either abolish this rule *or* take it seriously by actually starting to implement it.

ENVIRONMENT FRIENDLY DISTRICT HEATING IN CHINA: Evaluation of 5 Investment Projects Supported by Concessionary Credits from Sweden

I BACKGROUND AND PROGRAM CONTEXT

1. The five Swedish financed District Heating projects evaluated

The projects

The projects evaluated here are the five *district heating* investments, part-financed by Swedish concessionary credits, in China during 1993-1995. Their purpose was to introduce and expand respectively a district heating system in the following five Chinese cities:

1. DALIAN
2. TAIYUAN
3. SHIJIAZHUANG
4. JIAMUSI
5. FUSHUN

The overall objectives on part of the donor BITS for these projects were *environmental protection* and *energy conservation.*

Each investment belongs to a separate project in a different city and even province. Each project, in its turn, belongs to a larger program for introducing or expanding district heating in the respective city. Each project was planned and designed separately and independently from the others and at different times, and was implemented by different local district heating companies, and with different Swedish suppliers.

The general purpose of the projects was to expand the district heating network which means connecting additional building area to the central heat network thus replacing many smaller scattered boilers. The expected results from the projects were large savings in energy consumed, as well as very large reductions in emissions of pollutants in the cities.

Although the contents and the objectives vary between the five projects, the main objectives of all were to

- save energy by enhancing efficiency in heat and power generation, and to
- reduce environmental pollution

The Swedish financing was meant to cover the import contracts with different Swedish suppliers of district heating equipment. The composition of different type of equipment varied between the different projects but covered imports from Sweden of mainly

- heat exchangers for sub-stations
- shut-off valves, regulating valves,
- circulation pumps,
- flow metres
- prefabricated insulated pipes
- hardware and software products for a computer monitoring system,
- installations supervision
- documentation
- training

The cities, where the projects are located belong to the most polluted cities in China, and a direct correlation had been found between air pollution levels and hospitalization for respiratory and other diseases.

According to appraisals the projects would have enormous economic benefits for China. If China had the same tax levies on emission of sulfur and CO2 as Sweden, then the total savings expected to be realized in only one of the projects would amount to some 750 MSEK.

The main information regarding the five projects is summarized in table 1.

Table 1: The five district heating investment projects in China supported by Swedish concessionary credits; million SEK

District Heating Project	Total invest-ment	Imported from Sweden	Financed by BITS/ Sida	Date of BITS decision	Swedish Supplier
Dalian	55	30	25	24 March 1993	Powerpipe
Taiyuan	405	28	24	23 Nov 1993	Alfa-Laval
Shijiazhuang	84	41	35	19 March 1995	ÅF
Jiamusi	84	35	30	25 April 1995	Powerpipe AB
Fushun	85	36	31	28 April 1995	ABB
Total	713	170	145		

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The exact contents and structure varies between the projects, but can in a general way be illustrated by the Taiyuan project: The project is based on Chinese design and on 95 % Chinese equipment. Only those key elements which are not produced domestically of the exact specification or sufficient quality, along with training and supervision, were imported from Sweden under the BITS concessionary grant. By introducing *district heating* a new co-generation plant was to replace 423 small boiler houses and about 10,000 family stoves . Given that the thermal efficiency of the power plant is about 90 %, the small boiler houses 30-50 % and family stoves 10-20 % the yearly savings in coal consumption were calculated at 600,000 tons due to better boiler efficiency, and dramatically reduced emissions of particulates, CO2, SO2 and NOx.

The general motive behind all the five projects was to decrease the use of coal and reduce pollution by introducing or expanding a district heating system which concentrates heat production to one or a few large, more efficient and cleaner, boilers which replace many smaller, inefficient, ones without any filtering systems.

All the five projects were based on Chinese design and a majority of Chinese made equipment, coupled with importation of some key equipments, not yet produced in China of sufficient quality or capacity, in order to improve efficiency and availability of the DH systems. The main things imported from Sweden in the five projects are heat exchangers, circulating pumps, regulating valves and other control equipment, and prefabricated preinsulated pipes. There is generally also, at least meant to be, a substantial transfer of knowledge, mainly embodied in training, and installation supervision.
The terms of the credits granted by BITS in the five projects are virtually the same, with only some slight marginal variations: 10 years at 0 interest rate and with 1 or 2 years of grace period, yielding a grant element of some 35 %.

Early contacts
The first contacts, of a general character, between Swedish suppliers and Chinese buyers date already from 1985 when a Swedish DH delegation visited China and presented the relevant Swedish technology in Beijing, Harbin and Shenyang. As a follow-up to this visit some pilot projects were planned and a three week long seminar was held in Shenyang for representatives from various DH companies from northern China.

Following this, delegations from Dalian and Shenyang visited Scandinavia in 1990 in order to scout for suitable products and suppliers for their upcoming projects. Among the ”new” items that attracted the Chinese were the advanced alarm system built into the preinsulated pipes, the computerized control system, the high efficiency heat exchangers, and the foam agent, used for insulation, not being based on freon.

An earlier DH project in the Liaoning province, in the city of Xing Cheng, had only imported the preinsulated pipes, and the experience reported from this project was that given the limited Chinese experience in DH, the optimal share of imports should be bigger. Distribution pipes in Chinese district heating projects were previously laid in concrete or brick channels with light concrete insulation, but this method was being questioned because of water leakages leading to rapid corrosion to the pipes

History of DH

Sweden's credentials in offering support in district heating comes from a long and thorough experience. It was systematically introduced in all Swedish cities starting after the 2nd world war, and since then Sweden has developed advanced technology, which is internationally acknowledged to be competitive both w.r.t. price and quality, regarding the following products:

- sophisticated control equipment,
- prefabricated pipes with small thermal losses, high water protection of the insulation, combined with moisture alarm system for all pipes, and
- automatically controlled and compact substations

But, as is pointed out in a report from the Swedish district heating association, district heating is neither new nor specifically Swedish. As early as 1877 a DH system was operated in Lockport in New York. Seven years later a system was built for the University of Berlin and in the early years of the century to various other German cities.

The DH system

District Heating is a hot water system in which heat from a heat generating plants is transported via a network of pipelines to individual customers or groups of buildings. The heat is transported as hot water or steam through a distribution net, called primary circuit, to a consumer central. Via a heat exchanger the heat is here transferred to the buildings´ own distribution systems. Most household customers receive their heat through a sub-station.

The complete system comprises generation, distribution and transmission of heat to the local heating stations.

A DH system can supply large areas with heat and replace small inefficient boilers. Heat is therefore generated with less fuel.

District heating comprises the three subsystems, all independent from one another, which means that disturbances in one of the systems will not carry over to the other two.

- 1. Generation of heat: water is converted to steam or hot water in the heating plant. the heat medium then passes through a heat exchanger, where it discharges its energy to the distribution system
- 2. Distribution of heat to buildings:

Pipes in the DH network are laid in pairs. Hot water from the plant is transported to the customer in one pipe and returned in the other.

- 3. The local system and the customers end:
the substation at the customer includes heat exchanger for a closed radiator circuit and for the domestic hot water supply system

The three sub-systems thus interface with each other via heat exchangers.

Direct and indirect systems

The earlier systems were *direct* systems where the water from the distribution network circulates directly in the radiators. This system was developed in the soviet Union and then adopted in Eastern Europe as well as in China. Today however it is being abandoned in favor of the *indirect* system as described above. In the indirect system leakages are much less and the consumer is safeguarded against damage to radiators since the heat exchangers block pressure surges,
Because the pressure and temperatures are higher and since the customers radiators are not included in the distribution system, much less water has to be circulated. Pipe diameters can be reduced and fewer pumps are needed.
all this contributes to lower investment and operating costs of indirect systems.

Most modern DH systems use prefabricated piping, which consists of an inner pipe of steel or copper and a casting of polyethylene. Polyurethane is commonly used as insulation between the inner and outer materials.

Valves of various types are used to sectionalize the DH network. These valves , which may be of the ball, plug, butterfly or globe type, are operated manually or by motor. Circulating and pressure-retaining pumps are important elements in DH systems.

The great advantage of DH over traditional heating systems is that one large heating source replaces many small inefficient boilers. The bigger plant will have better flue gas cleaning which causes great improvements to the environment. The disadvantage of District heating is the relatively high capital cost especially for cogeneration. Therefore DH is suited primarily for densely populated areas. However, environmental aspect may justify DH systems also to more sparsely populated areas

The benefits of District Heating ax compared to traditional methods where each residence or building supplies its own heating, can be summarized thus:

<u>To society:</u>
- reduced air pollution
- better efficiency in both heat and power generation
- allows a flexible heat source, which makes the system not dependent on one single heat source
- easier and more efficient operation

To the consumers:
- reduced heating costs (in areas over a certain minimum load density)
- more simple and more cost efficient operation
- increased safety
- occupies less space
- improved heating quality
- better quality domestic water
- increased reliability
- improved local environmental conditions
- less fuel being transported within the local residential areas

Co-generation plants

Heat can be generated in a plant designed entirely for heat or in a plant for *cogeneration* of heat and power. In the latter case power can be generated at a very high efficiency - 80 to 90 % efficiency as compared to power from a common power plant which only reaches 30-40 % efficiency. This means that power is generated with less than half the amount of coal. And all other things remaining the same, the emission of dust will be 30 % less.

A co-generation plant is usually designed to supply a specific base load and supplemented by boilers for peakload needs. Co-generation of electricity production with heating purposes is the most economical and efficient system. To produce both electricity power and heating. To produce electricity with coal and as well as with oil very high temperatures are needed, and if excess heat is not used up for heating purposes a lot of it will be wasted as it is just emitted in the air or into lakes.

2. Energy, energy conservation and District Heating in China

General

The Chinese power sector has in the last two decades experienced considerable growth with about 15 GW of new capacity added every year. Technical capabilities have improved, and the supply of power to national minorities and rural electrification has increased The pricing system has been reformed so as to allow the investors to recover the cost of providing new power.

However the sector still faces important challenges, as it has not been able to satisfy the country´s demand for power. Industry must often curtail production due to lack of power. Households, accounting for only 10 % of total electricity consumption, often experience shortages. In spite of recent improvements efficiency in the power sector remains very low. 100 million rural households are still without electricity.

According to a recent World Bank analysis (*China: Power Sector Regulation in a socialist market economy;* World Bank discussion Paper 361, 1997) the underlying weaknesses of the sector arise from

"a combination of factors that are the legacy of the old style command and control approach to central management of the economy". The basic problems are:

- the centralized organization,
- government´s direct management,
- lack of transparent legal and regulatory systems, and
- the absence of incentives for efficiency.

The government recognizes these problems and has initiated ambitious structural and institutional reforms to transform the sector. Mainly these reforms consist of a separation of the government from the enterprises and commercialization of the enterprises, as well as the introduction of competition in the power generating industry.
In its analysis the World Bank strongly emphasizes that the regulatory system must be radically changed, stating that:

"A socialist market economy in China´s power sector requires a new style regulation that is limited and transparent and that allows power enterprise managers to manage."

Of all the regulatory systems the one regarding tariffs is by the Bank, seen as the most important. Energy tariffs in China remain essentially the result of administered prices. Power prices as still set by the government at the central level, and set without any reference to economic efficiency or willingness to pay by the users.

The absence of clear pricing principles discourage investors to make those investments, and using the technology that would be expected in a market economy. Customers do not get the right price signals, and a as a consequence the sector fails to produce electricity at the lowest possible cost (productive efficiency), and the electricity does not go to the consumers who could produce the most benefit for the overall economy (allocative efficiency).

Therefore scarce resources are being wasted. The same amount of electricity could be generated at a lower cost with a more rational pricing system. The current pricing system fails to achieve the basic goal of producing electricity at the lowest possible cost to the economy.

According to a new law -*new plant-new tariff* principle - investors are able to recover their costs for new investments because the law gives them the right to price the output related to a particular new loan-financed plant according to actual cost and actual financing terms. Therefore the price may vary between different provinces depending on the actual production cost.

Energy sources

Coal is the most important source of energy, accounting for 75 % of all energy consumption, which makes China one of very few countries in the world relying on coal as its major source of energy. Oil accounts for 17%, hydroelectric power for 6 % and gas for almost 2 %.

China is the world´s largest producer of *coal* with an annual production of 1,2 billion tons, a figure which is estimated to grow to 1,5 billion by the year 2000. Total recoverable deposits of coal in China amount to some 900 billion tons of which 30 % are proven.

China is rich in *water resources.* Of its total potential however only 9 % is developed, most of it located in the country´s southwestern part some 1500 kms away from the main demand centers in the north-east and east.

The country´s recoverable reserves of *oil* are estimated at some 80 billion tons. Production in 1995 amounted to 150 million tons. China´s refining capacity is the 6th largest in the world, but with today´s sharply increasing consumption the country will become a net importer in the near future.

Natural gas resources are estimated at 33 trillion tons of which 3-5 % are proven.

China is the second largest producer of *electricity* in the world. Its largest consumer of electricity is industry accounting for 2/3 of total consumption while households account for less than 10 %, services for 8 % and agriculture for 6 %.

Transmission and distribution losses are estimated to about 16 % of generation if one looks at the power supply as a whole from production to end user. Power generation has increased by an average or 8 % annually over the past 14 years. Despite this strong growth, however, most areas in China continue to suffer from severe power shortages.

Coal

China will continue to burn coal on a massive scale for many years to come. Even though its intensity of coal use, measured as per cent of GDP , has fallen by half over the last two decades, it is still between three and ten times higher than in major industrial countries. In the Liaoning province, where one of the Swedish-supported DH projects is located, some 70 % of the total consumption of energy is based on coal. In 1985 there were 15 cogeneration plants for DH in operation. There were also some 33,000 smaller boilers for steam and hot water which used up 18 million tons of coal annually.

Alternative sources of energy cannot significantly reduce the country´s dependence on coal in the foreseeable future. According to a recent World Bank analysis even if ten new 600 megawatt nuclear facilities were installed each year, that would only make nuclear power contribute some 6 % of total energy consumption.

Most alternative sources to coal are today too expensive to be able to compete with coal. The only sizable and affordable alternatives to coal in the medium term would be oil and natural gas, primarily from imported sources. But the conclusion emanating from analyses of the country´s energy situation, carried out both by the Bank

and by the Government, are clear on point, namely that all conceivable alternatives to coal will be too expensive, and that the only realistic source of energy for the country for many more decades to come is coal.

Based on this fact we are already able to make an important conclusion regarding the five District heating projects to be evaluated in this report, namely that: The decision on part of BITS to finance district heating projects in China does not comply with one fundamental requirement of Sida´s policy on aid in the field of energy, which is that no aid should be given to countries that increase its coal dependency, or take no steps to reduce it. In the case of China it is clear that the country, even in the opinion of the World Bank, has no other choice than to increase its use of coal. Furthermore, since we believe these district heating projects to be highly beneficial for the country, our conclusion is not that there was something wrong with the BITS decision to finance. Instead we conclude that there is something wrong with Sida´s energy policy, at least in the form that it is today written.

Conclusion: The decision on part of BITS to finance district heating projects in China does not comply with one fundamental requirement of Sida´s policy on aid in the field of energy, which is that no aid should be given to countries that increase its coal dependency. For compelling economic reasons coal will remain the only economical option for most of China´s cities Since this evaluation has found the district heating projects to be highly beneficial for the country, our conclusion is that there is something wrong with Sida´s energy policy, at least in the form that it is today written.

In a few Chinese cities nearby coal reserves have almost been depleted, and the cities find themselves in a situation where they need to consider their options for future energy supplies. In one of these cities, Fushun, the available untapped coal reserves are actually located exactly under the city, and their exploitation would be uneconomical. In Fushun there is today some talk of studying the feasibility for the city to switch over to natural gas, which is also available at large quantities nearby, for its future main source of energy.

However, even if individual cities were to resort to the option of switching to natural gas or some other new nervy source it must be remembered that for the overall energy balance it would not be significant amounts. For compelling economic reasons coal will remain the only economical option for most of China´s cities. Cooking in Chinese households is done on individual coal stoves, which is now however increasingly being replaced by gas stoves.

Energy Conservation

Although substantial progress has already been achieved in the field of energy conservation it is widely recognized, both by the Chinese government and outside observers, that further future economic growth requires much bigger improvements in energy efficiency. All recent macroeconomic forecasting has shown convincingly that continued growth is not physically, financially or environmentally sustainable without dramatic further improvement in energy efficiency.

Improving the country´s energy efficiency today stands out as the government´s main environmental protection strategy in its fight to reduce air pollution and stop increases in green houses gas emissions. Enormous potential for cost effective improvements in energy efficiency remains untapped in China, especially in the industrial sector, which is expected to continue to dominate energy consumption for decades. The strategic importance of and the huge remaining potential of energy conservation is well documented in many studies both by the World Bank and others.

Finding: Improving the country´s energy efficiency today stands out as the government´s main environmental protection strategy in its fight to reduce air pollution and stop increases in green houses gas emissions. Enormous potential for cost effective improvements in energy efficiency remains untapped in China.

During the 1980s China successfully developed a comprehensive energy conservation program including policy directives, and regulations. This system was quite effective under the centrally planned system. But with the present transition to a market economy it is judged, at least by the World Bank, as not being able to deliver results.

In 1990 Chinas economy was among the most energy intensive in the world, with an energy use per unit of GDP about 3 to 10 times higher than major developed countries, This was in spite of the fact that the country´s commercial energy intensity per unit GDP had fallen by over 30% between 1980 and 1990, which is in itself a remarkable achievement by international standards.

There remains today a tremendous scope for further improvements in the technical efficiency of energy use. The, by far, largest potential lies in the industrial sector, where potential energy savings between today and 2002 have been estimated to be more than 500 million tons of coal equivalent per year, *or more than half of Chinas current annual total energy consumption.*

There are many different obstacles to implementing energy conservation projects in China today. Some constraints are because of the current transition to market economy , while others are common in developed market economies as well. A draw-back with planned economy measures is that they are not automatic or built into the economic

system. Administration of proper prices and incentives to achieve positive change becomes cumbersome and complicated. Pressures applied to different industries and to different firms becomes greatly uneven and therefore arbitrary from an economic point of view.

A variety of energy efficiency projects have been shown to result in substantial reductions in the emissions of both particulates and sulphur, principally through the reduction in energy consumption, but also through the introduction of more sophisticated technologies that are less pollution-intensive and that often embody pollution control technologies. Such projects also result in considerable health benefits for residents by reducing ambient concentrations, and thereby reducing human exposure and the incidence of respiratory illnesses. They also reduce the ill effects on crops, ecosystems and materials.

In a group of industrial energy conservation projects, recently analyzed by the World Bank, it was found that the *economic rate of return* ranged between 30 to 90 % (!) with an average *economic internal rate of return* of 47 % !!. (See *"Project appraisal document on a proposed loan in the amount of USD 63 million..... for an energy conservation Project",* February 26, 1998, World Bank report no 17030-CHA)

District Heating

Coverage

About 50 of the 150 cities in northern China are today estimated to have introduced some kind of district heating system, usually covering less than 10 % of the total floor space in the respective cities. The total heating area today connected to district heating in all of China is believed to be some 55 million sqm.

The first DH systems in China were installed around 1950 with steam supply for the textile industries, in combination with steam or hot water supply for heating purposes. These district heating systems were built according to the *eastern* model developed in the Soviet Union and adopted by Eastern Europe and China.
In 1980, approximately 11% of total power generating capacity was estimated to be used by the country´s district heating systems. DH in China is used only for heating purposed and so far not at all for hot water delivery.

Government policy

Heating in China´s cities is exclusively based on coal fired boilers and stoves. No filtering of the emissions is being done. The coal used is of comparatively low quality and has a high content of sulphur, ash and other polluting components. The smoke is emitted through chimneys at quite low level. The heating systems therefore are very big

contributors to the high levels of pollution found especially on cold winter days in China´s cities.

The Govt. has today an explicit policy of promoting co-generation plants and district heating, which they see as the best ways of attacking the country´s main pollution problem by replacing individual boilers and family stoves, to conserve energy by replacing inefficient heating sources with cogeneration plants with an efficiency of 95%, and to improve the country´s living standards by providing more stable and reliable heating and eliminating the need for local transport and handling of coal and ashes.

Through the series of DH projects now being implemented throughout China thousands of smaller coal fired boilers in the city centers will be replaced by heat being produced in efficient co-generation plant or heat water centrals, all of which are equipped with efficient burning processes, requiring considerably less consumption of coal. The smoke gases are filtered and emitted at high elevations. The one thing preventing a massive further expansion of DH in China today is the lack of capital needed for investment. this has also been shown to be a major obstacle for the cities engaged in introducing DH, to complete their projects on time.
The main actor in the field of DH in China is the Association of District Heating Companies (ADHC) established in 1987.

In recent years several of the equipment needed for a modern district heating system has started to be produced within the country. Factories for prefabricated and preinsulated pipes have been built in several places in China, so far in Harbin, Shenyang and tinjin. The dimensions of the pipes produced are however small, up to a maximum of 300 or 500 mm. the quality is at least so far judged to of somewhat lower r quality than imported pipes. Previous design and construction of pipelines in China gave high thermal loss and leakages resulting in high maintenance and operation cost. Large dimension pipes must therefore be imported.

Other donors

China has had or has cooperation with several donors in DH, in several cities and with varying modes of financing. In addition to Sweden the following donors have had or have supported district heating projects in China: Finland, Denmark, Japan, Germany. Also the World Bank and the Asian Development Bank has engaged in some DH projects. In most cases district heating is included as one component in a much larger , *integrated*, urban or regional development project, but there are also a few pure DH projects.

Tariffs

The charge today for heat consumption is only a flat rate per sqm of heating area connected, and with no relation to the amount consumed or to the insulation and other characteristics of each particular consumer. All charges to the consumer, both connection fee and annual fee, are thus fixed, and do not provide any incentive for energy conservation. Consumers pay the same irrespective of how much they use.

Consumption metres do not exist, and the heating bill is always paid by the houseowner, never by the consumer directly.

There is today however said to be a growing awareness within the Government of the need to move towards a system which has both a fixed, installation component and a variable usage component.

Heating tariffs today vary between different cities: Here are some examples:
In Beijing high standard hotels and international organizations, connected 8 months a year, pay a tariff of 20 RMB per sqm per year; middle standard hotels and organizations, connected 6 months a year, pay a tariff of 12 RMB per year, and residential houses, connected 6 months, pay 9,6 RMB per sqm. In Mudanjang there is a unified rate of 20 rmb per sqm per year when the connection lasts for 6months, while in Dalian the corresponding figure is 11,4 RMBs but lasts only for 5 months a year.

3. The Environment

(The following section draws on, and quotes extensively from, a recent world bank report: *"China 2020: development challenges in the new Century",* September 18, 1997, report No 17027-CHA")

Chinas´s air and water, particularly in urban areas are among the most polluted in the world. According to estimates of the World Bank as many as 289,000 deaths a year can be ascribed to the air pollution alone not reaching up to Chinese government standards. Overall, the economic *cost* of China´s air and water pollution has been estimated at 3 to 8 % of GDP per year.

A major factor is Chinas extreme dependence on coal for its use of energy, and in particular due to the many small individual boilers and stoves used in industry as well as in households. Environmental problems occur at every stage of the coal chain: mining and disposal of mine waste, coal washing, transport and handling, processing and combustion, and ultimately ash disposal. Coal accounts for almost 80, % of the current demand for energy, making the country the worlds largest consumer of coal.

Another factor is China´s booming cities. Between 1978 and 95 their populations swelled by 180 million residents plus some 50 million unregistered migrants from the countryside. Rising urbanization has not only been accompanied by increased use of cars and largely untreated emissions of municipal waste, it has also increased the proportion of the population exposed to the greater pollution found in the urban areas.

Over the last two decades urbanization, industrialization and motorization have seriously damaged air and water quality. Moreover, increasingly intensive Agricultural practices have led to a new generation of environmental threats, as run-offs from fertilized fields has contributed to water pollution.

For, particularly, air and water pollution the benefits of investments into abatement measures so clearly outweigh the costs that they justify massive investments in pollution abatement.

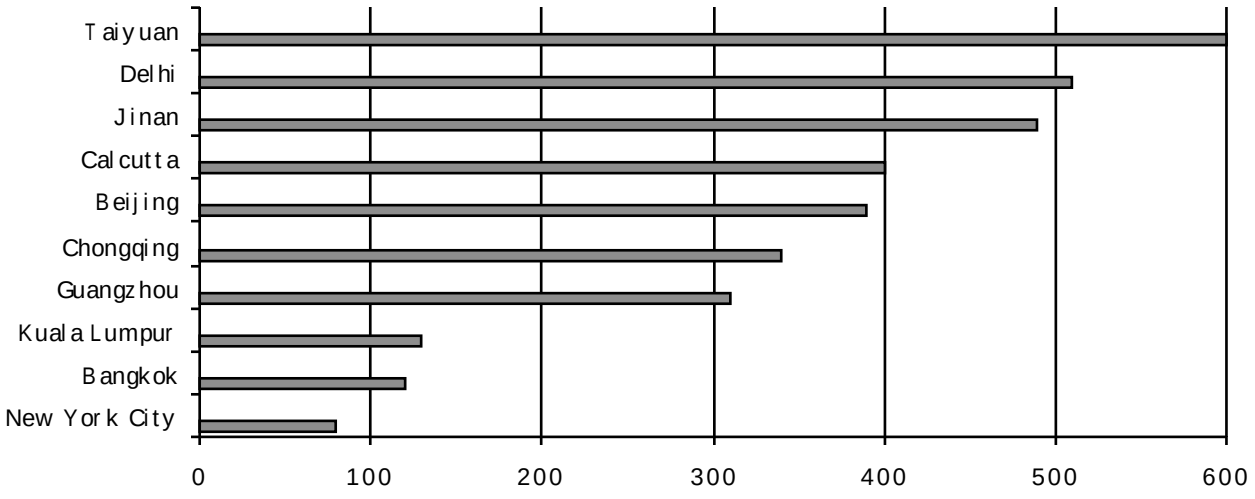
The extent of environmental damage i China is obviously related to the lack of systematic knowledge on part of the inhabitants about how grave the environmental situation actually is. In 1989 China´s government passed a law requiring local government at all levels - i.e. cities, districts and provinces - to compile and publish environmental reports. But this order was largely ignored until may 1997 when 27 cities began to making weekly air pollution reports. The country´s capital Beijing was the last major city to comply with the regulation, beginning to release data only in February 1998.

Finding: A major factor in environmental pollution is Chinas extreme dependence on coal for its use of energy, and in particular due to the many small individual boilers and stoves used in industry as well as in households. Environmental problems occur at every stage of the coal chain: mining and disposal of mine waste, coal washing, transport and handling, processing and combustion, and ultimately ash disposal. Coal accounts for almost 80, % of the current demand for energy, making the country the worlds largest consumer of coal.

Air pollution

Air pollution in China´s cities is very high even by developing country standards. This is illustrated by the following figure

Figure 1: Total Suspended particulates (TSP); micrograms per cubic meter; Source: World Bank 1997



In the figure we can see that of the seven most polluted cities in the World, five are Chinese.

In relation to many European countries the allowable standards as determined by the Chinese government are much higher as can be seen from the following table comparing China with Sweden.

Table 2: Chinese official air pollution standards as compared with Swedish, mg/Nm3

	Chinese Class II standard	Swedish standard 1990
TSP	0,3	0,05
SO2	0,15	0,05
NOx	0,10	0,05
CO	4,0	6,0

As can be seen the Swedish limits are much more stringent than the Chinese.

Although *particulate* emissions have remained app. constant since the 1980s, which in itself is extremely impressive considering the fact that coal consumption has more than doubled, *sulfur dioxide* emissions have risen sharply. Ambient *lead* levels also appear to be rising. Recent evidence suggests that as many as half the children in Shanghai suffer from elevated levels of lead in their blood.

There are, according to analyze carried out by the World Bank, three main responsible factors for Chinas air pollution:

Firstly, small and inefficient industrial boilers which often emit from low stacks, accounting for between one third and one half of ground level particulates and sulfur dioxide.

Secondly, the residential use of coal. Although residential use accounts for only 15 % of total coal consumption , it is responsible for 1/3 of emissions of particulates and sulfur dioxides. It also harms the indoor air quality causing a health hazard about as serious as smoking.

Thirdly, cars, whose volume are growing by 10 each year. The damage is aggravated by slow average driving speed which is due to the congestion, and low vehicle emission standards. The cars of Beijing although only on tenth the number of those in Los Angeles, produce as big pollution.

Health

Mortality rates from chronic obstructive pulmonary disease, which is the main cause of death in China, are five times as high as in the United states. This is not only because of China´s much higher rate of smoking and poorer health care. Epidemiological studies indicate that the difference in particulate and sulfur dioxide concentrations between Beijing and New York city (about 300 and 50 micrograms per cubic meter respectively)

is associated with 130 % higher mortality rates from chronic obstructive pulmonary disease. Reducing outdoor pollution level to the standard set by the Chinese Government would save 178,000 lives a year, and doing the same for indoor pollution would save another 110,000 lives.

Air pollution has also been calculated to cause an estimated 566,000 additional hospital admissions and nearly 11 million Emergency room visits directly attributable only to that part of air pollution which exceeds Chinas own standards. A recent World Bank report estimated the number of working days lost because of air pollution to 7,4 million person days each year. Numerous studies have also documented the damaged to children of lead exposure, from stunted growth to neurological disorders and intelligence quotient deficiencies.

Women and children who spend more time at home in closed rooms where coal briquettes are used on home stoves and for heating in winter, are being hit especially hard by indoor pollution. There major health risks associated with the domestic use of polluting fuels: acute respiratory infection, a leading killer of children under the age of five; chronic lung diseases such as bronchitis, emphysema, asthma; and cancer. the coal used on home stoves is said to be the main cause of lung cancer in rural areas where women are disproportionately affected.

Children in the e.g. the Shenyang area (where one of the Swedish supported DH projects is located) have blood level averaging 80 % higher than levels considered dangerous to mental development. This has been associated with the increased use of cars.

In Beijing researchers have found an association between air pollution and low birth weights. They also found a "significant exposure response relationship" between maternal exposures to sulfur dioxide and TSP during the third trimester of pregnancy and infant birth weight.

Acid rain is another by-product of air pollution which causes crop damage, deforestation, structural damage to buildings, and of course harm to human health. Emissions of sulfur dioxide and nitrous oxide react with atmospheric water and oxygen to form sulfuric acid and nitric acid, which can return to earth nearby or even thousands of miles away. In a study 1993 it was found that as much as one quarter of the vegetable crops in a Southern province was damaged by acid rain.

Finding: Reducing outdoor pollution level to the standard set by the Chinese Government would save 178,000 lives a year, and doing the same for indoor pollution would save another 110,000 lives.

Water pollution

Industrial and municipal waste and chemical and organic fertilizer runoff are the main sources of water pollution in China. The increasing pollution has considerably increased the cost of providing drinking water to growing population. Because of pollution one municipality in Shanghai had to move its drinking water source upstream at a cost of USD 300 million. In many cities households must boil their water before drinking it, which is much more expensive than centralized chlorination.

In 1993 about 8 % of the agricultural lands received water so polluted that it was unfit for use, leading to an estimated loss in grain production of 1 million tons.
One study found that if waste water treatment were improved from the current 20 % to 50 %, total annual grain production could increase by 24 million tons by 2020.

Cost of pollution:

Analysis carried out by the World Bank shows that the current annual cost of pollution is extremely high. Air pollution alone costs the economy 2 to 6 per cent of GDP per year. Water pollution costs another 1 per cent of GDP, and possibly much more given the difficulties to quantify the economic damage it causes.

The economic cost to society of different types of environmental pollution can be seen from the following table, in billions of USD:

Table 3: Economic costs to Chinese society from different kinds of pollution

type of pollution	conservative estimate	moderate estimate
urban air pollution	11,3	32,3
indoor air pollution	3,7	10.6
lead exposure	0.3	1,6
water pollution	3.9	3,9
acid rain	4,4,	4,4
Total	24	53
% of GDP	3,5	7,7

Market forces introduced gradually in China over the past two decades have provided foundation for rapid economic growth, but, despite recent reforms in natural resource pricing and taxation, the market forces have so far not been deployed so as to reflect the real economic cost of e.g. pollution, and thus contribute to altering the consumer behavior in ways that benefit the environment. Most prices today can be said to reflect production cost , but they are far away from reflecting the social and economic cost to society.

With coal and other energy prices being subsidized there is little incentive to apply conservation measure or coal washing technologies that are economical at higher prices. If an environmental tax were introduced this would lead to a number of pollution abating investments including more district heating programs.

Recently the country´s *National Environment Protection Agency* has suggested a tenfold raising of the air pollution levy. Given that the effective air and water pollution levels have actually fallen in real terms since 1987, this would appear to be a necessary corrective.

That investment in pollution abatement can have dramatic economic benefits to society can be seen from an example from Zhengshou in Hunan province where air pollution is typical of China as a whole. There the incremental cost of reducing sulfur dioxide by 1 ton was calculated by the World Bank to be USD 1,7, and this would save 0,63 percent of a "statistical life". The implication of this is that one human life, with the current pollution tax system, is valued at only1,7/0,00625 = USD 270.
The optimal levy, i.e. the one at which the cost to firms of abatement equals the social benefit of cleaner air - is estimated to be nearly fifty (!) times the current levy.

Also investments in public infrastructure would lead to very large environmental benefits. Increasing the availability of gas for households would dramatically reduce indoor and outdoor particulate and sulfur dioxide concentrations as gas replaced coal for cooking and heating. Exactly the parallel case we have with the introduction of district heating.

Standards for car emissions are still much below those of industrial countries and should be raised. A car operating in China emits 30 to 40 times as much carbon monoxide and forty to sixty times as many hydrocarbons as a car in the united States.

The world bank has calculated the overall ratios of benefits to costs resulting from pollution abatement investments, as shown in the following table:

Table 4: Returns to investment in pollution abatement

		Ratio of benefits to investment costs in %	
	Required expenditure, % of GDP	Conservative estimate of cost of pollution	Moderate estimate of cost of pollution
Air pollution , excluding lead	2,1	117	336
Water pollution	1,1	236	236
All forms of pollution	3,1	114	285

The results are dramatic: investments in air pollution abatement will yield benefits 17 % higher than the investment if the cost of pollution is conservatively estimated, but if the same costs are more realistically estimated, the benefits will be 236 % higher than the investment. For water pollution the corresponding yields would be 136 % for both the conservative and the realistic estimate.

Finding: The World Bank has shown that investments in air pollution abatement can yield benefits of several 100 % higher than the investment cost..

Conclusion

A major Swedish study of China´s environmental problems (*Environment and Development in China: a framework for Sino-Swedish Environmental Development cooperation;* Stockholm May 1996) , carried out in 1996, summarizes China´s environmental conditions adequately. It reached the conclusion that the country

"is exploiting her natural resources far beyond what is sustainable... ..Already today the country is a dominating source of greenhouse gases and ozone depleting substances. In future years China´s environmental problems are likely to be felt increasingly around the world".

The study links the country´s dismal environment situation to three basic problems:

- an intensifying population pressure on already scarce resources,
- an economic development linked to yet higher per capita resource use, and
- a socio-economic climate yielding wasteful behavior and providing little incentive or guidance for reaching a sustainable situation

Regarding the price system the study concludes that

"China suffers from a firm socialist heritage of adversely under-priced natural resources and free-of-charge right to pollute. Yet with the present unrestrained embrace of market economy China risk having the worst of both worlds, as raw materials are still heavily subsidized and pollution fees are kept at a fraction of the real cost of polluting the environment. As a result economically rational choices at the level of individual enterprises lead to excessively wasteful and polluting behavior."

Of six different companies visited by the mission not one paid an environmental fee that had any relation to the bad environmental effects they caused. Firms running financial deficits did not have to pay anything at all.

Locations of the Swedish-supported DH-project

The general geographic and environmental conditions in the provinces where the Swedish supported DH projects are located are the following:

Shanxi (Taiyuan). The province suffers from erosion, partly very serious one. Lack of water is also a big problem. In spite of this it occasionally suffers from flooding.

Hebei (Shijiazhuang) is a densely populated province, which, because of the overpopulation, suffers from overexploitation of land as well as water shortage, which is at least partly due to overexploitation of existing water resources.

HeilongJiang (Jiamusi) is a forest clad province which often suffers from forest fires, as well as fairly abundant rains. The capital Harbin has grave sewage problems.

Liaoning (where both Fushun and Dalian are located), has average rainfall, and some forest resources. Little soil erosion. The provincial capital of Shenyang is a heavily industrialized center and has, according to WHO, the worst air quality in China w r t emissions of particulates and of sulfur dioxides.

4. Swedish Aid in the field of Energy and District Heating: Policy and Programs

Sweden´s development cooperation in the field of *energy* has as its overall objective

to improve the energy situation of the large proportion of people living in the world who do not have assess to reliable and efficient sources of energy.

It shall also contribute to the development of efficient and sustainable energy systems.

Long term Swedish support to the energy sector in the form of *grant aid* is today given to ten of the poorest countries of the world. In 1995 this support amounted to some 400 MSEK. As for *concessionary loans* to energy development the total amount granted over the last 15 years is SEK 8 billion. Disbursements in 1995 amounted to some 350 million.

Major criteria for granting aid in the field of energy is that the aid should go to projects that are economically and environmentally sound, and it should be *catalytic* in its development role. Projects which imply *energy conservation* will be given high priority.

These principles are stated in Sida Policy document on *"Environmentally sound energy support",* dated 23 April 1996. Strangely enough, although this document gives examples of various types of support in the energy sector, District Heating is not even mentioned by name.

Among the several different policy principles behind Sweden´s energy aid, stated in the above memorandum, some are very general in nature. At least one is of a type which, if taken literally, can be difficult to attain in many developing countries, namely that *"Sida´s support presupposes that the country implements a sound energy policy from an environmental, structural and economic point of view, or has taken initiatives that can be judged to result in such a energy policy."*

An important case in point is the continued dependence on coal in China. While Sweden´s policy seems to require that no support be given to projects which imply the continued or expanded use of coal as energy base, it is clear from analysis carried out by the World Bank that China has no other choice, than to rely on coal as its principal energy source yet for many decades to come. No observer of China´s development, nor internal nor external, has even suggested that China has any realistic possibility to get out of its heavy dependence on coal in the next half century or so.
It would thus seem that we can already at the outset of this evaluation conclude that Sweden's support to the 5 district heating projects in China is not in accordance with one of the main policy items of the Swedish aid policy w r t energy aid, namely that no support should go to countries that will expand its use of coal.

Finding: Sweden's support to the 5 district heating projects in China is not in accordance with one of the main policy items of the Swedish aid policy w r t energy aid, namely that no support should go to countries that will expand its use of coal.

The total Swedish support to the energy sector, except aid to Eastern Europe, in 1995 amounted to almost 1000 MSEK, distributed as in table x below.

Table 5: Distribution of Sweden´s aid in the energy sector in 1995

Type of aid	MSEK
- Project grants	357
- Concessionary credits	505
of which actual cost to the aid budget	207
- Contract-based technical assistance	61
- Research cooperation	23
Total	1,000

Swedish support to district heating has so far been surprisingly small. Of a total portfolio of 100 different concessionary credits granted in the field of energy, the 5 in China, which are evaluated in this report, are in fact the only ones. Given the fact that DH is an area where Swedish industry claims to have/ a technological and commercial edge internationally, and , perhaps even more significantly, given the very high economic rates of return of investments in DH- systems, it is even more surprising that there are no other DH projects in BITS portfolio.

When it comes to contract-financed technical assistance there are a handful, smaller , projects in the area of district heating that has been given to developing countries in Africa, Asia and Latin America.

However, in the last few years Sweden´s aid program to the **Eastern Europe** has been very active in aid to energy and environmental projects in general, including support to district heating.

Table 6: Swedish aid to environment and energy to Eastern Europe 1990-1997

Project type	Number of projects	Total amount MSEK
Environment	118	446
- investment	11	278
- technical assistance	107	167
Energy	44	104
- investment	1	20
- technical assistance	43	84
Total	159	550

There is so far only one investment project - to Estonia - supported by a Swedish concessionary credit of 10 MUSD plus a grant of 13 MSEK. But the number of technical assistance grants quite high, and steadily growing.
During 1991-1997 19 different technical assistance grants were given mainly to the Baltic countries, and to Poland at a total sum of 85 MSEK.
B the end of 1997 another seven grants at a total sum of over 20 MSEK had been granted - to Latvia and Russia - in the field of district heating.

5. Sweden´s Development Cooperation with China

BITS´ cooperation with China started already in 197, and increased progressively in volume until 1989. By 1985 China had become the biggest recipient of BITS´ aid regarding technical assistance and one of the largest regarding concessionary credits, As a protest against the events in *Tien an Mien Square* in 1989, Sweden decided to freeze its aid in so far that no new projects were granted, but the ones already decided were continued. In 1992 a normal aid relationship between the two countries was resumed.

Policy
Sweden´s development cooperation with China is based on the realization that developments in China has a great importance for Sweden's future. Sweden, like other West European countries, has adopted a policy to support the on-going reform process in China and the development of a modern judicial system.

Another important Swedish motive is that the development cooperation will enhance relations between the two countries. Increased personal contacts and exchange of expertise is therefore seen as an important element of the cooperation. Sweden´s aid should focus on areas where Swedish experience, knowledge and technology can play an important role for development, innovation and reform in China. Areas of primary interest include environment, education , trade, technology transfer, research, and cooperation with Swedish NGOs. The sustainability of the contacts should be seen as a positive criterium when choosing projects.

Apart form development cooperation Sweden is conducting an active dialogue with China regarding human rights, bilaterally as well as in cooperation with other countries, for instance within the European Union.

An area of special interest is environment. As also China wishes to cooperate in the area of environment this should be a priority area, as Sweden has considerable knowledge and advanced technology in this field. Sweden also has a self interest in this field given the global character of pollution problems. It also has a commercial interest to deliver suitable technology.

Experience

Sweden´s experience from development cooperation with China is quite good. In a number of project evaluations as well as in other documents conclusions have been reached that planned objectives were achieved in nearly all projects. The Chinese authorities have in these evaluations in general been found to be competent partners in the dialogue as well as in negotiations.

An important objective of Sweden´s aid to China, which according to these evaluations have been reached, is that it has helped Swedish commercial firms to open up and expand their business in the Chinese market.

Concessionary credits

Sweden´s concessionary credits to China started in 1982, and since then credits amounting to more than 5,500 MSEK have been approved, out of which almost 4,200 have led to commitments. At present the total volume of outstanding credits is 2,700 MSEK.

As much as 65 % of the credits have been in the area of telecommunications. Other areas have been in paper and pulp production, and agro and forest industry. During later years there has been a focusing on *district heating* (i.e. the 5 credits evaluated here totaling 145 MSEK) and on municipal sewage treatment (3 credits totaling 202 MSEK and water purification (7 credits totaling 174 MSEK). There has been a marked trend towards more infrastructural, municipal or public services, and this trend is no doubt, at least partly, a result of the Helsinki accord which forbids concessionary credits to be given to commercially viable projects.

Of the concessionary credits, so far only the many telecommunication projects have been evaluated. The evaluation found a high degree of goal fulfillment. Administratively, financially and technologically these projects were seen as successful, and in the evaluators opinion they had also contributed to further commercial exploits in the Chinese market by the Swedish companies involved.

There has been a pronounced tendency for the Swedish concessionary credits to go to the richer provinces in China. Of the total 4, billion so far 17 credit of a total of 2,2 billion have been granted to the advanced provinces of the east coast, among them Beijing, and Shanghai.
20 credit at a total sum of 1,089 million SEK have gone to middle economies provinces, among them Hebei, Liaoning, and HeilongJiang and Shanxi, while only 3 credits at a total credit sum of 45 million SEK have gone to the western regions and to poorer and more remote areas.

Contract financed technical assistance
Swedish *contract-financed technical assistance* was started in 1979 and covers to date 175 different projects at a total cost of 190 MSEK. The cooperation has been in a wide variety of fields, the most common ones being environment, research and education.. During the period from 1992 through 1995 18 projects were granted in the environmental area totaling some 21 MSEK, the volume of support to each project ranging from 15,000 SEK to 4 MSEK.

No comprehensive evaluation has been carried out of the Swedish aid to China in the form of contract financed technical assistance. But from various individual evaluations of individual projects as well as from other reports it is possible to draw the conclusion that the aid is seen as having been largely quite successful. The same conclusion is reported by many other donors regarding their own development cooperation in *contract-financed technical assistance* in China.
The Chinese counterparts in this cooperation is seen as having made good use of the transfer of knowledge contained in these projects. Sida has concluded that this form of development cooperation is very suitable for China.

Swedish support to **industrial and commercial cooperation,** including trade promotion, was started in 1993, but was never a prioritized area by China. Today these projects are seen as having had little impact.

A large number of Chinese people have over the years participated in **training** and various *courses* offered by Sida and other Swedish aid agencies, primarily BITS. During the three last years 189 Chinese have participated. Among recent courses have been *human rights* for officers within the Chinese prison system, financed by Sida during 1996-98.

Several *Swedish NGOs* have received support for their programs in China. In the last three years 11MSEK has been given in **disaster relief** aid following an earthquake and several floods.

Swedish commercial relations with China

Sweden's trade with China is increasing. It is however concentrated to only a few companies and types of goods. In 1994 the Swedish exports to Chinese made up only 1,9 % of all of Sweden´s exports, while imports from China constituted only 2,1 % of Sweden's overall imports.
After Sweden became a member of the European Union in 1995, Swedish imports from China have gone down, especially textiles and shoes, which declined by 9 %.

EKN

The Swedish Export Credits Guarantee Board (EKN) in may 1996 decided to place China in category 2 for short term credits and in category 3 for longer term ones.
For loans over USD100 million, stretching over longer periods, there will be a surcharge of 25 %.
EKN´s policy w.r.t. China is to opt for risk spreading together with the supplier , and to decline guaranteeing shipments of foreign goods.
EKN´s total engagement in China was in may 1996 8,2 billion of which 5,8 with fixed guarantees . Three quarters of this amount was Ericssons orders.

Aid to China from other countries

There is a general trend towards favoring environmental projects in most bi- and multilateral donors aid programs. the reason may at least partly be the Helsinki agreement which forbids grant or concessionary aid to commercially viable investments.

Japan is by far the biggest donor to China, one reason perhaps being that Japan claims that acid rainfall in Japan is partly caused by emissions in China. other countries with ambitious environmental assistance programs are Germany, Canada, the UK, Australia, Finland , Sweden and Norway.

Future development cooperation

For its future development cooperation with China the Swedish government has decided that the six Swedish overall development objectives - *economic growth, environment, equality, gender, democratization and independence* - shall continue to be guiding principles. Special emphasis is to be laid on human rights, environment and equality objectives in the dialogue as well s in the choice of projects to support. The cooperation shall be characterized by mutual benefit to China and Sweden. In terms of volume the largest share of Sweden's aid is foreseen to go to environmental projects.

Whenever possible and practicable there should be a coordination between the two aid forms concessionary credits and contract based technical assistance.

Sidas environmental mission to China

The special study on environmental cooperation between China and Sweden, referred to above, found that

"there are next to unlimited potential for increasing the volume of projects"

and it recommended that all environmental development cooperation projects be based on Chinese priorities, be initiated by a Chinese party, and be channeled through MOFTEC. All projects , including those financed by concessionary credits, should have demonstration value, and the issue of how to disseminate the knowledge transferred should be clearly outlined. One should further strive to concentrate the aid both w.r.t. to subject and w.r.t. to geographical areas. The subjects suggested by the mission include energy conservation and district heating, id est the areas of this evaluation.

As for geographical locations, the ones recommended by the mission include Liaoning, Hebei and Shanxi province, but not HeilongJiang, thus covering 4 out of the 5 projects evaluated in this report.

The report specifically recommends that Sida

"positively consider projects that match one-off investments with follow up, principally in the form of training, and encourage long term commercial contacts to arise from bilateral assistance projects."

The report also points out that the Swedish environment industry is characterized by many smaller companies who, notwithstanding high qualification and competitive environmental knowledge, often do not have the resources to approach the Chinese market. Ways should therefore be found so as not to exclude these companies from participating in the Swedish financed aid projects in China.

As for concessionary financing the report suggests that this aid form should not be used only for the purpose of providing soft financing. All projects should have a strong demonstration component and the issue of how to disseminate the knowledge that is transferred through the projects should be clearly outlined and followed up.

CONCESSIONARY CREDITS: POLICIES, NEGOTIATIONS, PROBLEMS

Policies, procedures

Sida´s general criteria for granting concessionary credits to China are that the projects should

- have high priority in China and be in accordance with China´s own development plans
- be economically viable
- be within areas where Sweden is technologically and economically competitive, and
- be in accordance with the overall objectives of Sweden's development cooperation

The contracts financed by Swedish concessionary credits should be awarded in competition. The credits are tied to purchases of Swedish goods, and they normally

finance 85 % of the total value of the contract. The typical terms are a 10 year credit period, interest rate 0 %, grace period 1 to 3 years and repayment period 5 to 9 years.

According to the OECD guidelines, as formulated in the so called *"Helsinki agreement",* projects which on the whole are considered commercially viable are not eligible for concessionary financing. Commercial viability is then defined according to the project´s ability to generate sufficient funds to cover operational costs and to service debts at market terms as well as the availability of commercial financing for the investment.

A Chinese bank shall have appraised and approved the projects. When the proposals have been submitted to Sida, Sida will carry out a technical, financial as well as economic appraisal of the project. Partly based on this appraisal a decision will be taken to approve financing or not.

Until now the Bank of China has been the only bank channeling the credit. Presently there are discussions going on to also involve the Export Import Bank of China.

A discussion has also been held between Sida and MOFTEC to set up a line of credit that could be used for smaller projects which would require only a simpler appraisal procedure.

A *"memorandum of understanding"* regarding concessionary credits was signed between Sida and MOFTEC on June 13 1996, with the apparent purpose to focus on some of the main rules pertaining to the use of Swedish concessionary credits, namely that

- concessionary credits may ordinarily finance up to 85 % of the a contract, but based on agreement between the two parties also 100 % can be financed especially in environmental and social projects.
- at least 70 % of the contract goods and services shall be of Swedish origin
- project proposals which have been appraised by MOFTEC and approved by the bank should together with a feasibility study be presented to sida
- when sida has appraised and approved a concessionary credit MOFTEC will ensure sida right to obtain insight into the project.

The stages of Sida´s handling of concessionary credits in China are these:

1. Sida receives a credit proposal from MOFTEC
2. Sida makes a preliminary evaluation appraisal of the project proposal
3. If Sida thinks its OK w.r.t. its policy Sida give the Chinese applicant a go ahead to carry out a feasibility study
4. Upon receiving this feasibility study Sida will send an appraisal mission to analyze the project
5. Sida communicates its main conclusions from the appraisal to the end-user
6. If required the report is sent to OECD for consultations
7. Depending on go ahead received from OECD Sida informs the applicant that the procurement of a Swedish supplier can start
8. Sida analyses the commercial contract
9. Sida decision to finance

Negotiations

On several occasions MOFTEC has raised with Sida and the Swedish Embassy the issue whether or not Sweden could improve the conditions with which concessionary credits are given, thereby also communicating that other donors are offering more attractive conditions on their loans.

On these occasions MOFTEC also adverted that Sida may find it hard to receive attractive offer of projects to finance in China since the best projects available would naturally go to the other donors offering better credits. This threat was seen as real in the sense that in china it is actually difficult to find projects which are ”good” in the sense that they have solved their local financing requirements and that they are ready to move ahead as soon as they receive a foreign concessionary loan.

According to reports also several of the other donor agencies providing concessionary credits have received similar suggestions/ requests from MOFTEC. In fact it may seem like there might have been an implicit perhaps unintentional policy on part of MOFTEC to play out aid agency against the other. Consultations between the different bilateral donors has usually revealed that, at least until recently, all the donors were in fact offering very similar conditions on their concessionary loans, which is natural since they all adhere to the recommendations given by OECD for concessionary loans.

In the beginning of 1998 however some bilateral donors changed the share of the loans which must be used for imports from the donor country. Norway announced that only 50 of its concessionary loans need to be purchased in Norway. Also, according to unconfirmed reports, Denmark is contemplating a similar decision.

According to the Sida officer responsible in the Swedish Embassy in Beijing most likely Sweden will see itself forced to follow suit with the others, and abandon the current requirement that 70 % of the goods must be imported from Sweden. Otherwise Sida, in this officers opinion, may in the future experience a real difficulty to find worthwhile projects to finance.

Another aspect where MOFTEC has tried to ”pressure” donors is regarding the financial terms contained in the concessionary credits. In one communication to SIDA, in 1996, MOFTEC insists that other bilateral donors, among them the other Nordic countries, are offering more flexible (read= more generous) conditions. The Chinese letter also pointed out that e.g the UK gives credits consisting of 35 % grant element and 65 % export credit, and Holland 45 % grant and 55 % export credit. If Sweden did not improve its financial terms Sida would not be able to receive any attractive projects, at least not in the field of district heating, as the end-users would prefer to take concessionary loans from other countries instead.

No revision of the share of grant element in the concessionary credits has, however, been decided by the Swedish side. But, in a meeting between MOFTEC and Sida in

Stockholm December 1997, the head of Sida´s Credit Division informed of new possibilities opening up in the field of development loans offered by Sida. Among such new initiatives are so called ”aid credits” (Swedish=“biståndskrediter), which contain a grant element of about 80 (?%, the possibility of receiving untied credits, and the possibility of receiving independent loan guarantees. No formal decision has however yet been taken by the Swedish Gov.in this regard, and it is not clear at present to what extent China will be able to avail itself of these new facilities.

Degree of Sida involvement

In China, because the client is not always able to prepare appraisal reports of sufficiently high standard, sometimes Sida´s involvement in project planning and design becomes bigger than in other recipient countries. Therefore Sida´s aid officers see the degree of their intervention in the project as a balance act between being a contract financier and a regular project financier, which it is not supposed to be according to its own rules.

In the opinion of this evaluation Sida has managed this balance act very well. Often the issue is raised in internal memoranda in order to document the motives for various interventions and actions. One officer in charge of DH at BITS had prepared a complete and thorough 9 page checklist of all the items that one would wish to see in a full-fledged appraisal study. This check-list was applied both when checking up on the completeness of the appraisals handed in by the borrower, but also when commissioning an appraisal report to be carried out by a Swedish consultant.

Finding: In China, because the client is not always able to prepare appraisal reports of sufficiently high standard, sometimes Sida´s involvement in project planning and design becomes bigger than in other recipient countries. Its interventive role in the project is a balance act between being a contract financier and a regular project financier. In the opinion of this evaluation Sida has managed this balance act very well.

Insufficient training and supervision included in contracts

In many financing applications received from China Sida finds the training included in the contract to be insufficient or poorly specified. The same is often true regarding the amount of supervision as well as amount of spare parts provided for in the contract. Chinese clients are, at least by Sida, generally known to be very reluctant to include these items in the contract, preferring to spend the entire credit amount on hardware. Often the Chinese borrower will try to make use of the advice and information which it can get for free from the various suppliers contending for the order during the

negotiations conducted with each of the contenders in preparation for final selection of the successful bidder. This is a way that the Chinese hope to get as much know-how and training and transfer of knowledge without having to pay for it. Several of the Swedish suppliers were of the opinion that their Chinese clients are overly focusing on the hard-ware part of a contract and hesitant to use the funds to pay for soft-ware by way of supervision and training.

Because of this situation the donor Sida finds itself actively controlling that the required items like supervision, spare parts and training are always present in the contract and in sufficient amounts.

The observations made by in this evaluation seem to support these contentions. In all of the five projects interviews showed that the training and supervision parts of the contract were on the small side. In a two cases these items appeared in the contract but were subsequently dropped and exchanged for hardware, seemingly without informing or asking the donor agency BITS/Sida about it.

Finding: Several of the Swedish suppliers were of the opinion that their Chinese clients are overly focusing on the hard-ware part of a contract and hesitant to use the funds to pay for soft-ware by way of supervision and training. Because of this situation the donor Sida finds itself actively controlling that the required items like supervision, spare parts and training are always present in the contract and in sufficient amounts.

Procurement supervision

Also the procurement situation in China is different from other countries, and often involves Sida to a greater extent than elsewhere. In the projects evaluated here, Sida has routinely been involved, not only in analyzing and appraising the commercial contract signed between the Chinese importer and the Swedish supplier, but also in exercising a measure of control to ensure that the procurement procedure followed was satisfactory.

For Sida it was always a delicate and rather difficult issue to decide in each case how much of control advice and active involvement is feasible both w.r.t. its administrative capacity, but, perhaps more importantly, w.r.t. Sidas principles regarding this aid form.

Chinese intermediary bank

A problem in some of he projects has been that the Bank of China, which by MOFTEC had been designated as the only bank allowed to act as on-lender of the Swedish credits to the end-users, was very hesitant to participate in some of these projects. The Bank´s motive was simple and easy to understand. It felt that, without proper security being posted by the end-user, the Bank, given the new requirement posed by the Chinese

government that the Bank conduct its business in a commercially sound way, should not risk its solidity by granting new loans to municipalities who are in arrears regarding other, previous loans to Bank of China or to any other Bank.

For this reason the Bank of China has on several occasions threatened to stop a loan or delayed it because the end user or the provincial government guaranteeing the end-users credit had not satisfactorily serviced other credits received.

6. Sweden's Program of Concessionary Development Credits

Up until 1995 the Swedish concessionary credits were given by the Government´s agency BITS. In July 1995 BITS merged with four other organizations (among them "old" SIDA) to form "new" *Sida,* and from then on these credits are given under Sida´s name.

Sweden´s program of concessionary credits for development was introduced in 1980 with the following general purposes:

(1) a wish to support also other than the poorest LDCs, a support which must then be given on less than grant terms

(2) to give this group of developing countries a wider opportunity to choose Swedish suppliers

(3) to exploit the "multiplier effect" which consists in the grant element attracting additional commercial resources to be invested in the third world, and

(4) to facilitate the transition from grant aid to other (commercial) forms of financing

The main motive behind the concessionary credits was said to be developmental, and the credits would therefore be given only to countries whose development policy was in line with the overall goals of Sweden´s development aid. The Swedish exporter´s interests were obviously also an important motive, but - as emphasized in all official documents - always secondary to the developmental motive.

Even though the credits are tied to Swedish goods and services, it was assumed - given the sharp international competition between different suppliers - that the grant element would always accrue to the recipient country and not as a subsidy to the Swedish exporter.

After a revision in 1983 an even greater relative emphasis was laid on the developmental aspects, and also the initiative for applying for a concessional credit would to a higher degree be placed with the recipient country.

As the credit instrument was seen as being most suitable for productive investments yielding economic surplus, it was foreseen that the credits would be mainly used to satisfy the objectives of economic growth and economic independence, and not economic and social equality and democracy, which were then the other overall goals of Sweden´s development aid.

The rules and criteria for the Swedish concessionary credit scheme have evolved somewhat over the years. Currently they are as follows:

(1) The credits can be given only to countries that are credit-worthy, or which are judged to be able to become credit-worthy in the foreseeable future. Sida classifies countries according to whether they should be receiving only grants, only credits or if they can receive both grants and (soft) credits. This is a question which is judged on

the basis of the country's level of income, but also its macroeconomic performance. It was recently studied by a special task force at Sida.

(2) The projects must be highly prioritized by the recipient government

(3) The credits are normally directed to the economic sectors of the economy, particularly to projects run by public utilities or corporations. So far, priority has been given to infrastructure projects as energy, transport and telecommunications. These are often projects which, because of low regulated tariffs, can not attain financial viability, but which are seen as economically sound for the country.

(4) The projects must be technically and financially sound, as evidenced by a thorough feasibility study or the like.

(5) Projects must give a satisfactory economic rate of return or create conditions for other activities which would lead to such returns

(6) The projects should have a positive impact on the country´s ability to earn or save foreign exchange

(7) Projects for production for the domestic market should preferably be directed towards basic utilities which benefit a large section of the population

(8) Projects which on balance are deemed to have a negative environmental impact are *not* eligible for financing. This criteria seems to have been added sometime in the late 1980s.

(9) Due to the agreement reached in 1992 within OECD (the *Helsinki-agreement)* projects deemed to be "commercially viable" shall not be eligible for financing by concessionary credits which are tied, such as e.g. the Swedish concessionary credits. Commercial viability is tested according to two criteria. *firstly*, if the project´s net cash flow is high enough to service credits given on market terms. *Secondly*, if finance at market terms is available for the project.
The logical conclusion of the Helsinki accords is that concessionary credits can now only be given to projects which show a positive economic rate of return but which are *not* financially viable. The Helsinki agreement was signed in 1991 to take effect in 1992. However, there was a transition rule stating that old criteria could apply for another two years in those projects which had already been notified by 1992.

(10) The Sida-credit may finance only up to 85 % of the contract sum, while the rest must be covered by a cash payment. At least 70 % of the part financed by the Swedish credit must be used for products and services of Swedish origin.

(11) The credit is normally a bank-to-bank credit, i.e. from a bank in Sweden to one in Zimbabwe, but the borrower may also be ministry, a public utility or corporation or some other entity like for instance a town.

(12) The grant element of the credit is financed out of Sidas (formerly BITS´) aid budget.

(13) The grant element is at least 35 % which can be achieved by different constellations of the level of the interest rate, the length of grace period and the length of the repayment period. A standard constellation in the Swedish scheme seems to be a 10 year credit period at 0 % interest rate, with a grace period of 1 year and a repayment period of 9 years. The starting point of the credit period is normally the

time of commissioning, i.e. when the contract obligations of the Swedish supplier are officially finished.

(14) Sida does *not* avail itself of the right, given by the OECD consensus rules, to "match" higher grant elements offered by other competing countries.

(15) The concessionary credit terms may, if the government so wishes, be passed on to the end-user of the credit, *or* be retained by the government while other - often more commercial - terms are given to the user of the credit in an on-lending agreement. On this point there seems however to be an unsettled situation. While the position referred to here is stated in a memorandum from Sida of January 1996, there is another document (*Guidelines for the concessionary credit scheme* dated December 1995) which says that: "the grant element shall, where at all possible and practicable, be absorbed by a central government authority in order to avoid giving signals which distort efficiency and/or which distort competition in the local market.". We may comment here that BITS´s awareness of this aspect was not always very high, at least as evidenced from documentation in the files.

According to one interview the situation changed in the late 1980s when the question of *counter part fund payments* became important in development aid. Then also BITS started to pay attention to what conditions were passed on in the on-lending agreements, when such were at all made. When the grant element is given to an infrastructure public utility like e.g. electricity generation one may of course argue that it is the large mass of consumers who benefit, however at the exclusion of the poorest groups in the countryside who do not have electricity.
In all of the five district heating projects evaluated here the grant element is absorbed by the end-users, which are municipal public utility companies.

(16) The credits are guaranteed, for a fee, by the Swedish Export Credits Guarantee Board *(EKN)* on behalf of Sida.

(17) Procurement should normally be done through international competitive bidding. However, as no specific procedure has been laid down by BITS/Sida, it may also follow guidelines established by the recipient countries, provided that these guidelines are judged to be satisfactory BITS/Sida.

(18) The credit is to finance a *specific* contract won by a Swedish supplier in international competition.

(19) The initiative for Swedish concessionary credit financing may come from the prospective Swedish contractor or the user in the recipient country, but the formal request for credit must always be endorsed by the finance Ministry or the Ministry responsible for aid coordination. Inherent in a system where the initiative for concessionary credits comes from one of the two contracting parties - the supplier or the client - is the risk of limiting the choice to very few projects, thus risking to lose the view of other alternative uses of the funds.

(20) Regarding competition between the exporters of different countries an important element is that, according to the Helsinki accords, a soft credit - if it is offered at all - must always contain a grant element of at least 35 %. Also, the different donor countries offering concessionary credits are allowed to match each others´ offers with respect to the grant element. The purpose of this rule is that a

contract should always be awarded on the merits of the technical quality and the price offered by the exporters, and not on the grounds of a soft credit being available. As was noted above, however, Sweden´s policy has always been not to use this matching option.

(21) Sida may, according to its statutes, decide to grant a credit only *after* the Swedish contractor has already been awarded the contract, won through international competition or *after* bid closing. This is to safeguard that the knowledge of a prospective granting of a Swedish concessionary credit will not unduly influence the recipient of the credit in his choice of contractor.

If and when there is more than one country offering a subsidized credit there would not seem to be any problem to make sure that a contract is awarded purely on the basis of technical quality and on price. However, when there is only *one* offer it is hard to see how the prospect of a soft credit being available would *not* influence the decision. for obviously the Swedish contractor will have told the client that a credit is most likely forthcoming if and when a contract is awarded. So, in these cases the formality of deciding about the credit only after the contract has been awarded, would seem to be a mere formality with no practical meaning.

(22) According to BITS´s own rules it is very important to evaluate the projects which have been financed by a Swedish concessionary credit.

The current **volume of total Swedish concessionary credits** is about MSEK 1,200 to 1,500 a year, with a grant element of about SEK 400 million. Of the total xxxxx accumulated amount of credits since the start of the program in 1980, about **X** % has gone to China, making it the y largest recipient of this type of aid from Sweden. On a per capita basis China has received SEK 4, which can be compared to about 50 in Zimbabwe and over 100 for small countries like Lesotho and Mauritius.

II THE EVALUATION and METHODOLOGY

1. Reason for, scope and focus of evaluation

Reasons for evaluation

Firstly, none of the projects, which have all been completed with respect to the involvement of the Swedish suppliers, has been evaluated. According to Sida´s evaluation policy a final evaluation is therefore due.

Secondly, according to the BITS project preparation documents, the projects, in varying degree, were seen as important *demonstration cases* and large expectations were raised with respect to their outcomes. The Chinese authorities saw the projects as possible demonstration cases in so far that it would show to what extent advanced western technology could be used alongside with Chinese know-how and equipment in order to modernize China´s municipal and other heating systems. The lessons from the project would be incorporated into future Chinese district heating planning and equipment standardization.

Thirdly, Sida has today no information whatsoever on the outcomes of these projects, nor with respect to their implementation or their outputs. Nor does Sida have any insight into the extent to which the main objectives have been reached.

Ex post and ex ante analysis

The projects have to date achieved near completion only on the *input/activity* levels, and *output* levels, while outcomes on *effects* and *impact* levels have only partly started to manifest themselves This evaluation can of course be an *ex post* analysis only in relation to the outcomes which have already happened. In practice the difference between undertaking an evaluation before all the outcomes have happened, as is done here, and doing it when all the outcomes are already at hand, is however not that great. Because even in the latter case, it will often take many years before some effects, and especially some impacts start to manifest themselves. So in both cases the evaluation will have to rely on a mixture of ex post and ex ante analysis.

Sida´s evaluation program does not in practice (although it *does* conceptually) separate project completion reports from other ex post (impact) evaluation reports, like is done in some of the larger aid agencies such as the World Bank. This is unavoidable given the limited size of Sida´s aid program.

Scope and focus

Following Sida´s normal level of ambition the investment projects financed by Sweden should be subjected to a *comprehensive* ex post evaluation, comprehensive meaning that it should cover not only all levels of the projects´s goal hierarchies - inputs, activities, outputs, effects and impacts - but also all the usual aspects and criteria which are important for Swedish aid, among them the six main objectives of Sweden´s development cooperation.

The general *objective* of the evaluation is to assess the outcomes of the projects at the different relevant levels, as judged against the aid criteria of BITS and Sida, as well as against applicable development cooperation principles of Swedish aid, e.g. Sida´s *Policy for Support to Energy and Environment* established in April 1996.

The *scope* of the evaluation, according to the terms-of-reference, includes:

(1) to provide background *information* about:
- the development of the *district heating* sector in China
- the financial status, operational results and institutional strength of the companies and institutions involved

(2) assess the *implementation* of the project, i.e the delivery of the Swedish equipment and the efficiency of use of this equipment in the respective projects.
- identify delays in project implementation and operational areas, if any
- analyze financial, economic and operational consequences of deviations from the implementation plan (if any)
- evaluate the Swedish supplier´s training efforts with regard to transfer of know-how
- assess follow up and maintenance routines etc. of the respective projects
- assess the recipients capability to operate and maintain the systems
- evaluate the performance of the Swedish supplier in interaction with the client

(3) evaluate the *effects* that the use of the Swedish deliveries have had on the respective programs,
- ascertain whether the project objectives have been attained
- collect operational data and quantify results wherever possible

(4) evaluate the *impact* that the respective projects have had, or are likely to have in the future, on relevant local, regional and national goals.
- investigate and report on environmental impacts from the projects
- investigate and report on gender issues related to the project

(5) The outcomes should also be assessed against the stated project targets as well as the overall objectives of Swedish development cooperation, namely

- *Social and economic equality / poverty alleviation*
- *Economic growth*
- *Independence*
- *Democratization*
- *Gender equality*
- *Environment*

The terms-of-reference does not specify any particular *focus* of the evaluation, implying that the analysis should be - conventionally - distributed over the relevant topics given above at the different levels of the projects´ goal hierarchies.

2. The assignment

The assignment was for 33 person-days, which were spent as follows:

- *four* days of preparatory work in Sweden, mainly reading file documents, and conducting interviews.
- *five* days in Beijing for discussions and interviews at the Ministry of Foreign Trade and Economic Cooperation, at the Swedish Embassy, and at the World Bank Regional Office.
- *15* days field trip, by plane and by road, visiting the five different cities in four different provinces where the five Swedish-supported district heating projects are located. In each of the cities I was able to visit virtually all project sites related to the use of imported Swedish equipment. I met with all the relevant project personnel and company managers, as well as with the relevant officers in the local government and municipal offices respectively.
- *nine* days of analysis, follow-up interviews and report writing in Sweden

3. Methodology

Firstly, I will analyze the entire contents of each project in terms of its component parts and its targets and objectives (explicit as well as implicit) at all levels of the goal hierarchy in the short, medium and the long run.

In none of the projects this has been done by BITS, but the most essential elements usually - if not always - follow from the texts of the relevant documents. The logical framework analysis - although sometimes under a different name - was widely used in most donor agencies already in the early 1950s, and BITS could therefore be criticized for having devoted too little effort in describing the goal structure of its

projects in more explicit log-frame terms. However this is a criticism which it would then share with very many other aid agencies - also SIDA. For while most agencies at that time officially adhered to some kind of *logical framework analysis*, very few of them actually applied it in their regular project work.

Where possible we will identify an *intended* (again, explicit *or* implicit) *target group* for the project.

Based on this analysis the information will be systematically arranged in a *logical framework* schedule of the following fashion.

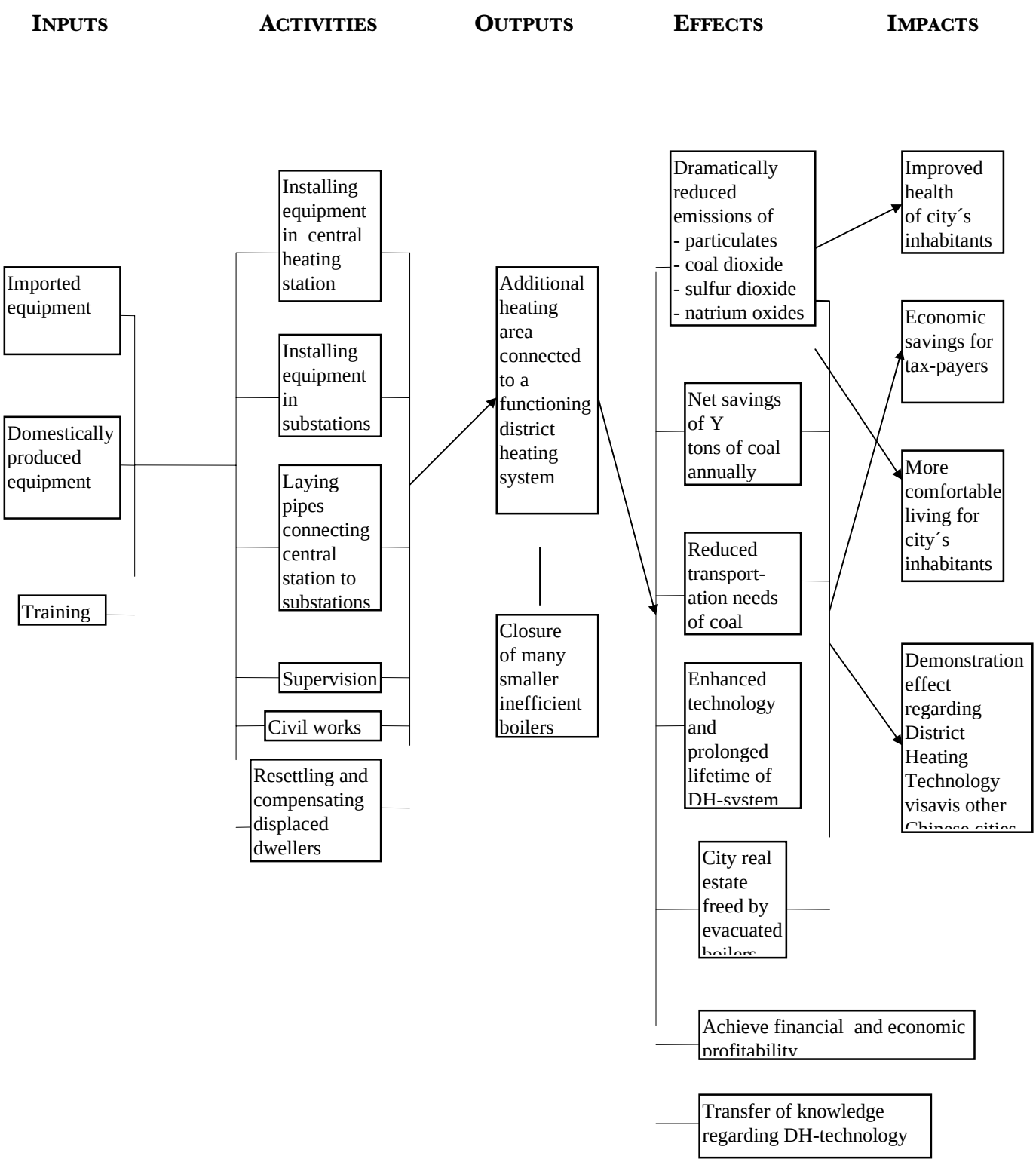
Targets and objectives at the following five levels: inputs, activities, outputs, effects, impacts	*Assumptions made; Restrictions*	*Criteria for measurement; indicators*	*Achieved*

This is done in section III "FINDINGS" under each of the five projects.

A *goal hierarchy* model based on the logical framework analysis will also be shown for each of the five projects. As is often the case, this goal hierarchy could not be based solely on the targets and objectives as stated explicitly in the available project documentation. Our analysis led us to include some elements which were overlooked (or at least not explicitly mentioned) in the project documents.

A common *goal hierarchy* structure covering the common features of all the five projects can be shown schematically as in figure 2 on the next page.

Figure 2: Schematic goal hierarchy common for all the projects



Secondly, I will analyze and assess all outcomes - as seen against *planned* targets at the following five levels:

- planning stage,
- implementation,
- outputs,
- effects, and
- impacts.

Under *effects* I will assess the projects *financial* profitability, and under *impact* I will discuss the projects *economic* viability. Under impacts are also assessed the project´s performance with respect to

- Economic growth
- Social and economic equality/ Poverty orientation
- Environment
- Gender
- Sustainability
- Democratization
- Independence

4. Availability of information

Availability of written information regarding the district heating projects is very uneven:

For the project preparation stage, i.e. during the period leading up the BITS´ decision to finance the availability is quite adequate, although by no means plentiful, and of generally high quality.

For the post-decision period, however, starting with the implementation of the project, there is virtually nothing. Mainly this lack of post-decision data is inherent in the aid form of concessionary credits. (See below). But it would seem that it is also to a large measure due to the language barrier and perhaps to style of operation of Chinese public utilities.

LIMITATIONS W.R.T. INFORMATION GATHERING IN CHINA

The language problem

The language problem is a real obstacle: In none of the projects was there anyone at all of the responsible officers who spoke English, so all interviews had to be conducted through an interpreter. This in itself implies an important restriction on the possibility to gather information and insights. Even with the presence of a fully professional interpreter - which in this mission, with perhaps one exception, was not the case - there

is a lot of informal information which goes missing. In projects like the present ones where written information is very scant or actually non-existent, it is crucial to be able to soak up not only " hard facts", but , perhaps more importantly, all kinds of informal remarks, and perhaps even innuendoes and insinuations. Evaluation experience shows that often weak points, hitherto unknown, are discovered by the evaluator only because of sometimes very small hints that are given either very indirectly or even inadvertently by the person being interviewed. Such informal information is very difficult to extract when interviews are done through an interpreter, and virtually impossible when the conversation is made with a non-professional interpreter.
When the language barrier i so large as between a non-Chinese speaker like myself and public utility officials who only speak Chinese and whit little experience from dealing with foreigners it is also not possible to throw around questions , and to give and receive short comments as you move along during site visits etceteras. Such quick and unsystematic exchange of comments can sometimes lead to unexpected insights.

It is very important to remember that the difficulties of accessing information - be it due to language or other problems - is something which may vary between the five district heating companies evaluated. It is quite conceivable that due to various circumstances some of the companies were more willing and able to share information than others. We must therefore take into account that the information bases for this evaluation is non-congruent and therefore can produce biased findings and conclusions.

Finding: The language problem was a real obstacle: In none of the projects was there anyone at all of the responsible officers who spoke English, so all interviews had to be conducted through an interpreter. This in itself implies an important restriction on the possibility to gather information and insights. Even with the presence of a fully professional interpreter - which in this mission, with perhaps one exception, was not the case - there is a lot of informal information which goes missing.

Individual interviews

Another possible limitation is that the Chinese are apparently unused to or unwilling to submit to interviews in a one-on one situation. In other words an interview is carried out with only one person present at the time. Virtually all interviews in this mission , even the ones conducted standing and moving around the floor of a heating station or pipe-line site, was in the presence of a large group of people usually 5-10. In my opinion such a presence of a large number of persons does usually not promote the disclosure or utterance of critical or sensitive issues.

Company premises

Another observation is that interviews with company officers were always conducted in a special conference room or even a banquet room of the hotel which was rented for the occasion, and I therefore missed out on the possibility of being able to study the

atmosphere of the company premises, where small observations of seemingly unimportant small things can sometimes lead to follow up questions of various sort which sometimes can lead valuable insights in an unexpected area..

Lack of written documentation

Secondly, there seems to be very few report available in the Chinese public utility companies even in Chinese. I have no way of judging whether this is a typical occurrence in China. But the five district heating companies in this evaluation seemed to have very little written documentation in general.

Another puzzling circumstance, perhaps explainable by a general lack of written reports and information, was the following: On some occasions it was not possible to receive information of very general and basic character because the officer concerned was on vacation or otherwise absent. On my question if there was not a copy of his report elsewhere available the answer was that it was only available in his office, and furthermore my question whether it would be possible to enter the said office with another key, the answer was that there was only one key and that the key was with the person missing.

The persons interviewed generally seemed to be very knowledgeable and in command of their subjects, but there was the natural limitation that there is only so much information that you can get out through the intermediation of a translator at a limited time.

To sum up, the interview and data collection stage of this evaluation is very different from what one is used to in most other countries, and I must reckon with the possibility that a lot of invaluable source of information which is derived from informal comments and opinion, may have been largely missing in this evaluation. And in consequence we must also therefore take into account that important aspects of the projects may have gone undetected.

GENERAL LIMITATIONS OF INFORMATION REGARDING BITS CONCESSIONARY CREDITS

Little substantial data

BITS´ mode of work differs from that of Sida and other aid agencies in that it is the contracting parties themselves, i. e. the supplier/contractor in Sweden and the credit user in China, who assume responsibility for the project, with Sida remaining an outside financier. Because of this it is also logical that the amount of documentation available in the Sida files is much smaller than there would have been in a regular project, financed by a Sida grant of comparable size. This does not mean that the actual physical volume of documentation in the BITS files is small. It is not. For the projects evaluated here there are a total of about 15 full ring binders of documents. But most of them are formal documents - contracts, specifications of equipment, covering letters, etc., and very few substantive or analytical.

No socio-economic information

Furthermore, BITS credits cater primarily to infrastructure an economic projects rather than social projects, it may therefore seem logical that there should be little data on particularly the social aspects. This is of course an important shortcoming for our evaluation, for - this being a Sida evaluation - we need in principle to address all the social issues as well as the economic ones.

Complete lack of ex-post data

The most striking feature of the documentation available in the BITS files is that all documentation seems to end when the credit agreement has been signed and the actual project work starts. Also this can perhaps be seen as logical in the sense that once the financier BITS has satisfied itself that the project is sound, it is up to the contracting parties to do the job. During the months preceding the final signing of the credit there is an avalanche of documents, mostly dealing with formalities regarding legal and financial matters, but also an abundance of covering letters and short notes. After that there is complete silence, a complete vacuum regarding documentation, which lasts until several years later when BITS sends a letter asking to receive a final report which it has been promised in the credit agreement. As concerns financial data the responsibility to follow-up project reporting rests with the Swedish bank issuing the credit.

NON COMPLIANCE WITH REPORTING OBLIGATIONS.

An inventory of the Sida files at the start of this evaluation revealed that of the ten reports due (one from the end-user and one from the supplier in five projects) none had been delivered. Thus none of the contracting parties had complied with the contractual obligation to send in a final completion report.

During the time of evaluation I received from two of the projects very basic - incomplete and inadequate - ”project completion reports.

SUMMARY EVALUATION

This being a *summary* evaluation of five separate investment projects, to be carried out in a limited time, will have its obvious implications both w.r.t. depth of analysis and availability of data. With a total time available of 33 days, of which 20 in the field, for five projects, there is an average of 4 days available for gathering new information during site visits.

We must therefore count with a risk that not all relevant information is brought to the fore, and that erroneous or misleading conclusions regarding a project - either positive or negative - can occur.

F I N D I N G S

CHAPTERS III - VIII

Since we are here evaluating five projects that are very similar not only in terms of structure, objectives and contents, but also w.r.t. to the equipment imported, there would be certain advantages, if the findings for all the five different project were presented together in an integrated fashion under each of the 12 subject headings.

We have however decided against that alternative and instead chosen to present each project, with all the subject headings, separately because the advantages of this alternative are much greater. It is after all 5 different projects, in 5 different cities and even provinces with different project managers and responsible companies, who have basically no contact with the others, with different Swedish suppliers, with programs that have been planned separately and independently from each other and at different times. For each of the five individual projects there is a constituency which is interested in the factual information and discussion of that particular project.

For all these reason the most correct procedure is to present and discuss the findings for each project separately. the common features and the common findings will then be presented in an integrated fashion in chapter *VIII Summary of Findings and Conclusions* and also in the *Executive summary*.

The order of presenting the five projects will be by "seniority", id est by the date of the financing decision, which at least partly, also follows date of implementation: this criteria gives us the following order, with the respective dates for BITS decision to finance:

1. DALIAN, 24 March 1993
2. TAIYUAN, 23 November 1993
3. SHIJIAZHUANG, 19 March 1995
4. JIAMUSI, 25 April 1995
5. FUSHUN, 28 April 1995

In the next five chapters each project will be described and its goal hierarchy will be defined, then assessed and analyzed w.r.t. the following aspects:

Procurement
Implementation
Results/outputs
Effects
Financial profitability
Impacts: Attainment of long-run objectives:
Economic benefits
Environment
Equality/ Poverty orientation
Gender
Democratization

Independence
BITS´s project preparation
Reporting requirement
Sustainability

Regarding some of these aspects however, namely *Equality/poverty orientation, Gender, Democratization,* and *Independence,* there is often little to say regarding the projects evaluated here since these aspects are either not relevant for the project in question or simply due to unavailability of data. Furthermore, what little there is to say is usually similar for all of the five projects. We have in spite of this chosen to always include the respective heading in order to facilitate for those readers who want to use this evaluation report for reference purposes. For the same reasons there will sometimes appear repetitions of the same or similar type of reasoning under the different projects.

Regarding *Sustainability* there is sufficiently to say but it is all identical for all the projects and will therefore also be presented collectively for all the projects.

III DISTRICT HEATING IN DALIAN

1. The Project

Pollution in Dalian

Even if Dalian, a city of over 5 million inhabitants, today counts as one of the most progressive cities in the country, not only in terms of its economic growth but also because of a foresighted and environmental friendly city planning, its environmental situation is very serious. Before the present project there were in the city center some 3500 boilers and 1700 chimneys owned by small factories all emitting their dust at low level. In addition there were 200,000 small residential heating chimneys. The dustfall exceeded by 3,43 times the national standard.

To improve this situation the city decided to build two new thermal power stations to supply a 9,500 sqm area with heat. Simultaneously a DH distribution system would be built.

The total building area to be heated in Dalian is 20 million sqm. According to plan 9,5 of this would be under DH system four years later. Of the total area about 3 million is under the jurisdiction of the Dalian District Heating company, and of that app.1 million sqm is covered by the present project. It was not possible to have data on how much of the rest is served by district heating and how much is served by many individual boilers.

The DH system will depend on steam generation from a cogeneration plant, which is now being extended. This plant will supply power to local factories as well as steam for others and to the DH system.

Given the city´s present rapid growth, Dalian finds itself in a privileged position w.r.t. being able to undertake large public investments as tax revenues from an expanding business sector are high. GDP growth in Dalian has in the past 5 years has been 2,8 % *above* the already very high national average 8-10 %.

Of the 50 largest cities in China Dalian ranks as number six in revenue, number eight in size of total economy, and number 12 in size of population. The city also receives a substantial amount of foreign aid. Total accumulated foreign aid today - including mixed credits and grants - is 450 USD million for 42 projects from a total of 9 countries.

At present a large Japan - China joint project in environmental protection is in preparation with a planned total investment of USD 300 million in abatement of water

and air pollution. Dalian is one of three chosen model cities. It has not yet been decided whether this project will also contain some DH-components.

Design

The design of the DH-system is as follows:

Steam from the backpressure turbine in the power station is transmitted via a 42 km long pipeline to the central heat exchange station, from which the thermal energy in the steam is transferred to the District Heating system through three heat exchangers.

A DH-network, with a total length of over 21 kms consisting of double piping - one supply and one return pipe, connects the Central Station with 15 substations. In each of the substations the thermal energy is transferred to the respective local heating systems by one or two heat exchangers.

The project

The project is designed as a three circle system, including a central heat exchange station, 15 sub-stations and distribution pipelines as well as computerized control center and aims at introducing DH into the central parts of the city covering an area of 2 sqkm, with some 120,000 inhabitants and an additional 20,000 employees The parts financed by the Swedish credit covers the central station, the sub-stations and the piping network. But not the local distribution systems. The idea is to import the equipment which can not be purchased in sufficient good quality in China

As a result of the projects app. 120 smaller boilers of different sizes were to be replaced by centralized heat generation.

Total investment cost has been estimated to 54,5 RMB of which 54 % will be foreign imports . While the foreign imports were financed by a concessionary loan with a 35 % grant element, we can note for comparison that for its domestic credit needs the DTCP had to pay an interest of 8 % with a repayment period of 6 years starting after commissioning.

The entire project can be summarized in the following project budget:

Table 7: Cost structure of Dalian District Heating project, million RMB

Cost items	**Total**	**Imported**
Compensations for resettling displaced dwellers	4,7	-
Buildings and structures	3,2	-
Civil works	2,2	-
Equipment and installations of central and sub-stations	12,5	10,6
Pipings	18,9	12,6
Other equipment	7,1	4,7
Contingencies	3,5	1,4
Pre-production expenditures	2,4	-
Total	54,5	29,3

The complete list of *inputs* and *activities* as well as expected *outputs, effects* and *impacts* of this project are the following:

Inputs
Equipment imported from Sweden
for the Central station:
- Steam-water heat exchangers (2)
- High temperature cycling water pumps (4)
- Plane typed heat exchangers (2)
- temperature and pressure reducer (1)
- Condensing water pumps (2)
- Make-up water pumps (2)
- Condensing water tank (1)

for the 15 sub-stations:
- Heat Exchangers (18)

- Training
- Other equipments, material and other inputs

Activities
- Resettling and compensating displaced dwellers
- Civil works
- Installing equipment in central and sub-stations
- Lay pipes
- Supervision

Outputs
- Functioning district heating system with connected area of x sqm

Effects
- Net savings of x tons of coal annually
- Reductions in emissions of pollutants SO2, CO, particulates
- Reduced transportation needs of coal
- Enhanced/Prolonged technical lifetime of DH system

Impacts
- Improved health of city´s inhabitants
- Economic savings for tax payers
- more comfortable living for city´s inhabitants

Assumptions:
- Power plant serving new district heating system to be completed on time
- Credit intermediation of Bank of China to materialize
- Envisaged heat tariff raise to be carried Out

Role of Swedish contractor

The contract for supplying imported equipment was awarded to the *Powerpipe* Company, which is today Sweden´s by far largest producer of preinsulated pipes for distribution of heat as well as of coldness. According to the contract between Powerpipe and DXTP the seller would be

"responsible for design and manufacture of the equipment and for correctness of its performance parameters, its manufacturing drawings, regarding its written technical instructions, as well as for its technical requirements as specified."

The equipment imported from Sweden was the following:

- For the Central station: 2 Steam-water heat exchangers, 4 High temperature cycling water pumps, 2 Plane typed heat exchangers, 1 temperature and pressure reducer, 2 Condensing water pumps , 2 Make-up water pumps, 1 Condensing water tank
- For the 15 sub-stations: 18 Heat Exchangers

According to contract 2 % of the total was set aside for spare parts. As much as app. 50% of the goods were to be procured by the Swedish contractor from *sub-contractors* in Sweden. About 10 % of the equipment is of non-Swedish origin. Formally the goods were imported from Sweden by the China National Industrial Machinery Import and Export Company (MACHIMPEX), and the contract negotiations were handled by the China National Technical Import & Export Corporation (CNTIC). The credit agreement was between a Swedish bank and the Bank of China acting as an intermediary. According to agreement the on-lending terms of the credit from the Bank of China to the end-user DTCP was on the same terms as those received by Bank of China.

All construction work as well as installations of central and substations and of the entire network was carried out by the company´s own staff, suitably trained and supervised by the experts provided by the Swedish contractor Powerpipe. The volume needed of such foreign expertise was always a point of contention between the Chinese buyer and the Swedish supplier. In the latter´s opinion the client was heavily biased towards spending all the foreign credit only on imported hardware and not nearly enough on necessary software in terms of training and supervision.

The training and supervision were also by BITS seen as vital ingredients in the contract, and it recommended an increase in these items after having reviewed a preliminary draft of the contract. The consultants retained by BITS to appraise the project strongly emphasized that "the scope of training, supervision and documentation should be extended". They also remarked that transfer of know-how between similar projects in other provinces is very limited, which in itself accentuated the need for proper training and supervision to be included in the project.

BITS expected the project to contribute to transfer of technology and know-how to the end user, and these aspects were therefore important for BITS´ decision to

support the project. Subsequently, in its financing decision BITS judged that there was sufficient training, supervision and adequate documentation included so as to ensure implementation and safe operation in the future.

The independent appraisal that was carried out of the project on contract from BITS found, provided some modifications suggested by the consultant were included, that the DH system proposed by the project is well balanced and based on professional design, and that intended plans to import equipment were adequate and appropriate.

The importance of using prefabricated pipes imported from Sweden was emphasized by the consultant on the ground that such, prefabricated, pipes with built in alarm system, could be laid directly on the ground without any special preparations of the ditches. This was important t for the project because of the complex underground conditions in the area.

2. Logical framework and Goal hierarchy

The information on inputs and activities as well as the project´s expected outputs, effects and impacts can be organized in the following outline of logical framework schedule.

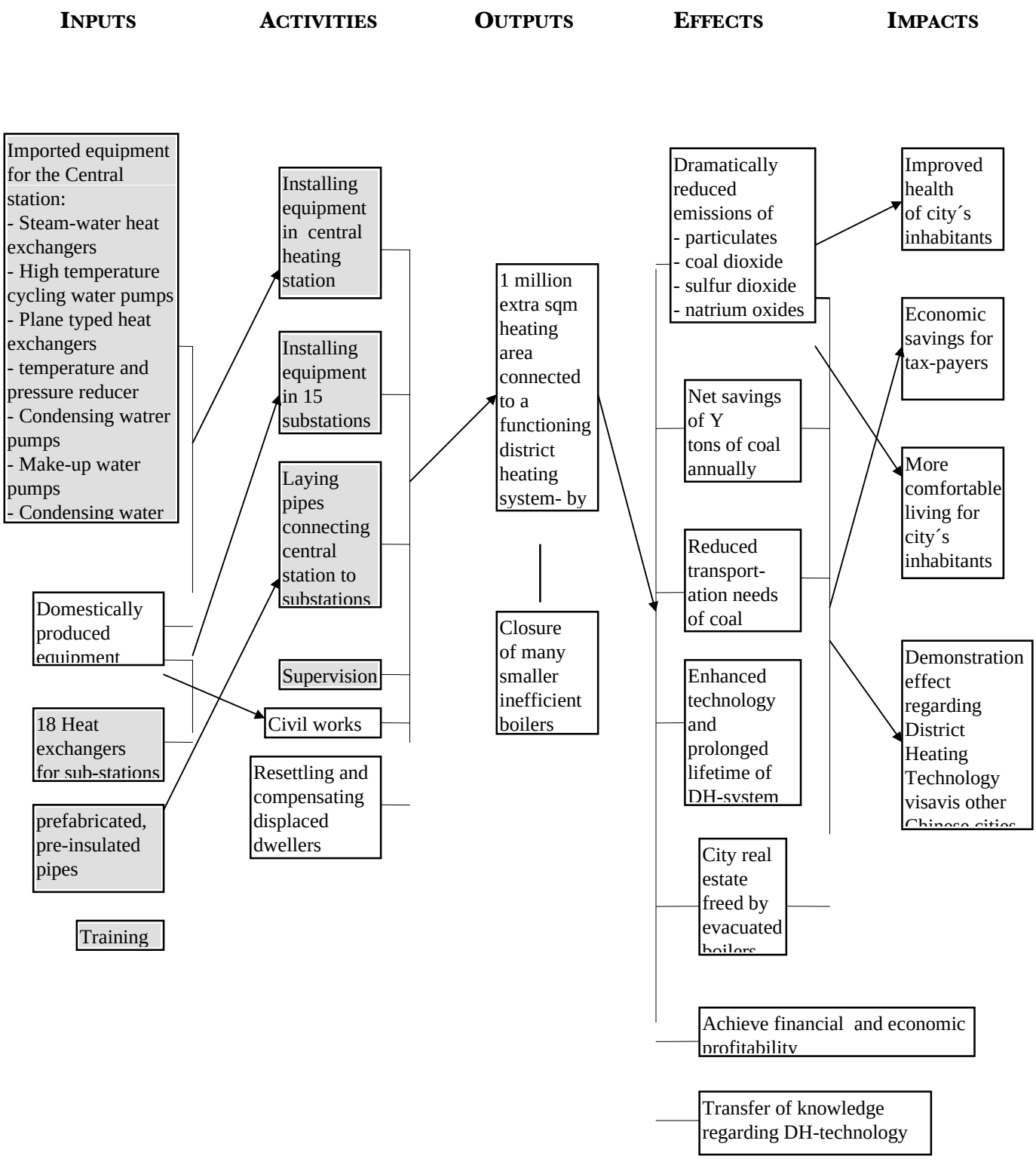
*Table 8: Outline of logical framework model of the **Dalian** District Heating project*

TARGETS AND OBJECTIVES AT DIFFERENT LEVELS	*ASSUMPTIONS MADE; RESTRICTIONS*	*Criteria for measurement; indicators*	*Achieved*
Inputs			
Equipment imported from Sweden			
<u>for the Central station:</u>	Credit intermediation of Bank of China to materialize		
- Steam-water heat exchangers 2			
- High temperature cycling water pumps 4			
- Plane typed heat exchangers 2			
- temperature and pressure reducer 1			
- Condensing water pumps 2			
- Make-up water pumps 2			
- Condensing water tank 1			
<u>for the 15 sub-stations:</u>			
- Heat Exchangers 18			
- Training			
- Other equipments, material and other inputs			
Activities			
- Resettling and compensating displaced dwellers			
- Civil works			

- Installing equipment in central and sub-stations			
- Lay pipes			
- Supervision			
Outputs			
- Functioning district heating system with connected area of x sqm	Power plant serving new district heating system to be completed on time		
Effects			
- Net savings of x tons of coal annually			
- Reductions in emissions of pollutants SO2, CO, particulates			
- Reduced transportation needs of coal			
- Enhanced/Prolonged technical lifetime of DH system			
- Financially sustainable operation by DH-company	Envisaged heat tariff raise to be implemented		
Impacts			
- Improved health of city´s inhabitants			
- Economic savings for tax payers			
- more comfortable living for city´s inhabitants			

The *causal links* between the various factors of the logical framework table can be shown in a goal hierarchy model like in figure 3 on the next page.

*Figure 3: Goal Hierarchy of the **Dalian** District Heating project*



3. Negotiations; Procurement

The end-user, Dalian District heating company, received offers from three (4?) Swedish suppliers - ABB, Powerpipe and ATF - and had advance negotiations with all. Then the choice was narrowed down to two - ABB and Powerpipe. ABB, in an initial stage, offered the lowest price but in the client´s opinion ABB had presented a design

”according to their own idea not according to the wishes and needs of the client. Therefor we did not choose ABB because their design was not suited for our needs.”

Finally Powerpipe was chosen, mainly, as the company itself reports, because of Powerpipe´s lower price.

Before the final decision was made there were however a number of ”skirmishes” between the Swedish contenders. One issue seems to have been the client´s wish that the Swedish contenders should actively participate in analyzing and providing suggestions for modifications to the design of the project. This is something which the Chinese side wished the contenders to do, as a means of getting expensive consultancy advice for free.

ABB at one time complained to BITS that they would be barred from getting the contract just because they had not been sufficiently forthcoming in this respect. In their opinion the task at hand was to deliver equipment not to provide free technical consultation.

“Performance guarantee”

A related issue is that the Chinese side wanted the Swedish supplier not only to supply the equipment but also to guarantee its perfect functioning *after* installation. In the opinion of ABB such a function guarantee could only be given on condition that the Swedish supplier had also formally been entrusted with the task of planning and designing the project, not otherwise. In a fax message, dated 1992-10-16, ABB states:

”We do not understand how anyone can deliver ”performance guarantee” on a system that is designed by someone else?”

In the same fax the ABB representative, Bo Strömquist, also states his opinion that

”The present design contains some basic construction errors that are unacceptable in a project of this kind to receive BITS approval”

Another of the contenders, ATF, reported to the Swedish Embassy in Beijing, its suspicion that Powerpipe´s Chinese representative had slandered and given false information about ATF to the end-user. One such false information was reportedly that BITS had not approved of ATF as a supplier. This particular piece of information was later denied by BITS in a letter to the end user.

My impression after discussing these matters both with the client, with representatives of the contending Swedish companies and with BITS, is that none of the alleged faults were of a very serious nature. The interviews carried out by this evaluator could not reveal any fact or circumstance to substantiate that any serious disregard of sound and generally competitive procurement practices had taken place.

Finding: There were many claims from the bidding Swedish companies that sound procurement rules had been violated. My impression is that none of the alleged faults were of a very serious nature.

Powerpipe had incurred losses during its last two or three years of operation and because of that BITS insisted that its mother company *Birka Business Development* issue a complete financial guarantee for the delivery before BITS would agree to finance the contract.

4. Implementation

The construction and installation of equipment in the sub-stations would be carried out in step with the extension of the network.

In a progress report dated 18 may 1995 the end-user reports that implementation of the project is proceeding largely satisfactorily.

On 31 October 1996 Powerpipe informed BITS that Bank of China wanted to postpone the payment of the last 5% of the contract sum until the whole project was in operation. However PP rejected that proposal claiming that it had completed all its obligations under the contract.

Powerpipe also rejected the end-users suggestion to scrap a little over 1 million worth of spares and supervision as specified in the contract. PP claimed that this delivery was important for the projects future success.

On 1997-09-05 Sida extended the credit disbursement period until 1997-12-15.

On April 1, 1997 in an ”Acception Report” signed by both Powerpipe and DTPC, the parties confirm that 28,5 million of equipment have been delivered, and that quantities and quality are in accordance with the contract. It also states that ”some shortage and misunderstanding has already been solved by friendly discussion”, and further that ”Two years commissioning and running has already proved advanced technology and reliable quality”.

My visit to the project revealed however, that this statement seems to have been quite premature, as the end-user is still today experiencing some important problems.

A letter of commissioning was sent by the company in 1997 of May. The positive text of this letter is, however, misleading to an uninformed reader. The letter does mention some of the problems, but not all of them, and does so in a very soft manner. It praises the Swedish delivery as being of highest quality and suitability, which stands in stark contrast to the impressions received during my site visits. As will be shown in the next section there is today considerable discontent, at least among some of the client´s engineers, about the Swedish equipment and their functioning.

I did not get a clear answer to my question whether the company today, in the light of subsequent experience, thought it was too early to send a letter of acceptance in May of 1997 when the machinery was not even installed yet.

Finding: According to an *Acception Report* signed in April 1997 "the equipment has been delivered,.. quantities and quality are in accordance with the contract" ...and "Two years running has already proved advanced technology and reliable quality". In spite of this however, there is today considerable discontent, at least among some of the client´s engineers, about the Swedish equipment and their functioning

Notes from visit

First stage installations covering 1,13 million sqm of heating space were completed in the end of 1997.

The central station was completed only at the end of 1997. According to original plan the central station was to be completed by the end of 1995. Earlier it was housed in temporary quarters just beside the new location. The pumps, of Chinese production, used in the temporary central station, are now stored nearby.

Installed capacity in all the substations is 3 million sqm, all based on Swedish investment. So far 1,13 million sqm have been connected through the 11 substations. As demand grows additional building space will be connected.

The sub-stations, there are 11 not 15 as said in the BITS decision memorandum, were erected and installed from 1994 to the end of 1997.

Two year delay

Overall there is a two-year delay in the project as the first stage was finished in late 1997 instead of, as according to plan, end of 1995.

The main reason for the delay is that it took the authorities longer than expected to move away the people living in the location where the central station was to be built and to find suitable replacement housing for them.

It is important to remember that the reason for the delay was a circumstance beyond the control of the project management.

Finding: Overall, there is a two-year delay in the project, the main reason being that it took the authorities longer than expected to evacuate the people living in the location where the central station was to be built and to find suitable replacement housing for them.

In general the client claims to be very satisfied with Powerpipe´s performance. "They always answer our questions, and if they do not know the answers, they direct us to somebody else who knows, usually the subcontractor." Apparently also strong personal relations have developed between representatives of the two companies. The Client´s Chief Engineer remarked to me regarding Powerpipes´ main representative: "He is a very good man. If it were not for him we would not have chosen Powerpipe."

Judging from the many critical points - described below - that surfaced during the site visit it is difficult to understand this enthusiasm on part of the client.

5. Results/outputs

According to an informal completion report, dated May 1998, that was prepared by the company for this evaluation, the project has achieved the following:

Cumulative development of connected and serviced heating area:

1994	500,000 sqm
1995	750,000 sqm
1996	980,000 sqm
1997	1,130,000 sqm

Fourteen old fashioned boiler houses, with a total of 20 boilers, with high energy consumption, low efficiency and high pollution have been closed down. Because of the closures the city has gained an area of 10,000 sqm earlier used for storage of coal and sludge, which can now be used for residential purposes.

It was not possible for the company to specify how much these closures meant in terms of saved consumption of coal or of reduced amounts of pollution.

A substantial decrease in the needs for local coal transportation has alleviated both the traffic congestion and the pollution in the City´s center.
Pipe network has been extended to a capacity of 3,000,000 sqm heating area.

The main equipment s have reached planned effect levels:

- circulation pump 1000 tons per hour
- steam consumption 60 tons per hour
- water temperature 105-110 degrees C
- Return water temperature 78-82 C

Overall the company feels that the performance of the project´s advanced technology justifies calling it a demonstration case.

But the company also mentions the following shortcomings:
- plastic buoys of the magnetic fluviograph attached to the heat exchangers are not functioning
- oil gauge of the water circulation pump is leaking
- the pumps vibrate and shake and make too much noise
- the training of the Chinese technicians in Sweden did not get the effects expected, as they are not able to independently take responsibility for maintenance and commission
- lack of various spare parts for parts that break or wear down quickly

Findings: The company experiences the following problems w.r.t. the Swedish equipment:
- plastic buoys of the magnetic fluviograph attached to the heat exchangers are not functioning
- oil gauge of the water circulation pump is leaking
- the pumps vibrate and shake and make too much noise
- the training of the Chinese technicians in Sweden did not get the effects expected, as they are not able to independently take responsibility for maintenance and commissioning
- lack of various spare parts for parts that break or wear down quickly

VISIT TO CENTRAL STATION

The central station, with a capacity to service 3 million sqm floor area is situated 4,2 km away from the power station located next to the company's headquarters.
In the power station itself there are four water circulating pumps bought from Sweden.

Problems with Swedish equipment

Speed regulator for pumps (frequency varied circulation cabinet)

This equipment was believed by the central station staff to be out of date already when bought in 1995, mainly because, inside the cabinet, they had found a label stating 1985 as production year. This they found after having opened the cabinet by coincidence.
Also, according to information received by them, this equipment is no longer used in Sweden. Similar equipment is produced in China, but from what is believed not of the same high quality as the Swedish equipment. The reason it was imported from Sweden is that "It came with the pumps".

This suspicion was however not shared by the chief engineer. Upon investigation he informed me that the sign 1995 denoted the model or design year, and that the actual production date was 1991.
A question remaining was however why in 1995 equipment is delivered which was produced four years earlier. In some peoples´ view normally equipment of this type is more or less produced to order and delivered immediately.

The reason I relate this suspicion held by some of the staff is not that they were necessarily right - in fact no real evidence, or even indication was produced to support the contention that the equipment would have been outdated. It is because this suspicion seems to be symptomatic of a general lack of contacts between the suppliers and the client. Perhaps it indicated that there was not enough supervision and training surrounding the introduction and use of the new Swedish equipment.
Experience, related below, regarding some of the other equipment seemed to indicate a similar situation.

Heat exchangers

The four heat exchangers are in general functioning well, but there is a problem with the **float** belonging to the measurement instrument for the quantity of water passing through the heat exchanger. This instrument arrived together with the heat exchangers in the original shipment, but without any spare parts. The glass of one of these instruments was broken as they unpacked the shipment. The others have the problem that the float in the measuring instrument keeps sinking. Apparently the instrument is leaking.

The company has the intention of requesting the supplier to replace these instruments as they only lasted for one month. Now they re out of them and have no way at all to measure the optimal functioning of the heat exchangers. In the meantime the company is trying to find a domestic replacement.

This type of heat exchanger is also produced in China but its efficiency is lower.

Connecting the heat exchangers there are two valves, side by side, one Swedish and the other Chinese. They both have the same function and as far as one can tell the same quality. But since they have only been operation for few months it is not possible to know.

Single panel computor (marked *Alfa-LAVAL "Satt control")* : This is a monitoring unit, not a control unit, to be connected to the computor which is not yet installed. The company has no spare parts for this. The operation/ function of this unit seems to be satisfactory. At least they have not yet seen any problems with it.

Computor has not yet been installed , so the company does not yet know how the Swedish equipment will perform together with the Computor. Today there is in place a Chinese manually operated, control equipment. The Computor will be installed, by the company´s own staff probably at the end of the year. They have the proper experience for it since they already did it in the substations.

Pumps

After installation the staff found that 1 pump is leaking water excessively. In addition all of the four pumps are leaking oil. The company has no spare parts for these pumps and has not yet decided on how to fix the faulty pumps

In the opinion of the chief engineer it is normal for pumps of this kind to have some oil leakage. It was not possible by this evaluation to determine whether the extent of leakage could be deemed to be "excessive" or not.

The **noise** level of the Swedish pumps is perceived as too high and exceeds the levels stipulated by the Chinese Environmental Protection Agency, which prescribes a maximum of 30 db in residential areas and 40 in others.
The central station is located right in the middle of an urban residential area and the surrounding neighbors are complaining of the high noise level.
DDH will try to remedy the noise problem by asking a local Chinese firm to try to find a way to overcome the excessive noise - probably by erecting sound barriers.

In the company´s opinion the Swedish pumps are not noisy compared to Chinese pumps, although there is at least one brand in China which is less noisy.

Installation supervision

According to the contract the Swedish supplier should have come to Dalian to assist in installation and test running. But the company decided to do without external assistance and use the corresponding funds to buy additional hardware instead. In the words of the Chief Engineer: ”we thought that we were experienced enough to do the job ourselves.

Some of the staff interviewed told a different story. In their recollection the company Had asked Powerpipe to send its technicians, but the Swedish supplier had declined referring to the fact that there had been a long delay in the installation and that the supplier therefore, according to contract, was under no obligation to send someone, since the company´s obligation in that respect had already expired. According to this version, the Swedish supplier, because the time period stipulated in the contract had elapsed, wanted to have an extra fee to come and assist in the installation.

Further discussions on this point has led me to believe that the former version is the correct one, but, just as regarding the pumps above, the deviating recollection is interesting because it seems to suggest that personnel training leaves something to be desired.

The absence of the Swedish installation supervisors was a general occurrence. There was no Swedish expert present for any of the installations of any of the Swedish financed equipments, not for the heat exchangers not for any other of the equipment. My question how could they manage without the Swedish technicians was answered with: ”Well, we did the job ourselves, but the presence of Swedish technicians to supervise and to give advice would have greatly facilitated the work.”

A general problem reported present w.r.t. all the Swedish equipment is the lack of original spare parts. This is obviously seen be the engineers and technicians, who were the ones usually accompanying me in the site visits, as a real problem. At the same time it is clear that management responsible for the import contract gave preference to save the contract money to be used for hardware at the expense of, on the one hand, spare parts and the other, training and supervision.

Finding: A general problem experienced by technicians w.r.t. all the Swedish equipment is an acute lack of original spare parts. At the same time it is clear that management responsible for the import contract preferred to use the available credit funds for hardware at the expense of, on the one hand, spare parts and the other, training and supervision.

VISIT TO SUB-STATIONS

A typical substation, equipped with Swedish equipment, looks like this:

- Six pumps with a total capacity of serving 300,000 sqm heating area.
- 20 (=4x5) heat exchangers of type *Värmeväxlare "AJEWEX", "Armatur Jonsson"* and *Heat Exchanger AJ 8431-128*
- an automatic temperature controlling valve for each group of five heat exchangers
- Each substation also has one unit of a "single panel controlling system *"Satt control"*

Installations in the substation we visited was finished in 1995. The station is a newly built one. Before each house in this area had a boiler of its own causing extensive pollution.

Problems

Control panel

One of the components broke down, and because the company has no access to spare parts the entire panel has been out of operation since.

In the control room there is also a large pump controlling panel, produced in China which reportedly functions quite well.

According to the company it is only in the substation that I visited where the controlling panel is out of order.

Pumps *("ABB Motors, MBT 180L")*

For three of the six pumps the capacity water flow per hour is 180 tons, while the engine´s capacity only permits 22 tons. In other words the engine is too small to handle the marked water flow capacity.

Noise level for these pumps is said to be lower than for domestic pumps.

In two of the pumps a rubber seal has broken and the company is using a domestic spare part instead: "We had no choice other than to use a Chinese spare part, but obviously the Swedish original part would be better".

This would thus seem to be another example - in a long row of cases - where the company´s failure to include sufficient spare parts in the Swedish import order has been detrimental.

Heat exchangers
This is a *water-to-water* heat exchange so no measuring instrument is needed. The company´s experience with these is good. There have been no problems whatsoever so far with these heat exchangers installed in 1995.
Plant manager does not know about the production of heat exchangers opened up by Alfa Laval in Southern China in 1995.

Temperature controlling valves
The sub-stations five *temperature controlling valves* are not in operation at all since the controlling panel regulating them has broken down. This is however only in the substation which I visited.

Before these valves were closed down they had only operated for one month so the company does not yet really know if the quality good.
Such valves do exist in the Chinese local market and to the knowledge of the technicians interviewed by me there is no difference between the imported and the Chinese controlling valves.

Installation supervision
There were no Swedish technicians present at the installations of any of the sub-stations. Only once did a computer technician arrive. According to my sources it is sure that the installation work became much more difficult because of this.

Insulated pipes
The insulated pipes from Sweden were installed successfully in 1994-95, covering a total length of 10 kms from the central station to the substations.
Foam was used to cover the connections of the Swedish pipes.

Foaming machine
The foam machine *was* working well until it broke down. Again, due to lack of spare parts it was out of operation. Now the spare parts have been received but not yet installed, so the machine is still not functioning. In the plant manager´s opinion the wear and tear of the foaming machine experienced by the company is a normal one. But an adequate supply of spare parts are needed.

Training and supervision
There are many indications suggesting that the amount of *training and supervision* in the contract was insufficient. There seems to have been a strong temptation for the company to use money, potentially destined for training and supervision purposes, for importing additional equipment in stead. Today it would seem that many in the company wish that more training and supervision had been included.
One engineer remarked:

"The CITC (the Beijing Import agency negotiating and signing the import contract) did not make it clear to us that it was important to include ***supervision*** *in the contract. We ourselves had no*

experience whatsoever from international procurement, so we were taught a lesson here! In retrospect it seems clear that e should have included supervision in the contract. this we will surely do in the future".

The appraisal study, contracted by BITS, strongly emphasized that more training and supervision should be included.

One reason why the company was reluctant to include more training and supervision was that the company, knowing that Powerpipe is a manufacturer of pipes only, did not think that such training would be very useful. For the company´s main training needs were not in pipe installation, but rather in other areas.

Regarding the installation supervision the company thought that since eight persons from the company had gone to Sweden for a 28 days of intensive training, it would be able to install the Swedish equipment alone without the help or supervision of the Swedish experts. They therefore chose to use the money for importing additional equipment instead of paying for Swedish experts to come here for the supervision.

In retrospect the company feels that the training carried out in Sweden was timed too early, because it was long before their own installation was due.

The company also feels that, since the contract with the Swedish supplier did not specify exactly the contents and nature of the training, the supplier should therefore have presented the company with a plan and a suggestion for the training to be carried out. But that was not done.

The total training and supervision that took place in this project is the following:

<u>Before the contract signing:</u>

1. mission investigating the equipment in Sweden: 4 people for 21 days in 1991

2. mission investigating the equipment in Sweden: 4 people for 21 days in 1992

<u>After the signing of the contract:</u>

3. Training seminar/course: 8 people for 28 days in 1994. These were mainly the company engineers and all of them are still employed by the company.

4. Course in computor systems: 4 people for 35 days in Malmö (Alfa Laval) in 1994.

5. Delegation for discussing with Powerpipe and Alfa Laval in Sweden (Göteborg and Malmö) in 1994: 6 persons for 12 days

Items 3,4 and 5 were financed out of the contract amount.

As for the Swedish supplier´s visits to Dalian there have, in the eyes of the company, been ”very few” few such visits. Before the signing of the contract three people came a total of three times to Dalian staying from 3 to 5 days each time. After the contract was signed there have been the following visits:

- one person came twice staying for two days each time
- one expert from Alfa Laval came once and spent 10 days working on the control system
- one representative from Powerpipe came in 1994.

Nobody had visited after the installation of the machinery.

According to the General Manager *training* of personnel today stands out as perhaps the most important need for the company. In his view the best help the Company could get would be training supplied free of charge in maintenance, repairing, installation, environmental aspects etc.

The areas where the company´s current training needs are felt to be the most urgent are the following:

- pipe installations
- foaming machine operation
- the welding of the connections in the pipes
- the control system
- the frequency converter

Finding: There are many indications suggesting that the amount of *training and supervision* in the contract was insufficient. There seems to have been a strong temptation for the company to use money, potentially destined for training and supervision purposes, for importing additional equipment in stead. Today it would seem that many in the company wish that more training and supervision had been included.

To underscore the importance attached to the training factor the company is today preparing a request for Swedish or other aid in setting up a training institute in district heating technology in Dalian. The students of such an institute would not be only the companies own staff; Students would be recruited from all over China. The faculty would be Chinese but Swedish or other foreign teachers/experts could come and visit from time to time. The investment cost is estimated to some 900,000USD, which would cover infrastructure, and equipment, etc. A building next to the present Central station, would be provided by the provincial government. Operational costs are extra.

Domestic versus imported equipment

A question which was constantly present in the interviews was whether or not the company could just as well, or almost as well, have used domestically produced equipment instead of the imported Swedish one. More often than not the answer given by the company was "yes". And the answer to my follow-up question of "why didn't you?" was often along the following lines:

"At the time the Swedish ones seemed much more attractive and better than the Chinese ones. The residential area where the central station is located is a model area and therefore we wanted only the best and most modern equipment to be installed there."

There is no denying that the fact that a concessionary Swedish credit was offered, most probably also influenced the choice of at least some of the equipment. Even if the company actually thought that the quality of for instance Swedish pumps was superior to the Chinese it is quite clear that they might not have opted for the Swedish ones if they had not been offered as part of a package financed under concessionary financing. The following argument was heard often:

"As we had a cheap credit from Sweden, and we had no credit which would allow us to buy Chinese equipment, therefor it was natural to buy the Swedish pumps. A Chinese credit if you can get one, is much more expensive than the Swedish one."

To sum up, the Chinese end-user believes that the quality of Chinese equipment is not yet good enough, but they admit freely that an important reason for buying the Swedish equipment was that the company was offered a Swedish concessionary credit.

Conclusion: Even though the Chinese end-user believes that the quality of Chinese equipment is not yet good enough to compete with imported Swedish equipment, they admit freely that an important reason for buying the Swedish equipment was that the company was offered a Swedish concessionary credit.

The only real way to know how attractive Swedish equipment is for the Chinese district heating companies, considering its price, quality and performance, would be to observe what they would buy if they were offered a concessionary grant untied to purchases in Sweden. Faced with this hypothetical question a common answer was that a substantial amount of Chinese equipment would be purchased, mainly because it is so much cheaper than the Swedish one.

However in assessing this answer one must bear in mind that the Chinese DH companies are not yet fully autonomous with respect to long run responsibility for profits and losses. If they had a complete autonomy perhaps they would be more quality oriented - and willing to pay a higher price for higher quality knowing that this strategy would in the end turn out to be the most economic one.

Often the impression given was that the price of the Swedish equipment may have been twice that of the Chinese, but that the technical durability was three or four or five times longer. If this is true then it is clearly economic to opt for the more expensive equipment.

A case in point is provided by a recent investment done in the second power plant being built in Dalian. There, even though the company was here using its own proper funds it still chose to buy the boiler in the USA simply because it is so much better quality than the Chinese one.

On the other hand we may consider the fact that, in addition to DDH, there are another four public companies dealing with heat production and district heating in Dalian, all using domestic equipment. And as far as is known they seem to be doing well.

Conclusion: There are today many semi-autonomous, public district heating companies that are investing in Chinese equipment instead of imported one. But one must consider the fact that if these companies were completely autonomous w..r.t. *long run profits and losses* perhaps they would be more quality oriented - and willing to pay a higher price for higher quality knowing that this strategy would in the end turn out to be the most economic one.

Inclusion of hot tap water

A definite draw-back with the design of the project is that the system does not include the provision of hot tap water to the offices and residences served by the company´s heating service. In chapter I above it was argued that such a solution makes the DH system more efficient as well as more economical. In the future the company plans to do that.

Today some big hotels and some other users who need hot water year round are using the company´s hot water, supplied through the DH-system, for their bathrooms and the steam to run steam engines generating electricity for the air conditioners. Therefor the central station of the company is run all year around, but the substations supplying heat to residences, are closed down from April 15 to November 5th.

6. Effects

The economic savings to society because of this district heating project are very large as are the beneficial effects on environment.

Finding: The economic savings to society because of this district heating project are very large as are the beneficial effects on environment.

6.1 Financial profitability

The cost of heat production is higher than the tariff. Tariffs today are 18 yuan per sqm for ordinary citizens, 20 for shopping centers and businesses, and 15 for teachers, while the cost of production is 90 yuan per ton which works out to 26 yuan per sqm. The government has decided to raise the tariffs in the near future but it is not yet known by how much.

But even though the revenue received per unit of heating is lower than the corresponding cost the project is still able to service its debts, because of surpluses realized in the company´s other lines of business. The debt repayment realized by the company so far are 1,470,000 in Dec 1996 and 1,470,000 in June 1997.

The total sales revenue of the project is given as 28,600,000 Yuan for 1997 while the cost is 32,740,000 Yuan thus leaving a financial loss of 8,250,000. The company believes that a marginal adjustment upwards of the heat tariffs, of a magnitude that has already been announced in Gov. plans, would allow the company to run a surplus also in its heat generating and distribution activity.

The financial deficit in heat delivery the company can today compensate by its profits in electricity sales to the electricity company. (The company has two activities: apart from delivering district heating it also sells electricity.) Apart from selling electricity the company is allowed to make and expand business in other, non-related, sectors and in that way raise finance necessary to cover losses at DH activities.

Finding: The financial deficit in heat delivery can today be compensated by profits realized in electricity sales which is the company´s other branch of business.

Even thought the end-user, DTPC, is not a separate legal body (from the city government) it is clear that it is strictly responsible for the implementation of the project, including negotiations, signing of contract etc.

The grant element in China is routinely passed on to the end user of concessionary credits

Ex ante appraisal

An appraisal study was carried out by the donor, which was based on an appraisal previously carried out by the China North-East Building design Institute in the provincial capital Shenyang. However the consultants have added contingencies and sensitivity analysis, and modified some of the figures.

The financial analysis carried out is complete, even thorough regarding some aspects, and equipped with the proper measures of sensitivity analysis, and would not seem to leave anything else to be desired.

The cash-flow analysis showed the cumulative financial net cash flow to be negative for nine years. An analysis performed to determine the project´s ability to opt for other commercial financing as an alternative to the concessionary loan offered by BITS, showed that a commercial export credit at market terms would impose heavy financial burden on the project.

Financial analysis

Revenues in the project consist of fixed connection fees based on a fixed charge per sqm and the accumulated use multiplied by a tariff set by the local government.

Depreciation is calculated as 25 years for buildings and structures and civil works and equipment at 15 years. It is also stated that the main components of the system will have an economic life which is much longer but that the net benefits of this will be only marginal in the overall calculations.

The financial analysis assumed a capacity utilization of 70 % during the first year. and 100 % after that. The consultants, wisely, doubled the estimated need for spare parts in the their calculations as compared to the appraisal done by the company.

Total operating cost was estimated to app. 6,6 rmb per sqm building area, and total production cost to 10,6. A planned annual heating charge of 11,4 rmb per sqm would therefore be just enough to give a small operating margin of 0,8 rmb per sqm.

The internal rate of return (IRR) was found to be 10,2%. Sensitivity analysis showed that if steam, coal and electricity costs went up by 2 % a year, and wages , salaries and welfare payments by 4 % a year, then the project´s IRR would decrease to 8,2%.
If the project would have to pay taxes of 12 % (a figure which was used by the World Bank in a simultaneous DH project loan in Beijing) then the IRR would go down to 6,6%.

The debt service ratio, measuring the projects debt servicing capacity, was calculated to be satisfactory given a concessionary loan amounting to half of the entire investment.

The outcome of the IRR assuming various modifications in used parameters can be seen in the following table, (see appraisal report page 32)

Table 9: Sensitivity analysis of financial rate of return

Parameter	*per cent change in parameter*	*IRR*
Revenues	-10	6,5
Revenues	-5	8,4
Operating costs	-5	11,1
initial investment	-5	11,2
revenues	+10	13,7
operating cost	+10	8,5
initial investment	+10	8.5

Even though the general level of the IRR is not very low, we can see that there are a number of rather small changes, which can easily happen in the real world, which will , in and by themselves, appreciably change the outcome of the financial analysis. So it would seem that the consultants had good basis for claiming that the project would not be viable for commercial financing. We see for instance that it would be enough with the revenues to fall by a mere 10 % to bring down the IRR to only 6,6 %. The same outcome would happen if a 12 % sales tax was instituted on heating.

Ex post financial profitability

It has not been possible to retrieve from the company financial data compatible with that used in the ex ante analysis in order to permit calculation of ex post profitability. But given the fact that the project is experiencing a two year delay, and also that an expected tariff change still has not materialized, it is entirely clear that the financial targets can not have been met. Based on the reasoning below regarding "fallacies of financial analysis" we do not thing this is very grave. The important thing is that the economic profitability is good.

Finding: Although it was not possible to retrieve financial data which permit calculation of ex post profitability, it is entirely clear that financial targets can not have been met. This is because the project is experiencing a two year delay, and also that an expected tariff change still has not materialized.

OECD consultations

Consultations were requested by the USA in OECD as it felt that the financial profitability of the project was possibly good enough to service a loan at commercial terms. The US thereby compared the Swedish calculation s with those carried out in a similar World Bank project regarding DH in Beijing. This was natural as the Swedes had themselves referred to and used some price and other assumptions applied by the

World Bank. But, in reality it is not relevant to compare the two projects because their objectives are inherently different. This is discussed elsewhere in this report.

After however having received and having examined the Swedish appraisal study they concluded that "while there is room for discussion on some points, we do not believe that these issues are of sufficient import to change the fundamental conclusion. Therefore we withdraw our request for consultation of other participants do not object".

In the OECD consultations the Swedish side also had to defend the rationale for importing this type of equipment to China, namely that the Chinese side felt that the domestic equipment still was not of sufficiently high quality. The present project had been approved by the country´s highest central planning authority, MOFTEC.

Fallacies of financial analysis

There is one point which needs to be pointed out w.r.t. the appraisal (See e.g page 35 of the Swedish appraisal report), as in deed with very many financial studies of development projects, namely: Such studies often convey the message, usually implicitly, that the main analysis deciding the projects desirability is the financial analysis. In reality it is, or at least should be, the opposite, namely that the criterium which makes a project worth while and desirable is its economic profitability.

The financial analysis is important for it will decide whether or not the project can be financed in the commercial market, or whether it needs subsidies by way of e. g. domestic or foreign concessionary credits. But in doing the financial analysis one must keep in mind that the outcome of the analysis can at any moment be changed simply by the government making a political or administrative decision which changes a tax, a subsidy or modifies a tariff which is not set according to supply and demand.

Conclusion: The financial analysis is important for deciding if a project can be financed in the commercial market, or if it needs subsidies by way of e. g. domestic or foreign concessionary credits. But in doing the financial analysis one must keep in mind that the outcome of the analysis can at any moment be changed simply by the government making a political or administrative decision which changes a tax, a subsidy or modifies a tariff which is not set according to supply and demand.

Even in a country like China, which has taken important steps towards a market economy, there are enough remaining regulations and subsidies both on the cost and revenue sides, and with enough distortions , due to hidden subsidies and tax payments structure to make it difficult to understand for the foreigner. This of course makes the financial analysis of a limited interest. On e.g page 25 the authors show that they are aware of the limited function of the financial analysis, but most of the report is written in a way that an uninformed reader may get a wrong impression.

On page 24 the authors say that "given the complex taxation system, the financial analysis focuses on pre-tax considerations". this may have been a slip of thought by the authors because the financial analysis is the only place where you need to worry at all about the tax incidence. In the economic analysis taxes can be excluded since they merely represent transfers of the economy. A complicated or confusing tax structure can then be seen as just one more circumstance which makes the economic analysis all important while the financial one often is of limited importance.

If we can take for granted that the parameters will not be changed for the project, then the financial analysis, including the cash-flow analysis will of course determine what kind of financing is needed if the project is to be carried out. But in a situation where e.g the financial outcome tells us that an investment cannot be financed at market terms, we also know that the government, by changing some of the parameters so as to create a cash-flow positive enough to allow the investment to happen even if no concessionary financing were available. And the important message that should be made in this project as well as in others is that the criteria for the govt. to decide to go ahead with a project is its economic desirability. Economic viability is a *necessary* condition, whereas financial viability is not, because it can be changed at will by the govt.

7. IMPACTS: ATTAINMENT OF LONG-RUN OBJECTIVES

7,1 Economic benefits

There are very large economic benefits due to fuel savings in this project, and they are based on the following fundamental fact: the efficiency rate of small boilers is around 40% while in a modern cogeneration plant is it is well above 80%, so for each given amount of heat produced at least a 50 % savings can be achieved in coal consumption.

The size of the present pollution level, which can be at least partly overcome by the present project, is so large that it is obvious that it must have an appreciable effect on peoples´ healths.

From what can be ascertained by available appraisal studies, both as calculated by the Chinese and the donor side, no health effects have been included in the economic analysis. This is understandable, because, even though health effects analytically belong in the economic analysis, it is very often left out (also in other countries) because it is difficult to get reliable statistical data.

But with available techniques for cost benefit analysis there is really no problem to calculate the economic effect on society as a result of improved health, even if you do it with no more than figures estimating the order of magnitude regarding hospitalization cost , lost production etc.

In this case it is obvious that an inclusion of the health factor in the economic analysis would increase economic profitability considerably, over the already high level which was found in the Swedish appraisal study. Because of this there is really no reason to dwell at length on a discussion of the proper economic or shadow prices which should be applied in present day China. In relation to the generally satisfactory economic reasoning presented in the appraisal study in this evaluators view some of the points would normally merit discussion, but in this case it would be more of an academic interest, since it is so obvious that the project must be very profitable from an economic point of view.

Finding: An inclusion of health factors in the economic analysis would increase economic profitability considerably over the already high level found in the appraisal study. Leaving aside all discussion of appropriate methodology of calculating the economic rate of return it is clear that the project is very profitable from an economic point of view. In similar projects the World Bank has calculated the economic rate of return to be in the neighborhood of 40-90 %.

The appraisal undertaken by BITS calculated an EIRR of 17 % for the project. It includes in the economic analysis indirect effects from less transport of coal necessary when total coal consumption goes down, also the large savings in coal needed for heating a given area. However, it does not include effects such as transfer of know-how, additional employment creation and various environmental effects. Nor had they taken account of health effects. The analysis of economic benefits was therefore very conservative. On the other hand, the assumption of a price of USD 30 per ton of domestic coal used in the Swedish appraisal report was criticized by independent observer who maintained that the cost of Siberian coal which is about USD 20 was more relevant to use in this economic analysis.

Contrary to what the report states, it does not adjust any of the prices so as to better reflect economic or shadow prices. Nor is this actually necessary. Firstly, as the report points out, the most important prices can for various reasons be expected to approximate economic price, e g, the price of the low grade coal being used, and also wages and salaries. Secondly, as was pointed out above, the order of magnitude of other economic benefits, namely the environmental and health, are so important so as to make the marginal changes in prices relatively less important for the outcome of economic profitability.

A point to remember in this context is however that the "market" price of the foreign equipment and spare parts is really distorted because they are in effect subsidized by the availability of a soft credit. The valid criteria would seem to be if the foreign product would be chosen even in the absence of a subsidized credit.

Another problem is that even if the actual heating tariff were set so as to reflect its "economic" cost, very often institutional arrangements may be such, not only in China, that the end consumer is unaware of the heating cost and therefore has no incentive to conserve energy.
The world bank has reportedly in a study in 1991 suggested that the government work out a new tariff system which would make the end consumers more liable to energy conservation. So far as is known today nothing further has come of this initiative. If Sweden decides to continue cooperation with China in the field of DH and energy conservation, this would certainly seem to be a very worthwhile point tot bring up in the dialogue .

7.2 Environment

The environmental situation in Dalian in 1991 was the following:
Most of the buildings are heated with boilers of low efficiency without dust collection
All heat production is based on coal with a very high ash content of between 23 and 30%.
There were 107 large and medium size factories which had a total of 3,500 inefficient small boilers and 1700 chimneys exhausting virtually unpurified smoke. In addition to this there were 200,000 small residential boilers likewise emitting the smoke without any filtering.
The monthly dustfall had been measured to be 27,4 tons for the whole city thus surpassing the legal norm by 3,43 times!!. In addition to causing a very harmful pollution it has been estimated that the extra coal consumption of all of these many small boilers , as compared to a large cogeneration plant is estimated to be 400,000 tons of extra coal consumption each year.

With the planned investment in DH the levels would be brought down to near standard levels. The project would reduce dustfall by some 70 %, which means that a project area of some 2 sqkm would lead to a total of 40 tons less dust emissions each month!! Mainly the dust will be diminished by the filters installed in the chimneys of the cogeneration plant while many small unfiltered heating sources would be closed down.
Emissions of SO2 would be reduced because of the savings in coal consumption.

Another improvement would be the important saving in gasoline usage with its corresponding pollution effects which will be the result of less coal having to be transported to the boilers of the city.

Furthermore there are the prefabricated pipes which will be insulated in Sweden using foam based on CO2 as driving agent instead of freon.

Noise level of the Swedish pumps: Environmental protection agency in China has prescribed maximum 30 db in residential areas and 40 in others.
The 4 Swedish pumps today exceed this noise level, because they are in a residential area.
DDH will try to remedy this problem by approaching a local Chinese firm and ask them to try solve the problem of excessive noise.

Because the project is experiencing a considerable delay, most of the environmental effects have not yet materialized. This however does not change the fact that the environmental benefits of this project are enormous.

Finding: Because the project is experiencing a considerable delay, most of the environmental effects have not yet materialized. This however does not change the fact that the environmental benefits of this project are enormous.

7.3 Equality/ Poverty orientation

No specific social or distributional analysis was made in the Swedish appraisal. It was assumed that an improvement in the environmental situation will have a positive effect on the whole urban life in Dalian.

According to new material from the World Bank it is however possible to argue that such environmental improvements are indeed relatively more beneficial to poorer strata of society. Mainly this is because the poor people usually have less means to "protect" themselves and to escape from pollution's ill effects.

7.4 Gender

This project is not judged to have any special gender bias in it effects.
As for employment generated by the project we have the following:

- total employment is 1750 of which 320 women

Of the 1750, 350 are in office, management and professional categories and 1400 are workers.
Of the 350 professional and office staff 175, i.e. half, are women.

7.5 Democratization

It does not appear possible to detect any particular effect w.r.t. democratization, direct nor indirect, emanating form this project.

7.6 Independence

It does not appear possible to detect any particular effect w.r.t. the country´s independence, direct nor indirect, emanating form this project.

Demonstration effect

One implicit objective of the project was that it should serve as a reference and set a standard for future DH systems in China. Because of all the problems discussed above it would be hard to claim that it has attained that objective. But perhaps it is not too late yet.

According to the company there are five other towns who have sent delegations to study Dalian´s investment in a modern DH-system.

Finding: Because of several (minor) problems that have afflicted the project, and also because of the delay experienced it would be hard to claim that the objective of the project becoming a demonstration project has been attained. But perhaps it is not too late yet.

8. BITS´s project preparation

BITS analysis of a project to be financed by a concessionary credit can be divided in two parts. *Firstly,* a general study regarding the projects desirability and feasibility including technical financial economic and environmental aspects. *Secondly,* an analysis of the offers provided by the Swedish supplier chosen by the Chinese end-user.

In the Dalian project BITS decided to intervene in the process to a greater extent than is usual, also involving the Swedish Embassy. The reason was that the Bank of China was delaying its decision to act as intermediary for the credit between the Swedish bank and the end user DDH. In letters both by BITS and by the Swedish Embassy the Bank of China was asked to expedite its handling of this credit. The Bank´s motive for the delay was that the city of Dalian had other unpaid credits and arrears on other credits. Therefore the Bank of China took the stance that it could not grant any more credits to Dalian before the previous ones had been cleared.
BITS in its letter pointed out that it understood and even sympathized with the Banks attitude but felt that innocent parties, such as the Dalian District heating Company and the Swedish supplier Powerpipe would be the ones suffering from the Banks principally correct stance.
The Bank of China´s attitude was that the mere fact that a soft credit is contemplated shows that the project is not commercially viable and that it would thus have a problem to generate enough cash to repay the loan.
Given the Bank´s new independence and the demand posed on it on part of the government to work in a commercially sound way it emerged that the bank is by no means happy to be told by the Govt. to act as intermediary for a foreign soft loans. There is very little profit for the bank from those credits in a situation where the domestic market is busting of dynamic construction and other productive activity.

BITS has in this as well as in some of the other projects shown a willingness to play an active roll to improve the project for the project´s own sake. Another case in point is its letter to the end-user recommending it to pursue a recommendation to install special equipment whereby a further reduction in emissions of SO2 could be achieved.

Finding: BITS has in this as well as in some of the other projects shown an active attitude to want to play an active roll to improve the project for the project´s own sake

9. Reporting requirement

According to the agreement both the supplier Powerpipe and the end-user were obliged to, separately, provide BITS with a completion report, no later than 6 months after commissioning. None of the parties have complied with this rule and should be criticized for that.

IV DISTRICT HEATING IN TAIYUAN

1. The Project

With a heating area of over 10 million sqm potentially benefiting over half a million inhabitants the DH-project in Taiyuan is said to be the biggest one in China. This seems to be fitting since the city ranks as China´s (and thereby probably the world´s) most polluted city. Taiyuan is situated in the middle of one of China´s main coal areas, which accounts for almost one third of the country´s known supplies.

Because it was one of the first ones to be implemented, it was seen by both the donor and the Chinese authorities as a demonstration project, whose outcome would be closely watched by many other cities in China contemplating the introduction of a new DH system. However it should be pointed out that representatives from the Taiyuan district heating company visited other so called ”demonstration projects” in China when preparing their own DH project. According to reports they visited Nudanjang a total of eight times and also Dalian several times.

The heating source for the DH system is a *cogeneration* plant, producing both heat and electrical power, and is owned by the central government. Its capacity is two times 300MW. In addition, Taiyuan is also served by another cogeneration plant of 2 x 12 MW. A third CHP plant with an output of 2 x 200 MW is currently under construction.

Before the present DH project there was only one DH system in Taiyuan, located in the city´s northern part. It was developed with the help of Soviet experts in the 1950s and relies on industrial waste heat as its main energy source.

The Taiyuan Heating and Power Company, THPC, established in 1982, and fully owned by the Municipality, has two other DH projects apart from the one evaluated here: The *Donshan* project which is to cover some 1 million sqm of building space is currently being constructed with financial support from Finland, and another one, called *Project 2,* currently being prepared and designed, which is to cover 7,5 million sqm when ready.
The heating company has a staff of 505 employees, of which 172 are engineers and technical staff

The Swedish-supported part

The project consists of building a total of 60 new substations. This figure was subsequently revised downwards to 44. Eventually only 28 of them were to be equipped with equipment imported from Sweden.

Of the total project investment cost of 436 million RMB only 6,3 % represent foreign imports, reflecting a new concept by which a marginal import of foreign know-how and equipment can be integrated efficiently into a large scale system of Chinese design. The total investment of the project, in 1983 calculated at 125 million RMB, was in 1996 re-estimated at 580 million RMB. So far 450 million have been spent. Of these 28 million were used for the import of Swedish equipment

The Swedish-supported project is very different in character from the Donshan DH project, financed by Finland and being implemented more or less simultaneously. In the Finnish supported project, which is only one tenth the size of the other, virtually all equipment is imported form Finland. This would obviously not be feasible in a much larger project which must necessarily rely on domestically produced equipment for the bulk of the needs. In the Donshan project also the insulated pipes were imported (but not at all in the Swedish-supported project), the only reason being that there was money available in the Finnish project.

The project was designed by the company itself assisted by the Taiyuan Heating Power Engineering Institute. Originally the company had contracted a Swedish consultant, ÅF, to carry out a study at a cost of 90,000 USD, but later backed out of this contract for lack of funds.

When the project is completed (in January 1995 according to the original plan) it will serve a total building area of 10,4 million sqm of the very central parts of the city with district heating.

The contract was awarded *Alfa Laval Thermal AB,* which used the following Swedish subcontractors for the various equipments: Landis & Gyr Sverige AB, Perfecta Pump AB, Procab (Process Instruments AB), Somas AB, and ABB Motors AB.

The credit agreement was between be Swedish *Nordbanken* and *Bank of China,* and the formal importer was the *China National Technical Import and Export Corporation (CNTIC)*

Regarding repayment of credits the end-user THPC is responsible both for domestic and external credit repayment. The repayment of the external credit will be to Bank of China, who received guarantees for the loan to TPHC from the provincial as well as the city government.

Of the domestic credit given to TPHC from the government about 150 million RMB was received at only 2,4 % interest rate, and the rest at 7,2 %. In addition same 10 million RMB were borrowed at commercial interest rate - 9,2 % - from a local bank. The possibility to get subsidized credits from the Government existed until 1993, but was then stopped.

Inputs

The Swedish delivery consists of the following:

- Hardware and software for a complete computerized monitoring and control system for the systems central station
- Control regulators placed at the exit of the power-station
- Shut-off valves
- Regulating valves
- Circulation pumps
- Automatic and variable speed equipment
- A portable flow metre
- Complete units for 60 sub-stations, including heat exchangers, filters, butterfly and regulating valves, flow and pressure metres, and pumps
- Configuration drawings for regulation vales, pumps, central stations and valve chambers
- Installation supervision
- Documentation
- Training
- Commissioning

According to plan three training sessions were to be carried out in Sweden before the delivery. After delivery the supplier was to assist the buyer with installation supervision and on-the-job training amounting to a total of 60 man-weeks.

The breakdown of the total contract price is given in the table.

Table 10: Break-down of total contract amount

Equipment and materials	25,237,200
Spare parts	316,000
Technical services	1,960,000
Training	940,000

The import contract consisted of 250 pages, which however, as it turned out, did not prevent a subsequent dispute between buyer and seller regarding some of the obligations on part of the supplier. For the signing of the contract the buyer sent six persons to Sweden who stayed for two weeks - at the expense of the seller.

A clause was included which allowed the buyer to use funds not utilized for technical supervision for spare parts instead.

During negotiations the Swedish side suggested that the project should also import the pipes needed of larger dimensions, as there was no production of pre-insulated pipes in dimensions of over 500 mm in china, but that option was rejected as being too costly.

Motives

In principle, the equipment being imported from Sweden is only that which can not be found of sufficient quality in the local market. Below we will argue that it is not always easy to determine whether this condition is fulfilled or not.

The motives for buying Swedish equipment instead of domestic were the following:

Computerized control system : apparently, in China, there was no system available which is standardized with respect to both hardware and the needed soft-ware. Imported systems, on the other hand, are based on standard modular and universal components, which are interchangeable and compatible between different brands

Chinese valves in large dimensions have problems with internal leakages, which may negatively affect availability of the whole DH network. In the case of Taiyuan it was estimated that 1 % less availability would cost about 800,000 yuan a year due to extra fuel costs for local heating.

Domestically produced *regulating valves* are said to have problems with the regulating function, which can lead to thermal losses as well as reduced availability.

The most efficient type of *heat exchanger,* which is the one best suitable for this project, is not manufactured in China. The domestically produced heat exchangers have a low heat transfer coefficient and a rubber gasket which lasts only a relatively short time, and therefore requires more maintenance. A disadvantage with the Swedish heat exchangers is however that they cannot be disassembled and must therefore be cleaned chemically, the advantage being however that there will be no leakage.

Automatic variable speed pumping equipment is not manufactured in China, and regarding electrical *flow metres* there were, at the time, none available in China with the correct specifications.

The Swedish appraisal remarked that the training component included in the Swedish offer was not large enough, and suggested that it be increased.

Expected effects and benefits

The effects at the project level of using Swedish equipment were summarized thus:

(1) better automation and control of the system will lead to
- reduced pumping costs
- lower losses in the network due to lower and better controlled temperature
- lower energy consumption in buildings due to better temperature control in third network.
- better availability of the system due to the control system, and

(2) better quality network will lead to
- fewer leakages
- longer operation times

The main benefits expected from this projects were:
- a dramatic saving in coal consumption
- a dramatic reduction of emissions of pollutants in the city center
- better monitoring and control system will make system more efficient technologically as well as economically
- higher availability of heating facility
- project will serve as reference and demonstration object for other cities in China

The benefits would be attained *assuming* that TPDH demonstrated sufficient technical knowledge and capability to carry out the project.

Provision of hot tap water

The question of providing hot tap water to the consumers by use of special heat exchangers as part of the DH project was discussed without any result. The appraisal commissioned by BITS suggested this possibility to be seriously investigated. It also suggested that a study be undertaken with a view to making the cost to the consumers to be influenced by the actual consumption of heating.

Simultaneously with the present DH project there is an on-going project to construct a gas distribution network to be used by the households who invest in their own small gas-fired water heaters. Over 40 % of the Taiyuan households are already connected to the city´s gas distribution lines, while another 30 % use bottled gas for their cooking and sometimes also for their heating needs. Household consumption of gas, as opposed to heat, is measure by individual metres installed in the homes.

The general conclusion of experts is that it is more efficient and more economical to merge the two services heating and hot tap water, such that the hot water is distributed as a part of the DH network system.

2. Goal hierarchy and logical framework

The information on inputs and activities as well as the project´s expected outputs, effects and impacts can be organized in the following outline of a logical framework schedule.

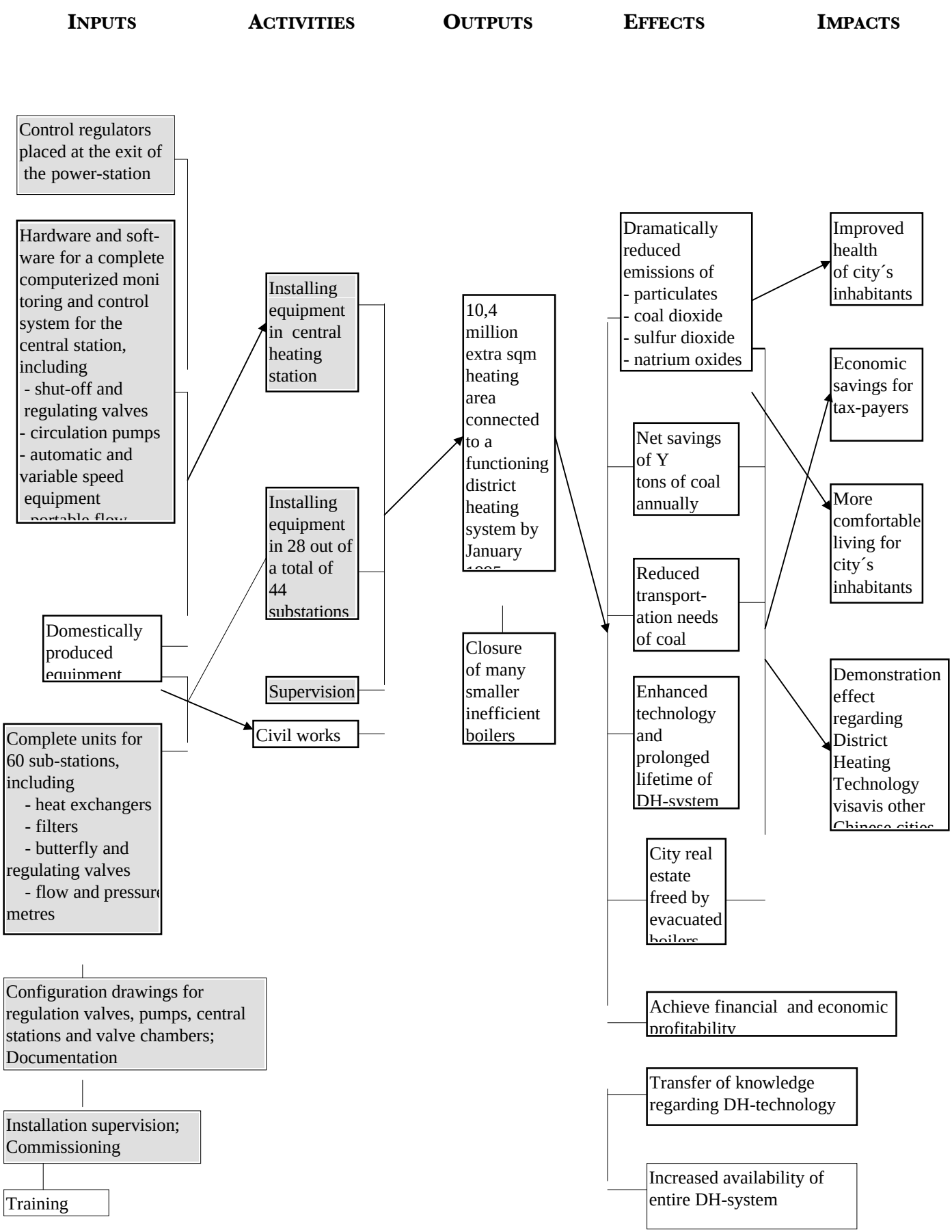
*Table 11: Outline of logical framework model of the **Taiyuan** District Heating project*

TARGETS AND OBJECTIVES AT DIFFERENT LEVELS	*ASSUMPTIONS MADE; RESTRICTIONS*	*Criteria for measurement; indicators*	*Achieved*
Inputs: Equipment imported from Sweden			
Control regulators placed at the exit of the power-station	Credit intermediation of Bank of China to materialize		
Hardware and software for a complete computerize monitoring and control system for the systems centr station, including - shut-off and regulating valves - circulation pumps - automatic and variable speed equipment - portable flow metre			
Complete units for 28 sub-stations, including - heat exchangers - filters - butterfly and regulating valves - flow and pressure metres - pumps			

Configuration drawings for regulation valves, pumps, central stations and valve chambers; Documentation			
Installation supervision; Commissioning			
Training			
Other equipments, material and inputs			
Activities			
Civil works			
Installing equipment in central and sub-stations			
Supervision			
Outputs			
- Functioning district heating system with connected area of 10,4 million sqm by January of 1995			
Effects			
- Net savings of 700,000 tons of coal annually			
- Reductions in emissions of pollutants SO2, CO2, particulates			
- Reduced transportation needs of coal			
- Enhanced/Prolonged technical lifetime of DH system			
- higher availability of heating facility			
- Financially sustainable operation by DH-company			
Impacts			
- Improved health of city´s inhabitants			
- Economic savings for tax payers			
- more comfortable living for city´s inhabitants			

The *causal links* between the various factors of the logical framework table can be shown in a goal hierarchy model like in figure 4 on the next page.

*Figure 4: Goal Hierarchy of the **Taiyuan** District Heating project*



3. Negotiations; Procurement

Three Swedish firms were asked to submit offers for this delivery: *ABB, ATF, and Alfa-Laval.* Of these, the latter two actually submitted offers. The type of procurement was by the Chinese side labeled as ”direct procurement with competition” rather than ”international competitive bidding”, and the project was characterized as a ”component-supply” project.
There were some discussions between ATF and THPC regarding the appropriateness of turn-key delivery. ATF took the position that if it could not influence the design of the project it was not logical for the supplier to shoulder a turn-key responsibility for the outcome of the project.

Finding: There were some discussions between ATF and THPC regarding the appropriateness of turn-key delivery. ATF took the position that if it could not influenced the design of the project it was not logical for the supplier to shoulder a turn-key responsibility for the outcome of the project.

4. Implementation

Even if the Swedish deliveries were contracted only in 1994, the project in Taiyuan first started in July of 1990. Since then 12,6 km of main pipelines has been laid (using Chinese pipes), as well as 21,2 km of feeder lines and branch lines. 44 substations have been built with a capacity to serve a total area of 6,5 million sqm with heating. The system was put into operation in November 1994, and the present floor area heated is 4,3 million sqm.
Of the 44 substations19 have so far been equipped with Swedish equipment.

The project has not yet reached its design capacity which specifies a water temperature of 150 degrees. The feed temperature today is only 120. Therefore the performance of some of the Swedish equipment can not yet be tested.

A general letter of acceptance was signed in the end of 1996

So far 28 of the 44 substations have been equipped. It may take another two years before all the 44 substations are equipped and connected to the computer system The remaining 19 substations are planned to be connected to the computer system within 2 years.

Finding: Since the project has not yet reached its design capacity, the performance of some of the Swedish equipment can not yet be tested. So far 28 of the 44 substations have been equipped. It may take another two years before all the 44 substations are equipped and connected to the computer system The remaining 19 substations are planned to be connected to the computer system within 2 years.

5. Results/outputs

VISIT TO THE COMPANY HEADQUARTERS HOUSING THE AUTOMATIC CONTROL STATION

The company has a large, app five by three metres, relief model of the whole city showing the entire DH-system including all its substations and underground pipelines.

The control system, installed in November 1997, was very well kept and clean, as was the whole building. The total cost of the control system is about 1 million including the training component.

Computers stored for three and a half years!

The four computers were delivered already at the end of 1994, then kept in storage until November 1997 when they were installed. According to the original plan the computers should have been installed at the end of 1996.

In spite of many questions I was unable to get a good answer to why the data equipment was procured and delivered two years before they planned to use it. In reality it became over three years. Even if the Chinese importer apparently was not aware of the very rapid development in price and capacity of computers going on in the west, it is quite remarkable that neither the donor agency nor the supplier reacted. They knew about the design plans and the timetable, which were all part of the contract and the negotiations.

The supplier´s (and perhaps BITS´) passiveness in this respect can at best be described as careless, but perhaps as irresponsible.

Finding: The four computers were delivered already at the end of 1994, then kept in storage until November 1997 when they were installed. According to the original plan the computers should have been installed at the end of 1996.

The supplier´s, and perhaps BITS´, passiveness w.r.t. the delivery of computers and software being done two years *before* their intended installation, can at best be described as careless, but perhaps as irresponsible.

The answer given to my question why the company did not specify in the contract that the computers should be delivered only two years later, was:

"The control system includes a lot of different equipment - control panels and many various things in the substations etc., which all came as part of a big package. So therefore we got the whole thing at once;..... No-one in the Swedish delegation suggested to us that the computor e could be delivered two years later."

Nor was the company helped in this matter by the CTNCT which handled the commercial part of the negotiation on the Chinese side. (The technical part of the negotiations were however handled by the company itself.)

Possible system failure

Analyzing this delivery one gets the impression that the client has felt rushed into accepting an immediate delivery in order not to loose the opportunity of concessionary financing. Could it be a system-failure of the Swedish concessionary credit scheme, in the sense that it does not contain an easy mechanism for part deliveries to be postponed to a later date? According to one responsible Sida officer there is no legal obstacle for a concessionary credit to be arranged in different tranches, although this might slightly complicate the calculation of amortization periods etc. Another solution could be to for the credit agreement to specify a very long disbursement period. One set-back with a long disbursement period or different tranches would however be that the client must pay a higher commitment fee, as well as higher insurance fee.

Another snag is that the Swedish agency supplying the commercial part of the credit, SEK, will only procure a credit at the time when it is needed. If a credit is negotiated in several tranches, wide apart in time, it would thus bring an added complication for SEK.

Theoretically, the best solution would perhaps be to opt for two separate credits, instead of a single one of long maturity. This would, in consequence, also imply that the commercial negotiations between importer and exporter are held at two different times. But it is not clear whether such a solution would be agreeable for the donor agency Sida.

In this case the client has apparently seen it as a necessity that a credit be used up within a specified time period. The Swedish supplier also comes out as a victim of this system because he has no incentive to work out an optimal package for the client even though it would not cost him anything. In this case there was no gain for Alfa Laval to deliver a

system to the client which will be totally out of date by the time it is installed. But this is what happened, and as a result also the Swedish supplier may suffer commercially when the client slowly but surely becomes aware that his computer system is outdated already from the start.
Also in the Finnish-supported project in Donshan the computers were delivered way ahead of their planned installation date. Neither the Finns suggested to the company that they should delay the delivery of the computers.

Training

The company feels that it still needs a lot of training in operating the computerized control system. That seem logical since the training to be provided as per contract, still remains to be delivered. This is supposed to include six persons for a two week training program in Sweden.

Also there are other things where the client expects the supplier to deliver services. One example is that they can improve, or shape up the system, perhaps with a new modem or soft ware. This the client would have to pay for.

Use of telephone cables

According to original plan design the project would have used a cable as connection between the control station and the sub stations, but for cost reasons it was decided in 1996 to use the public telephone system instead. This, at least partly, explains the delay in installing the control system.

An expert from Alfa Laval came to advise the company regarding the possibility to use the public telephone lines. So far telephone lines have been connected only to 3 of the 44 substations, and consequently it is only these three stations that today are connected to the control system. It was not possible to establish how much it would mean in terms of increased efficiency if the substations are connected to the control system and not run manually as today.

In the company´s opinion the telephone lines are too slow today, and are not able to provide full information and feedback from the stations as a cable could do. Possibly the reason may be that software of the present data system is not suited to telephone lines. Or that the modem is too slow. The telephone lines in themselves should be sufficiently fast for the company´s needs.

Finding: According to original plan the project would have used a cable as connection between the control station and the sub stations, but for cost reasons it was decided in 1996 to use the public telephone system instead. This, at least partly, explains the delay in installing the control system.

VISIT TO THE SUBSTATION NO 407

This substation which , according to the company is a typical one, contains the following equipment imported from Sweden:

- 1 flowmetre: OK
- 3 valves: too small to fit with the Chinese pipes
- 3 heat exchangers (all were taken down and taken away for cleaning at the time of my visit): all have some problems
- transmitters: OK
- 3 pumps: OK
- filters: OK

There is also the following Chinese equipment in this sub station:

- Makeup water pump
- water treatment equipment
- Pumps

All of the Chinese equipment was said to be functioning very well.

Heat exchangers

In general the heat exchangers are performing well, but pressure loss is quite big in all of them, and has been so from the beginning. According to the company the limits for the pressure loss provided them by Alfa Laval is not correct. In reality it is bigger.
In the managers opinion Chinese heat exchangers would not have had that problem.
My question "So why did you buy them from Sweden?" was answered with "Alfa Laval is so famous so we thought their heat exchangers must be really good". The company does not see this as a serious problem: "The heat exchangers still satisfy our requirements . Only that the quality is not as high as we expected it to be".

Lifetime for Swedish heat exchangers is estimated to 30 years, for the Chinese theoretically 30 but in reality perhaps only 15. No-one really knows since the Chinese ones have not been in production that long.
Another aspect is that the company would have preferred heat exchangers, which - like the Chinese ones - can be dissembled for cleaning. This is not possible to do with the Swedish ones heat exchangers. "We suggested this to the Swedish side during negotiations but they said the present type is much better."

Pumps

The pumps are functioning well. No problems have been encountered. The noise level is acceptable, at least people in the neighborhood have not complained. There is some slight leakage of water, but within acceptable limits.

In the Chief Engineer's opinion Chinese pumps are of comparable quality and function as the Swedish ones, and the only reason he could see why these pumps were imported is "Because we used a Swedish loan. that is the only reason!"
The chief engineer did however concede that Swedish pumps have easier oil feeding and that they are considerably smaller than the Chinese ones.
But Swedish pumps, because of their higher speed (twice that of Chinese pumps) have a much higher noise level. In his opinion that a pump spins twice as fast as another does not say anything about quality or performance . It is simply a different type and technological structure.

Valves

A somewhat confused situation has arisen w.r.t. the correct specification of the valves. In the company´s opinion they should be bigger so as to fit the dimension of the Chinese pipes they are connected to. The pipes are 150 mm so the valves should be 125 but they are only 50! It is the same for all 28 substations.
It is the same situation for both the *pressure differentiated valves* and the *temperature valves.*
The company has pointed out its position to the Swedish side but the supplier´s representative insisted that the valves delivered are the correct ones. The company however remains unconvinced. The Chief engineer stated that:

" Alfa Laval knew the size of our pipes and we even pointed this out to them, but they insisted this was the correct valves. We think they made a mistake. We gave Alfa Laval our data from the project design and they chose the equipment".

According to reports received by the company the same problem had recently happened in Mundanjang in connection with another Swedish financed project.

In the company´s opinion the problem with the too small valves is a serious one, as the valves can not satisfy its regulatory function because they have been opened at maximum because of the pressure loss.

In other words these valves are today not performing their intended function, and it is the same situation in all the substations. In three of them the company has installed bye-pass pipes. The company has suggested to Alfa Laval to replace the valves but they insist that the valves fulfill the needed function.

Finding: In the company´s opinion the problem with the too small valves is a serious one, as the valves can not satisfy its regulatory function. The valves are today not performing their intended function, and it is the same situation in all the substations. The company has suggested to Alfa Laval to replace the valves but they insist that the valves fulfill the needed function.

Filters
working well

Transmitters
working OK

Chinese control panel
functioning very well

Swedish control cabinet on the wall
functioning well. No problem

Temperature transmitter
The *temperature transmitters* from Sweden are functioning well. One, however, broke during installation. The damage was done by the company itself.

CENTRAL STATION
There is no Swedish equipment in the central station, only Chinese. There is some leakage of pumps and of valves. All the pumps there have some leakages, but only one is serious. The solution to the problem is to change the sealings. They have already been in operation for four years. Also some of the valves are leaking.

VISIT TO A SUBSTATION WITH ONLY CHINES EQUIPMENT
This sub-station, in operation from November 1995, is a typical one according to information given to me. The station looks very neat and is very well kept, and contains the following equipment, all manufactured in China:

- Two *heat exchangers* made in the city of Siping in the northeast of China. It functions very well, but is much larger than the Swedish, perhaps twice as large. In the company´s opinion it does however perform as well as Swedish heat exchangers, and is of the same quality.

- three *pumps*. These pumps have low speed rotation. They are functioning just as well as the Swedish pumps.

- *Regulation valves*. These valves are much bigger than the Swedish. Quality, according to the Chief Engineer, ”so-so”. But are functioning without major problems, or breakdowns. Only minor leakages of water.

- Two *make-up water pumps*. Both are functioning well

Conclusions

A general conclusion from the above visits is that - even though all of the Swedish equipment is basically functioning according to plan - the client is not satisfied with all his purchases. The reasons for the malcontent are the following:

Firstly, in some cases one may question whether the imported equipment had the exact *correct specification* to suit the client´s needs. It is quite possible that this need is today different from what it was when the order was placed. This is so because in some cases other surrounding equipments were changed in relation to original plans.

Secondly, in some other cases there may be a simple question of a mal function which needs to be adjusted or repaired, but where lack of close relations or disagreements between supplier and client has prevented this from happening in a prompt fashion.

Thirdly, in other cases there is a perception that the same equipment, with the same or possible somewhat lower quality, could have been bought in the domestic market at maybe less than half the price. It has not been possible by this evaluation to determine in what cases this perception is realistic and when it is only wishful thinking. In most cases I tend to believe that the quality and durability of the imported equipment that it becomes economical even if it cost twice or thrice the price of domestic equipment. But surely we can expect that in some of the cases it would really have been much more economical to buy locally produced goods. And the only reason for not doing that is simply because the credit was tied to purchases in Sweden.

According to Sweden´s aid philosophy w.r.t. tied aid, tying may only be present when the product purchased in Sweden is internationally competitive. Or put differently: Swedish concessionary credits may only be used to purchase Swedish goods which are internationally competitive. This is something which is generally assured through Sida´s careful pre-decision appraisal both of the technical parameters of the project, and the commercial conditions of the contract. However, it is apparently possible that individual products, which are not in themselves competitive, slip through as parts of a complete *package* of equipment delivered to satisfy the comprehensive needs of a project. In the case of for instance a complete and integrated district heating system it may be difficult for the client to have the expert knowledge to extract some of the equipment and have it delivered from other sources.

A lesson learnt from the five projects could be that collaboration between the client and suppliers have not been close enough, and this has produced many instances of discontent and misconceptions and misunderstandings. Obviously some of the problems encountered also could be due to a simple conflict of interest between the client and the supplier, e.g. when the contractor feels that its contractual obligations have already been fulfilled, and the client is still not satisfied with the product.

In Chapter x Recommendations it will be argued that Sida should arrange and finance a post-project seminar for a all the clients and suppliers as well as appropriate representatives from the donor and host government institutions. In my opinion such a seminar, if properly designed, could go a long way of settling many of the outstanding misunderstandings and disputes which are today unresolved.

Conclusion: Even though all of the Swedish equipment is basically functioning according to plan - the client is not satisfied with all his purchases. There are several reasons for this. In some cases the equipment may not have had the exact *correct specification* to suit the client´s needs. In some cases there is a mal function which needs to be adjusted or repaired, but where lack of close relations or disagreements between supplier and client has prevented this from happening in a prompt fashion. In other cases it would seem that the same equipment, possibly of somewhat lower quality, could have been bought in the domestic market at maybe less than half the price. And the only reason for not doing so was simply because the credit was tied to purchases in Sweden.

The extensive discussions I had in the various sites about the appropriateness and price of the different equipment's show that there is a varied bag of reasons for the malcontent with different equipment. It has not been possible to determine exactly in each case who, in each particular case, is in the right and who is wrong. All things having been said and considered I tend to believe that the shortcomings as exposed, are after all only marginal phenomena , and that basically the equipment is appropriate and function without problems, and that the critical points that have been raised largely belong to what are normal occurrences in commercial life.

Asked where the company would prefer to buy each particular equipment for its sub-stations if it were to receive a concessionary loan <u>not</u> tied to purchases in Sweden, the answer was the following:?

- Regulating valves in northern Europe
- Pumps in China
- Heat Exchangers in China
- Control system including transmitters in northern n Europe

According to the company this answer was based on consideration of both quality and price.

AFTER-DELIVERY SERVICE

Except for the control system, in general the company is satisfied with the performance of the Swedish supplier. However they seem to be less satisfied with the after-delivery service provided by the Swedish supplier, feeling that they do not always get prompt response and help. The company complains that it sometimes sends a fax with questions that are not always answered. Other times they agree upon a visit to be made by the Swedish supplier which is canceled. One simple explanation for this state of

affairs could be that the Swedish supplier believes that its obligations as per contract have already been used up.
On many occasions there have been a difference of opinion between the client and the supplier, and the company feels that the supplier has no time to respond to its needs. Often they find it hard to get in touch with Alfa Laval, "because they are so busy; .... we need more time to discuss and understand each other."

Finding: The company is not satisfied with the after-delivery service provided by the Swedish supplier, feeling that it has not received prompt response and help when needed. One simple explanation for this state of affairs could be that the Swedish supplier believes that its obligations as per contract have already been used up. On several occasions there have been a difference of opinion between the client and the supplier.

STORED EQUIPMENT

So far only 28 out of a total of 47 (?) sub-stations have been equipped. Of the 19 remaining ones nine are going to use Swedish equipment. This equipment has been lying in the warehouse since it was shipped at the end of 1994. Has now been stored for about 3 and a half years !!!

In the storage room there are today about 30 heat exchangers, 28 pumps, 9 control cabinets, transmitters, valves, flowmetres etc.- equipment enough for nine complete substations as per original plan.

According to plan all the Swedish equipment should have been installed by the end of 1996. The company´s current plan is that all the installations will be terminated within a two-year period. The main reason stated for the delay in installing the substations is lack of funds for civil works, for pipes and for labour.

Just as in the case of the computers we here have a case of equipment being delivered long before its *planned* use. Which raises serious questions of the efficiency of both the recipients and donors planning and negotiating systems.

I was not able to visit this warehouse, but the Chief Engineer assured me that it was kept in the perfect condition, and that there was no corrosion or other damage taking place. In his opinion the Swedish equipment is in perfect shape even today after 3 and a half years of storage.
According to other observers it is reasonable to be worried about the risk of corrosion. Because of the great amount of sulphur in the air, the corrosion of steel products is supposed to be much faster in China than in, say, Scandinavia.

Finding: In a storage room today there are 30 heat exchangers, 28 pumps, 9 control cabinets, transmitters, valves, flowmetres etc.- equipment, enough for nine complete substations. They were delivered from Sweden at the end of 1994, to be installed by 1996. But due to lack of funds they were not. Now the company hopes to install them within two years. According to the company the goods are kept in the perfect condition, with no risk of corrosion. However, due to the great amount of sulphur in the air, the corrosion of steel products is much faster in China than in, say, Scandinavia.

Finding: Just as in the case of the computers we here have a case of equipment being shipped from Sweden long - about two years ! - before its *intended* use. Including the unforeseen delay the equipment will be installed about 5 years after delivery. This raises serious questions not only about the competence of the Chinese importing agency, but also about the efficiency and meaningfulness of the donor agency´s planning and negotiating systems.

The Finnish-supported district heating project

The Finnish project was evaluated by a person from Finland in 1996, but the company has not been informed of the conclusions of this evaluation. Nor have they received a copy of any report. The evaluator spent only one day here, and, according to the manager, did not ask as many and as detailed questions as I did..

It would be interesting to compare the Swedish and the Finnish-supported projects w.r.t. to their performances. But it is very difficult to do because the Finnish, since it uses exclusively Finnish equipment, is a complete and self-contained system, which did not need to be fit together with other equipment of Chinese production.
The Swedish project on the other hand consist of different parts which need to be integrated into and connected to Chinese equipment which is sometimes of different dimension and type.

The Finnish system is generally working well, but there are some small problems, ”small” being understood to be much smaller that the ”small” problems afflicting the Swedish project.
Also the Finnish computor system has some problems.

Hot tap water

Hot tap water was that not included in the project. Partly the reason seems to have been that Taiyuan city is short of water and some buildings only have radiators and no hot water system. Nor are their any plans to include hot tap water in the next DH-project planned in the City.

The engineer, at first, had not heard about the argument that there are technological efficiency as well as economic reasons for including hot water, and he did not recall that this was suggested to the company during the negotiations with BITS. It was actually recommended strongly by the Sida appraisal report. Later however he changed his mind and said that Chinese engineers know about this, and that he knows that this is economical, and that such studies have been made.

6. Effects

By the end of 1997, with a heated floor area of about 4,3 million sqm, 174 boiler houses have actually been dismounted, and the plans for adding 7 new boiler houses were scrapped, it is calculated that 240,000 tons of coal are saved annually, and 600 tons of gasoline is saved because about 400,000 tons less of coal and ashes need to be transported.
The expected savings in coal consumption when the whole project is finished is estimated to 692,000 tons of coal annually given a five month long heating season.

In addition there will be savings in gasoline due to less transportation of coal and ashes being needed. This has been estimated at 1730 tons of gasoline a year.

6.1 Financial profitability

Lack of knowledge and awareness of financial matters
No follow-up report has been made of the financial feasibility study carried out by the company in 1992 (dated August 27 1992). In fact, among the dozen company officers present in the conference room during the interviews session, none was aware of the existence of this feasibility study, nor had any idea whether the figures still hold.

In general, it is my opinion that the knowledge and awareness of financial information by the company´s officers leaves much to be desired. Discussions revealed that there is no clear information about the total cost of a sub-station based on exclusively Chinese equipment as compared with one based on Swedish equipment. Nor were there any clear price information even for the items imported from Sweden. In the recollection of the officers interviewed the contract with the Swedish supplier only gave a total sum for all the heat exchangers, valves and other equipment together. And since some of the heat exchangers have different dimension etc it is not possible to calculate a unit cost. Even if this was the case with the Swedish contract, it is no excuse for the company today not being able to identify each individual cost item.

Nor were they able to give a figure of the company´s cost to produce heating for one sqm. i.e. the same unit in which they receive their revenue. This is indeed remarkable since the topic was discussed extensively in connection with the Swedish appraisal study 5 years ago. Even today I found it very difficult to explain the concept that the two measures should be the same so as to allow comparison.

Finding: In this evaluators opinion the knowledge and awareness of financial information by the company´s officers leaves much to be desired. Discussions revealed that there is no clear price information regarding several central cost items, among them for the items imported from Sweden.

As is usually the case in China the Municipal Heating Company comprises a number of different both production units as well as distribution nets, all of them together forming one aggregate profit center. These companies therefore often find it difficult to calculate financial profitability for one branch separately.

A circumstance which acts as a built-in bias against increased efficiency is that the heat tariff is based on a fixed charge per sqm building area. It does not take into consideration the actual consumption of heating. So there is no incentive for the consumers to improve insulation of the buildings or otherwise modify their habits w r t heat consumption.

Finding: The heat tariff is based on a fixed charge per sqm building area and does not take into account the actual consumption. Therefore there is no incentive for the consumers to improve insulation of the buildings or otherwise modify their habits w r t heat consumption.

No heat metres

The price of heating in China is per sqm an is not related to how much heating is being consumed.

There are no current plans to introduce heat metres so that the consumers can have an incentive to economize on heating. According to the company this would be difficult to implement in China since it goes against a very old Chinese tradition. In the Chinese tradition electricity is debited according to usage - there are metres -, but heating is not. A contributing factor in the company´s opinion may also be that Chinese metres are of very low quality and foreign ones would be very expensive to import.

Nowhere in Chinese is there today a system with heating metres. The consumer ´s cost is always per sqm building space.

Some observers think that it will be difficult to change this in China. But , according to an unconfirmed report, the Chinese City and Towns Heating Association in its last national meeting passed a resolution in support of individual heating metres.

Profitability calculations

The profit calculations carried out by the company today, i.e. at "half-time" when more or less half of the total building area has been covered (4,3 out of a total of 10,6 million sqm), indicate that it will be difficult to achieve the profit as planned, because the cost of producing heat has increased more then the tariffs received from our consumers.
At the present capacity operation of 4,3 million sqm the sales income reaches only 65,57 million Yuan, while costs and taxes amount to 78,8 million, thus leaving a financial loss of 13,21 million. This is to be compared with the planned full capacity operation with a heating area of 10,58 million sqm, where revenues would amount to 173,77 million y and costs and taxes 159,78 thus leaving a profit of 13,99

Finding: The profit calculations carried out by the company today, i.e. at "half-time" when about half of the total building area has been covered indicate that it will be difficult to achieve the profit as planned, because the cost of producing heat has increased more then the tariffs received from our consumers.

The Swedish appraisal made of the project showed that the project would not be commercially viable given an assumption of a 11 % tariff increase, yielding an internal rate of return of 7,5 %. The accumulated financial net cash flow would turn positive only after 13 years. In order to make the project financially sound enough to be able to serve a loan at commercial terms the tariffs would have to be raised by som 35 %, something which was not seen as being possible for political reasons.

An interesting question which arose during the preparation of this projects was how the Helsinki rules should be interpreted in a situation where the government subsidized the project with cheap domestic credit, thereby making it financially sound enough to bear commercial financing of the foreign import.
As it developed, no such subsidized credits were offered the project. For its domestic credit the company had to pay 8,5 % interest for a loan repayable over 8 years, thus very close to regular market terms.

Like in Sweden also the Chinese DH companies use connection fees to finance part of their investment. Compared to Sweden however they set the connection fee at a level much higher than its actual investment cost. In Taiyuan about 35 % of the total

investment is financed by customer connection fees, a figure which by far exceeds the actual cost of connecting new customers.

After BITS notified the project in July 1993, Japan requested a project analysis. After BITS had made an Aid Quality Assessment no more reactions were heard from the Japanese side.

7. IMPACTS: ATTAINMENT Of LONG-RUN OBJECTIVES

7.1 Economic benefits

While being judged as commercially non-viable this project is highly profitable from an economic point of view.

Intuitively it is easy to understand that the economic rate of return of a DH project becomes very high, because the project in effect makes use of a free resource, namely waste energy, which in the absence of a DH solution in a co-generation plant, would be just emitted unused into the air.

By generating heat in large efficient boilers that replace a multitude of smaller inefficient boilers, the economic savings of this project, mainly due to the large expected saving in coal consumption, can be expected to be enormous.

Finding: The project is highly profitable from an economic point of view. Intuitively this is easy to understand because the DH-system in effect makes use of a free resource, namely waste energy, which in the absence of a DH solution in a co-generation plant, would be just emitted unused into the air. Also, by generating heat in large efficient boilers that replace a multitude of smaller inefficient boilers, the economic savings of this project, mainly due to the large expected saving in coal consumption, can be expected to be enormous.

BITS´ appraisal

The appraisal carried out by Sida estimated the project´s economic internal rate of return to be 24,6 %. The adjustments made in the economic analysis relative to the financial analysis were the following:

(1) indirect taxes were adjusted since these do not represent costs from the economy´s point of view

(2) the savings in fuel consumption: 700,000 tons of coal and 1,700 tons of gasoline annually. Assuming a coal price of 105 yuan this means an annual savings of about 80 million yuan per year. The appraisal found the official coal price to very nearly reflect the real economic cost of coal to the economy.

(3) A 35% upward adjustment was made in salaries to reflect bonuses being paid in Taiyuan.

No other adjustments were made to reflect the benefits to environment, nor to peoples´ healths. In addition the area previously used for cold storage and replaced boilers, estimated to represent and area of about 169,000 sqm, will be freed for other uses. Since this is locations situated in the very center of the city its economic value is quite high.

An alternative way to estimate the economic value to society of this project is by using measures of pollution taxes which can then be assumed to reflect the benefits to society. Assuming the same level of emission taxes on sulphur and on CO2 as in Sweden, which are supposed to reflect the economic cost to society of these emissions, the economic savings due to the project can be calculated to

- 249 MSEK because of reduced SO2 emissions, and
- 500 MSEK because of reduced CO2 emissions.

In other words, if this project were located in Sweden its annual savings in environmental pollution taxes could be were estimated at some 750 million SEK.

This saving of 749 MSEK a year could be seen as a rough approximation of the project´s economic benefit.
These measures have not been used in the economic calculation performed in the Swedish appraisal.

7.2 Environment

In the following table average ambient concentrations of air pollutants in Taiyuan in 1992 are compared with the Chinese national air quality standards of three classes

Table 12: Pollution levels in Taiyuan compared to Chinese standards

	Actual in Taiyuan 1992	China standard class I	China standard class II	China Standard class III
TSP, total suspended particles	638	150	300	500
SO2	301	50	150	250
NOx	92	50	100	150
CO2	3000	4000	4000	6000

In some areas in Taiyuan the concentration of benzopyrene, which can cause cancer, is up to 70 (!) times higher than the national standard.

The total amount of coal saved in the project , calculated on a five month long heating season, when the project is brought into full capacity operation will be some 690,000 tons. This is mainly because of the very high efficiency of the cogeneration plant.

The environmental effect of this saving in coal, in the form of expected reductions in emission levels, is shown in the table:

Table 13: Reduced emissions of pollutants in Taiyuan because of DH-project

Type of emission	Tons per year
Dust from flue gasses	27,700
Sulphur dioxide	16,000[1]
Carbon dioxide	2,000,000 (?)

There will also be reductions in harmful gases such as nitrogen oxides and carbon dioxides. In addition there will be a reduction in air pollution due to the reduction in gasoline consumption because of less need for transportation of coal and ash.

Pollution reduction achieved to date

According to the company there is today no systematic pollution measurement done in the city as was done in 1992, and which is reproduced in the BITS appraisal report (page 22). The company does however have data for TSP and SO2. The current levels (average for the whole year) are given as

- TSP 599
- SO2 174

This is not at all as good as according to plan. But since the project has not yet reached full capacity is to be expected. Several people that I spoke to however had remarked that they could feel by eyes and nose etc that air quality has become clearly better in recent years.

Finding: The reductions in different types of pollutive emissions largely correspond to the degree of implementation, i.e. the share of the building space connected. Several people that I spoke to had remarked that they could feel by eyes and nose etc that air quality has become clearly better in recent years.

[1] According to one source 24,000

By the end of 1997, with a heated floor area of about 4,3 million sqm, 174 boiler houses have actually been dismounted, and the plans for adding 7 new boiler houses were scrapped, it is calculated that 240,000 tons of coal are saved annually, and 600 tons of gasoline is saved because about 400,000 tons less of coal and ashes need to be transported. The effect on environment is a yearly reduction of 8160 tons of SO2 discharge, and also 11,500 tons of dust particles.

When the entire project is operational, and 626 boiler houses will have been closed, then 600,000 tons of coal will be saved annually and 1500 tons less of gasoline will be used because the need to transport coal and ashes will be reduced by some 1 million tons annually. Then the SO2 discharge will be reduced by 21,600 tons per year, as well as 28,800 tons of dust particles

7.3 Equality/ Poverty orientation

There does not appear to be any specific effect on the equality or distribution effect from this projects as the environmental and other benefits from this project will benefit the entire population. In a more general sense however one may argue that the poorer groups gain relatively more from an improved environment than do other groups.

7.4 Gender

It does not appear possible to detect any particular gender effect, direct nor indirect, emanating form this project.

The total employmnet of the Taiyuan District Heating Company is 505 of which 146 are women. Higher level staff, including managers, engineers, and technicians are 174 of which about one third are women.

7.5 Democratization

It does not appear possible to detect any particular effect w.r.t. democratization, direct nor indirect, emanating form this project.

7.6 Independence

It does not appear possible to detect any particular effect w.r.t. the country´s independence, direct nor indirect, emanating form this project.

Demonstration effect

An explicit objective of the project, stated emphatically by BITS, was that the project would become a demonstration project which would show the feasibility of mixing advanced technology imported from abroad with Chinese produced equipments accounting for the bulk of the investment.

Given the delays experienced by the project and given the several uncertainties that today seem to exist regarding possible adequacy of domestic equipment that, in some peoples´ opinion, could have been used instead of some of the equipment imported from Sweden, I do not believe that one can say that this objective has been achieved. At least not yet. Below is suggested that Sida organize a seminar as an overall follow up to all of the five DH projects in China. Possibly, a successful outcome of such a seminar could go some ways toward contributing to achievement of this objective.

Finding: Given the delays experienced by the project, and because of the uncertainties that exist in peoples´ minds w.r.t. importing equipment of instead of buying some of it much cheaper domestically, it is not possible to say that the objective, of the project becoming a *demonstration case,* has been achieved. At least not yet. Different follow-u activities organized and financed by Sida could go some ways toward contributing to achievement of this objective.

8. BITS´s project preparation

BITS´s project decision document was of very high professional quality. This is true of all the five projects, but perhaps to an extra high degree in the Taiyuan project.

Finding: BITS´s project decision document was of very high professional quality. This is true of all the five projects, but perhaps to an extra high degree in the Taiyuan project.

Sida decided to coordinate and cooperate with *Finnida* in producing the appraisal of the project. This was probably wise so as to avoid double work. What is surprising however is that none of the reports, neither the Finnish nor the Swedish one, mentions one word about this cooperation, making the uninformed reader confused when he finds two entirely different reports with largely the same content word for word without this fact being acknowledged.

BITS played an active role in trying to influence the end-user to include hot tap water provision in the DH system, to no avail however.

It also gave specific recommendations regarding additional equipment which in its opinion should also be imported from Sweden in order to improve the technical solution of the project. Even though these recommendations implied an increased scope of Swedish exports, they were clearly based on technical arguments and there is no basis whatsoever for suspecting that BITS motive in making recommendations was influenced by a wish to increase Swedish exports.

Although some of the BITS recommendations were heeded by the end-user others were not. In the latter category belong for instance BITS suggestion that the scope of training and also of preventive maintenance be increased in the project.

Finding: BITS played an active and dynamic role in trying to assist the end-user to improve the projects, both from a technological and economic point of view, sometimes with a positive result, sometimes not.

9. Reporting requirement

According to the agreement both the supplier Powerpipe and the end-user were obliged to, separately, provide BITS with a completion report, no later than six months after commissioning. None of the parties have complied with this rule and should be criticized for that.

Finding: None of the parties have complied with the requirement to provide BITS with a completion report, no later than six months after commissioning, and should be criticized for that.

V DISTRICT HEATING IN SHIJIAZHUANG

1. The Project

The project in Shijiazhuang consists of

- construction of a new coal-fired heat production plant, and
- construction of district heating network and substations for connection of heat supply to 1,1 million sqm building area within the Wanlimiao, downtown district, new development area.

The total investment is about 99 MRMB of which 43 are for imports.

The project was primarily initiated and justified for environmental and for energy conservation motives.

The city of Shijiazhuang is capital of the Hebei province rich in textile, mechanical and chemical industry, and has a population of 1.5 million inhabitants.

Before the project only some 13 %, or 6,6 million sqm, of the city´s building area was connected to district heating. Like in most other Chinese cities at least two thirds of all households use their own small household stoves for heating as well as for cooking.

The Shijiazhuang Thermal Gas Company, founded in 1982, has today about 2,100 employees and operates a total of 8 different energy production plants. In addition to heating it also delivers electricity and gas to its customers. The current official name of the group is *Shijiazhuang Thermal Electric and Gas Enterprises Group Company* and it has 10 branches, among them Thermal Power Plant 1 through 4, Heating Supply Company etc. The group has owns and operates four co-generation plants, one heating plant - *The Wanlimiao Heat Source Factory* (the one supported by Sweden) and 6 districts stations each with 3 to 5 boilers of their own. There are presently 128 persons working in the Wanlimiao power plant.

The company also has

- a plant that cracks coal and produces and distributes gas to consumers (?)
- a construction company
- an installation company, and
- a design institute

The supply of district heating started in 1982 and of the 6,6 million sqm built so far 2,6 is to residential housing and the rest to industrial, commercial and public

buildings. At the outset of the project there are still some 3400 stacks from coal-fired boilers as well as some 340,000 individual stoves, also coal fired.

District heating is today supplied from 4 cogeneration plants.

The 1,1 million sqm of building area to be constructed and supplied through the present project corresponds to a total heating demand of 77 MW and a cooling demand of x MW. The distribution network will consist of 12 substations, and each substation will be equipped with heat exchangers, circulating and pressure holding pumps for the secondary system, meter valves and control equipment.

The pipes will be prefabricated preinsulated pipes consisting of three components: a steel carrier pipe, polyurethane foam insulation, and a high density polyethylene-PEH jacket. The piping system will also be equipped with a leak detection system. The total length of piping in the project is 1,700 m and dimensions vary from 100 to 500 mm.

The cost structure of the whole project can be seen from the following table:

Table 14: Beakdown of project cost

	Million RMB
Boiler plant: buildings and public works	10
Boiler plant: equipment and installation	34
12 Heat exchange stations (sub-stations)	19
Thermal network	15
Other and contingency	13
Land	45
Total	135

The breakdown between local and foreign costs is seen in the following table.

Table 15: Distribution of domestic and foreign costs, million RMB

	Domestic	Foreign
Heating station	34	10
Network	4	10
Exchange stations	1,5	17
Other	14	3,4
Total	54	41

The financing of the total project is the following:

Table 16: Sources of financing

	Million RMB
Connection fees	57
Bank loan	17
BITS concessionary credit	43

The Bank loan is of 11 years maturity after commissioning and at 14 % interest.

According to the contract which formed the basis for BITS´ decision to finance this project the imports from Sweden would be as in the following table:

Table 17: Imports from Sweden under BITS concessionary loan

	Million SEK
Preinsulated pipe system	22
Heat exchangers	2
Circulation pumps	2
Compensators	1
Other and spare parts	3,4
Transport and packing	3,5
Training and supervision	0,7
Total	35

However, during the time of my visit to the boiler plant as well as other project sites, I discovered that there is no Swedish equipment whatsoever, neither heat exchangers, pumps nor anything else, in any of the substations like it is said in BITS´s decision memorandum. Nor are there any insulated pipes or a foam-making machine. Nor are there any pipes, valves or pumps in the distribution net. All of these things are from China .

As it turns out, after the BITS decision to grant financing was taken, the parties agreed to change the contents of the import order of a magnitude of app. 20 % of the total order. The reason was a general lack of funds which prompted the company to look for a Chinese firm and they found a local joint venture production with Alfa Laval, that could supply some of the distribution network equipment including some heat exchangers.
This was accepted by BITS on condition that the quality of the project would not be reduced because of the change. Strangely enough there is no documentation at all of this dramatic change o contract in the Sida or BITS file, except for a short letter where Sida accept the change.

Finding: After the BITS decision to grant financing was taken, the parties agreed to change the contents of the import order of a magnitude of app. 20 % of the total order.. Strangely enough there is no documentation at all of this dramatic change o contract in the Sida or BITS file, except for a short letter where Sida accept the change.

In the end, the equipment actually imported from Sweden was mainly the following:

1. The whole water treatment system
2. Blowing machine and draught fan
3. The whole coal transport system
4. Pump
5. Low pressure distribution system
6. Boiler control system

While, according to the BITS decision memorandum the Swedish delivery was to consist of equipment for the central station, for the substations and for the distribution network, in actual fact the Swedish delivery was thus entirely concentrated to equipment, needed for the expanded boiler plant, including a computerized control system

Some of the equipment delivered by the Swedish contractor was actually produced in China - about 20 % of the total - namely coal refiner, coal crane, and electrical filters, while the rest came from Sweden.

The Chinese importer is China National Machinery Import and Export Corporation.

The technical appraisal of the project carried out by BITS found the project, both from a technical and environmental point of view, to be ”well planned and of good technology”. They pointed out the advantages of the equipment chosen being well known, and that the company has its own design as well as construction department who would be responsible for the respective activities.

The appraisal, however, also pointed out that the contract had no provisions for spare parts.

The amount of training consisting of a course for 10 persons during two weeks in Sweden, and other training, supervision and discussions amounting to a total of 88 man-weeks, was judged by the appraisal to be satisfactory.

2. Goal hierarchy and logical framework

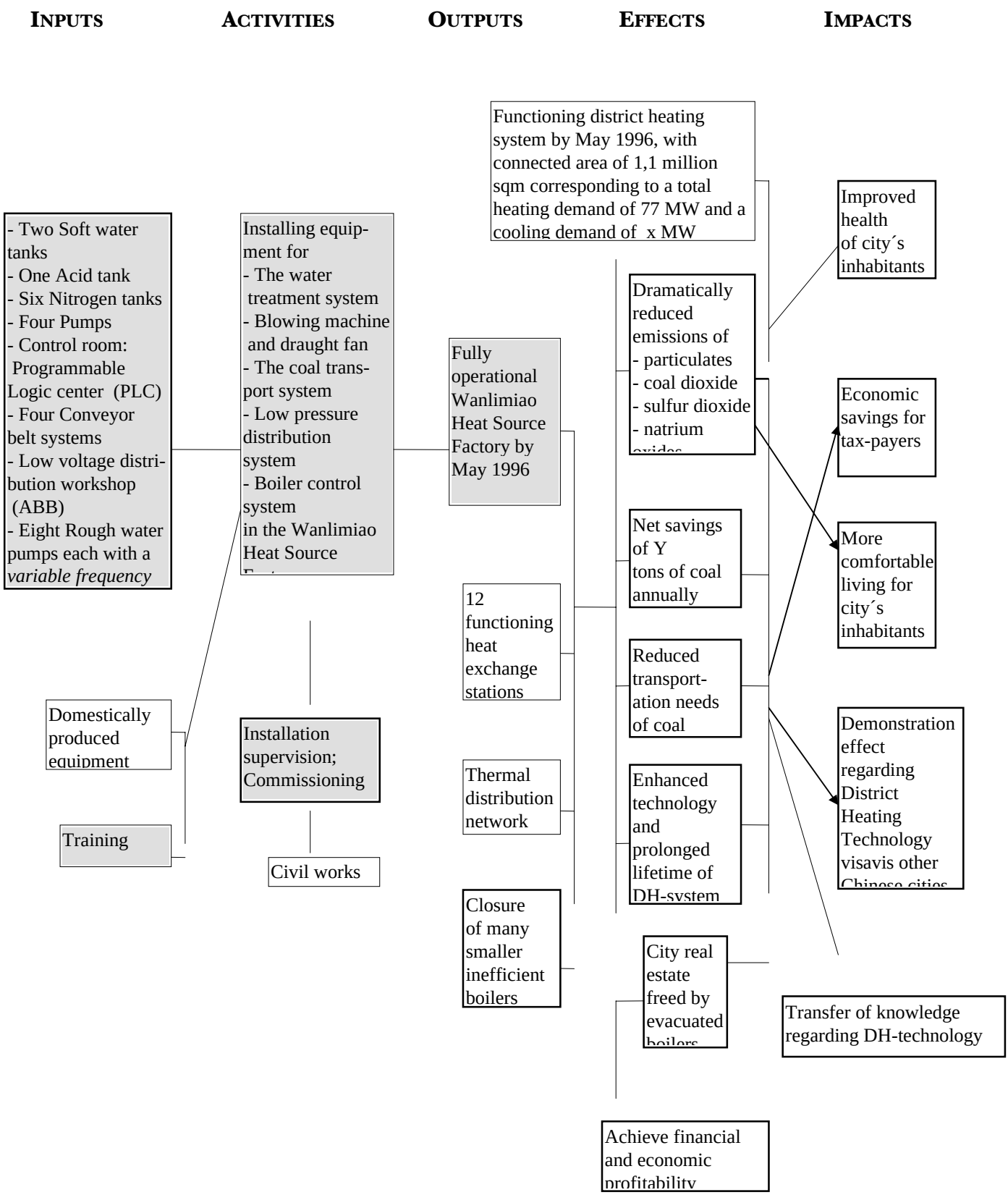
The information on inputs and activities as well as the project´s expected outputs, effects and impacts can be organized in the following outline of a logical framework schedule.

*Table 18: Outline of logical framework model of the **Shijiazhuang** District Heating project*

TARGETS AND OBJECTIVES AT DIFFERENT LEVELS	*ASSUMPTIONS MADE; RESTRICTIONS*	*Criteria for measurement; indicators*	*Achieved*
INPUTS: Equipment imported from Sweden			
- Two Soft water tanks **- One Acid tank** **- Six Nitrogen tanks** **- Four Pumps** **- Control room: Programmable Logic center (PLC)** **- Four Conveyor belt systems** **- Low voltage distribution workshop (ABB)** **- Eight Rough water pumps** each with a *variable frequency regulator*	Credit intermediation o Bank of China to materialize		
Installation supervision; Commissioning			
Training			
Other equipments, material and inputs			
Activities			
Civil works			
Installing equipment for - The water treatment system - Blowing machine and draught fan - The coal transport system - Low pressure distribution system - Boiler control system in the Wanlimiao Heat Source Factory			
Supervision			
Outputs			
- Fully operational Wanlimiao Heat Source Factory by May 1996			
- 12 functioning heat exchange stations			
- Thermal distribution network			
Effects			
- Functioning district heating system by May 1996, with connected area of 1,1 million sqm corresponding to a total heating demand of 77 MW and a cooling demand of x MW			
- Net savings of X tons of coal annually			
- Reductions in emissions of pollutants SO2, CO2, particulates			
- Reduced transportation needs of coal			
- Enhanced/Prolonged technical lifetime of DH system			
- Higher availability of heating facility			
- Financially sustainable operation by DH-company			
Impacts			
- Improved health of city´s inhabitants			
- Economic savings for tax payers			
- more comfortable living for city´s inhabitants			

The *causal links* between the various factors of the logical framework table can be shown in a goal hierarchy model like in figure 5 on the next page.

*Figure 5: Goal Hierarchy of the **Shijiazhuang** District Heating project*



3. Negotiations; Procurement

The contract was awarded, in competition with two other Swedish companies, to the ÅF group, founded in 1895 and today one of Europe´s largest companies in technical consulting, employing over 1800 engineers.

The client held technical discussions with four Swedish companies - *Alfa Laval, ABB, Powerpipe and ÅF,* and the tendering procedure was carried out in four stages. In the first offers were received from all four contenders, but in the second and third rounds ABB and Alfa Laval withdrew from competition, and the final stage was a competition between ÅF and Powerpipe.
The reason given by the client for deciding in favor of ÅF were

- its price was over 1 million cheaper
- ÅF ´s quoted price was CIF while Powerpipe´s was ex-works
- the equipment offered by ÅF was all from Swedish ”famous manufactures”
- the local agent used by ÅF had a very good reputation for efficient and generous after sales service.

Sub-contractors used by ÅF in this project are ABB-Flak, Alfa Laval, ABB Fjärrvärme, SATT-Control and Ödeshögverken.

An advantage with ÅF, pointed out by the client, was that the company has no production of its own, and therefore presumably would have greater freedom in choosing equipment from various different producers according to what is best suited technically and which price is the best.

A letter sent by BITS to the client caused an misunderstanding to the effect that BITS was by some interpreted to support only one type of boiler, the CFB *(”Fluidized Bed Boiler”).* This caused one of the Swedish bidders, Powerpipe, to claim that its product would in effect be excluded from contention and therefore requested that BITS retract on its letter. BITS however denied any improper endorsement and claimed its right to express its views on what is an advantageous choice of technology.

4. Implementation

Delay
There was a delay of about 6-7 months in the final design of the project (see page 23 of Appraisal report). This delay that carried on through all the stages of the project. Later there was also a delay in the civil works of the project.

The pace of implementation of the project can be seen in the following table where the original time table is compared to the actual.

Table 19: Time-table of project implementation: Planned versus actual

	Planned	Actual
Final design	April 1995	August 1995
Purchase of equipment	Feb -May 1995	January 1996
Construction	May-Dec 1995	March-Oct 1996
Trial operation	Feb 1996	15 Oct 1996
In operation	May 1996	13 Nov 1996

In its completion report the company states that the Swedish supplier completed the project to full satisfaction and in a professional manner.

Most of the above equipment has been put into operation on schedule and the performance basically meet the specified requirements. However with the following exceptions:

- the ignition oil pump and the oil removing pump: Because the ignition system of the plant was changed to use charcoal instead of oil the two type oil pumps became useless and have consequently never been used.
- the boiler control system has not been put to use, because there is a difference between the design of the system and the actual operation. Test runs failed and the computer system has therefore never been used.

So far , because of the project over 20 chimneys and 50 smaller boilers have been shut down. this is substantially lower than target, but it will grow as the company develops its customers for the summer season.

Finding: the company states that the Swedish supplier completed the project to full satisfaction. Most of the equipment has been put into operation on schedule and the performance basically meet the specified requirements. However with the following exceptions:
- the ignition oil pump and the oil removing pump: Because the ignition system of the plant was changed to use charcoal instead of oil the two type oil pumps became useless and have consequently never been used.
- the boiler control system has not been put to use, because there is a difference between the design of the system and the actual operation. Test runs failed and the computer system has therefore never been used.

The reasons given by the company for the 6-7 months delay in the final design of the project are the following factors:

- The project had chosen CFB boilers and that was the only time that we had used them so we were not familiar with that technique.

- It took a long time to evacuate and evict the people and tear down the buildings which were on the spot before the heating station, and
- It took time to meet with ÅF in order to get the specifications of the Swedish equipment

5. Results/outputs

Visit to the newly expanded boiler plant - Wanlimiao heat production factory:

The plant is in operation from November 1996.
The boilers in the expanded Wanlimiao boiler plant in operation today are:
- a 35 tons per hour circulating *fluid bed boiler*
- a 75 tons an hour circulation *fluid bed boiler,* and
- a 20 tons per hour *chain boiler*.

These are Chinese boilers of "CFB" type, with some pneumatic valves from Sweden, which are more suited for cogeneration because they cannot handle big variations in load factor. At present there is a big seasonal change, therefore the boilers are not functioning well. The company needs to develop and attract many more customers e.g air conditioner users in the summer to make the load factor more even and thus make the boilers perform better. During the summer only one of the three boilers is working. In the winter two are working and one is standing by.
The control system of the boilers is not functioning due to lack of spare parts.

Other equipment, like *fans, middle tank,* and four *feed water pumps* are all functioning well, and without any problem so far:

Finding: Due to the big seasonal change the boilers are not functioning well. The load factor must be made more even in order for the boilers to perform better. The control system of the boilers is not functioning due to lack of spare parts.

The total coal consumption so far of the new heating plant is 36,000 tons a year. The factory at present has 26 customers with a total heat supply area of 600,000 sqm. The highest load in the winter is 50 tons per hour and in summer 18 tons per hour.

The equipment imported from Sweden

The equipment imported from Sweden, covering

- The whole water treatment system
- Blowing machine and draught fan
- The whole coal transport system
- Pump
- Low pressure distribution system
- Boiler control system

is, according to the company, generally speaking satisfactory. But part of the system has still not been put into use.

Most of the above equipment has however been put into operation on schedule and their respective performance basically meet the specified requirements. But with the following exceptions:

- the ignition oil pump and the oil removing pump: Because the ignition system of the plant was changed to use charcoal instead of oil the two type oil pumps became useless and have consequently never been used.
- the boiler control system has not been put to use, because there is a difference between the design of the system and the actual operation. Test runs failed and the computer system has therefore never been used.

The company is also satisfied with the training services offered by the Swedish government.

The main remaining problems, according to the company, are:

-lack of spare parts. Some cannot be found in China. Other parts, among them some that wear down quickly, are unknown to the Chinese, because no drawings were made available by the Swedish supplier. Only when the part breaks down and is removed or taken apart can the company search the Chinese market for similar parts or order new parts to be produced for measure in China. One example of such a part is the mechanical sealing element.

Finding: Most of the imported equipment has been put into operation on schedule and their performance basically meet the specified requirements, and the company is satisfied with the training services offered by Sida, but points out the following problems:
- Because the ignition system of the plant was changed to use charcoal instead of oil the two type oil pumps became useless and have never been used
.- the boiler control system has not been put to use, because there is a difference between the design of the system and the actual operation. Test runs failed and the computer system has therefore never been used.
- lack of spare parts. Some cannot be found in China. Other parts, among them some that wear down quickly, are unknown to the Chinese, because no drawings were made available by the Swedish supplier.

INSPECTION OF THE SWEDISH EQUIPMENT:

Soft water tanks

The two soft water tanks, forming part of the water treatment system are working perfectly well. They were installed with assistance from Swedish expert. So far no problems have arisen.
The engineer on duty could not say why these were imported from Sweden, since there is similar equipment in China, but assumed that the quality of Swedish tanks is better

Acid tank

One *acid tank* imported from Swedish is working quite well

Nitrogen tank

There are six nitrogen tanks (produced by *Malmbergs),* in the *water treatment shop,* used for making rough water into soft. Three of the tanks are nitrogen exchangers and the remaining three are for natrium. There is one injector containing acid, and one for salt . All of these equipments are functioning quite well.

Similar tanks are produced also in China, but the quality of Swedish tank is supposed to be somewhat higher than Chinese. However, the two injectors that belong to the system which are not produced in China, and therefor it was necessary to buy the whole system in Sweden. Would it have been possible to use the Swedish injectors together with Chinese tanks instead of Swedish? Yes it is technically perfectly possible but lifetime of the Swedish tanks is much higher.

The company has no spare parts at all for this system. If one part breaks down then the whole system will stop. The Swedish contractor, AF, said that there is no need for spare

parts for the injectors But during almost two years of operation we have seen that spare parts are needed. but so far there have been no breakdowns.

Pumps

The four pumps delivered from Sweden are running well but there is a small problem with mechanical sealings. Such sealings can not be found in China. The same pumps can be found in Chinese but perhaps of lesser quality.

Control room: Programmable Logic center (PLC)

This is the control center for the whole power plant. All the equipment for the control room was imported from Sweden, except for the Chinese panel board, with Alfa Laval acting as sub-contractor to AF.

The whole control system is out of order since February 1998, the probable reason, according to the company, is that the software is not able to handle unannounced electricity cuts.

It is possible that the problem is at least partly due to the fact that some designs of the plant were changed in relation to the original plans on the basis of which the computor program was procured. An example of such a change could be that the company changed the ignition for boilers from oil to wood. Another could be the combustion system. So possibly the reason why the combustion control is not functioning is the fact that we the company changed the design.

The problem first appeared already in 1997 after an electricity black-out. That time it could be fixed with the assistance of three Swedish experts who happened to be present in Shijiazhuang. They used a mobile phone to get instructions from Sweden, and Alfa Laval did not have to send anyone.

Then the same thing happened again in February 1998 after another black-out, and the problem remains unresolved today. The company has sent a fax to Alfa Laval and AF, but no reply has yet been received. The company believes that the data program, which is based on the UNIX-system, may be appropriate to Swedish conditions where there are no blackouts, but it is obviously not suitable to the Chinese environment where blackouts are frequent.

The situation today is that the boiler plant is without its computerized control system since three months. The company has asked the Swedish contractor for help, but have as yet not even received an answer. According to the people interviewed nobody from Alfa Laval people have ever been her..

Finding: The whole control system is out of order since February 1998, a possible reason being that the software is not able to handle unannounced electricity cuts. But it may also be due to the fact that fact that some designs of the plant were changed in relation to the original plans on the basis of which the computor program was procured. The company has asked the Swedish contractor for help, but have as yet not even received an answer

Parallel to the Swedish control system there is the Chinese system Which is still working but that one is not an automatic control system, but a manual one and also partial.

The computerized control system is today the only part of the project which is not functioning. Everything else is today working without any problems whatsoever.

Conveyor belts

There are four conveyor belt systems from Sweden, installed during July to September, and put into operation in November of 1996. They have functioned perfectly ever since. The whole system is running very well and, and in the company´s opinion, clearly better than similar systems produced in China.
The company has however very little spare parts for these belt systems, but so far there has been no break-downs at all. During my visit the belts were not working since they are serving one of the boilers which is idle in the summer.
The installation of the conveyor systems was assisted and supervised for two weeks by three persons from the supplier, and the work went very smoothly.

Finding: All three conveyor belt systems are running very well and, and in the company´s opinion, clearly better than similar systems produced in China.

Low voltage distribution workshop (ABB)

This is an electricity distribution center which serves the entire plant. It was manufactured by *ABB Strömberg Distribution,* installed in March and opened for operation in November 1996. So far it has been working perfectly. There are similar systems produced in China but of lower quality.

The company has a suggestion on how it can be improved. It should be modified so as to contain one collective switch for each of the 30 groups. As it is today the company must shut down the entire electricity supply if they want to carry out repairs only on one group. Of the 30 groups today only 6 have individual switches the others do not.

It seem difficult to understand why this important need was not expressed earlier, or why, in deed, it was not specified already at the time of ordering the equipment. The company has not yet informed the Swedish supplier about this need.

Finding: The electricity distribution center is working very well. There are similar systems produced in China but of lower quality. However the company has a suggestion on how it can be improved

Rough water pumps

There are eight rough water pumps each with a *variable frequency regulator*, which regulates the speed of the pumps. This equipment was installed in June and operated from November 1996, and the experience so far is very good.
The pumps have worked very well, and in the company´s opinion they are of very high quality. The same type of pumps can be found in China but not of the same quality. The noise level of Chinese pumps is higher, and they need more repair and maintenance than the Swedish pumps. The price of Chinese pumps , however, only about half of the Swedish ones.

Finding: The experience of the eight rough water pumps so far is very good. The same type of pumps can be found in China but not of the same quality. The price of Chinese pumps are, however, only about half of the Swedish ones.

Visit to a substation

The substation I visited is in one of the new skyscrapers housing among other things a four-star hotel, serving a total heating area of about 50,000 sqm. There are in all 26 substations that belong to this area. 14 more will be added this year. All the equipment in all substations is made in China.

This sub-station, which according to the company is a typical one, had the following equipment installed in the winter 1996/97 and starting operation in May 1997:

- 12 heat exchangers. They have functioned well so far without any problems, and without break-downs. Their economic life we estimate to be some 15 years. They are manufactured in Jangsu province in Southern China
- 3 filters made in. They have been functioning without problems. The filters are made in the same province but by a different company.
- One large unit of cooling equipment, made in China
- four pumps made in Shanghai. Have been functioning very well. No leakage of water or oil. The pumps are manufactured by two different Chinese government owned companies.

Comparing the Chinese pumps with Swedish the lady engineer from the heating plant thought that they are quite similar but that the Chinese ones are bigger and noisier. In terms of life-time she estimated the Swedish pumps to be twice as durable: perhaps 30 vs. 15 years. Chinese pumps also have more vibrations . It is however very easy and convenient to get spare parts, service and maintenance for the Chinese pumps, as the manufacturer has an office in Shijiazhuang.

Conclusion

There does not seem to be any question that one can not only equip a complete substation relying exclusively on Chinese equipment, but also that one will be able to run it smoothly, reliably and with easy access to all service and spare parts needed. Technological lifetime of the equipment will surely be lower, perhaps by as much as half, but on the other hand the price of the equipment is probably less than half, especially if one considers the cost of spare parts and service.

Does this mean that - from a Chinese point of view - it would always be wiser to buy only domestic equipment for their substations? No , I do not think so, not necessarily even if the price were less than half. *Firstly*, chances are that the quality, both in terms of functionality and durability, of the Swedish equipment could turn out to be so superior that even at double the price it would be a much more economical for the Chinese district heating companies than domestic equipment. That is entirely possible and perhaps also probable. *Secondly,* irregardless of prices and of economy, it must be good for Chinese development to have a few show case projects where alternative - *id est* foreign - technology can be demonstrated , and against which the domestically manufactured equipment can measure its performance , quality and price. This is perhaps the only real effective way how China´s own capital goods industry will develop and in the future compete fully with the foreign imports.

Design

The responsibility of designing the new heating plant was the company´s own design department. However the responsibility for the design of the various sub-stations rested with each respective owner of the substations.

The design department did not find it very different to work on designing a regular Chinese heating plant and this one which contained lot of foreign equipment. Only some small extra work had been created by the fact that the installation connections are different. He is very cooperation with the Af experts.

The head of the design group was part of the negotiating team which spent 15 days in Sweden. And three experts from the Swedish supplier spent a total of about 2 months here in several installments.

A wish expressed by the company today is to be able to import preinsulated pipes from Sweden to be used for connecting the substations with the endusers.

6. Effects

6.1 Financial profitability

During winter the cost of production can today be recovered but not in spring, summer or autumn. The total cost of production is 13,8 million yuan, the sales revenue 8,96 million yuan and profit -3,1 million yuan. Because of the low load factor the operation of the Wanlimiao plant is not very smooth. However it is expected that in the near future more and more enterprises and institutions will become customers, and thereby increase the heat load.
The *Wanlimiao* heat source factory has so far replaced more than 20 boiler rooms scattered over the district. In addition some 50 smaller boilers have been removed.

The project revenue comes from the sales of heat to its customers, and the costs from the inputs coal, electricity and water, as well as operation, maintenance, wages, interest payments and loan repayments. The annual heating charges to the customers and also the connection loans have been set by the company, and approved by the government, on a cost recovery basis. The company in 1993 showed a o profit of 138 million RMB on which it paid 11 million in profit tax.

Current consumer tariff is 24,8 yuan per sqm, but in some time, probably in the year 2000, after the plants volume of business goes up, it will be decreased to 13,2

The groups total income is today 300 million yuan. Of this some 3 million, i.e. only 1 %, comes from Wanlimiao plant. When the Wanlimiao plant reaches full load, which is defined as 40 % capacity on average, the plant is expected to account for about 10-15 million, about 4 % of the total.

For 1997 the total cost of production for the Wanlimiao plant was 13,8 million yuan, the sales revenue 8,96 million yuan and consequently a loss of 3,1 million yuan.

Financial appraisal

The financial analysis carried out by BITS covered, apart from the two year long construction period, an operations time of 15 years. Some parts of the system can be expected to have a longer economic life than 15 years, but net effects happening after 15 years can only have a very marginal impact on the outcome of the financial analysis.

The result of the financial analysis was greatly influenced by the fact that the project is meant to service also air conditioners in summers. The absorption heat pumps allows production of cold as well as heat. The tariffs charged consumers for running of air conditioners is double that of heating. Another point to mention is that the cost of coal inn Shijiazhuang is only 113 yuan per ton, as compared to 230 in Fushun and 150 in Jiamusi respectively.

In the absence of a concessionary loan the cash flow of the project would have been negative for the first 10 years , and the accumulated net cash flow would remain negative for 16 years. With concessionary financing and with subsidized local financing the net cash flow is positive for the first three years of operation, and then turns negative for the next 7 years. The accumulated cash flow remains (just barely) negative for the entire10 year period.

The financial internal rate of return, FIRR, was calculated to be 3,8 % including tax payments and 9,5 % excluding taxes. With commercial financing and to 5 % and 12,4 % respectively in the case of concessionary credit

The conclusion drawn from this analysis by BITS, and implicitly supported by the OECD community, was that the project would probably not be implemented in the absence of a concessionary loan. Even though the project did not receive any opposition after notification to the OECD, BITS nevertheless carried out a financial analysis according to the *Helsinki guidlines*.

No financial data were made available to this evaluation which would make it possible to calculate the ex post financial profitability of the project. Nor was it possible within the short time available to attempt collecting raw data on revenues and costs and analyze the same.

But maybe this is not so important, because, a general reasoning will suffice to indicate that the project can hardly have achieved its financial targets. This is simply due to the fact that the project has been delayed is on an aggregate basis perhaps with a whole year. And it is clear from the financial analysis carried out during the appraisal that such a long delay in the projects revenues to start materializing would make financial profitability impossible to achieve.

Finding: A general reasoning will suffice to indicate that this project can hardly have achieved its financial targets. This is simply due to the fact that the project has been delayed is on an aggregate basis perhaps with a whole year. And it is clear from the financial analysis carried out during the appraisal that such a long delay in the projects revenues to start materializing would make financial profitability impossible to achieve.

7. IMPACTS: ATTAINMENT OF LONG-RUN OBJECTIVES

The total picture regarding savings in energy as well as reductions in pollution levels for the Swedish supported project in Shijiazhuang can be seen in the following table,

Table 20: Saving in energy use and reductions in pollution levels: DH-projects financed by Sweden in Shijiazhuang, Thousand Tons per year. Figures within parentheses refer to the whole projects.

	Shijiazhuang
Consumption of coal by boilers:	
- Savings in coal used by scrapped boilers	60 (746)
+ Added coal consumed by central boilers	42 (524)
- Net savings	*18 (222)*
Emissions of dust particles:	
- Reduction of particles emitted by scrapped boilers	4 (50)
+ Added emissions by central heat producing units	0,05 (2,8)
- Net reductions in emissions	*4 (47,5)*
Reductions in SO2 emissions	
- Reductions due to scrapped boilers	1,3 (16)
+ Added SO2 emissions from central boilers	0,3 (3)
- Net reductions of SO2 emissions	*1 (13)*
Reduced transportation needs of coal:	
- Reduced volume of transports, 1000s kms per year	40 (497)
- Reduced SO2 emissions due to less transports, kgs	120 (1490)
- Reduced NOx emissions due to less transports, kgs	60 (745)

Source: Own compilations based on report 1995-03-30 by Fjärrvärmebyrån AB

In addition to the reductions brought about in emissions of dust, SO2, and NOx, there will also be reduced emissions of heavy metals, mercury, lead etc.

Measurements in Sweden have shown that SO2 are often reduced by 80 % when DH is introduced. In Chinese cities, starting from a much higher degree of pollution, the effect can be expected to be even greater than that.

7.1 Economic benefits

As will be discussed below in the Chapter *Summary of Findings and Conclusions* it is quite clear that all of the five district heating projects, including this one, are highly profitable from an economic point of view. This follows from the very large savings realized in coal consumption, as well as through the dramatic reductions achieved in emissions of pollutants. These economic benefits are of such magnitude that the project´s economic profitability can not be threatened by the project suffering this or that set-back or because it is implemented with one or even a few years delay.

Finding: It is clear that all of the five district heating projects, including this one, are highly profitable from an economic point of view. This follows from the very large savings realized in coal consumption, as well as through the dramatic reductions achieved in emissions of pollutants. These economic benefits are of such magnitude that the project´s economic profitability can not be threatened by the project suffering this or that set-back or because it is implemented with one or even a few years delay

The EIRR, the internal economic rate of return calculated in the appraisal was in the neighborhood of 20 %.

Compared to a situation with many individual boilers, which are scrapped because of the project, the consumption of coal will be reduced by 18,000 tons annually, at a total economic value of some 2 million RMB per year.

The benefits to the environment were estimated using the Swedish tax for environmental pollution. Since the coal in Sweden contains only 0,5 % sulphur as compared to 1,4 % in China, this tax is actually an underestimation of the environmental effect.

The environmental tax applied obviously captures some of the economic benefits to society because of improved health or reduced illnesses due to less pollution . But probably not all of it. If one constructed a compete economic model, including also long run effects, then the expected economic rate of return of the project would most probably go up considerably.

Calculating the economic value of the decrease in emissions of CO2 and SO2 respectively, the appraisal arrives at two alternative values, depending on what tax rate to apply. In Sweden there are two levels - one for industrial polluters, one for other coal users. Additional benefits that were not included in the analysis are the reduced emissions of pollution brought about by the reduction in transportation of coal in the city center.

Another factor on the cost side which was not included in the analysis is the cost of relocating the 400 households that were living in the area where the new boiler plant was built. This cost , estimated at som 45 million RMB was paid for by the city. Some of it rightfully belongs in an economic analysis although not all of it.

BITS decision memorandum contains one misleading statement when it implies (page 9) that the large economic and environmental benefit of the project arises when comparing modern Swedish technology with continued use of old traditional methods. This is misleading because also if the project were to use modern *Chinese* equipment in its DH system there would be a very important environmental improvement as well as energy conservation improvement.

Given that the Swedish equipment is of better quality and is some cases also more efficient, it follows that the economic gain would be higher using "modern Swedish technology", but on the other hand it is also more expensive, so the EIRR would not automatically be higher, although chances are it would. However the important point to make here is that the bulk of the environmental improvement of introducing DH to replace a multitude of inefficient individual boilers would be reaped almost as well in a purely Chinese project as in one that relies on strategic imports from abroad.

Conclusion: The bulk of the dramatic environmental improvements as well as the large savings in energy consumption that are a result of introducing DH to replace a multitude of inefficient individual boilers, would be reaped also in project relying exclusively on Chinese technology. Imported , advanced technology can make these gains bigger, but are not a condition.

7.2 Environment

The Wanlimiao central district in the city of Shijiazhuang where the project is, is very heavily polluted. The situation in 1994 was the following

Table 21: Pollution levels in Wanlimiao district: Concentrations in mg/Nm3

Pollutant	Actual	Maximum allowed according to National standard
TSP	0,55[2]	0,3
SO2	0,35	0,15
NOx	0,24	0,10

2. According to one report a measurement undertaken Jiamusi in March of 1995 showed a concentration of dust particles of 0,88 mg per Nm3

In this project it was decided to build the boiler in the very center of town so as to avoid having to build long pipelines for heating water and steam. To neutralize increased noise and disturbances for the neighbors it was decide to plant trees and also erect a sound-proof shield around the boiler house.
Due to efficient emission control equipment being installed air quality in the city was not expected to be influenced by the central location of the boiler.
Therefore also it was important to choose a boiler of CFB type which is the best for operating with clean combustion.
The waste water from the boiler is discharged into the city´s sewers only after neutralization of PH.
The waste ash and coal dust that are left over from the heating generation in the *Wanlimiao* plant is taken directly to a local brick manufacturer to be used as raw material for construction of building materials.
Also the waste water is recycled within the production process instead of, as traditionally, simply be discharged into the sewer of the city.

My visit to the boiler station revealed that a lot of *noise reduction* measures still remain to be implemented. *Noise level* is still too high. It is the fans that are making too much noise. they will definitely fix it this year.
Trees as protection against noise, have not yet been planted, as construction work was just finished.

35000 tons of coal were used for the boilers last year, and emission of SO2 was 2 %.

This is much higher than the 0.5 % implied by the plan (see page 10 of the BITS

decision memorandum). (2% of 35000 is 700 tons as compared to X/100 x 42,000

where X works out to=0,5)

The reason to this discrepancy is that the plan refers to data regarding *full load.* When there is less than a full load the emission percentage becomes higher.

So far , because of the project over 20 chimneys and 50 smaller boilers have been shut down. This is substantially lower than target, but it will grow as the company develops its customers for the summer season.

There are no statistics available in Shijiazhuang on health, so we do not know how the project has influenced the city´s health situation.

In summary we may say that

- no real measurements of the pollution targets has been made yet, because the project has not yet reached a full load.
- but from what we can see today there will be no problem to reach the targets that have been set.
- the only environmental problem which at present does not have a ready solution is the noise level.

Finding: No real measurements of the pollution targets reached has been made yet, because the project has not yet reached a full load. From what we can see today there will be no problem to reach the environmental targets of the project. The only environmental problem which at present does not have a ready solution is the noise level.

7.3 Equality/ Poverty orientation

7.4 Gender

The Wanlimiao heating factory now has 129 workers and staff members of which 12 college graduates, 33 junior college and polytechnic school graduates. The gender division at various levels can be seen from the following table:

Table 22: Gender distribution of staff at the Wanlimiao heat factory

Category of employee	Total employees	Number of women
Total employment	129	35
Managers	30	12
Engineers and technical staff	45	5
Workers	54	14

My question why only 5 technicians /engineers out of 45are women was answered by:
"Its always like that. Girls want to study literature, art etc."
Do women avoid shift work jobs because they are responsible for the household?
"Yes perhaps a little, but that is definitely not the main reason. In general women have no problem with shift work."

Total employmnet of company is 2700 of which 30 % are women. 22% of the 2700 are managers and 20 % are engineers. The remaining 58 % are divided between the categories "in direct production line", "assistants", and "service personnel".
Of the managers and engineers, i e the 42 %, about one third are women.

8. BITS´s project preparation

Also in this project there are examples of how BITS through its appraisal was in a position to offer positive advice regarding technical modifications to the client in order to improve the technical solution of the project. One example is that the heat exchangers should be installed between the boilers and the distribution system so that the boiler circuit pressure and temperature are separated from the distribution system. Also that the substations should be designed so as to allow for the future use of heat exchangers for domestic hot water
Further BITS seems to have persuaded the client to buy a boiler locally in China instead of importing it from Sweden. In a letter BITS asked the Chinese side to explain why it had deviated from an earlier plan to buy a Chinese boiler, and in the same letter pointed out that "it falls outside BITS mandate to finance equipment that can be purchased inside the country in question (normally at a lower cost) and with no exposure of foreign currency fluctuation."

Finding: Also in this project there are examples of how BITS through its appraisal was in a position to offer positive advice regarding technical modifications to the client in order to improve the technical solution of the project

9. Reporting requirement

The contractual obligation of the parties to send in a project completion report within six months after commissioning had not been complied with neither by the buyer, nor by the Swedish supplier. At the time of my mission to Shijiazhuang the company did however put together a three pages long completion report for my benefit.

VI DISTRICT HEATING IN JIAMUSI

1. The Project

The project includes the following parts:

- a 6,3 km long *transmission pipe-line* from the new power plant in Jiamusi to the city distribution network. It consists of two hot water pipes with dimensions from 600 to 800 mm. The main part of the transmission line, as well as the distribution system within the industrial area to be serviced by the project, was built with the imported pre-insulated pipes.
- a *distribution network* for an industrial area including substations. The substations were equipped with a heat exchanger, circulating pump, water treatment equipment , energy meter and control equipment.
- *reconstruction of 5 pipe sections* in the previously existing network
- installation of a 29 MW *boiler*
- installation of heat exchangers, pumps and pressure vessels in Jijiang and Tiexi *Boiler houses*

The project thus consists *both* of an upgrading of the previously existing system *and* an extension to that system, and was implemented in parallel to the construction of a co-generation plant which will be the new heating source to replace many scattered individual boilers. The two bigger boiler houses will be kept while 8 smaller ones will be dismantled after the co-generation plant is operational.

The Swedish delivery consisted of:
For the *transition and distribution network*:

- prefabricated, preinsulated pipes
- Compensators
- pumps and valves

For the *Substations:*

- heat exchangers,
- filters
- distribution and water pumps
- shut-off and regulating valves

Other:

- computerized control and monitoring system for the three larger heat exchangers in substations, and for the operating center in the Jiamusi cogeneration plant
- foaming machine
- heat camera

In addition, the supplier organized a *study visit* for 10 persons during three weeks in Sweden, *training* for planning, installation, operation and maintenance for 7 persons during 3 weeks in China, as well as four weeks of installation supervision.
The technical appraisal carried out by BITS found the amount of training to be on the low side.

Of the total contract amount, which is 34, 7 M SEK, 30,6 was for equipment and spare parts, 3,3 for transport and packaging, while 737,000 was for training, study visits and supervision.

Subcontractors to the main contractor *Powerpipe* are the following Swedish firms: *SATT Control, Alfa Laval Thermal, KSB Mörck, KWH Tech, Grundfoss,* and *Scanpump.*

The local part of the project is financed through a *connection loan* amounting to 45 million RMB. The total 2,7 million sqm of building area which is to be built until year 2000 was planned to generate connection loans of a total of 160 million RMB. This future funding was also used by the company to guarantee repayment of loans.
The Jiamusi city has extended a guarantee to the Bank of China for the company´s timely repayment of the loan.

Before the project heat was supplied directly to the customers via 118 small ”substations”, but without any heat exchangers in between. The piping consisted of steel pipes insulated with mineral wool and placed in a concrete culverts in the ground.

The construction of district heating in Jiamusi started in 1984 and at the outset of the present project some 3,4 million sqm or 35 % of the total building area in the city was supplied be district heating. The main heat source was the state-owned Jiamusi co-generation plant which can supply 1,8 million sqm or 135 MW. In order to meet the expected very big expansion of DH in 1991 a new co-generation plant was started to be constructed.

Jiamusi is an industrial city with 2,3 million inhabitants, of which about 700,000 live in the city center. The responsibility for the district heating expansion of the city and for this project is the state-owned *Jiamusi District Heating Company* founded in 1984 with 300 employees. Today the total number of employees is 1034 (1,400?), including subsidiary activities, which the company keeps in order to even out the seasonal effects on economic activity, since the district heating part is only operating six months of the year - from September 15 to April 15. In addition to district heating, which is the main activity, the company has its own construction as well a designing divisions, but also economic activity in installations, farmland for cereal production, lumber tree plantations and even tourism establishments.

China National machine and Equipment import export signed the contact only as a matter of formality. JDH in practice controlled the entire purchase and all the decisions

2. Logical framework and Goal hierarchy

The information on inputs and activities as well as the project´s expected outputs, effects and impacts can be organized in the following outline of logical framework schedule.

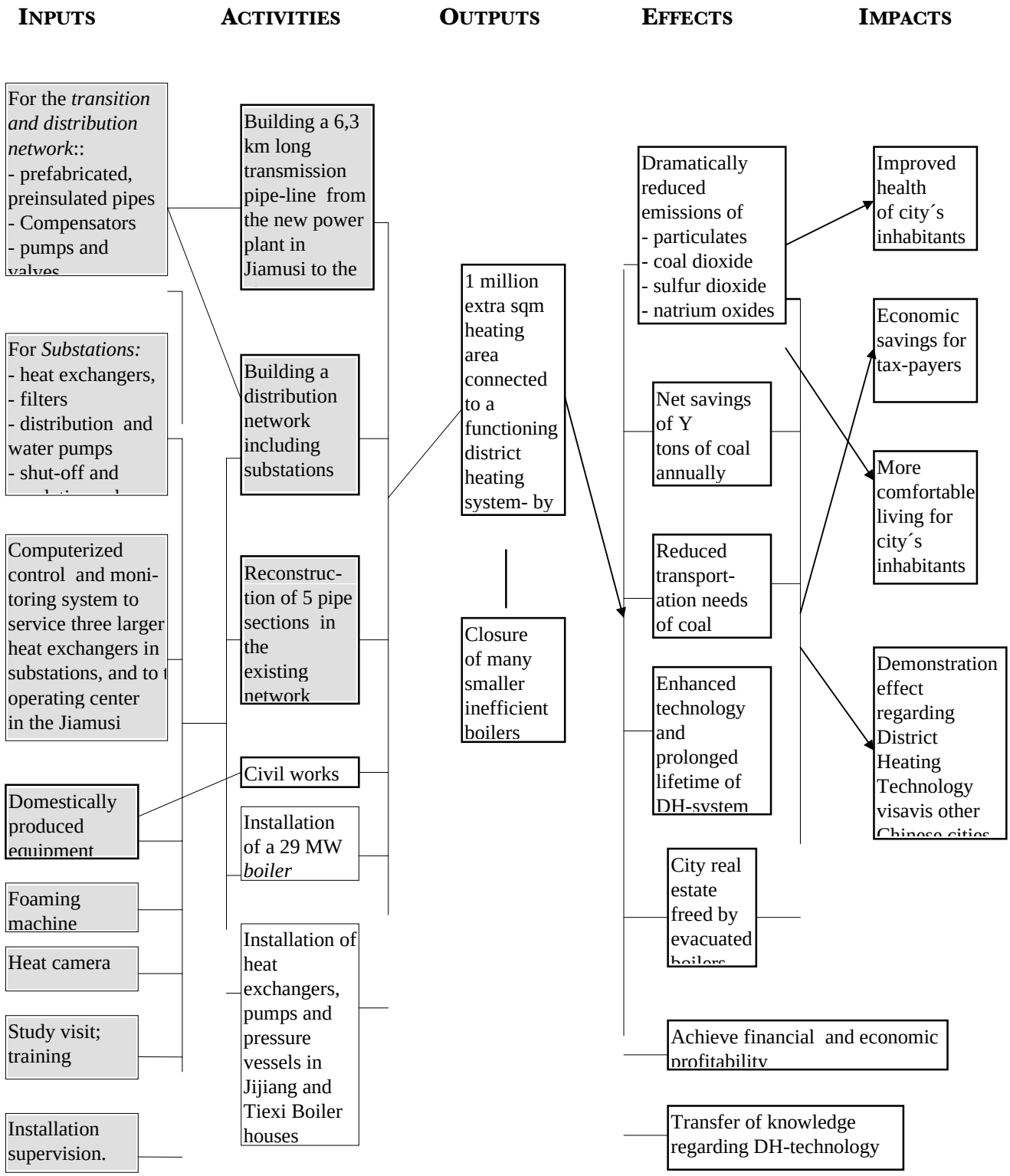
*Table 23: Outline of logical framework model of the **Jiamusi** District Heating project*

TARGETS AND OBJECTIVES AT DIFFERENT LEVELS	*ASSUMPTIONS MADE; RESTRICTIONS*	*Criteria for measurement; indicators*	*Achieved*
Inputs *(Equipment imported from Sweden)*	Credit intermediation of Bank of China to materialize		
For the *transition and distribution network*: - prefabricated, preinsulated pipes - Compensators - pumps and valves			
For the *Substations:* - heat exchangers, - filters - distribution and water pumps - shut-off and regulating valves			
Computerized control and monitoring system to service three larger heat exchangers in substations, and to the operating center in the Jiamusi cogeneration plant			
Foaming machine			
Heat camera			
Study visit; training			
Installation supervision.			
Activities			
Building a 6,3 km long transmission pipe-line from the new power plant in Jiamusi to the city distribution network.			
- Civil works			
Building a distribution network including substations			
Reconstruction of 5 pipe sections in the existing network			
Installation of a 29 MW *boiler*			
Installation of heat exchangers, pumps and pressure vessels in Jijiang and Tiexi Boiler houses			
Outputs			
- Functioning district heating system with	The new co-generation plant		

connected area of x sqm	being built to be completed on time		
Effects			
- Net savings of x tons of coal annually			
- Reductions in emissions of pollutants SO2, CO, particulates			
- Reduced transportation needs of coal			
- Enhanced/Prolonged technical lifetime of DH system			
- Financially sustainable operation by DH-company	An envisaged tariff raise to be implemented by the authorities		
Impacts			
- Improved health of city´s inhabitants			
- Economic savings for tax payers			
- more comfortable living for city´s inhabitants			
- Demonstration effect regarding District Heating Technology visavis other Chinese cities			

The *causal links* between the various factors of the logical framework table can be shown in a goal hierarchy model like in figure 6 on the next page.

*Figure 6: Goal Hierarchy of the **Jiamusi** District Heating project*



3. Negotiations; Procurement

Final offers were handed in by two Swedish firms - *Powerpipe* and *ABB Fjärrvärme AB*. According to the company´s report on the result of the tender, both of the bidders met the requirements w r t technique and quality. Powerpipe was chosen ”due to the low and reasonable price as well as reliable technique”. The price difference between the bidders was almost 1 million - SEK 34,735,787 compared to 35,708,000)

At an earlier stage of the tendering procedure the client apparently had in mind to choose the other firm, ABB Fjärrvärme, which led Powerpipe to complain bitterly to BITS, indicating that it suspected its competitor of having exerted undue pressure on the client. BITS, through the Swedish Embassy in Beijing, then requested that the Chinese ministry MOFTEC look into the allegations of any wrongdoing or improprieties, and that they provide BITS with a full report on the of the tendering process a tender evaluation protocol

On another occasion Powerpipe expressed its opinion that statements made by BITS regarding the appropriate pipe dimensions had prompted the client to - unjustly - favor its competitor. BITS, on its part, denied that they had exerted any undue influence, other than its natural right to express its opinion on what they thought was the best technical solution.

Apparently Powerpipe´s complaints paid off, because, shortly thereafter, the client formally decided to accept Powerpipe´s offer.

The discussion regarding the appropriate thickness of the pipes was this: ABB had maintained that its competitor Powerpipe was not following Swedish standards regarding appropriate thickness, thereby creating a very tense relation between the two companies.

According to an independent consultant *Fjärrvärmebyrån* , retained by BITS to settle the matter, there is no set standard regarding the thickness of the isolation for pipes that are laid down in culverts. The optimal thickness becomes a question of economy and is therefore, *inter alia,* a function of the relative cost of energy.

ABB stated that Powerpipe´s isolation was only 30 mm to be compared with 80 which is normal in Sweden, and therefore, according to information given to BITS, the energy loss with pipes offered by Powerpipe would be 2,5 to 3 % compared to 1,5% with pipes according to the Swedish norm. Interestingly enough however also ABB´s pipes were below the Swedish norm, as the respective energy loss was estimated to be 2 to 2,5 %.

Finding: There were several controversies with some bidding Swedish companies claiming that sound procurement rules had been violated. My impression is that none of the alleged faults were of a very serious nature.

This, involuntary, intervention on part of BITS led to a sole searching within the agency regarding not only what position to take in this particular instance, but more importantly, on its general policy: Should it go in a and scrutinize proposals at an early stage, getting the advantage of being able to offer advice to the client and not risking to have to say no to a credit request at very late stage of a project. If yes, should it also play an active role in the tendering procedure? Even though no concrete decision regarding the appropriate degree of involvement in the future, was taken, the internal debate was constructive and can have been expected to enhance BITS´ routines.

Like in the case of the district heating project in Dalian, where Powerpipe was also the Swedish contractor, BITS requested that Powerpipe´s mother company and owner issue a guarantee for fulfillment of all its contractual obligations to its Chinese client as a precondition for granting the concessionary loan. The motive behind this was that Powerpipe had shown financial losses in the preceding budget years.

Before the Ministry in Beijing (MOFTEC) eventually decided that the Jiamusi district heating project should be ”given” to Sweden, the company had contacts with potential suppliers in also other countries than Sweden. At that stage the Swedish supplier offered a price 10 % lower than a Danish competitor. The Danish credit was only 8 years and the Swedish one 10 %. The other bidders were Norway and Finland.

4. Implementation

In a report, given to this evaluator on April18 1998, the company states that the project and its auxiliary activities have basically been finished. A 7,2 km long pipeline has been built which is 0,55 km longer than planned. A fourth boiler with 29 MW capacity has been installed, the computor control system has been set up and put in operation in 1997.

However due to the fact that the Jiamusi co-generation plant did not test run until November 1997 the boiler houses have not yet been converted to heat sub-stations according to original plan. The project plan cannot be carried out before the co-generation plant is put into full operation, which is now expected to happen in October 1998. Before then it is obviously not possible to dismantle the existing boilers scattered over town as they are still needed for heat generation.

So, because the construction of the co-generation plant has not been finished according to plan, the project is currently running about one year behind schedule. The responsibility for the cogeneration plant rests with another state company, and this work can not be speeded up at the discretion of JDH. The reason for the delay

with the co-generation plant construction is reportedly that this other company had problems of raising finance.

Finding: Because the construction of the co-generation plant has not been finished according to plan, the project is currently running at least one year behind schedule. The responsibility for the cogeneration plant rests with another state company, and this work can not be speeded up at the discretion of JDH.

In the spring of 1997 the allowed disbursement time of the BITS credit was prolonged to July 31st 1997 through a decision by BITS.

In the above mentioned report it is also explained that the reason why the contract with the Swedish supplier did not come into effect until June 1995, was not only because of the hesitation shown by the *Bank of China* to act as intermediary for this loan, but also due to the reorganization undertaken at BITS. It has not been possible to establish what this refers to. None of the officers at BITS or Sida seem to be aware of any administrative difficulties on the donor side which would have delayed the credit.

Another problem reported by the company is that, because the company through a Government decision, was about to loose its tariff free status as of January 1st 1996, the company had requested that Powerpipe speed up its deliveries so as to send all the equipment to Dalian port by December 31st 1995. Powerpipe, on its part, formally undertook to do that, but apparently failed to carry it out as only 28 of the containers arrived in Dalian. Of the remaining ones 34 were sent to Shanghai and 16 to Yantian, which cost the company an extra 844,868 RMB in transportation costs. In the company's eyes this is a cost which should be born by the supplier. According to Powerpipe it is the Maersk shipping line which is responsible for this rerouting, and as Powerpipe felt it had done nothing wrong according to the signed contract, it was not possible for the Jiamusi DH company to recover any funds from the supplier. The issue remains unresolved today.

Finding: Because of errors committed in the shipment planning the company incurred an extra 844,868 RMB in transportation costs

5. Results/outputs

Visit to two boiler houses

There was no Swedish equipment in these two boiler houses. According to the company they were both functioning well. However, as could be optically verified by any visitor, they were not kept clean. There was a lot of dirt lying around, producing a foul smell.

Inspection of underground piping system

According to the company the installation of the prefabricated and preinsulated pipes, imported from Sweden, has been successfully completed. During brief visits to some portions of the 7,2 kms long piping system, mainly carried out by looking down through man-holes in the city streets, I could verify that this was apparently the case.

Visit to co-generation plant

The main part of the computerized control equipment delivered from Sweden is installed in the co-generation plant. This was completed in 1997, and according to the company its operation is today satisfactory.

Visit to various sub-stations

According to the company all the imported equipment installed in the sub-stations are performing well and in general according to expectation. The company is specially content with the Alfa Laval heat exchangers - 41 were imported - which they find to be of very high quality.

Interestingly enough the same heat exchangers could just a few years later be purchased from the newly established Alfa Laval joint venture in Shanghai.

Foaming machine

The foaming machine has not been functioning properly. At present it is out of order and the company lacks spare parts to put it in operation. (?)

Findings: The prefabricated pipes, the computerized control equipment, as well as the various kinds of equipment for the sub-stations, have all been successfully installed, and according to the company, are today operating well and according to expectation. The company is specially content with the Alfa Laval heat exchangers - 41 were imported - which they find to be of very high quality.
The foaming machine has not been functioning properly. At present it is out of order and the company lacks spare parts to put it in operation.

Training

The company is quite satisfied with the results of the training carried out and claims that the results meet the company´s expectations. As for the company´s capability today of handling the system they feel they have a good command of the whole system and feel they are able to operate it with out any problems.

In its appraisal of this project BITS suggested that the training and supervision part of the contract should be enlarged considerably. The training should focus on practical training for the technicians and managers directly involved in the project.

Maintenance

It is also satisfied with the follow up and maintenance inputs provided by the Swedish supplier. In some instances Powerpipe had replaced and repaired equipment free of charge. In general the company also feels that it has good cooperation with the supplier Powerpipe.

Finding: The company is quite satisfied with the results of the training carried out and claims that the results meet the company´s expectations. They feel they have a good command of the whole system and feel that they are able to operate it without any problems. The company is also satisfied with the follow up and maintenance provided by the Swedish supplier. In general the company also feels that it has good cooperation with the supplier Powerpipe

Local production or imports

Some of the equipment that was purchased from Sweden can today also be bought on the local market, often manufactured by various foreign joint ventures. A case in point is the Alfa-Laval joint venture in Shanghai which produces virtually the same heat exchangers that JDH imported from Sweden.

Another example is in near-by Harbin where there is a plant producing pipes of comparable quality as the Swedish pipes.

In the opinion of the some of the company´s senior engineers, that I interviewed, virtually all of the equipment, even the computer control equipment, could have been purchased locally - both the hard and software. Possibly in 1995 the computer control systems would have been of lesser quality but this is no longer necessarily true today.

Further discussions in more detail revealed, however, that there are definite differences between the Swedish and Chinese equipment, not only in terms of quality and durability, but also in function. One example would be that the Swedish pipes have a computerized alarm installed, which warns against leakages. One engineer thought that this could also have been supplied by a Chinese company, but it is not known at what cost. Also, regarding the heat exchangers, the rubber gaskets in the Swedish ones are perceived to be far superior in quality.

Most of the people interviewed in the Jiamusi district heating company seemed to be convinced that the main, if not the only, reason that the company had imported the equipment from Sweden instead of buying it from the local market was that the company could not raise finance in the local Chinese market. "We could not find a local credit (at a reasonable cost); then the Government informed us about the availability of a Swedish concessionary credit covering 85 % of our imports on condition that 70 % of the goods were purchased in Sweden."

In summary one may perhaps conclude that the reason for choosing the Swedish equipment was twofold:

- quality and price were competitive
- Sweden offered the best credit

Finding: Some of the equipment that was purchased from Sweden can today be bought on the local market, often manufactured by various foreign joint ventures. A case in point is the Alfa-Laval joint venture in Shanghai which produces virtually the same heat exchangers that JDH imported from Sweden.
Most of the people interviewed in the Jiamusi district heating company seemed to be convinced that the main, if not the only, reason that the company had imported the equipment from Sweden instead of buying it from the local market was that the company could not raise finance in the local Chinese market. However they are also clearly aware of the quality difference. In summary, one may perhaps conclude that the reason for choosing the Swedish equipment was twofold: 1. quality and price were competitive.
2. Sweden offered the best credit

Demonstration effect

Even if a possible demonstration effect emanating from the district heating projects could not be credited by having influenced Alfa Laval´s decision to produce in China, it is entirely possible that its future success at least to some measure will depend on the successful completion if the Sida-financed DH projects, among them the one in Jiamusi.

Finding: Even if a possible demonstration effect emanating from the district heating projects could not be credited by having influenced Alfa Laval´s decision to produce in China, it is entirely possible that its future success at least to some measure will depend on the successful completion if the Sida-financed DH projects, among them the one in Jiamusi.

6. Effects

The effects expected from this project are
- savings of coal consumption
- environment
- better living standard through greater access to heating for the city´s inhabitants
- increased technical life of the entire system
- transfer of knowledge in the field district heating

Since the project is not yet finished, very few of these effects have yet started to manifest themselves. There is however nothing at present which would indicate that the effects as planned would not be forthcoming once the project is completed.

Finding: Since the project is not yet finished, very few of the expected - highly beneficial - effects have yet started to manifest themselves. There is however nothing at present which would indicate that the effects as planned would not be forthcoming once the project is completed.

6.1 Financial profitability

The project consists of both an upgrading and an extension of the previously existing system, and is implemented in parallel to the construction of a co-generation plant which will be the new heating source to replace many scattered individual boilers. In that situation it is can be quite difficult to determine exactly what revenues and what operating costs that should rightfully be allocated to the project.

The Jiamusi district heating company as end user of the credit, receives the whole the grant element, and thus pays back to the bank of China the same amount as the Bank pays to Sweden.

BITS ´ appraisal

Assuming a concessionary credit to be available for foreign imports, the BITS appraisal estimated the *Financial Internal Rate of Return, FIRR,* to be 8,3 % when calculated over a 15 year operation period. The net cash flow of the project would become positive from the first year. This, according to BITS, was not sufficient to make the project commercially viable, in the sense that it could bear financing on commercial terms.

According to the company´s own estimation this project would have been profitable even if the company had not received a concessionary credit with a 35 % grant element. In my opinion, however, this can only be true if they refer to the *economic* profitability, not the financial one,

Project risks

The largest risks of the project was that the tariff raise envisaged by the government would not be implemented by the authorities. If such a raise did not materialize the FIRR would turn negative, and the project´s cash flow would remain negative for ten years even in the case of a concessionary credit being available to the project.

Another important risk was that the new cogeneration plant being built would not be completed on time which would prevent the network, and thus future revenues for the company, to grow. As we know today this has now become a reality.

Financial outcome

We have no access to relevant figures to calculate a revise ex post financial rate of return, but just by general reasoning we can easily see that the one-year delay, which now seems likely, is quite enough to upset the rates of return arrived at before the project.

Finding: We have no access to relevant figures to calculate a revise ex post financial rate of return, but just by general reasoning we can easily see that the one-year delay, which now seems likely, is quite enough to upset the rates of return arrived at before the project.

Corporatization and/ or privatization

The Jiamusi District Heating Company belongs to the state, not the municipality, and according to one report, the company belongs to a group slated for corporatization in a period of 2-3 years. It seems that the company´s management today does not have a clear concept of why the company might become more efficient after a corporatization n has been carried out.

According to information received by the management, district heating is not classified among the activities in China which will eventually be handed over for privatization - ever.

Apart from the fact that the company is a profit center of its own, so far it would seem that the company has not undergone any major reforms or structural changes.

7. IMPACTS: ATTAINMENT OF LONG-RUN OBJECTIVES

The total picture regarding savings in energy as well as reductions in pollution levels resulting from this project can be seen in the following table.

Table 24: Saving in energy use and reductions in pollution levels: Swedish-financed part of Jiamusi DH-projects. Figures within parentheses refer to the whole projects.

Type of effect	Thousand Tons per year
Consumption of coal by boilers:	
- Savings in coal used by scrapped boilers	146 (385)
+ Added coal consumed by central boilers	89 (235)
- Net savings	57 (150)
Emissions of dust particles:	
- Reduction of particles emitted by scrapped boilers	12 (31)
+ Added emissions by central heat producing units	0,5 (1,2)
- Net reductions in emissions	11,5 (29,5)
Reductions in SO2 emissions	
- Reductions due to scrapped boilers	4,2 (11,2)
+ Added SO2 emissions from central boilers	0,3 (0,9)
- Net reductions of SO2 emissions	3,9 (10,3)
Reduced transportation needs of coal:	
- Reduced volume of transports, 1000s kms per year	98 (257)
- Reduced SO2 emissions due to less transports, kgs	290 (770)
- Reduced NOx emissions due to less transports, kgs	150 (385)

Source: Own compilations based on report 1995-03-30 by Fjärrvärmebyrån AB

In addition to the reductions brought about in emissions of dust, SO2, and NOx, there will also be reduced emissions of heavy metals, mercury, lead etc.

7.1 Economic benefits

The economic savings in coal, as well as the reductions in pollution emissions can be seen from the table above.

When the whole project is completed and the new co-generation plant has replaced the individual boilers, then, in a matter of 4-5 years, the annual reduction in coal consumption brought about by conversion to district heating would be of the order of magnitude of 40 to 50 ,000 tons. At an assumed coal price of 150 yuan this would be equivalent to about 70 MRMB per year. In addition there are the huge potential economic benefits ascribable to the dramatically reduced pollution levels.

The appraisals report commissioned by BITS does not give much information regarding the methods used and the assumptions made in calculating the project´s economic rate of return. The figure arrived at is 15,8 % as *Economic Internal rate of return. EIRR.*. It is not clear exactly what indirect and intangible non-quantifiable effects - if any - have been included in the analysis. But judging from the very similar appraisals carried out of the other DH projects financed by BITS, there are some important effects which have not been included. Several of them are however discussed by the appraisal even though they are not included in the calculations. The most important example is health effects, but there are also technical aspects such that a modern DH system operated by computerized control system can entail reduced water losses and also a longer physical life time of the equipment. Further, there are savings realized because of reduced transportation need of coal.

We can therefore conclude that the calculation carried out by BITS is a conservative one, and that a full inclusion of all economic effects, whether quantifiable or not, would yield a substantially higher rate of return. This contention is also supported by calculations carried out by the world bank in other DH projects. There they arrived at figures in the neighborhood of 40-50 % depending on assumptions made.

The BITS decision document makes a very big understatement when it says that the project can be deemed to have ”an acceptable” economic rate of return. Judging from the indications we have the economic benefits of this project are enormous, notwithstanding the delays in the project´s implementation.

Finding: The BITS decision document makes a very big understatement when it says that the project can be deemed to have ”an acceptable” economic rate of return. Judging from the indications we have the economic benefits of this project are enormous, notwithstanding the delays in the project´s implementation.

7.2 Environment

The dramatic reductions in environmental pollution expected to be achieved by this project were summarized in the table above.

As was also stated above the co-generation plant has not yet been opened and the local boilers used under the old system are still in operation. It therefore follows that none of the expected gains in environmental factors have yet materialized. The environmental improvements can only start happening only when the cogeneration plant is opened and the old local boilers converted to heat substations with heat exchangers and all other needed equipment to make the conversion from a direct system to an indirect one.

The environmental effects at the beginning of the project would only be marginal because during the first few years the new cogeneration plant would replace only the two boilers in Jinjiang and Tiexi respectively where the efficiency and cleaning effect is rather good. Only after another 4-5 years would the co-generation plant start to replace the many scattered individual smaller boilers. An it is in that stage where the coal savings would be of the order of 40,000 ton s a year and the reduction in dust emissions some 9,000 tons and SO2 reductions about 3,000 tons a year.

In its report the company says that its boiler houses are discharging less pollutants this year than last year, but given that the system has not really changed yet, it is difficult to attribute such an improvement to the project. Nor does not appear to be possible to distinguish the effect from the Swedish equipment from the rest of the investment undertaken by Chinese own funds.

Findings: The reductions in emissions of pollutants due to this project are expected to be dramatic. But the co-generation plant has not yet been opened and the old local boilers are still in operation. Therefore the environmental gains have not yet materialized other needed equipment to make the conversion from a direct system to an indirect one.

7.3 Equality/ Poverty orientation

7.4 Gender

A quarter of the labor force in the Jiamusi District Heating Company is reported to consist of women, while they only constitute 16 % of the professional and technical staff. The explanation given by the management for the relative smaller number of professional women, is that many women prefer not to work in activities that require its employees to work shifts.

8. BITS´s project preparation

In this as in deed all of the DH heating projects in China BITS has held a rather high profile when it comes to carrying out its own analysis and forming its own opinion of the project, and also to strongly suggest or recommend and even request the loan-takers compliance on various points.

As in some of the other projects BITS, also in this project, strongly urged the company to at least design the substations as to allow for future use of heat exchangers for domestic tap water supply, if they were not willing and able to include it already as part of the present project.

It also recommended strongly that the dimension of the jacket pipes be increased, and that not only straight pipes but also bends and T-pieces in the piping system should all be pre-insulated and be of the same standard, as this would be a much more economical solution than mixing pre-insulated parts with traditional pipe. Not only from the point of view of efficiency but also w w.r.t. to environmental effect and maintenance requirements.

BITS also emphatically emphasized that the company needed to increase the thickness of the insulation of the pipes. This piece of advice was also, impressively, backed up by solid economic arguments: if the insulation thickness were increased by 50 % or, in this case, 20 mm, then heat losses would be reduced by some 1,000 KW (?) for the relevant portions of piping. Translated in economic benefit this corresponds to a 7 % savings, which should then be compared to the extra cost of the thicker insulation which was calculated to about 3 %.
The outcome of this question was that the supplier promised the buyer that it would increase the insulation thickness without extra cost, in the event that BITS did not accept a lower dimension.

As in all the other DH-projects in China BITS, also in this project, argued in favor of the training and supervision components to be substantially increased.

In all important aspects it seems that the end-user actually heeded the advice forwarded by BITS. One document almost gave the impression that the enduser felt pressured to do so even in a point where he was not completely convinced of the correctness of the advice given.

Finding: In this, as in all of the DH heating projects in China, BITS has held a rather high profile when it comes to carrying out its own analysis and forming its own opinion of the project, and also to recommend or even request the loan-takers compliance on various points. In all important aspects it seems that the end-user actually heeded the advice forwarded by BITS

9. Reporting requirement

Like all its colleagues from the other district heating projects *Powerpipe* has not fulfilled its contractual obligation towards BITS to send a report on the implementation after the project´s completion, nor has the Jiamusi District Heating Company.

VII DISTRICT HEATING IN FUSHUN

1. The Project

The city of Fushun, is an industrial city with extensive heavy industry such as metallurgy, petroleum, petrochemicals as well as machinery. It is economically expansive and has today 1,5 million inhabitants.

The city today attracts a lot of new investment. At present there are 400 planned foreign investment, of which 190 have materialized so far in actual investments. The city government is planning many investments to modernize infrastructure, including to modernize the heating system. There are also plans to build a new power generator.

The DH-system

The Fushun Heat and Power Company, owned by the city government, was started already in the 1950, but operates on a larger scale since 1983. It has today a staff of 1,515 of which 272 are at managerial level and 103 technicians.
In the beginning of the 1980s there were in the city some 1,630 boilers for heat production located in a total of 960 boiler stations, most of them with very low efficiency and high emissions of pollutants.

There are three independent district heating networks operated in the city with no interconnection between them. One of them is the *Middle area DH system,* which encompasses the present project. The Middle area services an area of 42 sqkm and has 600,00 inhabitants. The total building area is 10,1 million sqm, of which less than half was under District heating at the start of the present project.

Heat is today produced in two plants with a total capacity of 406 MW.
In addition to this, new capacity of 210 MW was added in 1995.
Before the project there was the traditional direct system which means that the customers are connected directly without heat exchangers, which limits the water temperature to 65/45 degrees in the supply and return pipes respectively.

The low temperature limits the capacity so the system is not able to accommodate new customers. The demand for heat is very large at present, and in the absence of a DH being developed many small scattered boilers would have to be taken into operations. To meet the new demand for heating the Fushun government therefore decided to

- increase the supply of heat
- increase the heat transfer capacity in the existing DH system
- expand the distribution network both within the existing system and in new areas.

The project

The project is defined as:

- to increase the capacity of the existing DH distribution network by raising the water temperature and converting the system from direct to indirect connection through the introduction of heat exchangers, and
- to expand the existing DH network with an additional 660,000 sqm of heated building area.

With the new pipes installed under the present project it would be possible to increase supply temperature to 110 degrees and return up to 60, which would raise the effective thermal capacity of the distribution system with by %.

Such an increase in temperature would, however, also require installation of heat exchangers in all the 118 existing customer substations, thereby making the transition from a direct system to a indirect DH system. These measures would make it possible to connect another 4,5 million sqm heated building space to the system, up from the present 2,55 million sqm.

There is a mistake in the BITS decision memo (page 10) when it says that the project will replace existing boilers houses. The new system will not replace or abolish any boiler houses but through the savings in energy and heat realized through the project, the city can expand the district heating network into new areas without having to build additional boiler houses.

Through the project all existing substations would be equipped with

- heat exchangers
- circulating pumps
- expansion vessel and pressure holding systems
- regulating valves and other control equipments

All of this equipment was to be imported from Sweden.

The total list of equipment imported from Sweden is the following:

- heat exchangers
- circulation and make-up water pumps
- control and closing valves
- pre-insulated pipes with fittings and accessories
- couplings
- foaming machine
- frequency converters
- Computerized monitoring and control systems

- filters
- spare parts
- training
- supervision

In terms of training there was a study visit to Sweden for 10 persons during 3 weeks, training in Sweden for 6 persons during 2 weeks, and training in China for 5 weeks.

Technical control and instruction/supervision during installation would be provided with a total of 20 man-weeks.
Spare parts were included at a sum of 800,000 SEK

In BITS appraisal the training, supervision and the amount of spare parts, included in the contract, were all deemed to be well balanced and adequate for the needs of the project.

Of the amount contracted to be imported from Sweden 1,5 was for consulting services, 2,2 for training and the rest - 36,3 MRMB - for equipment.

2. Logical framework and Goal hierarchy

The information on inputs and activities as well as the project´s expected outputs, effects and impacts can be organized in the following outline of logical framework schedule.

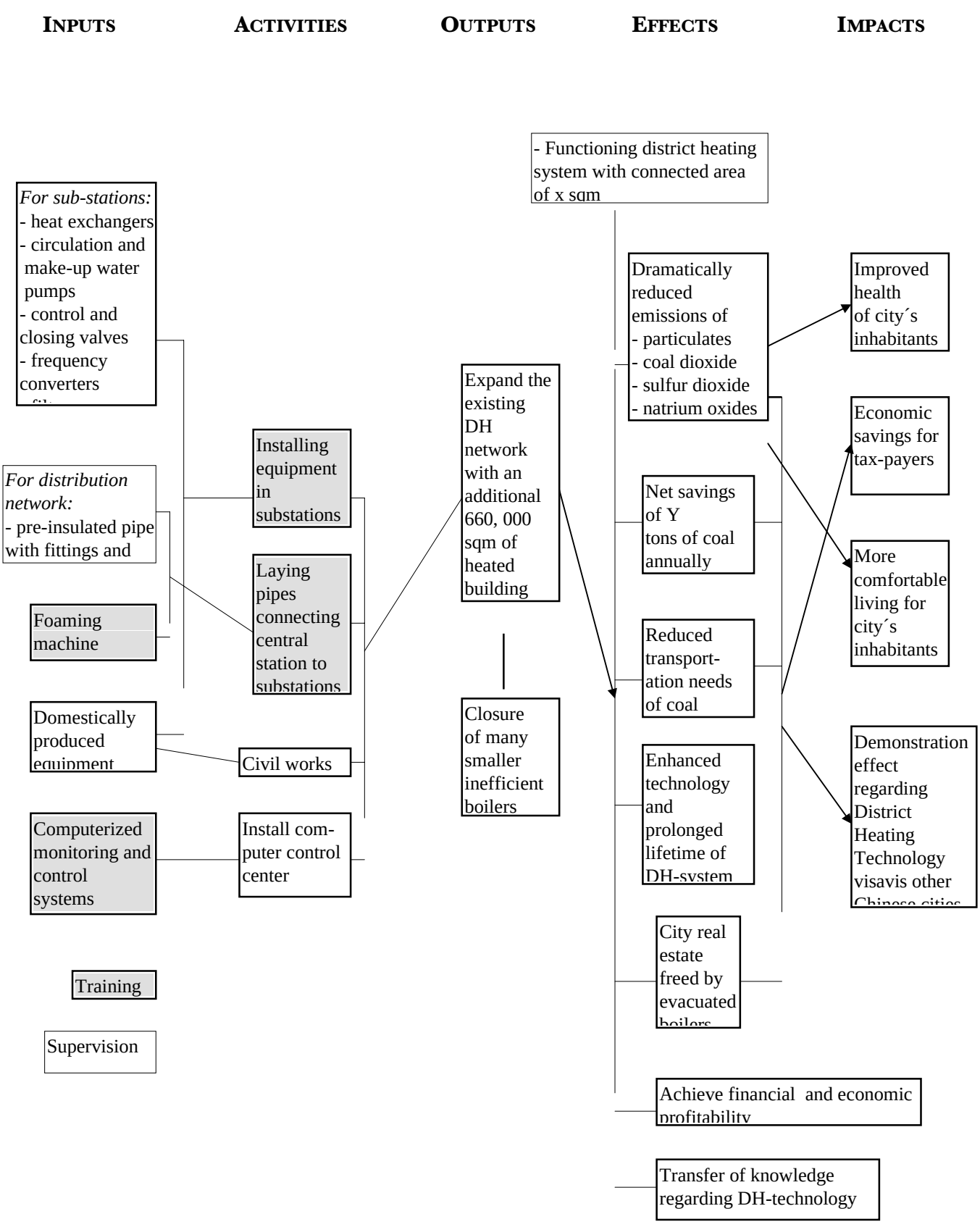
*Table 25: Outline of logical framework model of the **Fushun** District Heating project*

TARGETS AND OBJECTIVES AT DIFFERENT LEVELS	*ASSUMPTIONS MADE; RESTRICTIONS*	*Criteria for measurement; indicators*	*Achieved*
Inputs *(Equipment imported from Sweden)*			
For distribution network: - pre-insulated pipes with fittings and accessories - couplings	Credit intermediation of Bank of China to materialize		
For sub-stations: - heat exchangers - circulation and make-up water pumps - control and closing valves - frequency converters - filters			
Foaming machine			
Computerized monitoring and control systems			
Spare parts			
Training			
Supervision			

Other equipments, material and other inputs			
Activities			
Install equipment in sub-stations			
Install pipes			
Civil works			
Install computer control center			
Outputs			
Expand the existing DH network with an additional 660, 000 sqm of heated building area	Power plant serving new district heating system to be completed on time		
Effects			
- Functioning district heating system with connected area of x sqm			
- Net savings of x tons of coal annually			
- Reductions in emissions of pollutants SO2, CO, particulates			
- Reduced transportation needs of coal			
- Enhanced/Prolonged technical lifetime of DH system			
- Financially sustainable operation by DH-company	Envisaged heat tariff raise to be implemented		
- Transfer of knowledge regarding DH-technology			
Impacts			
- Improved health of city´s inhabitants			
- Economic savings for tax payers			
- more comfortable living for city´s inhabitants			
- Demonstration effect regarding District Heating Technology visavis other Chinese cities			

The *causal links* between the various factors of the logical framework table can be shown in a goal hierarchy model like in figure 7 on the next page.

*Figure 7: Goal Hierarchy of the **Fushun** District Heating project*



3. Negotiations; Procurement

Originally there were six to seven bidders, among them four Swedish companies - Alfa Laval, ÅF, Powerpipe and ABB. The Fushun district Heating Company (FHPC) had some previous experience with Alfa Laval´s Heat exchangers which had just been started to be produced in a plant in Southern China. In 1995 they purchased eight heat exchangers from Alfa Laval China in order to test. Then, in the project, they purchased another 100 of them.

The firms invited to give bids were *AF, Powerpipe, Alfa Laval* and *ABB*. All of the companies visited Fushun but none, in the client´s opinion, did a very detailed study of the needs. But all of them submitted complete offers. No other companies were invited to bid. FHPC got the information about these Swedish suppliers from the Chinese Building Heat Association in Beijing.

In preparation for the tender the company had compared technology from Sweden, Finland and USA and also some other countries and had found that the w Swedish one was the most suitable for their purposes.

Negotiations were held with ABB Fjärrvärme, Alfa Laval and Powerpipe, and the contract was awarded to ABB Fjärrvärme, which in this project acted as main contractor for the following four 4 subcontractors:

- *foam machine* from Finland.
- *automation control system* from Denmark,
- *pumps* from Italy, and
- *free currency converters* from Denmark

The main contractor also made use of the following Swedish sub-contractors: *Alfa Laval Industri, Alfa Laval Automation, ABB Drives, KMW* and *ESAB*.

The type of procurement applied in this project was by the Chinese authorities referred to as ”national competitive bidding between Swedish suppliers.”
FHPC took all the important decisions but contact with ABB signed by Agency in Beijing.

Also in this project the small company *Powerpipe* found reason to complain to BITS as well as to the Chinese government about unfair competition: *Firstly,* the company claimed that its competitor ABB had booked the end-user´s personnel into an expensive 4-star hotel at the time of negotiations in Beijing. *Secondly,* it complained that the Chinese institution responsible for the tender opening, INSTRIMPEX, had refused to apply a procedure with sealed offers and a simultaneous opening of the bids. In general they perceived that the tender procedure applied by the Chinese government discriminated against small bidders.

Sida has looked into these, as well as all other critique which has been directed at the procurement process, but found nothing that would constitute a serious breach against generally accepted rules of a competitive procurement system.

Finding: One of the Swedish bidders claimed that the tender procedure applied by the Chinese government discriminated against small bidders. Sida has looked into these, as well as all other critique which has been directed at the procurement process, but found nothing that would constitute a serious breach against generally accepted rules of a competitive procurement system.

4. Implementation

Delay of project

According to the original project schedule deliveries of the imported goods from Sweden would take place from December 1994 to May 1995, and the installations would be complete by November 1995, when the new co-generation plant was to start its operation. Instead installations started only in may 1996 and went on until October 1996. Commissioning, which according to plans would have been at the end of 1995, happened only in the end of 1997, i.e. two years later.

In the beginning the delay was caused by the Bank of China which hesitated to act as intermediary for this credit, as they had a suspicion regarding the solvency of FHPC and were afraid that they would loose their money. Earlier the Bank of China, as a state-owned bank, had to do what it was told by the Government to do. Today they themselves have to decide if a proposed credit is profitable for them and that it does not jeopardize their solvency. In this case the Bank had to convince itself that the project was realistic and profitable and that the FHPC company would be capable of repaying its loan. The Bank´s representatives came several times to Fushun to study the project and finally the Bank gave its approval to act as intermediary bank.

At a later stage there was, in the company´s opinion, also a delay caused by the shipping company retained by ABB.

Later the reason for the delay was mainly the pace of construction by the electricity company of its new power electricity plant, because the FHPC wanted to use heat water from the new boiler to be built. For that reason FHPC did not mind to postpone installation in the sub-stations somewhat.

The Bank of China signed the credit agreement in august 1996. The equipment arrived from Sweden from august 1996 to February 1997. Installation began in may 1997 and went on until late august 1997. On 4th of November, when the heating season officially started, the new system was put in operation on a test basis.

Finding: Overall, the delay in the project, as compared to original plans, is between one and two years depending on how one looks at it. The main reasons are: *At first,* the Bank of China hesitated to act as intermediary for this credit, as it had a suspicion regarding the solvency of FHPC. *Then,* there was, in the company´s opinion, a delay caused by the shipping company retained by ABB. *At a later stage* , the reason for the delay was mainly the pace of construction of the new power plant, whose boiler the FHPC wanted to use for heat water. Therefore FHPC did not mind to postpone installation in the sub stations somewhat

At present (May 1998) some 70% of the heating station equipment has been installed in 33 substations, i.e. filters, pumps, heat exchangers etc. Test runs began in February 1997. The rest will be installed by 1999. As for the pipes which are to be installed underground some 30 % have been installed to date. Some of the pipes delivered from Sweden will be installed in new areas, and the entire job is expected to be finished by 1999.

Overall, the delay in the project as compared to original plans is between one and two years depending on how one looks at it. In the company´s opinion, the delay of the project can be said to be only one year, not two, because when the Bank of China had signed with Nordbanken then it was already winter. Because it is not possible to cut the heating in the winter, the FHPC had to wait until the summer season started in order to start installation work.

Finding: At present about 70% of the heating station equipment has been installed in 33 substations. Test runs began in February 1997. The rest will be installed by 1999. As for the pipes which are to be installed underground some 30 % have been installed to date, and the entire job is expected to be finished by 1999.

Final acceptance certificate

On February 19, 1998 the end-user, FDHC, and the seller ABB together with the Chinese authority responsible for importing the equipment, signed a ”Final acceptance certificate” after the first test runs had been carried out. Attached to this document is a

memorandum which in 12 points specifies the remaining obligations w r t various problems that the seller undertakes to rectify.

According to the loan agreement the last day of utilization of the loan was 28 February. At that time almost 2 million SEK were left unutilized. In February 1998 Sida granted an extension of the credit period until June 30 1998.

Excessive insurance premium

The Company is very dissatisfied with the high cost of insurance fee for the EKN-guarantee - the premium payable being 1,41 MSEK. This is a cost item of which it was not made aware from the outset of the negotiations. Apparently there was a slip in information between the Chinese agency responsible for the negotiations and the Fushun district heating company. The company wishes that Sida would consider granting them a waiver for it.

According to the contract between Bank of China and Nordbanken FHPC had to pay an administrative fee of 1,413,437 SEK. Bank of China only asked for a service fee of 1 % for its services. this was paid only once - last year.

FHPC thinks that this fee to Nordbanken is excessive. One company representative told me: ”Only because we thought about the good relations between our two countries did we agree to pay this amount. otherwise we would have refused”.

Role of the communist party

Still today the communist party has a political secretary in each state company, who in many peoples opinion, has more power than the General manager. In FHPC this is a lady with economics and administration as educational background.

Many important decisions are made by this political secretary. There is a division of labour between the Manager and the political secretary, and the most important areas have shared responsibility.

According to one of the company officers that I interviewed, sometimes the political secretary respects the expert opinions of the company´s staff, sometimes not. But many bad decisions, which cost the company a lot of money, have been taken by the political secretary.

According to the Company´s Chief engineer, however, there are no cases where the Political secretary has had an opinion which differs from that of the management. In answer to my question if the political secretary sometimes would show more loyalty to the party than to the company, the Chief Engineer replied that ”the party has the same goals as the people”.

According to reports China´s new prime minister has promised that the system of political secretaries in all the companies will be dismounted.

Finding: Still today the communist party has a political secretary in each state company, who in many peoples opinion, has more power than the General manager. According to one of the company officers, sometimes the political secretary respects the expert opinions of the company´s staff, sometimes not. According to the Company´s Chief engineer, however, there are no cases where the Political secretary has had an opinion which differs from that of the management.

5. Results/outputs

Overall picture

Overall, two thirds of the equipment has been installed, and about 80% of the heat exchangers. Part of the Swedish equipment has also been test run. In the company´s opinion: "the tests have shown that the equipment generally runs very smoothly and efficiently." Overall the company characterizes the system installed as "sound and safe". It also however points out that there are existing problems, namely

- excessive noise level of pumps
- lack of spare parts for the frequency converters
- problems with the computerized monitoring system
- malfunctions in the foaming machine
- still inadequate training

The company´s Chief engineer says that "Generally speaking we are satisfied with the Swedish deliveries, but in the future we need to have spare parts for such parts which break easily. Does Sida have any funds to supply such spare parts?"

The company emphasizes the benefits created by the Swedish delivery:
"it changed our heating methods, the way we provide heat to the consumer;.....The Swedish technology is very advanced, more so than our own equipment in this field; Judging from the test tuns made we think that the equipment is very good;.....The output and the benefits of the system we think will be the ones as planned"

Regarding the remaining problems the company´s stance is the following:
"We hope that the problem with the excessive Nordbanken fee and that of the foam machine will be solved. With respect to the other problems mentioned above we if it turns out that we are wrong and that the delivery is normal, we will accept this."

In spite of the many rather serious points of criticism that were raised, some of which are presented below, the Company still insists that the cooperation with ABB is very good.

Finding: Two thirds of the equipment has been installed, and test run. In the company´s opinion the tests have shown that the equipment generally runs very smoothly and efficiently. It also however points out several problems, namely: noise level of pumps; lack of spare parts for the frequency converters; problems with the computerized monitoring system; malfunctions in the foaming machine; still inadequate training

Finding: The company emphasizes the benefits created by the Swedish delivery: *"it changed our heating methods, the way we provide heat to the consumer;.....The Swedish technology is very advanced, more so than our own equipment in this field; Judging from the test tuns made we think that the equipment is very good;.....The output and the benefits of the system we think will be the ones as planned"*

VISIT TO TWO SUB-STATIONS (In all there are 33 substations servicing a total area of 1,400,000 sq. metres)
I visited two substations located on the bottom floor in ordinary residential-cum-office buildings. The substations were installed in the autumn of 1997, opened for testing in November 1997 and have now been in service during one heating season. So far, according to the company only minor problems have been experienced. The sub-stations had a mix of Swedish and Chinese technology

Substation 1
The neighbors complain of the very high noise level from the **pumps**. There is also leakage in some of the pumps. The company has tried to isolate the pump room, but that only led to a slight improvement in noise level. At present there is no immediate, concrete solution in sight to the noise problem. They company has complained to ABB, which however claims that the noise level is normal.

Out of a total of 600 handles for valves, three have broken.

Further I saw three *currency converters, sensors* for temperature and pressure measurement, *filters,* and *valves* imported from Sweden, as well as *accumulators* for pumps, *water pre-treaters,* and a *switchboard* for electricity all made in China. All this equipment were functioning without any problems.

Substation 2:
The second sub-station I visited served an area of 80,000 sq. m. Among its equipment were 4 heat exchangers and 5 pumps imported from Sweden. All installed in the autumn of 1997 and operated for 4 months without any problems. However, there were complaints about the very high noise level of the Italian made pumps (which were delivered by a sub-contractor to the Swedish supplier).

Previously this substation had had no heat exchangers. The hot water from the power plant was put directly into the district heating system, resulting in a big loss of heat. Nor were there any pumps, the pressure came from outside and could not be regulated. This was a very uneconomical system.

Heat exchangers
No problems have been reported regarding the Swedish heat exchangers. On the contrary, the company is quite satisfied with their performance.

However, in 1995 Alfa Laval started producing heat exchangers from it sown factory in Jingo Yin in the Jingo Su province in Southern China. FHPC had tested these heat exchangers manufactured in China and was quite satisfied with them, and, according to what they told me, if the Swedish credit had not been tied to Swedish goods they would have preferred to purchase the heat exchangers in China.

Finding: The company is quite satisfied with the performance of the Swedish heat exchangers. However, in 1995 Alfa Laval started producing heat exchangers from its own factory in Southern China. FHPC had tested these heat exchangers manufactured in China and was quite satisfied with them, and, if the Swedish credit had not been tied to Swedish goods, they would have preferred to purchase the heat exchangers in China.

Pumps[3]
Residents in the area of some of the sub-stations have complained about a very high sound level of the pumps. One company officer told me:
"The Swedish pumps were a disappointment. We thought that in Western countries, and notably Sweden, pumps would be very advanced w r t environmental conditions such as e g noise level, so we forgot to include this aspect among the points which needed to be specified in the contract. When we received the pumps we were really surprised at the noise."

[3] The name of these circulating pumps, manufactured in Italy according to the specification manual received by FHPC, is CP1 AC32-160.

So the Chinese delegation, visiting Sweden for the negotiations, assumed that the Swedish pumps would be environmental friendly and did not bother to negotiate the specifications of the pumps.

One wonders why ABB chose to offer noisy pumps. Had they not studied the conditions in Fushun and understood the needs of the client, notably that the pumps would be placed in residential buildings and not as probably in Sweden and Europe, in special pump houses removed from residential units? According to one company representative ABB did not visit any substation. When they came to FHPC they studied drawings but did not actually go to any substation.

If the situation is as described, it would seem to be rather unprofessional on the part of ABB not to carefully study the actual need of the customer, even though the fault in a formal sense no doubt lies with the client who was careless enough not to specify the desired characteristics of this particular equipment. However, this outcome must be seen as a failure and a problem for ABB at least as much as for the client FHPC, for ABB has in effect delivered a product which does not meet the requirements of the customer.

Of the total xx pumps delivered, 4 or 5 have broken.

Many seem to be of the opinion that pumps produced locally in China are not only cheaper but also more silent than the ones delivered by ABB.

Pipes

The insulation for four of the pipes, representing a total length of 40 metres, broke during the winter. According to the company they broke by themselves without anybody having touched them, so maybe the breakage was due to the big temperature contrast experienced in Fushun, from -30 in the winter to + 30 in the summer. ABB has promised to compensate by repaying a corresponding amount. Also some pipe connectors have broken.

After about 30 % of the pipes have been installed no problems have been found with the remaining pipes. All, except the above four, are satisfactory w.r.t. dimensions, insulation etc.

Foaming machine

Another headache is the foaming machine, delivered by ABB´s sub-contractor in Finland, which is used to insulate the pipes and externally also to insulate the connections. Earlier when the machine was working well the company could use it to insulate the whole pipes. After a very short usage the machine´s main compressor

broke down, and now it can not function in the winter, and it can only be used to insulate the connections. The Finnish company has promised to repair it.
In the contract had been included about 400,000 SEK in spare parts for the foaming machine.

Automation system in control station

Another problem is the automation system in the control station. Generally speaking the company finds the system to be satisfactory, but feels that it needs more training on how to operate it. ABB has been here and carried out the training as specified per contract, but our workers still have problems operating the system. ABB has said that they will assist by sending new programs or instructions over e-mail, and, according to the company, also promised that "if FHPC has a problem in the future they will never take their hand away from FHPC".

Flow meter

The flow metre is not working well. It cannot show accumulated flows, as sometimes the meter goes back to zero. This is something the company realized only after the memorandum of test run was sent away. Now it constitutes an important problem, for without the meter it is not possible to see if, and how much energy is saved by the new system.

Free currency converters

The free currency converters do not function well, because the connection of the key board to the inside is very complicated.

Substation PRC computer

Substation PRC computer has a small part which breaks easily. When it does we are not able to fix it because there are no locally available spare parts.

LOCAL MANUFACTURE

Most of the equipment imported from Sweden could in principle have been bought locally from the Chinese market, but generally one must assume that the local quality is substantially lower.
Some of the items however, e.g. *free currency converters,* are not manufactured in China.

The question weather or not they had chosen Swedish equipment even if the credit had been untied had to be asked very many times and in different disguised forms in order to get a clear answer. I am still not sure, but it would seem to most likely that they had indeed purchased differently had they received an untied credit instead.

The price difference between Alfa Laval exchangers locally produced and imported from Sweden was reported to be merely 15 %, but this figure could not be confirmed.
The eight units purchased locally FHPC got at a promotional price.

There are in China today about 10 cities that have a modern heating system on par with Fushun: They are Jiamusi, Mudanjang, ChangChun. Harbin, Shenyang, Tangshan, Taiyuan, Shijiazhuang, Shibezi, Fushun and Dalian.

Mudanjang has used Finnish technology, Shibei equipment from ABB. bought commercially. The rest have used either Swedish of Chinese technology. How do the cities which have used domestic technology compare with the others? Some parts may not be so good, e g the heat exchangers but others element are probably almost as good, e g the control systems.

Transfer of knowledge

One company officer emphasized that the transfer of knowledge and training is much higher with imported equipment as compared to domestic. Especially when one buys a whole system ready planned including both hard and software.

Conclusion regarding local manufacture

The contention made in the BITS decision document that the equipment to be imported from Sweden could not be found at sufficient quality in China, in general still holds true, but probably to a considerably lesser extent today than when the decision was made in 1995. As for pumps, there are many observers who claim that you can buy pumps just as good - and with less noise - in China at a much lesser price. According to these persons, also some valves can be found in china. It is however recognized widely that the life span or technical durability of the Chinese equipment is considerably shorter than for Swedish goods.

Finding: Most of the equipment imported from Sweden could have been bought locally from the Chinese market, but generally one must assume that the local quality is substantially lower. Nevertheless it would seem likely that if the company had received an untied credit it would have purchased differently.

There are in China today about 10 cities that have a modern district heating system - half of them relying, apparently successfully, on Chinese technology.

6. Effects

The main effects expected from the introduction of district heating into the *Middle Area* are the following:

- a considerable energy conservation because of the coal that is saved when one large, highly efficient boiler replaces a multitude of stoves and small, inefficient boilers
- supply of heat to the city´s inhabitants
- increased possibility for future expansion
- reduced need of make-up water due to installation of heat exchangers. The control of water will decrease corrosion inside the pipes, which will lead to longer network technical lifetime
- installation of control valves at the substations will make it easier to balance the system and give better temperature control

Overall it was estimated that the savings in present fuel consumption would be about 30 %. Due to the project expansions planned for 1995/96 the savings in coal consumption would be about 55,000 tons per year and with the expansion planned until year 2000 the savings would be about 275,000 tons annually.

Finding: The main effects of the project are:
- a considerable energy conservation because of the coal that is saved when one large, highly efficient boiler replaces a multitude of stoves and small, inefficient boilers
- supply of heat to the city´s inhabitants
- increased possibility for future expansion
- reduced need of make-up water due to installation of heat exchangers
- control of water will decrease corrosion inside the pipes, which will lead to longer network technical lifetime
- installation of control valves at the substations will make it easier to balance the system and give better temperature control.

6.1 Financial profitability

Tariffs and taxes

Heating tariffs are today not varied for different consumer groups, only for different categories of buildings, and with respect to such properties such as which floor of the building the consumer has.

For the future the city government of Fushun is contemplating the introduction of differentiated tariffs w r t to different consumer groups such as firms, households etc., and also differentiate between state and private firms. At present a group from the city Government is studying the question of future heating tariffs. For gas, water and electricity there has already been such a differentiated tariff for 20 years.

The annual heating charge for the customer is 24 yuan per sqm per year. The charge is the same for all user categories

The company is allowed to keep the profit after they have paid four different taxes: income tax, development tax, commercial tax and city construction tax.
Tariffs are set by the local government

BITS´ appraisal

The appraisal commissioned by BITS calculated the financial rate of return for two cases: (1) assuming 100 % loan financing, and (2) with planned substantial subsidized local financing as well as concessionary financing for the equipment to be imported. The terms for concessionary credits are 10 year maturity, 7,5 years repayment period, 2,5 years grace period and 0 % interest. The terms used to calculate the commercial loan alternative was: 10 years maturity, first repayment 0, 5 years after the commissioning and an interest rate for USD of 7,6 %.

FHPC gets the whole grant element, amounting to about 35%, contained in the Swedish concessionary loan. It pays to the Bank of China the same as the Bank pays back to the Swedish govt. total 4,8 million USD credit amount. repayment begins in 2000 and ends in 2007. Interest rate i 0, repayment in 12 years and grace 5 years

In the commercial case the net cash flow was found to be negative for the first 7 years and the accumulated net cash flow remaining negative for the entire period, 15 years. The financial internal rate of return, FIRR, arrived at was about 8 %, later revised down to 7,2 %.

Sensitivity analysis

An increase of 10 % in the investment cost would cause the FIRR to go down to 6,6 %, later revised down to 5,8%. A 10 % increase in both revenues and operational cost would make the net cash flow negative till the 6th year , and produce a FIRR of 8,6%, while a 10 % increase in operational cost only, would make both the current and the accumulated net cash flows negative for the entire project life, and the FIRR would become -1,6 %. A 10 % rise in revenues only would make the FIRR 14,8 %

In general BITS saw the financial risk of the project as rather small mainly due to the fact that Fushun city had guaranteed that local financing for the project´s needs would be made available from the city´s reserve funds for investment and buildings.
A major risk factor was however seen to be that the amount of new customers connected would not grow as fast as planned.

In the case of subsidized loans, however, the net cash flow of the project becomes positive from the first year of operation.

Based on the analysis Sida concluded that it would not be possible to finance the project on commercial terms. Heating tariffs had already been raised substantially in the last years and the generally low income levels of Fushun makes it hard to undertake additional tariff increases.

OECD consultation

When the project was notified to the OECD, UK requested more information and BITS produced an *Aid quality Assessment* to be submitted to the OECD.
BITS there argued that

"the basis for the assessment of the financial viability....is the project´s capacity , with *appropriate pricing* (italics added) to generate cash-flow sufficient to cover the project´s operating costs and to service the capital employed"

On the basis of that report the UK withdrew its objections but noted the following:
"The UK does not accept the principle of "basic goods" being subsidized to all customers. Goods and services should be priced in accordance with the costs of their provision. Any subsidies should be targeted at vulnerable groups as necessary."

On the other hand the UK stated that

"we note the argumentation for commercial non-viability in this case is based on environmental concerns. Charges are set to encourage consumers to use the centralized supply rather than less energy-efficient and more environmentally damaging private boilers."

The very interesting and important question of what is an *appropriate* price was not pursued further and still eludes a final, or authoritative, answer.

It should be pointed out that the financial analysis is mainly of interest to determine that the OECD Helsinki accord rules are being followed, and to make a concessionary credit legitimate. Its main function is thus to serve as a decision basis for deciding eligibility according to the Helsinki rules.

In an ex post evaluation the analysis of financial rate of return for a state firm operating in a regulated economy can at best have only a marginal interest, as the rules of the game can be changed at any moment by a mere administrative or political decision on part of the government. In such an environment, the financial rate of return, being of course a function of the existing rules regarding taxes, subsidies etc., becomes unreliable as a measure of the strength and quality of a company´s operation. In such a project one should be more concerned with the economic analysis of the project.

Financial profitability

District heating is mainly a seasonal industry concentrated to the winter months when heating is needed. With the expanded use of air conditioners this unevenness will be progressively reduced, as the DH-system can also be used to deliver cold just as well as heat. In the meantime FHPC´s workers in the summer carry out maintenance work in the substations as well as in the reception rooms served by FHPC. These are also the responsibility of FHPC to maintain.

According to a report received from the company at the time of my visit the company has 170 MRMB worth of fixed assets. The company´s total heating area has reached 6,01 million sqm and the sales income is 137 million RMB. Cost of raw materials is 95 MRMB, labour 15, tax 8,8 MRMB. Depreciation charges are 17,66 million leaving a net profit of 0,44 MRMB.

No data are available to try to calculate the ex post financial profitability of the project. But even without data it is clear that due to the current two-year delay in the implementation of the project, there is no way that the financial target can be met.

Conclusion: No data are available to try to calculate the ex post financial profitability of the project. But even without data it is clear that due to the current two-year delay in the implementation of the project, there is no way that the financial target can be met.

7. IMPACTS: ATTAINMENT OF LONG-RUN OBJECTIVES

The total picture regarding savings in energy as well as reductions in pollution levels for Fushun can be seen in the following table.

Table 26: Saving in energy use and reductions in pollution levels: Fushun DH-project.. Figures within parentheses refer to the whole projects.

Type of effect	*Thousand Tons per year*	
Consumption of coal by boilers:		
- Savings in coal used by scrapped boilers	178	(881)
+ Added coal consumed by central boilers	122	(606)
- Net savings	56	(275)
Emissions of dust particles:		
- Reduction of particles emitted by scrapped boilers	11	(55)
+ Added emissions by central heat producing units	1,5	(8)
- Net reductions in emissions	9,5	(47)
Reductions in SO2 emissions		
- Reductions due to scrapped boilers	2,4	(11,9)
+ Added SO2 emissions from central boilers	0,2	(1,1)
- Net reductions of SO2 emissions	2,2	(10,8)
Reduced transportation needs of coal:		
- Reduced volume of transports, 1000s kms per year	119	(587)
- Reduced SO2 emissions due to less transports, kgs	360	(1,760)
- Reduced NOx emissions due to less transports, kgs	180	(880)

Source: Own compilations based on report 1995-03-30 by Fjärrvärmebyrån AB

In addition to the reductions brought about in emissions of dust, SO2, and NOx, there will also be reduced emissions of heavy metals, mercury, lead etc.

7.1 Economic benefits

The appraisals report commissioned by BITS does not give much information regarding the methods used and the assumptions made in calculating the project´s economic rate of return. The figure arrived at is 15,8 % as *Economic Internal rate of return. EIRR.*. It is not clear exactly what indirect and intangible non-quantifiable effects - if any - have been included in the analysis. But judging from the very similar appraisals carried out of the other DH projects financed by BITS, there are some important effects which have not been included. Several of them are however discussed by the appraisal even though they are not included in the calculations. The most important example is health effects, but there are also technical aspects such that a modern DH system operated by computerized control system can entail reduced water losses and also a longer physical life time of the equipment. Further, there are savings realized because of reduced transportation need of coal.

We can therefore conclude that the calculation carried out by BITS is a conservative one, and that a full inclusion of all economic effects, whether quantifiable or not, would yield a substantially higher rate of return. This contention is also supported by calculations carried out by the world bank in other DH projects. There they arrived at figures in the neighborhood of 40-50 % depending on assumptions made.

Finding: There are important effects, e.g. on health, which have not been included in the economic analysis carried out at the appraisal. A full inclusion of all economic effects, whether quantifiable or not, would yield a very high economic rate of return

7.2 Environment

The dramatic reductions in environmental pollution expected to be achieved by expanding district heating in Fushun were summarized in the table above.

In the last 20 years there has been a tremendous improvement in air quality in Fushun, mainly due to two factors: the introduction of district heating , and that households have switched from coal to gas for their cooking needs. In spite of that

however, air pollution in Fushun is today still worse than the average Chinese city, mainly due to the existence of large scale industry. So, there is still a long way to go even though the Government has already done a lot

The various effects as they occur over time - as given in the appraisal - are summarized in the following table:

Table 27: Fushun District heating project - environmental effects; thousand tons per year

	1994	1996	1998	2000
Heated area; million sqm	4,3	6,8	9,7	12,6
Savings in coal consumption	93	159	212	275
Reduction in SO2 emissions	2,1	3,4	4,8	6.2
Reduction in particulate emissions	16	26	37	47

In the table we can see that , as the connected area grows from today's 4,2 million sqm to 12,6 in year 2000, the annual savings in coal consumption, through the replacement of small scattered boilers with one large heat production plant, will grow from 93,000 tons a year to an estimated 275,000 tons .

Corresponding to the lesser coal consumption, the annual reduction in emissions of SO2 will grow from 2117 tons to 6,238 tons, and of particulate emission from 16,100 tons to 47,500 tons.

In addition to these savings there will be less need for transport of coal. If the planned schedule of district heating expansion is followed, then in the year 2000 the number of 20 tons coal truck loads needed to supply scattered boilers inside the city with coal will go down by 44,000 annually, and be replaced by about 20,000 thirty-ton truck loads going to the power plant.

Finding: There is no doubt that the benefits to the environment as well as to Peoples´ healths will be dramatic when the project is completed.

7.3 Equality/ Poverty orientation

No specific analysis of the project´s social or distributional effects have been carried out, as the project is not seen as especially favoring any particular group in society. It is assumed that it will uniformly benefit all the inhabitants of the city.

It could be conceivable that on average a smaller proportion of poorer groups live in buildings that are possible to connect to district heating than richer groups. If this were the case we could then claim that the introduction of district heating is a project which is biased against the interest of the poorer groups, just as we can claim that introducing district heating in the cities will favour (richer) city inhabitants at the expense of the(poorer) country dwellers.

There is however no available evidence that this would be the case in China. And in any case, according to the objective of equality as formulated in Sweden´s aid policy, the project is justified as long as is not producing harmful effects to other groups.

Finding: The project is not seen as especially favoring any particular group in society. It is assumed that it will uniformly benefit all the inhabitants of the city. It is however conceivable that on average a smaller proportion of poorer groups live in buildings that are possible to connect to district heating than richer groups. If this were the case we could then claim that the introduction of district heating is a project which is biased against the interest of the poorer groups, just as we can claim that introducing district heating in the cities will favour (richer) city inhabitants at the expense of the(poorer) country dwellers.

7.4 Gender

This project is not judged to have any special gender bias in it effects.
As for employment generated by the project we have the following:

Of the total 1800 employees 1/3 are women. Administrative staff is 18 % of total employmnet, while 8 % are technical staff. Women make up about 30 % also of these two categories.

Of the top level 8 officers only one is a women, but that happens to be the political secretary who is the most powerful of all.

In Fushun women are granted leave-of-absence for childbirth with full pay during one week before and 3 months after birth, altogether 100 days. After that children are minded by grandparents or placed in kindergartens which are free of charge. The Chinese social security system also gives the father a certain possibility to stay home with the children, provided he has paid an insurance fee.

7.5 Democratization

There does not appear to be any particular effect w.r.t. democratization, neither direct nor indirect, emanating form this project.

7.6 Independence

There does not appear to be any particular effect w.r.t. to the country´s independence, neither direct nor indirect, emanating form this project.

Finding: This project is not judged to have any special gender bias in it effects. Nor does there appear to be any particular effect w.r.t. *democratization* or *independence,* neither direct nor indirect, emanating form this project.

8. BITS´s project preparation

As in the other district heating projects evaluated in this report BITS was quite active in analyzing the project, and also active in offering recommendations to the end-user on the solutions favored by BITS.

For example it advised the company to design the substations so as to allow for future use of heat exchangers for domestic hot water, as this solution would turn out to be very economic in the future. It also recommended the company to increase the share of supervision in the contract as experience showed this to be a crucial factor of ensuring successful project implementation.

Further, BITS suggested that also the *bends* and *branches* and *fittings* for the preinsulated pipes should be imported, as this would optimize the entire piping system. This can be seen as a sensitive issue because BITS motives could be misconstrued as a wish to favour Swedish export industry. The impression one gets from documents and from interviews, however, is that BITS is guided by a genuine interest to see a successful project.

Finding: As in the other district heating projects evaluated in this report BITS was quite active in analyzing the project, and also active in offering recommendations to the end-user on the solutions favored by BITS.

9. Reporting requirement

Like in the other four projects none of the contracting parties - neither the seller nor the buyer - have complied with their contractual obligation to provide BITS with a completion report six months after commissioning of the project.

Finding: Like in the other four projects none of the contracting parties - neither the seller nor the buyer - have complied with their contractual obligation to provide BITS with a completion report six months after commissioning of the project.

VIII SUMMARY OF FINDINGS AND CONCLUSIONS

A. *Summary of each of the five projects individually*
B. *General conclusions regarding various aspects*

It is to be noted that, apart from summarizing the findings presented in chapters III-VII above, this summary chapter also raises other issues, which are common to all five projects, and which have not previously been discussed.

A. SUMMARY OF EACH OF THE FIVE PROJECTS INDIVIDUALLY

Dalian

Procurement
Several claims were made by the bidding Swedish companies that sound procurement rules had been violated, but none of the alleged faults seem to have been of a serious nature.

Output
Even though an *Acception Report* signed in April 1997, states that *"the equipment has been delivered; quantities and quality are in accordance with the contract; ...and already proved (to be of) advanced technology and reliable quality",* there is today discontent, at least among some of the client´s engineers, about some of the Swedish equipment and its functioning.

The company today experiences the following problems:
- plastic buoys of the magnetic fluviograph attached to the heat exchangers are not functioning
- oil gauge of the water circulation pump is leaking
- the pumps vibrate and shake and make too much noise
- the training of the Chinese technicians in Sweden did not get the effects expected, as they are not able to independently take responsibility for maintenance and commission
- lack of various spare parts for parts that break or wear down quickly

A general problem w.r.t. all the Swedish equipment is an acute lack of original spare parts. This is not surprising for it is clear that management preferred to use the available credit funds for hardware at the expense of spare parts.

There are indications that the amount of *training and supervision* in the contract was insufficient. There was a temptation for the company to use money, potentially destined for training and supervision purposes, for importing additional equipment instead. Today it would seem that many in the company wish that more training and supervision had been included.

Even though the Chinese end-user believes that the quality of Chinese equipment is not yet good enough to compete with imported Swedish equipment, it is freely admitted that an important reason for buying the Swedish equipment was that the company was offered a Swedish concessionary credit.

There are today many district heating companies investing in exclusively Chinese equipment instead of imported. Regarding some equipment this is probably a rational choice, but regarding some other equipment one must consider the fact that if these companies were completely autonomous w..r.t. *long run profits and losses* perhaps they would be more quality oriented - and willing to pay a higher price for higher quality, knowing that this strategy would in the end turn out to be the most economic one.

Financial
Although it was not possible to have access to financial data which permit calculation of ex post profitability, it is entirely clear that financial targets in this project can not have been met. This is because the project is experiencing a two year delay, and also that an expected tariff change still has not materialized.

The financial deficit in heat delivery can today be compensated by profits realized in electricity sales which is the company´s other branch of business.

The financial analysis is important for deciding if a project can be financed in the commercial market, or if it needs subsidies by way of e. g. domestic or foreign concessionary credits. But in doing the financial analysis one must keep in mind that the outcome of the analysis can at any moment be changed simply by the government making a political or administrative decision which changes a tax, a subsidy or modifies a tariff which is not set according to supply and demand.

Economic
The economic savings to society because of this district heating project are very large as are the beneficial effects on environment. An inclusion of health factors in the economic analysis would increase economic profitability considerably over the already high level found in the appraisal study. Leaving aside all discussion of appropriate methodology of calculating the economic rate of return it is clear that the project is very profitable from an economic point of view. In similar projects the World Bank has calculated the economic rate of return to be in the range of 40-90 %.

Environment
Because the project is experiencing a considerable delay, most of the environmental effects have not yet materialized. This however does not change the fact that the environmental benefits of this project - which will manifest themselves as implementation progresses - are enormous.

Equality/ Poverty orientation
The project is not seen as especially favoring any particular group in society. It is assumed that it will uniformly benefit all the inhabitants of the city.

Some people will argue that poorer groups gain relatively more from an improved environment than do other groups. On the other hand it is conceivable that on average a smaller proportion of poorer groups live in buildings that are possible to connect to district heating than richer groups. If this were the case we could then claim that the introduction of district heating is a project which is biased against the interest of the poorer groups, just as we can claim that introducing district heating in the cities will favour (richer) city inhabitants at the expense of the(poorer) country dwellers.

Gender, Democracy and Independence
It does not appear possible to detect any particular effects, direct nor indirect, on *gender, democracy* or *independence* emanating form this project..

Demonstration effect
Because of several (minor) problems that have afflicted the project, but mainly because of the delay experienced it would be hard to claim that the objective of the project becoming a demonstration project has been attained. But perhaps it is not too late yet.

BITS
BITS has, in this as well as in the other district heating projects financed in China, played a rather active role in planning the project.

Reporting commitment
None of the parties have complied with the requirement to provide BITS with a completion report, no later than six months after commissioning, and should be criticized for that.

TAIYUAN

Procurement
One of the Swedish bidders withdrew from the race due to a difference in opinion with the Chinese client regarding the appropriateness of turn-key delivery, taking the position that if it could not influenced the design of the project it was not logical for the supplier to shoulder a turn-key responsibility for the outcome of the project.

Implementation
Since the project has not yet reached its design capacity, the performance of some of the Swedish equipment can not yet be tested. So far 28 of the 44 substations have been equipped. None of the stations have yet been connected to the computer system.

Output
Even though all of the Swedish equipment is basically functioning according to plan - the client is not satisfied with all his purchases. There are several reasons for this. In some cases the equipment may not have had an exactly *correct specification* to suit the client´s needs. In some cases there is a mal function which needs to be adjusted or repaired, but where lack of close relations or disagreements between supplier and client has prevented this from happening in a prompt fashion. In other cases it would seem that similar equipment, possibly of somewhat lower quality, could have been bought in the domestic market at maybe less than half the price. And the only reason for not doing so was simply because the credit was tied to purchases in Sweden.

Four computers, which according to plan were to be installed at the end of 1996, were delivered at the end of 1994, i.e two years ahead of planned installation. When they were installed in November 1997 they were completely outdated. The supplier´s, and perhaps BITS´, passiveness w.r.t. the delivery of computers and software being done two years *before* their intended installation, can at best be described as careless, but perhaps as irresponsible.

According to original plan the project would have used a cable as connection between the control station and the sub stations, but for cost reasons it was decided in 1996 to use the public telephone system instead. This, at least partly, explains the delay in installing the control system.

In the company´s opinion the problem with the too small valves is a serious one, as the valves can not satisfy its regulatory function. The valves are today not performing their intended function, and it is the same situation in all the substations. The company has suggested to Alfa Laval to replace the valves but they insist that the valves fulfill the needed function.

The company is not satisfied with the after-delivery service provided by the Swedish supplier, feeling that it has not received prompt response and help when needed. One simple explanation for this state of affairs could be that the Swedish supplier believes that its obligations as per contract have already been used up.

On several occasions there have been a difference of opinion between the client and the supplier.

In a storage room today there are 30 heat exchangers, 28 pumps, 9 control cabinets, transmitters, valves, flowmetres etc.- equipment, enough for nine complete substations. They were delivered from Sweden at the end of 1994, to be installed by 1996. But due to lack of funds they were not. Now the company hopes to install them within two years. According to the company the goods are kept in the perfect condition, with no risk of corrosion. However, due to the great amount of sulphur in the air, the corrosion of steel products is much faster in China than in, say, Scandinavia.

Just as in the case of the computers we here have a case of equipment being shipped from Sweden long - about two years ! - before its *intended* use. Including the unforeseen delay the equipment will be installed about 5 years after delivery. This raises serious questions not only about the competence of the Chinese importing agency, but also about the efficiency and meaningfulness of the donor agency´s planning and negotiating systems.

Effects
By the end of 1997, with a heated floor area of about 4,3 million sqm, and 174 boiler houses dismounted, it is calculated that 240,000 tons of coal are saved annually, as well as 600 tons of gasoline because about 400,000 tons less of coal and ashes need to be transported. The expected savings when the whole project is finished is estimated to 692,000 tons of coal annually, given a five month long heating season, and 1730 tons of gasoline.

Financial
The knowledge and awareness of financial information by the company´s officers leaves much to be desired. Discussions revealed that there is no clear price information regarding several central cost items, among them for the items imported from Sweden.

The profit calculations carried out by the company today, i.e. when about half of the total building area has been covered, indicate that it will be difficult to achieve the profit as planned. This is partly due to the fact that the cost of producing heat has increased more then the tariffs received from consumers, but even more importantly, because of the long delay in implementation of the project.

Economic
The project is highly profitable from an economic point of view. Intuitively this is easy to understand because the DH-system in effect makes use of a free resource, namely waste energy, which in the absence of a DH solution in a co-generation plant, would be just emitted unused into the air. Also, by generating heat in large efficient boilers that replace a multitude of smaller inefficient boilers, the economic savings of this project, mainly due to the large expected saving in coal consumption, can be expected to be very large.

Environment
The reductions in different types of pollutive emissions largely correspond to the degree to which the project has been implemented, i.e. the share of the building space connected. Several people that I spoke to remarked that they could feel by eyes and nose that air quality has become much better in recent years.

Equality/ Poverty orientation
The project is not seen as especially favoring any particular group in society. It is assumed that it will uniformly benefit all the inhabitants of the city.

Some people will argue that poorer groups gain relatively more from an improved environment than do other groups. On the other hand it is conceivable that on average a smaller proportion of poorer groups live in buildings that are possible to connect to district heating than richer

groups. If this were the case we could then claim that the introduction of district heating is a project which is biased against the interest of the poorer groups, just as we can claim that introducing district heating in the cities will favour (richer) city inhabitants at the expense of the(poorer) country dwellers.

Gender, Democracy and Independence
It does not appear possible to detect any particular effects, direct nor indirect, on *gender, democracy* or *independence* emanating form this project..

Demonstration effect
Given the delays experienced by the project, and because of the uncertainties that exist in peoples´ minds w.r.t. importing equipment of instead of buying some of it much cheaper in the domestic market, it is not possible to say that the project has become a positive *demonstration case* for others to follow. At least not yet. Different follow-up activities, organized and financed by Sida, could, however, contribute to the achievement of this objective.

BITS´ preparation
BITS´s project decision document was of high professional quality, as were in deed also those of the other four district heating projects.

BITS played an active and dynamic role in trying to assist the end-user to improve the projects, both from a technological and economic point of view, sometimes with a positive result, sometimes not.

Reporting commitment
None of the parties have complied with the requirement to provide BITS with a completion report, no later than six months after commissioning, and should be criticized for that.

Shijiazhuang

Implementation
Most of the imported equipment has been put into operation on schedule.

Output
The performance basically meets specified requirements, and the company is satisfied with the training services offered by Sida. However there are the following problems:

- Because the ignition system of the plant was changed to use charcoal instead of oil the two type oil pumps (the ignition oil pump and the oil removing pump) became useless and have never been used.
- the boiler control system has not been put to use, because there is a difference between the design of the system and the actual operation. Test runs failed and the computer system has therefore never been used.
- lack of *spare parts.* Some cannot be found in China. Other parts, among them some that wear down quickly, are unknown to the Chinese, because no drawings were made available by the Swedish supplier.
- Due to the big seasonal change the *boilers* are not functioning well. The load factor must be made more even in order for the boilers to perform better.

The control system of the boilers is not functioning due to lack of spare parts.

- The whole *control system* is out of order since February 1998, a possible reason being that the software is not able to handle unannounced electricity cuts. But it may also be due to the fact that fact that some designs of the plant were changed in relation to the original plans on the basis of which the computor program was procured. The company has asked the Swedish contractor for help, but have as yet not even received an answer.

All three conveyor belt systems are running very well and, and in the company´s opinion, clearly better than similar systems produced in China.

The electricity distribution center is working very well. There are similar systems produced in China but of lower quality. However the company has a suggestion on how it can be improved

The experience of the eight rough water pumps so far is very good. The same type of pumps, but of lesser quality, can be found in China at half the price..

Financial
No financial data have been made available to this evaluation, but a general reasoning will suffice to conclude that this project can hardly have achieved its financial targets. This is simply due to the fact that the project has been delayed with a whole year. From the financial analysis carried out during the appraisal it is clear that such a long delay in the projects revenues to start materializing would make financial profitability impossible to achieve.

Economic
It is clear that all of the five district heating projects, including this one, are highly profitable from an economic point of view. This follows from the very large savings realized in coal consumption, as well as through the dramatic reductions achieved in emissions of pollutants. These economic benefits are of such magnitude that the project´s economic profitability can not be threatened by the project suffering this or that set-back or because it is implemented with one or even a few years delay

The importation of advanced technology from the West is <u>not</u> a pre-condition for achieving high economic profitability, as is sometimes implied by some donor agencies. The bulk of the dramatic environmental improvements as well as the large savings in energy consumption that are a result of introducing DH to replace a multitude of inefficient individual boilers, would be reaped also in project relying exclusively on Chinese technology. Imported, advanced technology can make these gains bigger, but are not a condition.

Environment
It is not yet possible to assess whether or not pollution targets have been reached, because the project has not yet reached a full load. From what we can see today there will be no problem to reach the environmental targets of the project. The only environmental problem which at present does not have a ready solution is the noise level.

Equality/ Poverty orientation
The project is not seen as especially favoring any particular group in society. It is assumed that it will uniformly benefit all the inhabitants of the city.

Some people will argue that poorer groups gain relatively more from an improved environment than do other groups. On the other hand it is conceivable that on average a smaller proportion of poorer groups live in buildings that are possible to connect to district heating than richer groups. If this were the case we could then claim that the introduction of district heating is a project which is biased against the interest of the poorer groups, just as we can claim that introducing district heating in the cities will favour (richer) city inhabitants at the expense of the(poorer) country dwellers.

Gender, Democracy and Independence
It does not appear possible to detect any particular effects, direct nor indirect, on *gender, democracy* or *independence* emanating form this project..

BITS preparation
Also in this project there are examples of how BITS, mainly through its appraisal, was in a position to offer positive advice to the client regarding technical modifications in order to improve the project

After the BITS decision to grant financing was taken, the parties agreed to change the contents of the import order of a magnitude of app. 20 % of the total order. Strangely enough there is no documentation at all of this dramatic change in the contract in the Sida file, except for a short letter where Sida accepts the change.

Reporting commitment
None of the parties have complied with the requirement to provide BITS with a completion report, no later than six months after commissioning, and should be criticized for that.

Jiamusi

Procurement
There were several controversies with some bidding Swedish companies claiming that sound procurement rules had been violated. My impression is that none of the alleged faults were of a very serious nature.

Implementation
Because the construction of the co-generation plant has not been finished according to plan, the project is currently running at least one year behind schedule. The responsibility for the cogeneration plant rests with another state company, and the work can not be speeded up by the Jiamusi District Heating Company.

Because of errors committed in planning the shipment - apparently by the supplier and/or the shipping agency - the company incurred a considerable extra cost of transportation.

Output
The prefabricated pipes, the computerized control equipment, as well as the various kinds of equipment for the sub-stations, have all been successfully installed, and according to the company, are today operating well and according to expectation. The company is specially content with the Alfa Laval heat exchangers - 41 were imported - which they find to be of very high quality. The foaming machine has however not been functioning properly. At present it is out of order and the company lacks spare parts to put it in operation.

Some of the equipment that was purchased from Sweden can today be bought on the local market, often manufactured by various foreign joint ventures. A case in point is the Alfa-Laval joint venture in Shanghai which produces virtually the same heat exchangers that the end-user imported from Sweden.

Most of the people interviewed in the Jiamusi district heating company seemed to be convinced that the main, if not the only, reason that the company had imported the equipment from Sweden instead of buying it from the local market was that the company could not raise finance in the local

Chinese market. However, they are also clearly aware of the quality difference. In summary, one may perhaps conclude that the reason for choosing the Swedish equipment was twofold: *Firstly,* quality and price were competitive; *secondly,* Sweden offered the best credit.

Effect
Since the project is not yet finished, very few of the expected - highly beneficial - effects have yet started to manifest themselves. There is however nothing at present which would indicate that the effects as planned would not be forthcoming once the project is completed.

Financial
We have no access to relevant figures to calculate a revised ex post financial rate of return, but just by general reasoning we can see that the one-year delay, which now seems likely, is quite enough to upset the rates of return arrived at before the project.

Economic
The BITS decision document makes a very big understatement when it says that the project can be deemed to have "an acceptable" economic rate of return. Judging from the indications we have the economic benefits of this project are enormous, notwithstanding the delays in the project´s implementation.

Environment
The reductions in emissions of pollutants due to this project are expected to be dramatic. But the co-generation plant has not yet been opened, and the old local boilers are still in operation. Therefore the environmental gains have not yet materialized

Equality/ Poverty orientation
The project is not seen as especially favoring any particular group in society. It is assumed that it will uniformly benefit all the inhabitants of the city.

Some people will argue that poorer groups gain relatively more from an improved environment than do other groups. On the other hand it is conceivable that on average a smaller proportion of poorer groups live in buildings that are possible to connect to district heating than richer groups. If this were the case we could then claim that the introduction of district heating is a project which is biased against the interest of the poorer groups, just as we can claim that introducing district heating in the cities will favour (richer) city inhabitants at the expense of the(poorer) country dwellers.

Gender, Democracy and Independence
It does not appear possible to detect any particular effects, direct nor indirect, on *gender, democracy* or *independence* emanating form this project..

Demonstration effect
Even if it is not because of a possible *demonstration effect* emanating from the district heating projects which influenced Alfa Laval´s decision to produce in China, it is entirely possible that its future success, at least to some measure, will depend on the successful completion if the Sida-financed DH projects, among them the one in Jiamusi.

BITS preparation
In this, as in all of the DH heating projects in China, BITS has held a rather high profile when it comes to carrying out its own analysis and forming its own opinion about the project, and also to recommend or even request the loan-taker´s compliance on various points. In all important aspects it seems that the end-user actually heeded the advice forwarded by BITS

Reporting commitment
None of the parties have complied with the requirement to provide BITS with a completion report, no later than six months after commissioning, and should be criticized for that.

Fushun

Procurement
One of the Swedish bidders claimed that the tender procedure applied by the Chinese government discriminated against small bidders. Sida having looked into this, as well as other critique which has been directed at the procurement process, has found nothing that would constitute a serious breach against generally accepted rules of a competitive procurement system.

Implementation
Overall, the delay in the project, as compared to original plans, is between one and two years. At first, the Bank of China hesitated to act as intermediary for this credit, as it had a suspicion regarding the solvency of the Fushun District Heating Company. Then, there was, in the company´s opinion, a delay caused by the shipping company retained by the Swedish exporter. At a later stage, a further delay was caused by the slow pace of construction of the new power plant, whose boiler the company wanted to use for heat water.

At present about 70% of the heating station equipment has been installed in 33 substations. Test runs began in February 1997. The rest will be installed by 1999. As for the pipes which are to be installed underground some 30 % have been installed to date, and the entire job is expected to be finished by 1999.

Still today the communist party has a political secretary in each state company, who in many peoples opinion, has more power than the General manager. According to one of the company officers, sometimes the political secretary respects the expert opinions of the company´s staff, sometimes not. According to the Company´s Chief engineer, however, there are no cases where the Political secretary has had an opinion which differs from that of the management.

Output
Two thirds of the equipment has been installed, and the company believes that the test runs have shown that the equipment generally runs very smoothly and efficiently. It also emphasizes the benefits created by the Swedish delivery: *"it changed our heating methods, the way we provide heat to the consumer;.....The Swedish technology is very advanced, more so than our own equipment in this field;*

The company also however points out several problems, namely:
- noise level of pumps,
- lack of spare parts for the frequency converters,
- problems with the computerized monitoring system,
- malfunctions in the foaming machine, and
- still inadequate training.

The company is quite satisfied with the performance of the Swedish heat exchangers. However, in 1995 Alfa Laval started producing heat exchangers from its own factory in Southern China. The company had tested these heat exchangers and was quite satisfied with them, and, if the Swedish credit had not been tied to Swedish goods, it would have preferred to purchase the heat exchangers in China.

Most of the equipment imported from Sweden could have been bought locally from the Chinese market, but generally one must assume that the local quality is substantially lower. Nevertheless it would seem likely that if the company had received an untied credit it would have purchased differently.

There are in China today about 10 cities that have a modern district heating system - half of them relying, apparently successfully, on Chinese technology.

Effects

The main effects of the project are

- a considerable energy conservation because of the coal that is saved when one large, highly efficient boiler replaces a multitude of stoves and small, inefficient boilers
- supply of heat to the city´s inhabitants
- increased possibility for future expansion
- reduced need of make-up water due to installation of heat exchangers.
- control of water will decrease corrosion inside the pipes, which will lead to longer network technical lifetime
- installation of control valves at the substations will make it easier to balance the system and give better temperature control.

Financial

No data are available to try to calculate the ex post financial profitability of the project. But even without data it is clear that due to the current two-year delay in the implementation of the project, there is no way that the financial target can be met.

Economic

There are important effects, e.g. on health, which have not been included in the economic analysis carried out at the appraisal. A full inclusion of all economic effects, whether quantifiable or not, would yield a very high economic rate of return.

Environment

There is no doubt that the benefits to the environment as well as to Peoples´ healths will be dramatic when the project is completed.

Equality/ Poverty orientation

The project is not seen as especially favoring any particular group in society. It is assumed that it will uniformly benefit all the inhabitants of the city.

Some people will argue that poorer groups gain relatively more from an improved environment than do other groups. On the other hand it is conceivable that on average a smaller proportion of poorer groups live in buildings that are possible to connect to district heating than richer groups. If this were the case we could then claim that the introduction of district heating is a project which is biased against the interest of the poorer groups, just as we can claim that introducing district heating in the cities will favour (richer) city inhabitants at the expense of the(poorer) country dwellers.

ender, Democracy and Independence
It does not appear possible to detect any particular effects, direct nor indirect, on *gender, democracy* or *independence* emanating form this project..

BITS preparation
As in the other district heating projects evaluated in this report BITS was quite active in analyzing the project, and also active in offering recommendations to the end-user on the solutions favored by BITS.

Reporting
Like in the other four projects none of the contracting parties - neither the seller nor the buyer - have complied with their contractual obligation to provide BITS with a completion report six months after commissioning of the project.

B. GENERAL CONCLUSIONS REGARDING VARIOUS ASPECTS

Procurement

In virtually all of the five projects there has been at least some degree of controversy surrounding the procurement process with many claims from the bidding Swedish companies that sound procurement rules had been violated. On more than one occasion one of the Swedish bidding companies accused the Chinese authorities to conduct the tendering procedure in a way not consistent with accepted rules of competitive procurement. One of the Swedish bidders claimed that the tender procedure applied by the Chinese government discriminated against small bidders. My impression is that none of the alleged faults were of a very serious nature.

In some of the cases formal complaints were lodged with Sida, who in its turn approached the Chinese authorities with a request for clarification. From what can be ascertained from the archives as well as from interviews none of the reported cases was judged to constitute a serious enough breach of rules to warrant a choice of supplier to be overturned, nor any serious reprimand.

But the complaints as well as procurements carried out in other BITS projects in China, were by Sida seen to be serious enough to prompt its chief legal Adviser to write to MOFTEC[4], urging them to consider the following points in their future procurements:

- Evaluation criteria should be established before the invitations to tender are sent to the short-listed companies
- the invitation to tender should contain the evaluation criteria and their priority or weighting
- the evaluation should be undertaken according to the set criteria, and

[4] See letter dated Decembewr 2, 1997 from Sida (POL/JUR) to MOFTEC

- information on the results of the evaluation, as well as the scoring of all tenders and the reasons given for choosing the winning tender should be given to the participating companies as well as to Sida.

Competitive prices

Even if the procurement procedures used by the Chinese importing agencies are not fully in accordance, at least not in a formal sense, with standard requirements of competitive bidding, most observers seem to agree that the imported goods have been purchased at very competitive prices. For, even though the Swedish concessionary credits are tied to purchases from Swedish suppliers, there seems to have been a very keen competition between the half dozen Swedish companies that are considered to be internationally competitive suppliers in the field of district heating. Some have even characterized the competition between the prospective Swedish suppliers as irritated. One reason for this keen competition no doubt is the very skillful negotiating techniques of the Chinese importers. During the technical discussions between prospective suppliers and client, which precede the final selection of suppliers, the Swedish companies are put under considerable pressure to share their professional expertise in planning as well as designing the project.

Not only are the prospective suppliers tapped for a considerable amount of expert advice which - in the pre-contract period - is always provide free of charge, but they are also squeezed hard in price negotiations. This picture conforms in general with the experience made by also other Swedish firms in Sweden. The general attitude towards these hard negotiations and contracts which are sometimes seen as lean, is that this is a necessary sacrifice to make in order to establish oneself in the vast Chinese market.

The fact that a Chinese company is not allowed to import in its own name, and has to use the specialized import/export agencies is certainly advantageous in the sense that even provincial district heating companies, with no previous international experience of their own, will be able to negotiate good contracts with the big multinational exporters. On the other hand this system carries with it the disadvantage that the import agency may not always be 100 &% in tune with the technical needs of the end-user/ the importing company. One case in point is perhaps the computers that were shipped two years in advance of their intended installation date.

Chinese importers are by Swedish exporters sometimes perceived to be reluctant to spend money on carrying out studies and on soft ware. Often Chinese importers will not carry out their own appraisals of offers received by prospective foreign suppliers. Instead they will use the information contained in the bids of competing suppliers. Sometimes they will even invite, in the earlier stages of a tendering procedure, a competing firm to comment on technical proposals offered by another company.

Implementation

In all of the projects the Swedish equipment has generally been delivered according to contract and overall found to be of expected quality and function. Some of the client companies state that the Swedish supplier completed the project to full satisfaction, but all of them have a list of, mainly minor, complaints.

However, all of the projects are experiencing *delays* of between one and two years. In a few cases part of the delay in project implementation was due to the hesitation on part of the Bank of China to act as intermediary for the credit, because it had a suspicion regarding the solvency of end-user. In other cases it had to do with the parallel construction of a power plant outside of the control of the end-user.

As of today about two thirds or more of the equipment has been installed. In some cases enough test runs have not been made so as to effectively be able to judge the performance of the Swedish equipment. In the other cases most of the equipment was put into operation on schedule and, after test runs, found to perform basically as per specified requirements, however with some exceptions.
In one of the projects the end-user incurred a substantial extra transportation costs because of errors committed by the supplier in the shipment planning.

Hot tap water not included

The provision of hot tap water to the buildings is not included in any of the five projects, even though studies have shown that this would be not only technologically more efficient solution but also much more cost-effective. Also the studies carried out by BITS made a strong point that the inclusion of hot tap water provision in the projects would make the projects considerably more efficient technologically as well as more cost effective. Today hot tap water used in the buildings is heated by separate boilers usually driven by gas or by coal. It has not been possible to establish exactly why hot tap water provision is not included in the Chinese DH projects. Largely it would seem to be a question of tradition. Apparently the decision-makers are not yet sufficiently convinced of the profitability in order to accept the bigger investment cost which would be needed.

Non-flexible heating season

Another aspect which is difficult to understand for the outside observer is the insistence on part of the authorities to have one uniform calendar period for heating irregardless of how the actual weather conditions may change from one year to the next.
Administrating a more flexible system, where the opening and closing dates respectively of the provision of heating would be influenced by the actual outside temperature, would not only be more consumer friendly but probably also more profitable for the heating companies.

Output

Overall Swedish equipment is performing well….

Between two thirds and all of the imported equipment has been installed and put into operation on schedule. The test runs which have been made show their performance basically to meet the specified requirements, a major part running very smoothly and efficiently.

In Shijiazhuang all three conveyor belt systems are running very well and, and in the company´s opinion, clearly better than similar systems produced in China. The electricity distribution center is working very well, and the experience of the eight rough water pumps so far is very good. In Jiamusi the prefabricated pipes, the computerized control equipment, as well as the various kinds of equipment for the sub-stations, have all been successfully installed, and according to the company, are today operating well and according to expectation. The company is specially content with the Alfa Laval heat exchangers, which they find to be of very high quality.

Some companies also emphasize the benefits created by the Swedish delivery: *"it changed our heating methods, the way we provide heat to the consumer;.....The Swedish technology is very advanced, more so than our own equipment in this field; Judging from the test tuns made we think that the equipment is very good;.....The output and the benefits of the system we think will be the ones as planned"*

….but there are some problems…

All of the end-users, however, also points out a number of, mainly, minor problems. Among them: noise level of pumps; lack of spare parts for the frequency converters; problems with the computerized monitoring system; malfunctions in the foaming machine; still inadequate training.

Among some of the end-user´s staff there are some which harbor considerable discontent about the Swedish equipment and their functioning.

The most serious points noted by this evaluation are the following:

- In some projects some of the pumps vibrate and shake and make too much noise

- An acute lack of original spare parts is a problem experienced by technicians in all the projects and w.r.t. most of the Swedish equipment. This is not surprising for it is obvious that management sometimes preferred to use the available credit funds for hardware at the expense of spare parts.

- There are many indications that the amount of *training and supervision* in the contracts was insufficient. There seems to have been a strong temptation for the end-users to use money, potentially destined for training and supervision purposes, for importing additional equipment in stead. Today it would seem that many wish that more training and supervision had been included.

- In one project four computers were delivered two years ahead of their intended installation, making them obsolete already at the time they were put in operation.

- In one of the projects too small valves were delivered, and they can today not satisfy their regulatory function.

- At least one of the end-users are not satisfied with the after-delivery service provided by the Swedish supplier, feeling that they have not received prompt response and help when needed. One simple explanation for this state of affairs could be that the Swedish supplier believes that its obligations as per contract have already been used up.

- In one project there are today kept in a storage room 30 heat exchangers, 28 pumps, 9 control cabinets, transmitters, valves, flowmetres etc.- equipment, enough for nine complete substations. They were delivered from Sweden at the end of 1994, to be installed by 1996. But due to lack of funds they were not. According to the company the goods are kept in the perfect condition, with no risk of corrosion. However, due to the great amount of sulphur in the air, the corrosion of steel products is much faster in China than in, say, Scandinavia. Just as in the case of the computers we here have a case of equipment being shipped from Sweden long before its *intended* use. Including the unforeseen delay the equipment will be installed about 5 years after delivery.

- In Shijiazhuang the whole control system is out of order since February 1998, a possible reason being that the software is not able to handle unannounced electricity cuts. But it may also be due to the fact that fact that some designs of the plant were changed in relation to the original plans on the basis of which the computor program was procured. The company has asked the Swedish contractor for help, but have as yet not even received an answer

- In one project the control system of the boilers is not functioning due to lack of spare parts.

The extensive discussions I had in the various projects show that there is a varied bag of reasons for the malcontent with different equipment. It has not been possible to determine exactly who, in each particular case, is in the right and who is wrong. All things having been said and considered I tend to believe that the shortcomings as exposed, are after all only marginal phenomena , and that basically the equipment is appropriate and function without problems, and that the critical points that have been raised largely belong to what are normal occurrences in commercial life.

However there are some points which seem to be more serious than the others, and which raise serious questions not only about the competence of the Chinese importing agency, but also about the efficiency and meaningfulness of the donor agency´s planning and negotiating systems. A case in point is when large amounts of equipment were shipped several years before their intended use.

In the case of the computers shipped to China two years ahead of their planned installation the supplier´s, and perhaps BITS´, passiveness w.r.t. this faulty delivery can at best be described as careless, but perhaps as irresponsible.

Domestic versus imported equipment

Some of the equipment purchased from Sweden could have been bought locally from the Chinese market. Generally one must assume that the local quality is considerably lower, but it would seem likely that if the company had received an

untied credit in many cases it would have purchased domestic equipment instead of importing it from Sweden.

There are in China today about 10 cities that have a modern district heating system - half of them relying, apparently successfully, on Chinese technology. Many district heating companies are currently investing in Chinese equipment instead of imported one. But one must consider the fact that if these companies were completely autonomous w..r.t. *long run profits and losses* perhaps they would be more quality oriented - and willing to pay a higher price for higher quality knowing that this strategy would in the end turn out to be the most economic one.

Even though the Chinese end-user believes that the quality of Chinese equipment is not yet good enough to compete with imported Swedish equipment, they admit freely that an important reason for buying the Swedish equipment was that the company was offered a Swedish concessionary credit.
Many of the people interviewed seemed to be convinced that the main, if not the only, reason that the company had imported the equipment from Sweden instead of buying it from the local market was that the company could not raise finance in the local Chinese market. However, they are also clearly aware of the quality difference.
In summary, one may perhaps conclude that the reason for choosing the Swedish equipment was twofold: *firstly,* quality and price were competitive.
Secondly, Sweden offered the best credit

In a few cases the domestic equipment is actually manufactured by a foreign joint ventures. A case in point is the Alfa-Laval joint venture in Shanghai which produces virtually the same heat exchangers that are imported from Sweden. In these cases it would seem obvious that the company should prefer to buy locally rather than to import.

There does not seem to be any question that one can not only equip a complete substation relying exclusively on Chinese equipment, but also that one will be able to run it smoothly, reliably and with easy access to all service and spare parts needed. Technological lifetime of the equipment will surely be lower, perhaps by as much as half, but on the other hand the price of the equipment is probably less than half, especially if one considers the cost of spare parts and service.

Does this mean that - from a Chinese point of view - it would always be wiser to buy only domestic equipment for their substations? No , I do not think so, not necessarily even if the price were less than half. *Firstly*, chances are that the quality, both in terms of functionality and durability, of the Swedish equipment could turn out to be so superior that even at double the price it would be a much more economical for the Chinese district heating companies than domestic equipment. That is entirely possible and perhaps also probable. *Secondly,* irregardless of prices and of economy, it must be good for Chinese development to have a few show case projects where alternative - *id est* foreign - technology can be demonstrated , and against which the domestically

manufactured equipment can measure its performance, quality and price. This is perhaps the only real effective way how China´s own capital goods industry will develop and in the future compete fully with the foreign imports.

Conclusion

Even though, with some exceptions, all of the Swedish equipment is basically functioning according to plan - the respective clients are not satisfied with all their purchases. There are several reasons for this.

Firstly, in some cases the equipment may not have had the exact *correct specification* to suit the client´s needs. It is also possible that this need is different today from what it was when the order was placed. This is so because in some cases other surrounding equipments were changed in relation to original plans.

Secondly, in some cases there may be a mal function which needs to be adjusted or repaired, but where lack of close relations or disagreements between supplier and client has prevented this from happening in a prompt fashion.

Thirdly, in other cases it would seem that the same equipment, possibly of somewhat lower quality, could have been bought in the domestic market at maybe less than half the price. And the only reason for not doing so was simply because the credit was tied to purchases in Sweden. It has not been possible by this evaluation to determine in what cases this perception is realistic and when it is only wishful thinking. In most cases I tend to believe that the quality and durability of the imported equipment may be so superior that it becomes economical even if it costs twice or thrice the price of domestic equipment. But surely we can expect that in some of the cases it would really have been much more economical to buy locally produced goods. And the only reason for not doing that is simply because the credit was tied to purchases in Sweden.

According to Sweden´s aid philosophy w.r.t. tied aid, tying may only be present when the product purchased in Sweden is internationally competitive. Or put differently: Swedish concessionary credits may only be used to purchase Swedish goods which are internationally competitive. This is something which is generally assured through Sida´s careful pre-decision appraisal both of the technical parameters of the project, and the commercial conditions of the contract. However, it is apparently possible that individual products, which are not in themselves competitive, slip through as parts of a complete *package* of equipment delivered to satisfy the comprehensive needs of a project. In the case of for instance a complete and integrated district heating system it may be difficult for the client to have the expert knowledge to extract some of the equipment and have it delivered from other sources.

A lesson learnt from the five projects could be that collaboration between the client and suppliers have not been close enough, and this has produced many instances of discontent and misconceptions and misunderstandings. Obviously some of the problems encountered also could be due to a simple conflict of interest between the client and the supplier, e.g. when the contractor feels that its contractual obligations have already been fulfilled, and the client is still not satisfied with the product.

In Chapter x Recommendations it will be argued that Sida should arrange and finance a post-project seminar for a all the clients and suppliers as well as appropriate representatives from the donor and host government institutions. In my opinion such a seminar, if properly designed, could go a long way of settling many of the outstanding misunderstandings and disputes which are today unresolved.

Effects

The expected effects of the district heating projects, mainly by way of saved energy and reduced pollution, are very large in deed. They are:

- a considerable energy conservation, in the order of around 50 % (!), because of the coal that is saved when one large, highly efficient boiler replaces a multitude of stoves and small, inefficient boilers

- savings in gasoline due to less transportation of coal and ashes being needed

- dramatic reductions in polluting particulate emissions, primarily SO2, CO2, Nox

- a more reliable supply of heat to the city´s inhabitants

- increased possibility for future expansion

- reduced need of make-up water due to installation of heat exchangers.

- control of water will decrease corrosion inside the pipes, which will lead to longer network technical lifetime

- installation of control valves at the substations will make it easier to balance the system and give better temperature control.

Since none of the projects is yet completed, only a smaller part of the expected effects have yet started to manifest themselves. There is however nothing at present which would indicate that the effects as planned would not be forthcoming once the projects are completed.

Financial Analysis

Financial targets will <u>not</u> be achieved

No financial data was available to this evaluation which would permit calculation of *ex post* financial profitability. However, it will suffice with general reasoning to indicate that, most probably, none of the projects will be able to achieve its financial target.

This is simply due to the fact that all of the project are experiencing delays of between one and two years, and it is clear from the financial analyses carried out during the appraisal that such a long delay in the projects revenues to start materializing would make financial profitability impossible to achieve. Another, contributing factor is that in some of the projects a promised, or envisaged, raise in heating tariffs has not materialized, which has resulted in that the cost of producing heat has increased more then the tariffs received from our consumers.

Notwithstanding that the district heating projects will <u>not</u> result in financial profitability, at least some of the district heating companies involved are doing fairly well financially. This is because their financial deficits in heat delivery can be compensated by profits realized in electricity sales or some other branch in which is the company is engaged.

Fallacies of financial analysis

Sometimes appraisal and other financial studies, carried out of development projects, will convey the message, usually implicitly, that the main analysis deciding the projects desirability is the *financial* analysis. This is misleading, for in countries like China the outcome of the financial analysis can at any moment be changed simply by the government making a political or administrative decision which changes a tax, a subsidy or modifies a tariff which is not set according to supply and demand.

Therefore, it is the project´s *economic* profitability which should serve as criterium whether or not a project is worth while and desirable.

In an ex post evaluation the analysis of financial rate of return for a state firm operating in a regulated economy can at best have only a marginal interest, as the rules of the game can be changed at any moment by a mere administrative or political decision on part of the government. In such an environment, the financial rate of return, being of course a function of the existing rules regarding taxes, subsidies etc., becomes unreliable as a measure of the strength and quality of a company´s operation. In such a project one should be more concerned with the economic analysis of the project.

The financial analysis is obviously important, but its importance in a country like China lies mainly in that it will decide whether or not the project can be financed in the commercial market, or whether it needs subsidies by way of e. g. domestic or foreign concessionary credits. In today´s China, even though important steps have been taken towards a market economy, there are enough remaining regulations and subsidies both on the cost and revenue sides, and with enough distortions , due to hidden subsidies and tax payments structure to make it difficult to understand for the foreigner. This of course makes the financial analysis of a limited interest.

If we can take for granted that taxes, subsidies and other relevant parameters will not be changed for the project, then the financial analysis, including the cash-flow analysis will provide a correct assessment of what kind of financing is needed for a project to be realized. But in a situation where e.g the financial outcome tells us that an investment cannot be financed at market terms, we also know that the government, by changing some of the parameters so as to create a cash-flow positive enough to allow the investment to happen even if no concessionary financing were available. So the important message that should be made in this project as well as in others, is that the criteria for the govt. to decide to go ahead with a project is its *economic* desirability. Economic viability is a *necessary* condition, whereas financial viability is not, because it can be changed at will by the government.

The relevant decision procedure for the government is this: *Firstly*, an economic analysis should be made of different project alternatives using real opportunity costs. *Secondly*, the government decides on the degree of subsidy that it is willing to extend to the project - if tariffs cannot be raised enough to finance it. *Thirdly*, the government must find the most convenient way of bringing about a financial package which can make the project happen. This package can then include that the project is allowed to receive the whole grant element of a foreign concessionary credit and/or a combination of other direct and indirect subsidies. What is important is that the full subsidy be shown in the national budget. If it has been shown in a reliable economic analysis to be profitable for the country, then this subsidy will be a financial cost which will actually bring about revenues from the national economic point of view.

OECD rules

One very important reason why the donor agencies today devote a considerable attention to the question of financial analysis is the demands posed by the OECD. In order to determine that the OECD Helsinki accord rules are being followed, and to make a concessionary credit legitimate the donor is obliged to carry out comprehensive analysis of a project´s financial viability and of its cash flow.

In projects, like the present district heating ones in China, where the financial position of a project can easily be changed by a sometimes arbitrary administrative or political decision, one easily gets the impression that the main function of the financial analysis is to serve as a decision basis for deciding eligibility according to the Helsinki rules.

Sida´s appraisals

As far as the authors of the financial appraisals carried out by BITS, I am not suggesting that they were not aware of the limited function of the financial analysis, but many parts of the respective appraisal report were written in a way that an uninformed reader may get a wrong impression.

A comment is needed regarding the following statement in one of the appraisal reports "given the complex taxation system, the financial analysis focuses on pre-tax considerations". This may have been a slip of thought by the authors because the financial analysis is the only place where you need to worry at all about the tax incidence. In the economic analysis taxes can be excluded since they merely represent transfers of the economy. A complicated or confusing tax structure can then be seen as just one more circumstance which makes the economic analysis all important while the financial one often is of limited importance.

The World Bank

A very interesting difference between the World Bank and the Swedish DH projects is this:

The World Bank will only support - with a 6 % IBRD-loan - a projects which is commercially viable, while the bilaterals like Sweden, because they are using concessionalry financing which is restricted according to the OECD "Helsinki rules", are *not allowed* to choose commercially viable projects.

This very important difference not surprisingly has a significant effect on the way the respective donor analyzes and manages its project. While the Bank must insist that project efficiency is very high in all respects, a bilateral donor can accept a much wider "margin of inefficiency" in its projects, for the bilateral donor ´s main concern in reality is that the project is economically viable. This is not always admitted openly by a bilateral donor. They will carry out thorough financial analyses whose aim it is to show that a project is commercially not viable but economically viable. But since the project is already being subsidized by way of a concessionary loan, there is really no strong sense of the project having to stand on it own feet financially. Since there is already a strong presence of subsidization, which is of arbitrary size, there is no sense what is the real criteria by which to judge entrepreneurial efficiency.

Among the conditions posed by the World Bank in order to finance a project are the following:

- a project must be able to generate a surplus at least high enough to repay the credit, and
- the project should be owned and managed by a financially sound organization.

Sida shares the same objectives but that they are by no means posed as conditions for a project to receive a concessionary credit.

The world Bank´s task is to make a district heating project efficient enough to be able to repay a commercial loan. One way to do this is to make sure that tariffs are raised sufficiently so as to allow a DH company to recover its investment as well as operating costs.
Obviously the level of the tariffs is an important concern also for bilateral donors. On a few occasions Sweden even made a tariff raise to be a condition for granting a concessionary loan, although Sida apparently has not followed up whether such a tariff raise was actually implemented.

For the World Bank the question of appropriate tariff level, for obvious reasons, becomes a much more central issue. Before the Bank decides to finance there will have been a considerable amount of negotiations and other pressures for the tariffs to be raised to a certain level. In fact a large part of the project preparation and implementation work is dedicated to the tariff issue. A constant problem for the world bank is that the responsible price bureaus on provincial and municipal levels are independent from each other. In some case when the Bank had negotiated a certain tariff raise as a precondition for its financing, with the central government, then a provincial price agency refused to implement it. This problem was highlighted in a recent WB sector report (China: Urban Environmental Service Management" Report no 13073-CHA) which found that

"the major failing in environmental services has been dependence on municipal budget transfer to fund services, while greater reliance on user charges would be affordable, induce resource conservation, and create more dependable income stream".

This explains why increasing tariffs have been a major point of the policy dialogue between the Bank and the Chinese authorities.

A methodological complication in these projects is to distinguish between "project" and "company" so as to make the appropriate demarcation line of what costs and revenues belong to one and the other.

The Bank´s oldest DH project is in Beijing, which was started in 1991. Among the covenants (conditions) for this project is financial performance. It has not yet been evaluated and information regarding implementation and outcome is still formally restricted. It is however common knowledge that disbursements for the project were stopped more than once due to lack of compliance wrt implementing negotiated tariff rises, and that it is very unlikely that the project´s objective of financial viability will be met.

In broad terms we can say that the Swedish contribution, in case of a successful project implementation is helping China achieve the very important economic benefits which are gained through the introduction of DH, while the Bank´s contribution will also be in the field of *institutional* development, in the sense that it will help develop the DH companies into efficient enterprises that are able to deliver their services without becoming a drain on the taxpayers support, and also in more general terms help build a more efficient price structure in the economy. While the Swedish projects also certainly try to address these aspects and to some extent also succeeds in achieving beneficial

effects, their relative contribution lies in generating economic benefits to the country , not in institutional development.

No cooperation

So far there has been no cooperation whatsoever between the Bank and Sida in the area of district heating, nor have there been any exchange of information. In fact, as it would appear, the two donors have barely been aware of the existence of the other in the field of district heating in china. This state of affairs is clearly unsatisfactory, and Sida deserves t be criticized for it. For even though the contents of the projects will vary due to the banks emphasis on institutional development and Sida´s emphasis on the environment and energy conservation effects, it is obvious that there must be very large gains for both the donors if they can share whit each other analysis carried out and experiences gained.

Economic Viability

Highly profitable

All the projects are highly profitable from an economic point of view. Intuitively this is easy to understand because by generating heat in large efficient boilers that replace a multitude of smaller inefficient boilers, very large savings can be realized in coal consumption, and in reduced gasoline consumption because of reduced need for transportation of coal and ashes through the city . Furthermore, in the case of an already existing power-plant which is converted to a co-generation plant, the DH-system in effect makes use of a free resource, namely waste energy, which in the absence of a DH solution would be just emitted unused into the air[5]. As a result there are dramatic reductions achieved in emissions of pollutants, and the economic savings of the projects can be expected to be enormous. These economic benefits are of such magnitude that their economic profitability can not be threatened by the projects suffering this or that technological set-back or because it is implemented with one or even a few years delay.

In a recent World Bank DH-project in Weihai and Yantai districts, the economic rate of return from the savings in energy alone, was calculated to between 24 and 66 % depending on various assumption made. In addition there were substantial economic gains from land reclamation resulting from the elimination of the many small boiler houses, which was not included in the Bank´s calculation.

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[5] One contributing reason why the *economic rate of return,* in DH-projects which make use of an already existing heat source, can be dramatically higher than the *financial rate of return* could the fact that in the economic analysis the already existing heat production facility is treated as a sunk cost not a new invewtment. The only addditional expenswees incurred are the connecting costs to the new district heating network and the costs of foregone power production during trhe heating season plus the house connection costs from the heat substations to individual living quarters.

One of the BITS´ decision memoranda makes a very big understatement when it says that the project can be deemed to have ”an acceptable” economic rate of return. Judging from the indications we have the economic benefits of the DH project are enormous, notwithstanding the delays in the project´s implementation.

It deserves to be pointed out that the bulk of the dramatic environmental improvements, as well as a large part of the savings in energy consumption that are a result of introducing imported DH technology, would be reaped also in projects relying exclusively on Chinese technology. Imported , advanced technology can make these gains bigger, but are not a condition.

Including health effects

The dramatic reductions in pollution can also be expected to have a considerable effect on peoples´ healths. Health effects have not been included in the economic analysis carried out at the appraisal. An inclusion of health factors in the economic analysis would increase economic profitability considerably over the already high level found in the appraisal study.

Judging by various studies, carried out by the World Bank regarding DH-projects in China as well as in other countries, the economic rate of return could be in the order of a few hundred per cent, depending on assumptions made, when health and mortality effects are included in the analysis.

Economic value of health and loss of life

The methods by which effects on health and on loss of life can be measured raise not only economic and statistical problems, but also social, political and ethical. The most common is the *”willingness to pay”* method. Using it in China, and by scaling the values used in the US and Europe in relation to Chinas level of per capita income, the World Bank in its analysis arrives at a value of 60,000 USD per statistical life in urban areas and 31,800 in rural areas.

The other method is the *”human capital approach”,* which gives much lower values, because it includes only the wages and salaries lost due to premature death. By this method the statistical value of a life would be 9,000 in urban and 4,800 in rural areas.

The total economic cost to the country of premature deaths caused by air pollution was by the Bank calculated to 24 billion USD per year using the willingness to pay method, and two billion using the human capital approach. The cost to society as a result of illnesses, including hospital visits and lost work days, due to air pollution are much higher. The world bank estimated this cost to be som 20 billion USD each year.

The total annual economic cost to China of air and water pollution including premature deaths, loss of health and also crop and forestry damage caused by acid rain was by the Bank estimated to be some 54 billion USD.

The economic cost to Chinese society of different types of environmental pollution, as calculated by the World Bank, can be seen from the following table, in billions of USD:

Table 28: Economic cost to Chinese society of different types of environmental pollution, in billion dollars a year

Type of pollution	”human capital” approach	”willingness-to-pay” method
urban air pollution	11,3	32,3
indoor air pollution	3,7	10.6
lead exposure	0.3	1,6
water pollution	3.9	3,9
acid rain	4,4,	4,4
Total	24	53
% of GDP	3,5	7,7

Environment

The reductions in emissions of pollutants due to these five projects are expected to be dramatic, and there can be no doubt that the benefits to the environment as well as to Peoples´ healths will be equally dramatic. Measurements in Sweden have shown that e.g SO2 are often reduced by 80 % when DH is introduced. In Chinese cities, starting from a much higher degree of pollution, the effect can be expected to be even greater.

In the two recent projects in china supported by the World Bank the reduction in SO2 emissions was estimated to be 97 %, ad the reduction of TSP 96 % compared to the 0-alternative.

All five project are experiencing considerable delays in their implementation, and consequently most of the environmental gains have not yet materialized as many of the old local boilers are still in operation. This however does not change the fact that the expected environmental benefits of the five district heating projects evaluated here are enormous.

There is little data available showing the change in pollution levels in the respective cities since the start of the projects. But the few data are available to this evaluation indicate - just as one would expect - that the reductions in different types of pollutive emissions achieved to date largely corresponds to the degree of implementation, i.e. the share of the building space connected. From what we can see today there will be no problem to reach the environmental targets of the project. The only environmental

problem which at present does not have a ready solution is the noise level in some of the pump stations located in residential areas.

Equality/ Poverty orientation

None of the projects are seen as especially favoring any particular group in society. It is assumed that they will uniformly benefit all the inhabitants in the respective cities.

Some people will argue that poorer groups gain relatively more from an improved environment than do other groups. On the other hand it is conceivable that on average a smaller proportion of poorer groups live in buildings that are possible to connect to district heating than richer groups. If this were the case we could then claim that the introduction of district heating is a project which is biased against the interest of the poorer groups, just as we can claim that introducing district heating in the cities will favour (richer) city inhabitants at the expense of the(poorer) country dwellers.

Neither the objectives of enhancing China´s economic and social equality nor that of alleviating poverty were mentioned in any of the BITS decision to finance the five DH projects. This is logical for in general we would not expect there to be any connection between the degree of DH and the degree of poverty or equality.

Recent World Bank study

In a recent study on China´s environment, however, the World Bank did find a positive relationship between pollution and poverty: In a statistical regression analysis based on data from 50 Chinese cities it found that *as wages rise the pollution density of suspended particles falls.* It further found that poor cities have higher emissions of sulfur dioxide than rich cities, although emissions density rises from low to middle-income cities and then falls to the lowest levels in high-income areas.

In analyzing their findings the Bank arrived at the following three explanations for the seemingly paradoxical situation that richer cities with higher levels of industrial output, actually have cleaner environment than others:

Firstly, environmental regulations are stricter in richer areas because they contain better educated citizens, who are more concerned and better informed about the environment, and also ready and capable of defending their interests.

Secondly, production in low-wage communities generates more pollution because industrial facilities with unskilled workers are generally less efficient and produce more waste, and

Thirdly, demand in high-income markets tend to favour products whose production generates less pollution.

So with this fairly stable evidence we seem to be able to conclude that the five Swedish-supported District Heating projects evaluated here, have in deed had a positive effect on the distribution of equality in social terms, and in a very indirect way also on poverty alleviation, even though none of these pursuits were seen as objectives of these projects.

Gender, Democracy and Independence

It does not appear possible to detect any particular effects, direct nor indirect, on *gender, democracy* or *independence* emanating form this project..

Demonstration effect

An explicit objective of the first two district heating projects supported by BITS (Dalian and Taiyuan) was that the project should become a *demonstration case,* which would show those other Chinese cities contemplating the introduction of a modern DH-system, the feasibility of mixing advanced technology imported from abroad with Chinese produced equipments accounting for the bulk of the investment.

Given the delays experienced by the project, and given the uncertainty that today seems to exist regarding the possibility of much cheaper domestic equipment replacing some of the equipment imported from Sweden, I do not believe that one can say that this objective has been achieved. At least not yet. Below it is suggested that Sida organize a seminar as an overall follow-up to all of the five DH projects in China. Possibly, a successful outcome of such a seminar could go some ways toward contributing to achievement of this objective.

BITS´s project preparation

Sida´s interventive and controlling role

It would seem that Sida in all of the DH heating projects in China held a rather high profile in carrying out its own analysis and forming its own opinion of the projects, and also to recommend or even request the loan-takers´ compliance on various points. In all important aspects it seems that the end-user actually heeded the advice given. BITS thus played an active and dynamic role in trying to assist the end-user to improve the projects, both from a technological and economic point of view, sometimes with a positive result, sometimes not. Mainly through its appraisals BITS was in a position to offer positive advice regarding technical modifications to the client in order to improve the technical solution of the project . BITS´s project decision documents were generally of high quality.

Its interventive role in the project can be seen as a balance act between being a contract financier and a regular project financier. In the opinion of this evaluation Sida has managed this balance act very well.

The following were some of the reasons for Sida´s active role:

In relation to many other clients all over the world of BITS concessionary credits the municipal heating companies who were BITS´ clients in the China, were not seen to be strong enough to be able to negotiate successfully a technologically complicated contract with a foreign supplier. Therefore there was a constant debate going on within BITS on whether or not, in China, they should modify their traditional role which is to leave all planning as well as implementation to the contracting parties and generally to abstain from any involvement in the design of a project. Acting as an outside financier of ready negotiated contracts was always the cornerstone of BITS operating philosophy.

Nor was the ministry in Beijing, MOFTEC, responsible for all aid relations with foreign donors, seen as sufficiently strong in the sense of possessing competence in assessing technologically advanced projects or to guarantee a successful implementation in the case of new and inexperienced end-users, like the municipal DH companies.

Nor did BITS feel that they could expect the Swedish suppliers to take responsibility for the projects to be well planned and well balanced in terms of needs for import, and that ”appropriate technology” would be imported rather than just the latest technology.

Because of these considerations there was a readiness at least on part of some of BITS personnel to play a more active role in its Chinese credits than they were traditionally used to.

Nor were the clients always seen as able to prepare appraisal reports of sufficiently high standard. Therefore, sometimes Sida´s involvement in project planning and design became relatively large.

Because several of the Swedish suppliers claimed that their Chinese clients were overly focusing on the hard-ware part of a contract and hesitant to use the funds to pay for soft-ware by way of supervision and training, Sida found itself obliged to actively control that the required items like supervision, spare parts and training were always present in the contract and in sufficient amounts.

Also, like the World Bank, Sida was concerned about the fact that heat tariffs in China are based only on floor space and not at all on how much is consumed. Sida perceived a risk that when going from individual stoves (where cost is directly linked to amount of consumption) to central heating, people would start consuming heat in a more wasteful manner, and therefore consistently suggested to the end-users that new buildings and newly installed central heating systems should be equipped with two-pipe heating systems that allow for individual household metering and room temperature control.

This higher level of intervention on part of BITS, partly brought about against BITS will, led to a sole searching within the agency regarding not only what position to take in a particular question, but more importantly, on its general policy: Should Sida go in and scrutinize proposals at an early stage, getting the advantage of being able to offer advice to the client and not risking to have to say no to a credit request at very late stage of a project. If yes, should it also play an active role in the tendering procedure? Even though no concrete decision regarding the appropriate degree of involvement in the future, was taken, the internal debate was constructive and can have been expected to enhance BITS´ routines.

Possible system failure

In spite of its generally interventionist attitude and active control of the projects, in at least one of the projects Sida can be criticized for failing to detect major shortcomings. I here refer to the case of the Swedish equipment which was shipped two China two years before their intended use. In the case of the computers, these were grossly outdated - and overpriced ! - by the time they were finally installed in the project. The supplier´s, and perhaps BITS´, passiveness w.r.t this delivery, can, in this evaluator´s opinion, at best be described as careless, but perhaps as irresponsible. The case raises serious questions not only about the competence of the Chinese importing agency, but also about the efficiency and meaningfulness of the donor agency´s planning and negotiating systems.

Analyzing this delivery one gets the impression that the client was rushed into accepting an immediate delivery in order not to loose the opportunity of Swedish concessionary financing. Could this be a system-failure of the Swedish concessionary credit scheme, in the sense that it does not contain an easy mechanism for part deliveries to be postponed to a later date?

According to one responsible Sida officer there is no legal obstacle for a concessionary credit to be arranged in different tranches, although this might slightly complicate the calculation of amortization periods etc. Another solution could be to for the credit agreement to specify a very long disbursement period. One set-back with a long disbursement period or different tranches would however be that the client must pay a higher commitment fee, as well as higher insurance fee.

Another snag is that the Swedish agency supplying the commercial part of the credit, SEK, will only procure a credit at the time when it is needed. If a credit is negotiated in several tranches, wide apart in time, it would thus bring an added complication for SEK.

Theoretically, the best solution would perhaps be to opt for two separate credits, instead of a single one of long maturity. This would, in consequence, also imply that the commercial negotiations between importer and exporter are held at two different times. But it is not clear whether such a solution would be agreeable for the donor agency Sida.

In this case the client has apparently seen it as a necessity that a credit be used up within a specified time period. The Swedish supplier also comes out as a victim of this system because he has no incentive to work out an optimal package for the client even though it would not cost him anything. In the case referred to above there was obviously no gain for the Swedish supplier to deliver a system which is out of date by the time it is installed. But this is what happened, and as a result also the Swedish supplier may suffer commercially when the client slowly but surely becomes aware that his computer system is outdated already from the start. Also in the Finnish-supported project in Donshan the computers were delivered way ahead of their planned installation date. Neither the Finns suggested to the company that they should delay the delivery of the computers.

Violation of Sida´s energy policy

The decision on part of Sweden to finance district heating projects in China does not comply with one fundamental requirement of Sida´s policy on aid in the field of energy, namely that no aid should be given to countries that increase its coal dependency.

Improving the country´s energy efficiency today stands out as the government´s main environmental protection strategy in its fight to reduce air pollution and stop increases in green houses gas emissions. However, for compelling economic reasons, coal will remain the only economical option for most of China´s cities. The enormous potential for cost effective improvements in energy efficiency remains untapped in China

Since this evaluation has found the district heating projects to be highly beneficial for the country,
our conclusion is that there is something wrong with Sida´s energy policy, at least in the form that it is today written.

Reporting obligation

In none of the five projects has any of the contracting parties - neither the seller nor the buyer - complied with the contractual obligation to provide BITS with a completion report six months after commissioning of the project.

SCORING SYSTEM

The findings of this evaluation report can be summarized in the following scoring system, where performance with respect to each aspect evaluated is classified on a scale 0 to 5, where 0 is bad and 5 is excellent. N.a means that the aspect in question is not applicable or relevant in the project, and a dash (-) means that there is no information available.

Table 29: Scoring system for various aspects evaluated, 0-5

Project / *Aspect*	*Dali an*	*Tai yua n*	*Shijia zhua ng*	*Jiamus i*	*Fush un*	*Total score*	*Number of observation s*	*Average score*
Procurement	2	4	4	2	3	15	5	3
Implementation	2	3	3	3	3	14	5	2,8
Results/outputs	2	1	4	4	3	14	5	2,8
Financial profitability	2	1	2	2	2	9	5	1,8
Economic profitability	5	5	5	5	5	25	5	5
Environment	5	5	5	5	5	25	5	5
Equality/ Poverty orientation	na	na	na	na	na			na
Gender	na	na	na	na	na			na
Democracy	na	na	na	na	na			na
Independence	na	na	na	na	na			na
BITS´s project preparation	4	1	4	4	4	17	5	
Reporting requirement	0	0	0	0	0	0	5	0
Sustainability	5	5	5	5	5	25	5	5
Total score	27	25	32	30	30	144	45	3,2
Number of observations	9	9	9	9	9	45		
Average score	3	2,8	3,6	3,3	3,3	3,2		

IX SUSTAINABILITY

Assessing the project´s *sustainability,* following guidelines published by the EU, we can subdivide the concept into the following aspect: *technological, policy, socio-cultural, environmental, financial ,managerial and institutional* sustainability. And we will also add *economic* sustainability.

Technologically

Even though there are problems with spare parts in almost all the projects, we have seen that essentially the Chinese end-users are well familiar with the advanced equipment imported from Sweden. Some of the equipment is even started to be produced in China of a quality and capability which in a few years may compete with the imported products, which still today hold a functional and qualitative edge. We therefore do not see a situation where the companies today running DH operations based on the imported Swedish equipment, will in the long run find themselves lost not knowing how to maintain or repair the installed systems, maybe with marginal help from abroad - even several years from now - for advice as well as for some strategic spare parts. Such technological distress situation would not be surprising if they were to occur in the next couple of years, but I do not see them as very likely in several years time when the current DH operations have matured and when local manufacturers, often in Partnership with Swedish and other foreign firms, have caught up in production technology to be able to compete with imported equipment. I therefore conclude that while technological sustainability is not guaranteed in the short or medium term, there is little reason to worry about it in the long term.

Financially

It follows from our discussion regarding the financial profitability in this report that the financial profitability of the DH corporations involved in the Swedish financed projects stands and falls with administrative decisions regarding subsidies, tax payments and most of all tariff policy. Due to various delays and more or less minor shortcomings it would seem that none of the five projects analyzed in this report was able to achieve planned financial profitability. But the reason for these shortcomings were rather connected to circumstances outside the control of the mangers rather than reflecting incompetence or lack of knowledge on part of the companies. From an administrative efficiency point of view all of the companies seemed at least reasonably proficient and dynamic. There is therefore nothing indicating that, given proper legislation regarding prices and tariffs and a competitive structure in the industry, the district heating companies could not develop into financially viable and sustainable enterprises. This is not something we can determine today. It will depend on the government's policy w w.r.t. to tariffs, competitive structure and a host of other factors.

Financial, *managerial* and *institutional* aspects can - based on the above reasoning - all be seen as connected to one another.

Environmentally

Introduction of district heating to replace a multitude of scattered boilers, or a modern, *indirect* DH system introduced to replace an old soviet style, *direct* system will lead to considerable or even huge improvements in the environment. This is a truth which is not overturned by the fact that the fuel source for the heating will remain to be coal. Even if we allow for a situation where the project would experience technological difficulties and therefore not being able to reap all the expected advantages and benefits, the environmental effects would still be so much better than the old system that it replaced.

We can therefore categorically state that the five DH projects evaluated in this report are clearly environmentally sustainable.

Economically

The elements explaining the very large economic profitability of introducing district heating are well defined and obvious. Because district heating replaces many smaller inefficient boilers with a much more efficient big heat producing plant, the saving in fuel consumption and the reductions in pollutive emissions realized in the short run will inevitably and by definition be there also in the long run.
There is no foreseeable circumstance which could change this fact. Therefore it is clear that the projects are economically sustainable.

Policy-wise

It is obvious that China´s government is today totally aware of the large improvements in terms of environment, energy conservation as well as economic benefits for the country associated with the introduction of District Heating. It would therefore be totally unrealistic to imagine that something would happen on the policy level which could put in question the sustainability of district heating projects

Socio-culturally

There is no circumstance of socio-cultural nature going on in Chinese cities which would in any way question the sustainabilty of the DH projects.

X LESSONS LEARNED

Importance of spare parts, training and supervision

The analysis carried out of the five district heating projects once more confirms an old lesson which has been learned in many other projects all over the world, namely that it is not wise to try to economize too much on the amount of spare parts to include in a delivery.

The same holds true for the amount of *training* and *supervision* that should be included in the contract so as to ensure successful installation and operation of modern equipment hitherto unknown. In the projects evaluated here there were many
indications that the amount of training and supervision in the contracts had been insufficient.

Choice between imported versus domestic equipment

Even if it is today possible to equip and smoothly operate a complete DH substations relying exclusively on Chinese equipment, this does not necessarily mean that - from a Chinese point of view - it is always wiser to buy only domestic equipment. *Firstly*, chances are that the quality, both in terms of functionality and durability, of imported equipment could turn out to be so superior that even at double the price it would be a much more economical for the Chinese district heating companies than domestic equipment. *Secondly,* irregardless of prices and of economy, it must be good for Chinese development to have a few show case projects where alternative - *id est* foreign - technology can be demonstrated , and against which the domestically manufactured equipment can measure its performance, quality and price. This is perhaps the only real effective way how China´s own capital goods industry will develop and in the future compete fully with the foreign imports.

Limited role of financial analysis

In countries like China, where the outcome of the financial analysis can at any moment be changed simply by the government making a political or administrative decision which changes a tax, a subsidy or modifies a tariff which is not set according to supply and demand, the financial analysis is important mainly for deciding if a project can be financed in the commercial market, or if it needs subsidies by way of e. g. domestic or foreign concessionary credits. It is then the project´s *economic* profitability which should serve as the main criterium whether or not a project is worth while and desirable.

In today´s China, even though important steps have been taken towards a market economy, there are enough remaining regulations and subsidies both on the cost and revenue sides, and with enough distortions, due to hidden subsidies and tax payments structure to make it difficult to understand for the foreigner. This of course

makes the financial analysis of a limited interest. Economic viability is a *necessary* condition, whereas financial viability is not, because it can be changed at will by the government.

Financial and institutional viability of district heating company

There are interesting differences between the World Bank and Sida in their respective attitudes toward very similar district heating projects in China. The World Bank emphasizes *institutional* development, because its aim is to help develop the DH companies into efficient enterprises that are able to deliver their services without becoming a drain on the taxpayers support, and also in more general terms help build a more efficient price structure in the economy. While Sida also certainly tries to address these issues, its relative emphasis lies in generating economic benefits to the country, not in institutional development. But Sida is somewhat vague. On the one hand it claims, at least implicitly, that the financial viability of an independent district heating company is an important objective of the project. But it has done nothing by way of institutional or other analysis or follow-up to back up such an ambition.

Studying the difference between the World Bank and Sida one may learn the following lesson:

If a donor engages in financial analysis only, or mainly, in order to satisfy the requirements posed by the OECD Helsinki rules, which forbid concessionary financing to be given to commercially viable projects but which requires the project to be economically viable, a fairly modest level of ambition will suffice. If however the donor is genuinely interested in the financial viability of the district heating company in order to help develop it into an independent entrepreneur, mere financial and cash flow analysis will not be enough. Then the donor also needs to carry out also a considerable amount of institutional analysis.

Economic profitability of district heating investments

Introducing district heating in areas where none existed before can be expected to be highly profitable for the country´s economy. This is almost a general truth which is intuitively easy to understand, for by generating heat in large efficient boilers that replace a multitude of smaller inefficient boilers, very large savings can be realized in coal consumption, and in reduced gasoline consumption because of reduced need for transportation of coal and ashes through the city . Furthermore, in the case where an already existing power-plant is converted to a co-generation plant, the DH-system in effect makes use of a free resource, namely waste energy, which in the absence of a DH solution would be just emitted unused into the air[6]. As a result there are dramatic

[6] One contributing reason why the *economic rate of return,* in DH-projects which make use of an already existing heat source, can be dramatically higher than the *financial rate of return* could the fact that in the economic analysis the already existing heat production facility is treated as a sunk cost not a new invewtment. The only addditional expenswees incurred

reductions achieved in emissions of pollutants, and the economic savings of the projects can be expected to be enormous.

These economic benefits are of such magnitude that their economic profitability can not be threatened by the projects suffering this or that technological set-back or because it is implemented with one or even a few years delay.

The importation of advanced technology from the West is not a pre-condition for achieving high economic profitability, as is sometimes implied by some donor agencies. The bulk of the dramatic environmental improvements as well as the large savings in energy consumption that are a result of introducing DH to replace a multitude of inefficient individual boilers, would be reaped also in project relying exclusively on Chinese technology. Imported, advanced technology can make these gains bigger, but are not a condition.

Importance of follow-up contacts and cooperation

A close collaboration between the client and suppliers is essential in order to avoid many instances of discontent and misconceptions and misunderstandings.
Even though the Swedish equipment has been delivered according to schedule, and after installation found to perform basically according to plan, there is today a large amount of uncertainty and speculation going on regarding the quality of the Swedish equipment, and perhaps more importantly regarding the relevance of importing this equipment instead of buying alternative equipment from the local market.

This state of affairs seems to suggest that more attention should have been devoted on part of both the Swedish suppliers, and not least of the donor Sida to after-implementation contacts and cooperation. As it is today it almost seems that a considerable potential gain of good-will for Swedish aid and for Swedish export industry is lost unnecessarily. As a possible measure which may go some way towards improving the situation it is proposed below that a follow-up seminar be organized for representatives of end-users, suppliers, consultants, donors and relevant Chinese government agencies.

The lesson learned from this would be the following: In the case of concessionary financing of investment projects, where normally the donor participates actively only up until the financing decision, it could sometimes be a good idea to have a more active follow-up activity, starting already at the time of implementation, and not waiting several years until evaluation is due. This would seem to be especially true in cases like the present one, when there is a whole series of similar investments.

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are the connecting costs to the new district heating network and the costs of foregone power production during trhe heating season plus the house connection costs from the heat substations to individual living quarters.

XI RECOMMENDATIONS

Modification of Sida´s energy policy

It was found above that Sweden´s decision to finance district heating projects in China is incompatible with one requirement of Sida´s policy on aid in the field of energy, namely that no aid should be given to countries that increase its coal dependency.

Given the finding by this evaluation that these district heating projects are highly beneficial for the country, and given the fact that, for compelling economic reasons, coal will remain the only economical option for most of China´s cities, it is recommended that Sida modify the text of its energy policy so as to make it compatible with future Swedish aid to district heating development in china.

Wrap-up seminar

Sida should consider the idea of arranging and financing a ”wrap-up” seminar with the participation of the responsible managers and chief engineers from all the five DH projects, representatives from the suppliers, relevant consultants, and for key persons from Sida as well as from the Chinese government. This would allow all actors concerned to exchange views on the experiences gained and insights received. Not least for the Swedish suppliers it would be useful to learn more all the small mistake on how to design better more competitive systems in the future.

Today one can easily get the feeling that the projects have been left hanging in the air somehow. They have all been finished with generally good results, and even though the clients generally seem to be satisfied with the essential parts of the delivered systems, there are in deed quite a large number of small things which are not or have at some time not been working. It is no exaggeration to say that communication between suppliers and clients have not been enough. This is not to suggest that the Swedish suppliers, in most cases, have not done what one can reasonably expect to service their clients. But the long distance between Sweden and China (not only geographically) has taken its toll. In each of the five projects one gets an impression that there are a number of issues, problems, small confusions or disagreements which need to be talked about. This does not seem unnatural given the situation at hand: not only are the Swedish suppliers relatively inexperienced in doing business in China, but for at least some of the clients the contract with the Swedes was virtually their first and sometimes only contact with a foreign company. There seems to be a risk that a considerable potential gain of good-will for Swedish aid and for Swedish export industry maybe lost unnecessarily.

A seminar for all involved would seem to be a very timely forum for airing many outstanding small issues, to follow up and exchange the various experiences and insights and thus close the book on this first generation of cooperation between Sweden and China in the field of district Heating.

Cooperation with the World Bank

If Sida decides to support district heating projects also in the future it is imperative that cooperation, or at least exchange of information, be taken up with similar projects supported by the World Bank. This does not mean that they should strive towards cofinancing, for that may prove difficult given that the Bank has market loans and Sida concessionary credits, and because the objectives vary somewhat between the donors. The cooperation should mainly be at the level of an active exchange of information. Today´s situation, where the two donors are apparently barely aware of the existence of the other, is clearly unsatisfactory.

Even though the contents of the projects will vary due to the banks emphasis on institutional development and Sida´s emphasis on the environment and energy conservation effects, it is obvious that there must be very large gains for both the donors if they can share whit each other analysis carried out and experiences gained.

Reporting obligation

Given the fact that in none of the five projects any of the contracting parties have complied with their contractual obligation to provide Sida with a completion report six months after commissioning of the project, and given the fact that this seems to be the normal state of affairs in virtually every concessionary credit granted by BITS, it is recommended that Sida either abolish this rule *or* take it seriously by actually starting to implement it.

ANNEX 1

Acknowledgements

I am grateful to all the persons listed in annex two for making themselves available for interviews, meetings as well as for visits to project sites.

The very intensive program, covering five projects in five different cities in two weeks, would not have been possible without the very forthcoming attitude on part of the management of the various district heating companies, agreeing to meet also on Sundays, nor without the logistics managed by Mr *Xing Xiao Ming*, Deputy chief in MOFTEC, Ministry of Foreign Trade and Economic Cooperation. Also the assistance given to me by the Swedish Embassy was valuable.

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Finally, I wish to express my sincerest thanks to the officers of the district heating companies, as well as to the representatives of the respective local governments in Jiamusi, Fushun, Dalian, Shijiazhuang and Taiyuan for their fantastic hospitality and generosity in receiving me as their guest.

ANNEX 2 PERSONS MET

Dalian, Liaoning Province

Dalian Thermal Power Group Company, DTPGC

Da Zhen Ya	Deputy chief Engineer
Jaclyne	Translator
Li Tong Yan	Department of Heating Network, Engineer
Li Yong Jiu	Vice General Manager, Director
Sun Shu Zi	Vice Manager
Wang Zhi Jie	Head of Substation
Zhang Zhen Qiang	Department of Security and Education

Dalian Municipal Commission of foreign Economic Relations and Trade

Nee H.B. Catherine	Translator
Shijie Lee	Foreign Liaison Officer, translator
Wang Yanhui	Vice Director
Zhao Zhen	Division Chief and Secretary General of Dalian International Technology and Trade Association

Taiyuan, Shanxi Province

Tai Yuan Heating Power Company

Cui Huiping	Planning Department
Fan Min	Heating Engineer
Hao Gui Wen	General Secretary
Li Xiaozhong	Financial Department
Mou Lipeng	Substation (No 407) Operator
Yin Xingli	Substation (No 403a) Operator
Zhang Dingshan	General Manager
Zhang Jianwei	Chief Engineer
Zhang Xiao Yan	Control Engineer

Taiyuan foreign Economic Relations & Trade Commission

Ma Jian Ping	Vice Division chief Engineer
Tang Zheng Bao	Vice Director

Shijiazhuang, Hebei province

Shijiazhuang Cogeneration, Power & Gas Enterprises Group Company

Feng Shifeng	Vice Manager of plant
Guo Yinghua	Chief Engineer and Vice Director the Design Institute
Hao Jianqiang	Vice Manager of plant
Jian Huixing	Vice Manager of plant
Li Jingxing	Manager of Vandimie Plant
Li Shuying	Director of financial Department
Li Xiangdong	Vice General Manager
Yu Lixiang	Senior Engineer, Design Institute
Wang Menghong	
Zhang Huiyong	Director of Production and Technical Department
Xing Meng Xiang	Engineer, Technology Development Department; Translator

Independent Substation

Liu Bing	Manager of Technology department
Tan Hongjie	Sub-station chief; Assistant Engineer

Foreign Trade and Economic cooperative Department of Hebei Province

Li Xiao Feng	Deputy Director
Cou Fen Ding	Deputy Director

Jiamusi, HeilongJiang Province

Jiamusi City Heating Power Company

Dong Chong An	Manager, Control and Communications Department
Luan Guang Qing	Office Director; Political Engineer
Yan Ji Xiang	General Manager; Senior Engineer
Zhang Ming Chun	Vice General Manager; Engineer
Zhu Qing Bin	Vice General Manager; Chief Engineer

Heilongjiang Provincial Department of Foreign Trade and Economic Cooperation

Li Le Yu	Program Officer

Fushun, Liaoning Province

Fushun Heat and Power Company, FHPC

Meng Jie	Senior Engineer; Director of Technical Services
Zhang Wenchao	General Manager
Zhang Zuo Ming	Vice Manager
Zhu Yong Jian	Chief Engineer, Vice General Manager

Fushun University, Department of Applied chemistry and Fushun Petroleum Institute

Liu Guomin	Associate Professor of chemistry; Translator

Liaoning Provincial Bureau of Foreign Trade and Economic Cooperation

Wang Shou Guan	Vice Director

Fushun Foreign Trade & Economic Cooperation Committee

Zhao Shu	Vice Director
Zou Rong	Director

People´s Government of Fushun Municipality

Wei Dong Ping	Vice Mayor

MOFTEC, Ministry of Foreign Trade and Economic Cooperation

Xing Xiao Ming	Foreign Financing Administration, Deputy chief

Swedish Embassy in Beijing

Ericsson, Sofia	Programme Officer (Sida)
Anneling Kjell	Ambassador

World Bank, Beijing Office

Vermilya, Dawn	Financial Analyst Urban Development sector Unit
Plant, Georg	Programme Officer

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- *BITS Decision Memorandum No 11-94/95;* dated Stockholm 1995-03-19

Jiamusi District Heating project

- *Review of the Jiamusi District Heating project, China for potential Swedish credits;* Appraisal commissioned by BITS carried out by Björn Andersson and Birger Abrahamsson with cooperation of Olle Holmertz of BITS and Björn Andersson of AIEKA HB; Stockholm December 1994

- Untitled report regarding progress and implementation provided by the JDHC on April 1998

- *BITS Decision Memorandum No 7-94/95;* dated Stockholm 1995-04-25

Fushun District Heating project

- *Review of the Fushun Middle area District Heating Project, China for Potential Swedish credits;* Appraisal commissioned by BITS carried out by Björn Andersson and Birger Abrahamsson with cooperation of Olle Holmertz of BITS and Björn Andersson of AIEKA HB; Stockholm December 1994

- *BITS Decision Memorandum No 8-94/95;* dated Stockholm 1995-04-28

ANNEX 4 - TERMS-OF-REFERENCE[7]

for the **EVALUATION OF FIVE DISTRICT HEATING INVESTMENT PROJECTS IN CHINA PART- FINANCED BY BITS CONCESSIONARY CREDITS**

Background

During 1993 and 1995 BITS decided to grant concessionary credits in support of five *District Heating* investments in China, which are now to be evaluated. The investments concerned the following projects:

1. *District Heating project in Dalian*
2. *District Heating project in Taiyuan*
3. *District Heating in Shijiazhuang*
4. *District Heating in Jiamusi*
5 *District Heating in Fushun*

The total amount of concessionary credit granted to these five projects was app. 145 MSEK with a cost to the Swedish aid budget of app. 51 MSEK
The general purpose of the projects was to expand the district heating network which means connecting additional building area to the central heat network thus replacing many smaller scattered boilers. The expected results from the projects were large savings in energy consumed, as well as very large reductions in emissions of pollutants in the cities.

Although the contents and the objectives vary between the five projects, the main objectives of all were to

- save energy by enhancing efficiency in heat and power generation, and to
- reduce environmental pollution

The Swedish financing was meant to cover the import contracts with different Swedish suppliers of district heating equipment. The composition of different type of equipment varied between the different projects but covered imports from Sweden of mainly

[7] The terms-of-reference reproduced here does not correspond exactly to the terms-of-reference attached to the formal decision to evaluate taken by Sida. The reason is this: The Sida decison, was taken in two installments each covering parts of the total scope of work and also including a project from a diifferent sector. Therefore, for the conveneience of the reader, we have reconstructied a terms-of-reference applicable to the five DH heating projects, and in doing so, we are reperesenting *exactly* and *fully* the contents and the purpose of the assigm´nment given by Sida.

- heat exchangers for sub-stations
- shut-off valves, regulating valves,
- circulation pumps,
- flow metres
- prefabricated insulated pipes
- hardware and software products for a computer monitoring system,
- installations supervision
- documentation
- training

One of the points noted by BITS when deciding to approve the financing was that the project by the Chinese authorities was seen as a demonstration project in so far that it would show to what extent advanced western technology could be used alongside with Chinese know-how and equipment in order to modernize China´s municipal and other heating systems. The lessons from the project would be incorporated into future Chinese district heating planning and equipment standardization.

The cities, where the projects are located belong to the most polluted cities in China, and a direct correlation had been found between air pollution levels and hospitalization for respiratory and other diseases.

According to appraisals the projects would have enormous economic benefits for China. If China had the same tax levies on emission of sulfur and CO2 as Sweden, then the total savings expected to be realized in only one of the projects would amount to some 750 MSEK.

Reasons for evaluation

Firstly, none of the projects, which have all been completed, has been evaluated. According to Sida´s evaluation policy a final evaluation is therefore due.

Secondly, according to the BITS project preparation documents, the projects, in varying degree, were seen as important *demonstration cases* and large expectations were raised with respect to their outcomes.

Sida has today no information whatsoever on the outcomes of these projects, nor with respect to their implementation or their outputs. Nor does Sida have any insight into the extent to which the main objectives have been reached.

Type of evaluation

Following Sida´s normal level of ambition the investments financed by Sweden should be subjected to a *comprehensive* ex post evaluation, comprehensive meaning that it should cover not only all levels of the projects´s goal hierarchies - inputs, activities, outputs, effects and impacts - but also all the usual aspects and criteria which are important for Swedish aid, among them the 6 main objectives of Sweden´s development cooperation.

The objective and scope of the evaluation

The *objective* of the evaluation will be to assess the outcomes of the projects at the different relevant levels, as judged against the aid criteria of BITS and Sida, as well as against applicable development cooperation principles of Swedish aid, e.g. Sida´s *Policy for Support to Energy and Environment* established in April 1996.

The *scope* of the evaluation includes:

(1) to provide background *information* about:
- the development of the *district heating* sector in China
- the financial status, operational results and institutional strength of the companies and institutions involved

(2) assess the *implementation* of the project, i.e the delivery of the Swedish equipment and the efficiency of use of this equipment in the respective projects.
- identify delays in project implementation and operational areas, if any
- analyze financial, economic and operational consequences of deviations from the implementation plan (if any)
- evaluate the Swedish supplier´s training efforts with regard to transfer of know-how
- assess follow up and maintenance routines etc. of the respective projects
- assess the recipients capability to operate and maintain the systems
- evaluate the performance of the Swedish supplier in interaction with the client

(3) evaluate the *effects* that the use of the Swedish deliveries have had on the respective programs,
- ascertain whether the project objectives have been attained
- collect operational data and quantify results wherever possible

(4) evaluate the *impact* that the respective projects have had, or are likely to have in the future, on relevant local, regional and national goals.
- investigate and report on environmental impacts from the projects
- investigate and report on gender issues related to the project

(5) The outcomes should be assessed against the stated project targets as well as the overall objectives of Swedish development cooperation, namely
- *Social and economic equality / poverty alleviation*
- *Economic growth*
- *Independence*
- *Democratization*
- *Gender equality*
- *Environment*

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