Financing of Small-scale Hydropower Projects

IEA Technical Report

IEA Hydropower Agreement


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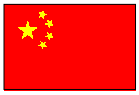
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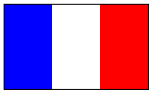
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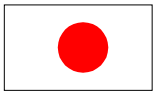
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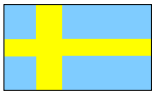
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OVERVIEW OF THE IEA IMPLEMENTING AGREEMENT FOR HYDROPOWER TECHNOLOGIES AND PROGRAMMES

The Hydropower Implementing Agreement is a collaborative programme among nine countries: Canada, China, Finland, France, Japan, Norway, Spain, Sweden and the United Kingdom. These countries are represented by various organizations including electric utilities, government departments and regulatory organizations, electricity research organizations, and universities. The overall objective is to improve both technical and institutional aspects of the existing hydropower industry, and to increase the future deployment of hydropower in an environmentally and socially responsible manner.

HYDROPOWER

Hydropower is the only renewable energy technology which is presently commercially viable on a large scale. It has four major advantages: it is renewable, it produces negligible amounts of greenhouse gases, it is the least costly way of storing large amounts of electricity, and it can easily adjust the amount of electricity produced to the amount demanded by consumers. Hydropower accounts for about 17 % of global generating capacity, and about 20 % of the energy produced each year.

ACTIVITIES

Four tasks are operational, they are: 1. upgrading of hydropower installations, 2. small scale hydropower, 3. environmental and social impacts of hydropower, and 4. training in hydropower. Most tasks have taken about five years to complete, they started in March 1994 and the results will be available in May 2000. To date, the work and publications of the Agreement have been aimed at professionals in the respective fields.

UPGRADING

The upgrading of existing hydropower installations is by far the lowest cost renewable energy available today. It can sometimes provide additional energy at less than one tenth the cost of a new project. One task force of the Agreement is studying certain technical issues related to upgrading projects.

SMALL SCALE HYDROPOWER

Advances in fully automated hydropower installations and reductions in manufacturing costs have made small scale hydropower increasingly attractive. The small scale hydropower task force will provide supporting information to facilitate the development of new projects.

ENVIRONMENTAL AND SOCIAL ISSUES

For some hydropower projects the environmental and social impacts have been the subject of vigorous debate. There is a need to communicate objective information to the public, so that countries can make good decisions with respect to hydropower projects. The environmental task force will provide such information on possible social and environmental impacts and on mitigation measures.

TRAINING

The availability of well-trained personnel is a key requirement in the hydropower sector. The training task force is concentrating on training in operations and maintenance, and planning of hydro power projects.

THE INTERNATIONAL ENERGY AGENCY – IMPLEMENTING AGREEMENT FOR HYDROPOWER TECHNOLOGIES AND PROGRAMMES

Financing of Small-Scale Hydropower Projects

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March 2000

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OTHER TECHNICAL REPORTS IN THIS SERIES

HYDRO POWER UPGRADING TASK FORCE (ANNEX 1)

Guidelines on Methodology for Hydroelectric Turbine Upgrading by Runner Replacement – 1998 (available to non-participants at a cost of US $ 1,000 per copy)

Guidelines on Methodology for the Upgrading of Hydroelectric Generators – to be completed in May 2000.

Guidelines on Methodology for the Upgrading of Hydropower Control Systems – to be completed in 2000.

SMALL SCALE HYDRO POWER TASK FORCE (ANNEX 2)

Small Scale Hydro Assessment Methodologies – to be completed in May 2000 (available to non-participants on request)

Research and Development Priorities for Small Scale Hydro Projects – to be completed in May 2000 (available to non-participants on request)

Financing Options for Small Scale Hydro Projects – to be completed in May 2000 (available to non-participants on request)

Global database on small hydro sites available on the Internet at:
www.small-hydro.com

ENVIRONMENT TASK FORCE (ANNEX 3)

Survey on Positive and Negative Environmental and Social Impacts and the Effects of Mitigation Measures in Hydropower Development – 2000 (available to non-participants on request)

A Comparison of the Environmental Impacts of Hydropower with those of Other Generation Technologies – 2000 (available to non-participants on request)

Legal Frameworks, Licensing Procedures, and Guidelines for Environmental Impact Assessments of Hydropower developments – 2000 (available to non-participants on request)

Hydropower and the Environment: Present Context and Guidelines for Future Action
Volume 1: Summary and Recommendations
Volume 2 : Main Report
Volume 3 : Appendices
– 2000 (available to non-participants on request)

Guidelines for the Impact Management of Hydropower and Water Resources Projects – 2000 (available to non-participants on request)

EDUCATION AND TRAINING TASK FORCE (ANNEX 5)

(All of the following reports are available on the Internet at www.annexv.iea.org Some reports may consist of more than one volume.)

Summary of Results of the Survey of Current Education and Training Practices in Operation and Maintenance – 1998 (available to non-participants on request)

Development of Recommendations and Methods for Education and Training in Hydropower Operation and Maintenance - 2000 (available to non-participants on request)

Survey of Current Education and Training Practice in Hydropower Planning – 1998 (available to non-participants on request)

Structuring of Education and Training Programmes in Hydropower Planning, and Recommendations on Teaching Material and Reference Literature - 2000 (available to non-participants on request)

Guidelines for Creation of Digital Lectures – 2000 (available to non-participants on request)

Evaluation of tests – Internet Based Distance Learning – 2000 – (available to non-participants on request)

BROCHURE

A brochure for the general public is available. It is entitled "Hydropower – a Key to Prosperity in the Growing World", and can be found on the Internet (www.usbr.gov/power/data/data.htm) or it can be obtained from the Secretary (address on the inside back cover).

Preface

This report is the result of the work of Annex II, Sub-task 8.1 – Financing of Small Scale Hydropower Projects – of the Task Force on Small Scale Hydropower, one of four task forces of the IEA Implementing Agreement for Hydropower Technologies and Programmes. The sub-task started its work in 1997 and has drawn on the resources and expertise of participating countries.

The process of arranging financing for small-scale hydropower projects is often difficult. The projects normally have to compete on the same terms as other projects even if they are environmentally sound. In spite of different obstacles, the financing situation for small-scale hydropower projects may be improved in several ways.

We hope that this report gives useful information of different, relevant ways of how to finance small-scale hydropower projects in a successful way.

The views presented in this report do not necessarily represent the views of the International Energy Agency, nor the governments represented therein.

Summary

This report describes methods for financing small-scale hydropower projects. Five main topics are covered:

1. The general aspects of financing of small hydropower projects, including the key players in the financing process.
2. Alternative financing strategies for small hydropower projects which includes a discussion of the different routes of financing, and factors affecting the choice of strategy.
3. A brief discussion of financing conditions
4. The key points in successful financing
5. Possible improvements to the financing situation

The main conclusions of this report are:

- Private involvement in the energy sector is becoming increasingly important as public funding diminishes. In spite of their environmental advantages, hydropower projects will have to compete for financing on the same terms as other projects, both in public budgets and in the private market.
- Obtaining finance for small hydropower projects is hard. Hydropower projects involve large up front investment, and are often regarded as high risk compared to thermal power projects.
- Small hydro projects face an additional obstacle. Because the investment involved is relatively small, limited recourse project financing is not feasible.
- The financing situation for small hydro projects may be improved in several ways:
    - By government incentives (loans, grants)
    - By reducing the risk to the developer and the financier (government guarantees, high quality stream flow data)
    - By reducing the development cost (joint development of several projects in an area, hydropower development groups, stepwise development)
    - By education and government resource centres to support developers during an early stage.

1 Introduction

This report covers the key points to be covered under Annex II, Subtask 8.1 ”Identification and Assessment of Financing Options for Small-Scale Hydropower Projects”.

This work has borrowed heavily from the guides: “Financing Renewable Energy Projects” and “Insurance considerations for renewable energy projects”, published by the Department of Trade and Industry, UK.

2 General aspects of small hydropower financing

2.1 Financial aspects

The construction and financing of power-generation projects have traditionally been the domain of the public sector. However, private investment in and ownership of power generation utilities have increased continuously in recent years. This is a consequence of a general liberalisation of the power market in many countries. Another factor in this development has been that funding from government and international agencies has become steadily more difficult to secure, making loans and equity capital from the private sector increasingly important in the financing of both thermal and hydroelectric power projects.

Compared to thermal power development, there are few examples of private sector development of hydropower projects. There are three important reasons for this:

1. The risk associated with investment in hydropower projects is often regarded as being higher than the risk of developing thermal power projects.
2. The large up-front investment required for hydropower.
3. The economic lifetime of a hydropower project is often far longer than the repayment period for the loan.

Small hydropower projects, i.e. those with a maximum output of less than 10 MW, often have additional features that make them less profitable and thus more difficult to finance than larger projects. Several of the cost components involved in developing hydropower do not change proportionally with project size. For a large project the feasibility study normally accounts for 1 – 2 % of total costs, while for a small project it may well amount to 50 % of the cost (Breeze 1997).

As the expected revenue of the project is small, there is little capacity to absorb unforeseen expenses. Consequently the economic feasibility of a small project is very cost-sensitive and the risk is higher than for larger projects.

Tight cost control is necessary to succeed. Very experienced engineers who can quickly identify a sound project design should do feasibility and design studies. Equipment should be “off-the-shelf” standard solutions.

The relatively small investment involved in each small hydropower project makes limited-recourse project financing difficult.

This report discusses the most important financing alternatives and their implications for the developer and the lender, and the distribution of risk between them. The report also attempts to identify possible ways of improving financing conditions for small hydropower.

2.2 Key players

The parties involved will vary, depending on how the project is financed. A large hydropower utility may design, construct and finance a new hydropower project with a minimum of involvement from other parties. In most cases however, the project will involve several parties: developer, lender, shareholders, contractors, etc. This section provides a general discussion of the parties involved and their interests in the power project.

2.2.1 Sponsor

The sponsor is the government agency or utility that is promoting a project. A private company that requires power may be the sponsor, but it may not want to build or own the plant (Breeze 1997). For large hydropower projects, the sponsor will normally be the national government or a government agency that wishes to improve the power-supply situation and to control the development of the power sector. For small hydropower projects the role of the sponsor is often less important. The project may be a part of a national or regional electrification programme with a government sponsor. However, in many cases the owners of the water rights develop small hydro projects.

2.2.2 Developer

The developer is the most important participant in the development project. They must secure the necessary permissions for the development, sign contracts with consultants, contractors and equipment suppliers, arrange a power purchase contract and secure the necessary financial resources for the development.

2.2.3 Lenders

Normally a bank or other investment institution will provide the majority of the financial resources needed, often in the order of 60 - 80 %. The lenders may be agencies established for the specific purpose of facilitating investment in the national infrastructure, e.g. the World Bank. They will provide financing at more favourable terms than can be obtained on the private market. Private agencies such as commercial banks and insurance companies can also provide funding for hydro projects. However, as their main concern is to earn money, their interest rates will be higher and payback times shorter. To obtain a loan the developer must convince the lenders of the project's economic feasibility and provide security for the lenders' involvement.

2.2.4 Investors

In most projects, bank loans will provide the largest proportion of the financial resources required. However, the last 20 – 30 % of the financing, the equity capital, must be provided from other sources. This capital is poorly secured and has the lowest claim on the project's assets and cash flow. In return for taking this risk, the investors will expect to have strong influence on the project, high-anticipated profits or other special benefits.

The project may be organised as a shareholders' company with the investors receiving shares in return for the equity they provide.

Possible investors include:

1. Power utilities that wish to influence or control the electricity supply in an area.
2. Industrial companies that wish to have access to power production utilities.
3. Local industry or local government agencies that provide venture capital to promote electrification in their area.
4. Financial institutions that are interested in long-term investments.

2.2.5 Power purchaser

The power purchaser will normally be a national or regional power utility or distribution company. It is also possible that the power will be sold directly to an end user, or to a power broker. The agreement between the developer and the user is spelled out in detail in the Power Purchase Agreement (PPA). It describes the amount of power to be supplied, prices and the price regulation agreement, and penalty clauses that come into effect if the conditions are not fulfilled. The PPA is extremely important for project development. It is the lenders' main security that the project will be able to pay its debts. Without it, limited-recourse project financing is impossible.

2.2.6 Contractor

The traditional approach to hydropower construction has been to let separate contracts for the individual elements of the project. The developer will also need an engineering firm to plan and describe the project, and for project control. As several parties are involved, it may be difficult to apportion the responsibility for cost overruns or delays.

An alternative is to use a single contractor and sign a turnkey contract. The responsibility for completion normally lies then with the contractor, to whom the risk, or a large portion of it, is transferred. Financiers may insist on a turnkey contract to avoid the risk associated with project construction and performance. The contractor will demand a higher contract price in return for assuming the risk.

3 Financing strategies for small hydropower projects

This section considers the main financing alternatives for small hydro projects, and discusses the implications for the developer and the lender. Thereafter the essential factors that must be considered when selecting the financing strategies are considered. The focus is on private market development, but a discussion of government incentives for promoting small hydro development is included.

3.1 Financing alternatives

Financing can be a major problem in many small hydro projects. In many cases, the developer does not have sufficient funds for self-financing, nor sufficient assets to provide security for a bank loan. In this situation, the developer can try to finance the project by securing loans against the anticipated cash flow of the project. However, this will require a series of complex contractual arrangements that are expensive to set up.

3.1.1 Use of in-house funds

The developer's accumulated reserves may be used to finance a project. This may involve company in-house funds or personal reserves. As hydropower projects involve relatively large up-front investments, the use of in-house funds as the sole source of finance is only possible for the smallest hydropower projects.

3.1.2 Ordinary bank loans (on balance sheet financing)

A bank loan supplies the majority of the required capital (60 – 80 %). Loans are secured against assets or property owned by the developer. Bank loans are relatively simple to arrange if the developer can provide sufficient security for the bank's involvement. As the lender's interests are well secured the need for a tight network of contracts to control risk can be relaxed, making the financing structure more flexible. This reduces the time and cost involved in arranging the loan. In addition, good security for the lender will normally result in lower annual borrowing costs. However, this route is normally closed to a developer with limited financial resources.

3.1.3 Co-development with a financially strong partner

The project is developed as a joint venture with a financially strong partner. A strong partner may provide equity capital and offer security for bank loans (assets/property). In addition to their risk-sharing potential, the partners may also be selected based on their ability to provide expertise important for the project (engineering, finance, and power market). A typical example of co-development might be a farmer who owns a waterfall. A power utility in the area may agree to finance, develop and operate a hydropower project at the site. In return for this the farmer may be allocated a number of shares in the project, a royalty payment or electricity supply.

3.1.4 Limited recourse project financing – "project financing"

The principal difference between on balance sheet financing and limited-recourse project financing is the way in which the bank loans are secured. In limited-recourse project financing the future cash flows from the project are the lenders' main security.

There are two important reasons for using limited-recourse project financing. The developer may not have sufficient assets to secure a bank loan, or the developer may not wish to bear all the project risk involved in the development.

As the lenders cannot rely on the liquidation value of the project (or sponsors) as a means of securing repayment, they will "take security". This involves exercising tight control over most aspects of the project development:

- Charge over the physical assets
- Assignment of the project contracts
- Contract undertakings
- Shareholder undertakings
- Insurance
- Bonding

All aspects of the project will be arranged to control the risk for the lenders, who will wish to see evidence of the project's economic viability. They will require an independent technical report by a credible consultant. They will scrutinise important agreements such as the power purchase agreement, the operating agreement, shareholders' agreement, etc. The lenders will wish contractors, suppliers and operators that have a strong record of accomplishment in their field. Whenever possible the risk is transferred to third parties. A contractor working on a turnkey fixed-price basis can be used to minimise the completion risk. A long-term Power Purchase Agreement mitigates the market risk. The lenders will even ensure that they have the right to step in and operate the project in the case that it is not paying its debts.

Limited-recourse project financing involves a series of complex contractual agreement. The initial arrangement costs are relatively high. This makes financing difficult for projects with a capital cost of less than US$ 5 – 10 mill (Mitchell and MacKerron 1994).

3.1.5 Leasing

Leasing the assets is an alternative to ownership. A lease can be defined as: "A contractual relationship in which the owner of the asset or property (the lessor) grants to a firm or person (the lessee) the use of the property's services for a specified period of time."(Levy and Sarnat, 1990). In 1980, the annual volume of the leasing industry was around 40 billion US dollars (Levy and Sarnat 1990).

In general, the types of leases available in the market today can be classified as either operating leases or financial leases. An operating lease is written for a short period of time, from a few months to a few years. The lessor assumes most of the responsibilities of ownership including maintenance, service, insurance, etc. The operational lease is not a long-term financial commitment, and is unlikely to be used for financing equipment in hydropower projects. A typical example is the rental of an office copying machine.

A financial lease (capital lease) is a long-term contract by which the lessee agrees to pay a series of payments that in sum will exceed the purchase price of the asset, and provide the lessor with a profit. The lessee takes on the fundamental ownership responsibilities such as maintenance, insurance, property taxes, etc. Normally the agreement is not cancellable by either party, but may provide clauses that allow cancelling should certain circumstances occur. Upon termination, the asset is returned to the lessor.

Leasing is most suitable for high-volume standard equipment, and is rarely used to finance hydropower equipment. However, this may be changing.

3.1.6 Build Own Operate (BOO)

In a BOO project the owner of the water rights grant the development rights to an independent developer. The developer controls the design, construction, and operation of the plant. In return, he pays a fee to the rights owner. In many cases, there is an agreement that the project will e transferred back to the owner after a period of time – Build Own

Operate Transfer (BOOT). BOO/BOOT projects do not necessarily involve a new route of financing. The developer may use one of the financing alternatives described above.

3.1.7 Pay-back using electricity or other goods

As an alternative to paying the debt in cash, the lender may accept payback in electricity or other goods. For example, a company with high power consumption may agree to finance a hydropower project. In return, it receives electric power from the developer.

1.1.1 Suppliers' credit

Suppliers are often willing to provide financing for their equipment. The purchase price is often closely linked with the financing terms. The conditions are subject to negotiation, and a competitive situation can significantly improve the terms available.

3.2 Factors which affect the financing strategy

Securing financing may be a major obstacle in developing a small hydro project, and the efforts involved should not be underestimated. In this section, several questions affecting the choice of financial strategy are discussed. The principal question for the developer is: should the project be financed by the use of in house funds, by co-development with a financially strong partner, by ordinary bank loans secured against the developer's other assets or property, or by limited-recourse project financing? The financing strategy will affect the developer in several ways. Risk, revenue, and control over the project are all closely related to the financial arrangements.

The developer's financial resources are the first things to consider. A financially strong developer can use in-house funds or ordinary bank loans. This gives a large degree of control over the project, which may be an important consideration, particularly if the project is a part of the developer's core activity. However, it also means tying up financial resources for a long time. With fewer financial resources, the developer must look for other routes of financing.

The size of the debt component is important when considering limited-recourse project financing of small hydro projects. The high arrangement costs make small projects unattractive to project lenders. In the UK, £5 million is considered an approximate lower limit (Mitchell and MacKerron 1994), which makes it an unlikely financing option for micro- and mini-hydropower projects. However, limited-recourse project finance ought to be available for projects in the upper segment of small hydro, i.e. 5 – 10 MW.

Co-development with a financially strong partner may be the only option for financing a small hydro project. At an early stage, the developer should consider possible partners for co-development. It may be worth approaching companies that are already involved in the operation of hydropower. Such companies are well qualified to judge the feasibility of the project and will already possess much of the expertise necessary for developing the project in-house.

Management of the project risks is another important consideration. In general, a high level of debt means a high cash-flow risk. Debt service has first claim on project earnings. The developer will receive revenue only if there is a surplus after interest and repayments.

The size of the financial obligations is important if the project is a failure. If the project fails, the developer in the case of in-house funding or ordinary bank loans carries all the losses. Using the same methods as in limited-recourse project financing can mitigate much of the risk. However, the developer should consider the consequences if the project is a failure.

In project finance, the cash flow risks are higher, but the involvement is limited. In a non-recourse project the involvement is limited to the equity. In a limited-recourse project the developer has accepted additional undertakings, but the involvement is still limited. The developer will have to pay a price for reducing the risk. The arrangement costs are high and third parties accepting a risk will require a premium.

The developer's desire to control the project is also affected by the financial arrangements. With a high degree of equity control of the project will remain with the developer. With much unsecured debt the financiers will control the project until it has been repaid. If control over the project development is important to the developer, he must also accept a larger financial involvement.

3.3 Current status for the financing of small hydro

Comprehensive statistics on financing of small hydro are not available. Some statistics concerning financing of renewable energy projects in UK are provided by Mitchell and MacKerron (1994):

Means of Financing 1990 and 1991 Non-fossil Fuel Obligation (NFFO) Projects with Total Capital Costs Below £5 million (excluding existing projects)

Technology	Total	MW	Project Finance	Corporate Finance	Company Reserves or Bank Loan	Private Reserves Bank Loan og "other"	? *	wd **
1990								
Biogas	1	1	0	0	1	0	0	0
Waste	2	4.5	2	0	0	0	0	0
Wind	3	4.18	2	1	0	0	0	0
Landfill gas	14	18.95	0	9	2	0	0	3
Hydro	14	3.59	0	4	3	2	1	4
Total	**34**	**32.22**	**4**	**14**	**6**	**2**	**1**	**7**
1991								
Wind	18	11.15	1	2	2	3	4	6
Hydro	4	0.78	0	0	0	4	0	0
Landfill gas	16	20.54	2	6	3	3	1	1
Sewage gas	2	2.35	0	2	0	0	0	0
Other	1	1	0	0	0	0	1	0
Waste	1	4.1	0	0	0	0	0	1
Total	**42**	**39.92**	**3**	**10**	**5**	**10**	**6**	**8**

Means of Financing 1990 and 1991 NFFO Projects with Total Capital Costs above £5 million (excluding existing projects)

Technology	Total	MW	Project Finance	Corporate Finance	Company Reserves or Bank Loan	Private Reserves Bank Loan og "other"	? *	wd **
1990								
Waste	4	65.4	3	0	0	1	0	0
Wind	2	7.06	1	1	0	0	0	0
Total	**6**	**72.46**	**4**	**1**	**0**	**1**	**0**	**0**
1991								
Wind	26	72.85	11	1	0	0	6	8
Landfill gas	7	17.43	0	7	0	0	0	0
Sewage gas	11	18.3	0	11	0	0	0	0
Other	3	29.15	2	0	1	0	1	0
Waste	8	262.7	1	1	0	0	2	4
Total	**55**	**400.4**	**13**	**20**	**1**	**0**	**9**	**12**

*? = unclear status **wd = withdrawn

4 Financing conditions

Financing conditions depend on the individual project, the financing institution, and the general conditions in the bank market. For this reason, any discussion of financing terms must be rather general.

In general, 50 % to 80 % of the total cost can be provided as debt. The level of debt that is acceptable to the lender depends on how the loan is secured a large debt component means increasing the lenders' risk. In turn, this results in a higher interest rate.

An ordinary loan is characterised by three components:
1. The interest rate
2. The loan life
3. The grace period

Normally the interest rate floats and varies with changes in some benchmark loan rate. Mitchell and MacKerron (1994) indicate that personal bank loans in UK may be made at 2-4 % over the base rate, while "on-balance sheet" loans will be made at 0.5 – 5 % above the base rate plus an up-front fee. Limited-recourse project finance will entail a banking fee of approximately 1 % of the total banking capital cost and an interest rate at least 1 – 2 % above the base rate.

Development institutions may provide loans with repayment spread over 10 – 20 years (Goldsmith 1993). Loans in commercial banks have a typical repayment time of 10 years, with 13 – 15 years as maximum (ETSU 1993).

For limited-recourse arrangements several additional elements must be considered:

1. Initial arrangement fee. The financiers will require an up-front fee for covering the arrangement expenses of financing.
2. Undertakings. The lenders may restrict the payment of dividends to shareholders. This is done in order to provide a buffer against unforeseen problems and may amount to half a year of debt service. Payment of dividends may also be cancelled in case the project is performing badly.
3. Conditions precedent. A number of conditions must be met before the loan can be drawn. Normally this requires that all contracts be to the bank's satisfaction, that all permits are in place, the existence of a favourable review from an independent technical consultant, all insurances in place etc.
4. Fees to external experts. The financiers will require all fees to external legal and technical advisers to be paid by the developer.

5 Key points in successful financing

Obtaining financing is a critical activity in developing a small hydro project. "Financing Renewable Energy Projects" (1993) lists the following key points for successful financing (abridged):

Consider the need for external advice

The developer should seek professional advice at an early stage in order to determine how to arrange the financing. Key advisers are financial, legal and technical advisers.

Verification of available resources

Lenders will wish to see evidence of the water flow available for power production. Reliable assessment of the water flow may be difficult, in particular at small hydro projects. It is suggested that flow gauging should start as early as possible, at a location close to the likely intake site. The developer should have at least 12 months of flow data. Correlating them with long-term stream flow or rainfall data from nearby gauging stations should extend the flow measurements.

Careful structuring of the contractual arrangements

The developer and his advisers should analyse the project risks and develop a plan for apportioning these risks. The principal agreements that the developer should focus on are:

- Engineering, procurement and construction agreement
- Power purchase agreement
- Operating and maintenance agreement
- Site agreements
- Shareholder agreement

Early attention to planning and consents

A checklist of all the permits necessary for the development must be drawn up, and a plan developed as to how these permits and consents will be obtained.

Approach to lending institutions

If the decision is made to utilise project finance, the developer in conjunction with his financial adviser should carefully select which lending institutions to approach. The local branch or the bank will not usually be equipped to deal with project financing other than small transactions. It is important to make contact with the specialist energy or financing group at head office. The best time to approach the lenders to request a formal commitment is when the contractual arrangements have been substantially negotiated (but not finalised) and the major development planning milestones have been met.

Information memorandum

The information memorandum is a business plan that gives the prospective lender a full picture of the project. It is an essential document that should be carefully and thoroughly prepared, as it is the principal means of attracting the lenders' interest in the project. An information memorandum should include the following:

- Project summary
- Overview of financial plan, sources and uses of funds
- Term sheet which describes the financial package as the developer expects the loan to be structured
- Description of development plan
- Description of the principal contracting parties
- Summary of major project contracts
- Summary of principal licences and permits
- Summary of risks
- Financing evaluation, which describes projected cash flows and project debt repayment for a number of scenarios.

Financial analysis and modelling

A comprehensive financial model of the project economy is important information to be provided to the lenders. The financial model should focus on project cash flow. The assumptions should be conservative, and a sensitivity analysis should demonstrate the viability of the project for a range of scenarios.

Project management of the development process

The developer should maintain and update a checklist of the outstanding items and issues that must be resolved in the project, together with a plan for how to make progress on each outstanding item.

6 Possible improvements to the financing situation

In many cases, arranging financing will be an important obstacle when developing a small hydro project, the most important reasons being:

1. Large up-front investment and very limited possibilities of gradual development.
2. The long-term nature of hydropower does not match the typical financial terms well.
3. The risks involved in hydropower are not well understood by financiers.
4. Many projects will be too small to attract the interest of project financiers.

Compared to thermal energy hydropower is environmentally sound. It is a renewable energy source with no polluting emissions. Regrettably, these important advantages of hydropower are not yet valued economically. In spite of their environmental advantages hydropower projects will have to compete for financing on the same terms as other projects, both in public budgets and in the private market. Three principal strategies have been suggested for improving the competitiveness of small hydropower projects:

1. **Public incentives**. Various government incentives to promote small hydro development.
2. **Cost reduction**. Reducing the cost of development and financing to make the project more profitable.
3. **Risk reduction**. Reducing the risks involved in small hydropower development and operation to make projects more attractive to developers and financiers.

6.1 Government incentives to promote small hydro

Governments faced with growing demand for energy and obligations to cut greenhouse emissions may wish to support the development of small hydro. Several methods are available:

1. **Public loans**. Loans on more favourable terms than can be obtained in the private market. These might involve an extra grace period, low interest rate, long payback period and less security. Part of the financial package might even be provided in the form of a grant.
2. **Power purchase agreements**. The government power utility can be instructed to purchase power from small hydro developers at a favourable price. This will secure the income from the project and is necessary for arranging limited recourse project financing.
3. **Guarantees**. The government may guarantee the payback of loans. This reduces lenders' risk and thus the developer's loan costs.
4. **Tax relief**.

6.2 Reducing the cost of small hydropower development

In many cases, hydropower projects will have to compete for funding in the private finance market, where the project is judged on the basis of its economic viability. In order to promote small hydro it is important to look for ways of reducing the costs of development. Three strategies are outlined below:

1. **Area development package**. The joint development of a number of small hydro projects in an area has several cost-saving effects: 1) collective planning and procurement of equipment reduces costs, 2) collective contract negotiations saves time and money, 3) the larger size of the project makes it more attractive to financiers and power purchasers. Projects that that are too small to obtain individual limited-recourse project finance may be attractive when developed jointly.
2. **Formation of multi-disciplinary development groups**. Each project involves a number of parties: developer, engineer, contractor, and various equipment suppliers, power purchaser and lender. For each project a series of contractual arrangements is needed to distribute responsibility, risk and revenue among all the parties involved. The cost and effort involved prohibits limited-recourse project financing of the smallest projects and adds considerably to the cost of larger projects. Permanent co-operation among important parties in the development will have several cost-saving effects. The parties will get to know each other better, which makes the arrangements run more smoothly. Contractual arrangements, risk and revenue distribution can be standardised. The developer deals with one instead of several

parties. The development group will develop experience in all fields, enabling them to quickly evaluate the feasibility of proposed projects.

3. **Simplifying legislation procedures**. In many countries unclear laws and regulations, in combination with a large but ineffective bureaucracy, tend to obstruct project development. Laws and regulations must be understandable for all the parties involved in a project. The bureaucratic process involved should be well documented so that inexperienced developers can easily understand it. Permits should be available within a reasonable time after applications are submitted.

6.3 Reducing risk in small hydropower development

Lowering risks makes a project more attractive and easier to finance. Two measures that reduce risk have already been discussed: long-term power-purchase agreements and predictable bureaucracy. Other initiatives are:

1. **Data measurement programmes**. Hydropower developers rely on measurement of stream flow and rainfall to estimate power production and floods. Data on sediment transport are essential when designing desilting basins. However, in many areas such important data are not available or are of extremely poor quality. Collecting and maintaining records of stream flow and rainfall data, etc. are clearly within the responsibilities of the national government.
2. **Stepwise development**. By developing a hydropower project by stepwise increase in the production capacity, the up front investment is reduced, and the debt obligations can more easily be adjusted to the economic strength of the project. Stepwise development gives the developer an opportunity to build up funding before the development step. However, a hydropower project will always require a considerable investment to be made at an early stage, and a stepwise development is likely to increase the total cost of the development.

6.4 Other strategies for improving small hydro financing

Education

Potential developers should learn how to assess project feasibility, alternative routes of financing, how to develop a project plan, and how to approach potential financing institutions.

Government-financed centres for professional advice on small hydro development

Most potential developers of small hydro projects will be inexperienced first-time developers, who need professional advice on whether or not to start the development process, and how to proceed in the process. Regional resource centres could provide low-cost professional support, in particular in the early stages of the project, for small hydro development. The resource centres would have to rely on government support. The centres could also provide support in the development of other renewable energy resources.

Equity funds for investing in renewable energy projects

Loan finance may be obtained for 60 – 80% of the project cost. The remainder must be provided from other sources, often in the form of equity capital from investors. Equity returns are paid after debt repayments, and the risk is therefore higher. This makes equity finance expensive (the investors require a high rate of return) and is often scarce. There is thus a need for sources of

equity finance, which might be provided by funds providing equity financing for selected areas of development. Such funding might come from government or development agencies, or from private organisations. Several such funds already exist.

7 Conclusions

The main conclusions of this report are:

- Private involvement in the energy sector is becoming increasingly important as public funding diminishes. In spite of their environmental advantages, hydropower projects will have to compete for financing on the same terms as other projects, both in public budgets and in the private market.
- Obtaining finance for small hydropower projects is hard. Hydropower projects involve large up front investment, and are often regarded as high risk compared to thermal power projects.
- Small hydro projects face an additional obstacle. Because the investment involved is relatively small, limited recourse project financing is not feasible.
- The financing situation for small hydro projects may be improved in several ways:
    - By government incentives (loans, grants)
    - By reducing the risk to the developer and the financier (government guarantees, high quality stream flow data)
    - By reducing the development cost (joint development of several projects in an area, hydropower development groups, stepwise development)

By education and government resource centres to support developers during an early stage.

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Appendix A: List of relevant literature

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Goldsmith, K (1993). **Economic and Financial Analysis of Hydropower Projects**, Norwegian Institute of Technology, Division of Hydraulic Engineering, Trondheim, Norway. The book discusses the economic analysis of hydropower projects in general.

Insurance considerations for renewable energy projects - A guide for developers. Sedgwick Power and Nuclear Services. Energy Technology Support Unit, Department of Trade and Industry, UK. ETSU K/FR/00031/REP/S. This guide gives a general overview of risk analysis, risk management and insurance, and discusses specific issues associated with renewable energy projects and insurance and project financing.

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