MARKET RESEARCH OF HYDROPOWER IN NORDIC COUNTRIES

Case: PowerMortar™

LAHTI UNIVERSITY OF APPLIED SCIENCES
Degree in International Business
Thesis
Spring 2008
Tuuli-Maria Ruuti

Lahti University of Applied Sciences
Faculty of Business Studies

TUULI-MARIA RUUTI:
Market research of hydropower in Nordic countries
Case: PowerMortar

Thesis, Degree in International Business, 80 pages, 15 appendixes

Spring 2008

ABSTRACT

This thesis examines market research and hydropower situation in northern markets. The purpose of this thesis is to describe hydropower capacity in the Nordic countries, find out PowerMortar's market potential for the case-company which is interested in expanding operations especially in Sweden and find the latest information about hydropower companies and hydropower plants.

Theoretical framework of this thesis consists of theories of market research. The focus is on explanation of central theories and classification of data.

The empirical part of this work consists of PowerMortar product presentation, market research of hydropower in different Nordic countries, Dam Safety Law and company presentations of biggest power companies.

The empirical part is based on desk research and field research. The desk research consists of examining and analysing statistics, databases of companies' and other material related to business. The field research was conducted by interviewing professionals in the field of business.

The market research made for the case-company forms a basis for further actions in Scandinavia. The companies' biggest hydropower plants were localized and based on the construction years, the future construction sites can be estimated. Based on the results can be pointed out that the company should direct to Swedish and Norwegian markets because of their big hydropower potential. By help of the results, marketing can also be aimed at the biggest power companies and ferias.

Keywords: market research, hydropower, Nordic countries, dam safety, PowerMortar.

Lahden ammattikorkeakoulu
Liiketaloudenlaitos

TUULI-MARIA RUUTI:
Vesivoiman markkinatutkimus Pohjoismaissa
Case: Voimalaasti

Opinnäytetyö, Degree in International Business, 80 sivua, joista 15 liitesivua

Kevät 2008

TIIVISTELMÄ

Tässä opinnäytetyössä käsitellään markkinatutkimusta ja vesivoiman tilannetta pohjoismaisilla markkinoilla. Työn tavoitteena on kuvailla vesivoimakapasiteettia Pohjoismaissa, selvittää Voimalaastin markkinapotentiaali case yritykselle, joka on kiinnostunut laajentamaan toimintaansa etenkin Ruotsissa ja löytää viimeisin tieto vesivoimayhtiöistä ja -laitoksista.

Opinnäytetyön teoreettinen viitekehys koostuu markkinatutkimusta käsittelevistä keskeisistä teorioista. Pääpaino on erilaisten tutkimusmenetelmien selostamisella ja informaation luokittelulla.

Työn empiirinen osuus koostuu Voimalaastin tuote-esittelystä, vesivoiman markkinaselvityksestä eri pohjoismaissa, patoturvallisuuslaista ja suurimpien voimayhtiöiden yritysesittelyistä.

Työn empiirinen osa perustuu työpöytä- ja kenttätutkimukseen. Työpöytätutkimuksessa tutkittiin ja analysoitiin tilastoja, yritysten tietokantoja ja muuta alaan liittyvää materiaalia. Kenttätutkimus suoritettiin haastattelemalla alan ammattilaisia.

Case-yritykselle tehty markkinatutkimus muodostaa pohjan tuleville toiminnoille Pohjoismaissa. Yritysten suurimmat vesivoimalaitokset paikallistettiin ja rakennusvuosien perusteella voidaan arvioida tulevat korjauskohteet. Tutkimustulosten perusteella voidaan todeta, että yrityksen kannattaa suunnata Ruotsin ja Norjan markkinoille niiden suuren vesivoimapotentiaalin takia. Tulosten avulla voidaan myös suunnata markkinointi suurimpiin voimayhtiöihin ja messuille.

Avainsanat: markkinatutkimus, vesivoima, Pohjoismaat, patoturvallisuus, Voimalaasti.

INDEX

1. INTRODUCTION

This thesis studies the process of market research and hydropower potential for PowerMortar repairs in Nordic countries.

The author's employer who was interested in expanding sales to Nordic markets, especially in Sweden, selected the topic. The employer wanted to gain overall information about the hydropower situation, the number of plants, new Dam Safety Law and the biggest power companies.

1.1 Subject of thesis and its structure

The aim of this thesis is to find new markets for PowerMortar which is a product developed for underwater repairs. The biggest customers are power companies and their hydropower plants and dams. The author will handle matters such as which Nordic country would be a possible market area for the product, which power companies do business there, what is the amount of hydropower and how Dam Safety Law is defined in different countries.

This thesis is divided into 8 chapters. The first one is an introductory chapter presenting the background, subject of the thesis, the structure, research problem, limitations and the methodology used.

In chapter two, the theory of market research is presented. Main market research divisions are introduced. After this, stages of market research are explained followed by research design. Further, classification of data is introduced and divided into primary and secondary data. The chapter ends with analysis of qualitative research.

Chapter three introduces PowerMortar, the product this study is made for. First, the qualities and possibilities of PowerMortar are explained followed by the explanation of work stages. Finally a company presentation of Matti Ruuti Oy and SWOT are presented.

In chapter four, the author will introduce facts of overall hydropower. Hydropower plant functions and operations are explained. Further the advantages and disadvantages are presented. After this, hydropower in Finland, Sweden and Norway is discussed. This is followed by hydropower in other Nordic countries.

Chapter five goes through the definition of dams followed by Dam Safety Law in Finland, Sweden and Norway.

Chapter six presents the seven biggest power companies in Nordic countries. The main facts of the companies are introduced followed a closer look on their hydropower activities and their biggest hydropower plants.

Chapter seven gathers the main themes of the thesis. The conclusions are presented and recommendations for further actions are given.

Chapter eight summarises the thesis.

1.2 Research problem and limitations of subject

The theoretical part is concentrating on main features of market research. The empirical part is concentrated on hydropower; dams are mentioned because almost every hydropower plant has one. Other possible repair sites for PowerMortar are not taken into account. Other energy sources are not taken into consideration. This thesis concentrates mainly on Finland and Sweden but other three Nordic countries are taken account for comparison after was found out the possibilities which Norway can provide for PowerMortar.

The subject of the study could be defined with the help of following questions: "Which power companies own hydropower plants and how many?", "How hydropower situation varies between Nordic countries", "To which companies the market efforts should be aimed at?" and "How dam safety legislation varies in Scandinavia?"

1.3 Methodology

The concept of method is ambiguous. Sirkka Hirsjärvi, Pirkko Remes and Paula Sajavaara (Tutki ja Kirjoita 2004, 172-174.) describe it as a manner of proceeding which is lead by the rules. It is used to search information and to resolve problems. Methodology is examination of methods. The choice of method is guided by what kind of information is searched and where the information is searched from. Market research is the theory of this thesis because it aims to find new markets for existing product and find information about customers. The methods applied in this thesis are observation and interviews. Questionnaires were excluded.

The research methods applied in this thesis are desk research and field research. Desk research was carried out by gathering secondary data from various sources such as books, brochures and Internet. The desk research required using a wide range of languages; Finnish, Swedish, English, Norwegian, Danish and Icelandic were all used to acquire enough information for the thesis. The field research was conducted by gathering data using exploratory research. This was carried out by interviewing professionals on the field of the business. Interviews with Managing Director Matti Ruuti were a vital aid for performing this research.

The interviews were carried out during author's practical training in the case-company. The interviews have been both theme interviews and open interviews and were repeated frequently. By this method the author gained information of all aspects in this thesis and benefited the employer's knowledge of the subject. Also observation was used. Observation has been participative observation during practical training and this method provided information which could not have been obtained from any other source. Questionnaires were excluded because earlier actions proved them unfit for this research. It is possible that in the next phase questionnaires are used to find out the budgeted repair sites or other information from the power companies.

The literature was mainly used for the theoretical part of the thesis. The theories of Naresh K. Malhotra and Peter Chisnall were decided to be used as the basis of chapter two. Hydropower information were found at the web pages of electricity companies, national statistics, official electricity ministry, Government web pages or gathered from various sources.

Due to the rapidly changing nature of hydropower plants' owners, power capacity, mergers and even change of head, no books can be found because the information is soon outdated. Therefore all hydropower information has to be found in the Internet where it can be easily updated. In general hydropower information is collected from various sources for comparison to gain to most updated information available.

2. MARKET RESEARCH

2.1 Introduction of market research

Although the term market research is widely used as a synonym for marketing research, there was originally a difference between the activities they covered. The responsibilities of a market research are extended when marketing research is limited to finding out information about the market for a particular product. (Chisnall 2005, 7; Kuokkanen 2007.)

Market research should reduce and control the risk in marketing proposals. It gathers and analyzes data and information about customers, competitors and markets. It can help to build a business plan, launch a new product or service, search new markets for existing products or services and expand into new markets. Market research can also be used to determine the target customer base. (Malhotra 1996, 3, 6-7.)

Malhotra (1996, 10-11.) says that organizations engage in market research for two reasons; to identify and solve marketing problems. Because of this, market research is divided into problem identification research and problem-solving research. The first one is undertaken to identify problems that may arise in the future. Examples could be market potential, market share, image and sales analysis researches. The latter one is conducted to arrive at a solution. The findings are used in solving specific marketing problems. Examples of this are product, pricing, promotion and distributions researches. In this thesis problem identification research has been used to solve market shares of hydropower companies and to help entering to a new market area.

Specific research applications are for example continuous market research, innovation and test marketing, advertising media and lifestyle research, business-to-business research and international market research. Both domestic and international market research has been used in this thesis in chapters four, five and six. (Chisnall 2005, 257, 282, 316, 424.)

Market research should be systematic at every stage; each stage should be documented carefully and planned in advance. It attempts to provide accurate information that reflects of a true state of affairs. Market research should be free from any personal or political biases. (Malhotra 1996, 9.)

Reliability and validity are important aspects of market research. Reliability refers to the stability, accuracy and consistency of the findings. Validity refers to how well a research method measures what it claims to measure. For a research measure to be valid it must be also reliable but if it's reliable, it doesn't necessarily have to be valid. Reliability is a necessary but not sufficient condition for validity. (Chisnall 2005, 40-41.)

Ethical issues arise in market research because of the amount and variety of contacts marketers have with the public. This has created a perception that marketing has unethical practices. Four different groups which can be affected during the process are public, respondent, client and researcher. Examples of unethical situations are incomplete reporting, misleading reporting, biased research, invasion of the privacy of respondents, unqualified researcher and abuse of position. (Malhotra 1996, 822-828; Kuokkanen 2007.)

Some questions have been made for ethical decision making; Does the action violate the law or moral obligations? What is the intention making this decision? Whom could your decision injure? Can you discuss the problem with other parties? Is it fair? (Malhotra 1996, 828-831)

Figure 1. explains the role of market research and its interaction. The emphasis is on the satisfaction of customer needs and to identify and satisfy those needs, marketing managers need more timely information about customers, competitors and other causes affecting the markets.

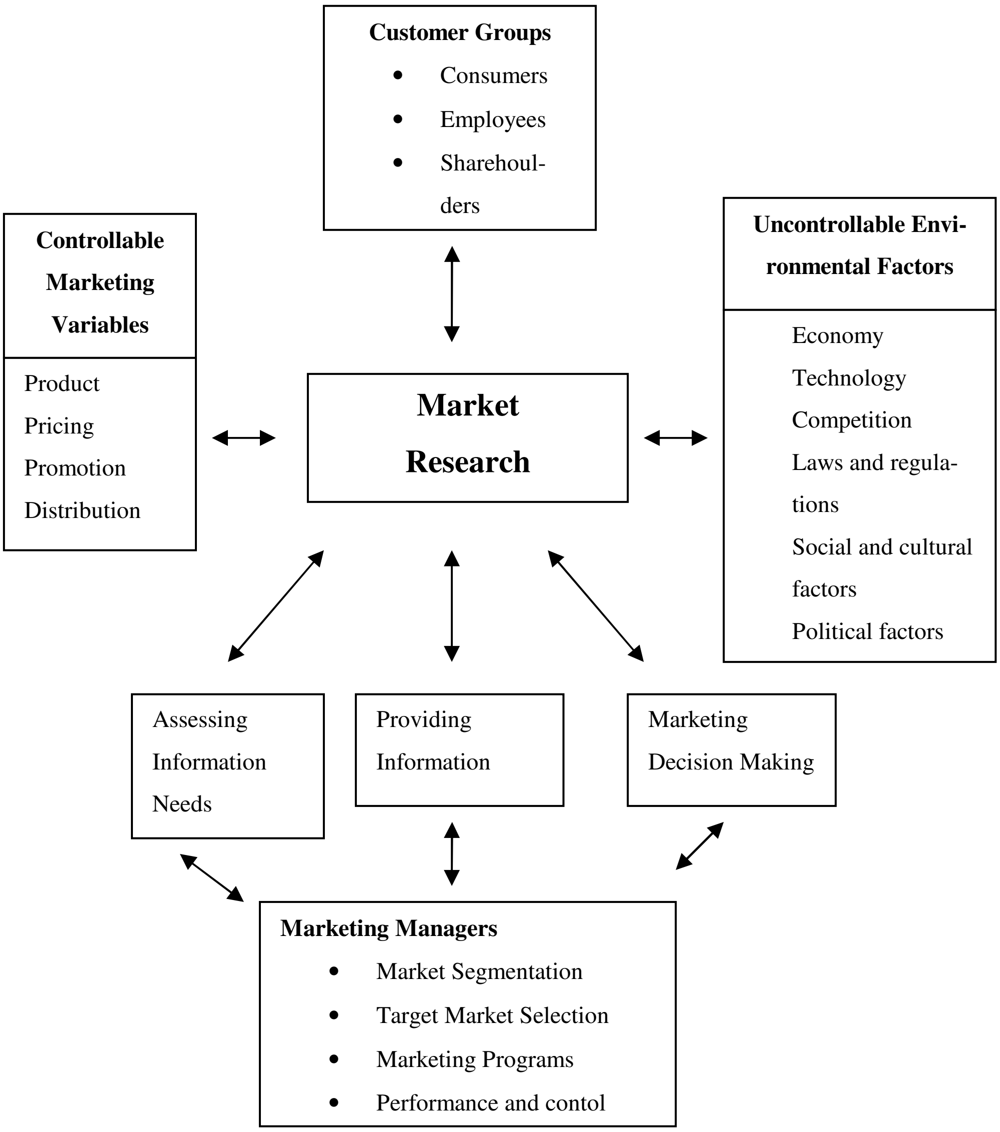

FIGURE 1. The role of market research. (Malhotra 1996, 7.)

2.2 Main divisions of market research

Market research should have detailed and throughout knowledge about all factors likely to influence demand for specific products or services. These divisions cover research into specific aspects of market behaviour but in actual design these all tend to be in the same overall research design. (Chisnall 2005, 14.)

2.2.1 Product research

This division is concerned with the design, development and testing of new products, the improvement of existing products and forecasting of trends. Comparison with competitive products should be undertaken to gain realistic goals. Strengths and weaknesses need to be identified and pricing studies should be included. Companies need to have information about specific trends and products, but also about the consumption of middle and long term. Product research is the base for chapter three, which deals with PowerMortar, a unique product designed for stone repairs. (Chisnall 2005, 14-16; Kuokkanen 2007.)

Product design has gained an increasingly important influence in the buying of goods. Research is needed to evaluate what customers expect in terms of package, comfort or performance. The customer behaviour changes; what was new and exiting few years ago, is unlikely to satisfy the customers today. Products that don't live up to customer's expectations will fail. (Chisnall 2005, 14-17.)

2.2.2 Customer research

This division covers investigation into buyer behaviour which includes the social, psychological and economic influences affecting purchase decisions. These researches can be taken at the consumer level, the trade distribution level or in the industrial field. Company should find out what kinds of people buy certain products and brands; this is influenced by their age, socio-economic status, family background etc. Customer loyalty should never be taken for granted. If complaint exists, customer research is useful clearing them and finding out the causes which affect them. Customer research is used in chapter six which summarises the biggest power companies thus the biggest clients for PowerMortar. (Chisnall 2005, 17-19.)

Companies should take note of people's media habits and their attitudes towards promotional campaigns on television or elsewhere. Increasing awareness with health, diet and exercise offer many opportunities and passing this trend might be devastating. Family life cycle affects the nature of the goods and services that customers demand and there are likely to be significant changes in the patterns of consumption. The role of women deserves particular attention. Older people represent an important sector of consumers in both actual numbers and buying power as they nowadays continue to be active even in older age. The boundaries between middle age and old age are elastic and disposable income tends to be greater in the older age group than in younger. (Chisnall 2005, 18-20.)

Customer research includes consumer surveys to study the opinions and behaviours. This may involve national enquiries using formal questionnaires or depth interviews to analyse the motivations of people in certain buying situations. This research tends to attract attention because of its direct impact of the customers. Fast-moving consumer goods companies are more likely to conduct a customer market research because of the dynamic nature of retailing. Customer research is particularly important in export marketing. (Chisnall 2005, 17-21)

2.2.3 Pricing research

Pricing is one of the critical factors affecting business success and it is also one party of the marketing mix which is the core of successful marketing. Too high price may encourage customers to substitute product. Cost from the production should be known but also knowledge of the demand in the market, the level of competition and technological development are equally important. Products and services should be analyzed for the benefits they give to customers and pricing should be relative to competitors' products. (Chisnall 2005, 21-23.)

Some products have high price sensitivity. Most markets have price ranges for specific products; too low price will cause suspicion about the quality and too high can hamper the sales. Companies can use market tests in which customers are asked to made selections of products at different prices. (Chisnall 2005, 21-23.)

2.2.4 Sales and distribution research

Sales research and distribution research are closely linked and most likely to performed together. Sales research covers throughout examination of the selling activities of the company when distribution research evaluates company's selling arrangements and identifies alternative methods of distribution. Sales and distribution has been analysed in chapter three and it has been taken into account in recommendations. (Chisnall 2005, 23-26.)

The position of a company in market should be analyzed in relation to competitors. If company is loosing sales and the overall trend of sales is steady or improving, research should aim to discover why the company isn't sharing this trend and where these extra sales are being made. The effectiveness of sales force and distribution plans should be checked. Also factors affecting consumption should be taken into account; this can be affected by economics, political situation, social development and legislation. (Chisnall 2005, 23.)

2.2.5 Promotion research

Promotion research is deals with testing and evaluating the effectiveness of methods used in promoting a company's products or services. These methods are exhibitions, public relations campaigns, consumer and trade advertising, merchandising aids and special promotional offers. (Chisnall 2005, 26.)

The big choice of media available makes the selection of the most suitable media difficult. The mass media is highly organized in developed countries but apart from technical limitations, cultural factors also influence the media that is suitable for effective promotional purposes in foreign countries. E.g. the level of literacy varies in different countries. The company should evaluate the costs and effectiveness of media and choose the most suitable. Continuous measurement of the effects of certain promotional campaigns should be performed. (Chisnall 2005, 26-27.)

Promotion research can be also made during trade and consumer surveys. Many such surveys include questions on media habits, brand recognition, attitudes towards merchandising practices and at what store purchases of products are made. (Chisnall 2005, 27.) Recommendations for promotion research for this thesis are given in the chapter seven.

2.3 Stages of market research

According to Chisnall (2005, 42.), five stages of market research are all applicable to all enquiries; consumer, business-to-business, services or public sector.

The first stage is called Research brief. The problem on which the research is focused should be clearly defined and it might be necessary to undertake some exploratory research in attempting to find out the significant areas for the research. Malhotra (1996, 36.) says that the problem definition is the most important step. This step will also decide the methods used and the direction of the research activity. This stage has been determined in chapter one. (Chisnall 2005, 42-43.)

Preparatory research is vital for the future of a successful market research. Clients and researchers should work closely together in developing research objectives. The researchers should decide whether it is wise to focus on particular areas of the customer's business activities or to provide knowledge of their particular problem. The limitations should be decided as well as accuracy required, costs and deadline. Limitations of the subject has been explained in chapter one. This research is focused on hydropower and Nordic countries. (Chisnall 2005, 42-43.)

The second stage is called Research proposal, also known as the work plan. This step includes analysing relationships between variables that are significant for the problem. It also specifies the research problem, objectives and methodologies. This is determined in chapter one. (Chisnall 2005, 43.)

After development and clarification of the research problem, a useful model should emerge. The model enables to develop and select hypotheses. Sometimes a problem won't need hypotheses if it is a numerical estimation problem. Data can be gathered from various sources but there might be errors. These errors should be checked and their efficiency and value for the research should be evaluated. (Chisnall 2005, 43-45.)

In chapter five, the hydropower data has been collected from various sources to limit the possibility of errors. Wide comparison with many secondary sources will lessen the possible misapprehension.

The third step is called Data collection and is central part of the research activities. First sampling plan is checked and put into practice. Data sources, internal or external are executed and time schedule of the operations is planned. The fieldwork organization will be chosen and the actual data collection is performed. In this thesis, both primary and secondary data has been used in the basis of chapters 2, 3, 4, 5 and 6. (Chisnall 2005, 45-46.)

Stage four is called Data analysis and evaluation. In this step the data which is collected has to be processed by tabulation, analysis and interpretation into a form which is understandable for the client. All terms should be fully explained. In this step it is vital to check that the processed data is fulfilling the research objectives and methods of analysis are suitable for type of data. (Chisnall 2005, 46.)

Stage five is the last step according to Chisnall (2005, 47.) and it deals with preparation and presentation of the final report. Findings should be presented logically and clearly, in a professional way. Tables, graphs and diagrams help the customer to understand the findings. Some customers are satisfied with facts being reported but some expect interpretation of the research problem. Many tables and figures were used in this thesis to clarify and gather hydropower plant information as well as for comparison between Nordic countries.

According to Malhotra (1996, 21-22.) there are six steps; problem definition, development of an approach to a problem, research design formulation, field work of data collection, data preparation and analysis and report preparation and presentation.

2.4 Research design

To ensure the continuous growth and aid of market research, it is vital that the process is carefully planned and organized. An important part of market research is developing an effective research strategy. It will detail the most suitable methods of investigation, the nature of the research instruments, the sampling plan and the types of data. (Chisnall 2005, 34.)

Although an approach to the problem has been developed, the research design specifies the details. The design should be precise, tight and use resources efficiently after studying the problem intensively. A good plan insures that the data is relevant to the research and that it was collected by objective and economic procedures. At this stage it is wise to take time and plan ahead. (Malhotra 1996, 86; Chisnall 2005, 34.)

Chisnall (2005, 34.) classifies research designs into three groups; exploratory, descriptive and causal designs.

Exploratory design is concerned with identifying the real nature of research problems. It is often the first step in research and it enables closer look to the research problem. Exploratory research is relatively speedy, economic and useful in developing hypotheses about specific markets. It is used in cases when the problem must be defined more precisely and the sample is small and non representative. The findings should be regarded as input to further research. The methods of exploratory research are expert and pilot surveys, secondary data and qualitative research. (Malhotra 1996, 86-89; Chisnall 2005, 37.)

Secondary data and qualitative research has been used in this thesis, surveys were excluded because earlier studies made for the case company showed that this method isn’t suitable for this product at this stage. Exploratory and Descriptive studies are also benefited together with observation during practical training.

Descriptive studies are generally developed from exploratory research findings. In contrast to exploratory design, this research describes specific market phenomena such as product usage. The questions should be precise and aimed to ask relating questions of product performance, market share etc. Other descriptive studies are e.g. censuses, public-opinion polls and industrial surveys. The objectives are different but have the same basic functions of describing specific features of certain kinds of people. Descriptive studies are useful and can give information about behaviour as develop profiles of customers and their preferences. The methods used in descriptive research are surveys, panels, observation and secondary data. (Malhotra 1996, 89-92; Chisnall 2005, 37-38.)

Causal research attempts to identify and evaluate factors of market behaviour, their relationship and interactions, in other words, determine cause and effect relationships. These market behaviours could be such as variations in pricing, packaging and advertising. Because it studies cause and effect problems, it might be difficult to deal those realistically and objectively. Jumping into conclusions is a temptation. Like descriptive research, causal research requires a planned and structured design. Causal research uses experiments as main method. (Malhotra 1996, 89, 97-98)

2.5 Classification of data

Figure 2. summarises the differences between two research methodologies which will be explained in next chapters.

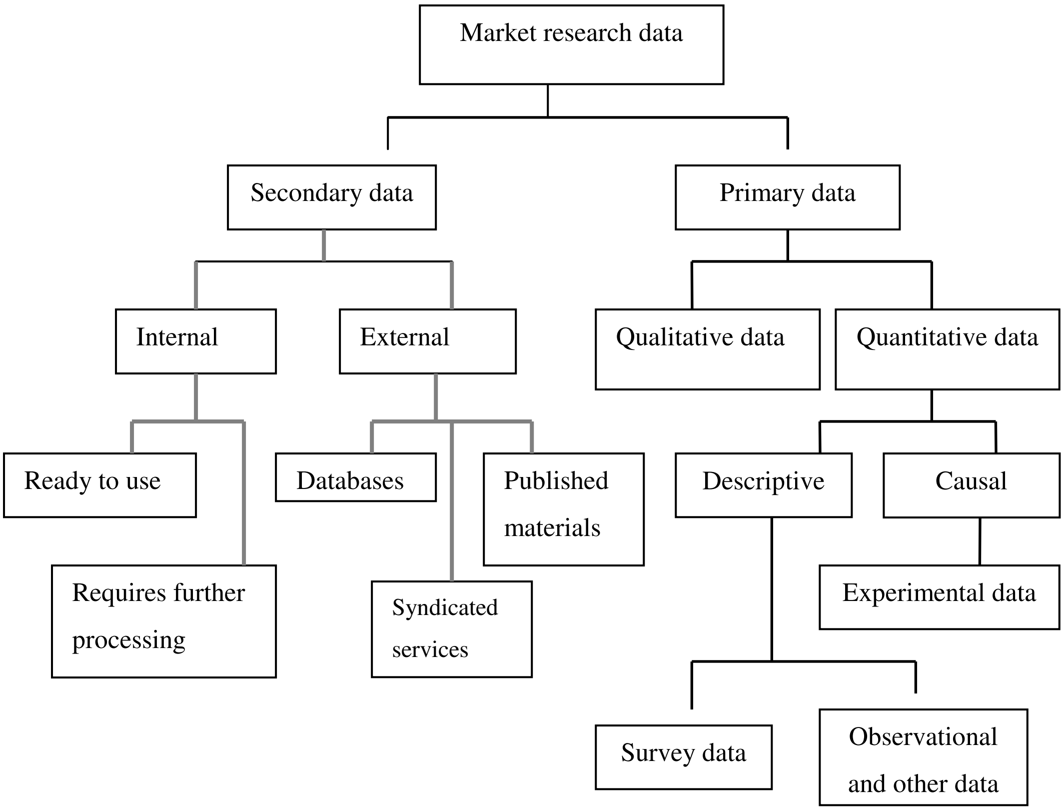

FIGURE 2. A classification of market research data, modified from Malhotra (1996, 164.)

There are two generic classifications of data; primary and secondary data. Primary data means that it has to be collected for the first time from observation, experimentation, questionnaires or desirable from combining all these techniques. Secondary data is already existing data which may be available internally or externally. (Chisnall 2005, 47; Kuokkanen 2007.)

Obtaining primary data can be expensive and time consuming compared to secondary data which is usually easily located and inexpensive. Discrimination should be made in the selection of data. Usually there isn't lack of information but it can be irrelevant, outdated or incompatible. Also the interpretation of data may lead to wrong decisions. (Malhotra 1996, 116-117.)

Two main categories of research techniques can be identified; reactive and normative, also known as non-reactive. Reactive relates to interaction between investigators and respondents e.g. interviews, experiments and questionnaires. Normative relate e.g. observation or library research where is no direct interaction. Chisnall recommends that non-reactive technique should be more widely used by researchers. (Chisnall 2005, 48.)

Secondary data are easily accessible, inexpensive, and quickly obtained. Examination of available secondary data is a prerequisite to the collection of primary data. The problem is that usually the information is collected for other purposes than the problem at hand and the information can be useless because of its accuracy or relevance. Data should be collected from various sources and then compared to discover the accuracy. (Malhotra 1996, 117-119.)

All researchers should use multi-technique because no research technique is without bias. Objectivity is guideline of research. (Chisnall 2005, 66.)

2.5.1. Primary data; Observation

Observation is a non-reactive research technique which is widely used in scientific studies. It can be used alone or with other forms of research and is particularly useful in checking the validity of answers given in questionnaires. Observation however doesn't reveal hidden buying motives. It can be economical method of acquiring knowledge about buying behaviour that couldn't be acquired by other methods. Three methods of observation are used in market research; audits, recording devices and watching people's behaviour as buyers. Observation can be participative or non-participative of which participative method has very limited use in market research. (Chisnall 2005, 54-56.)

The audit technique is part of shop audit research in which physical checks of selected types of products are made frequently in order to estimate actual sales at certain stores. Traffic flows are also taken into consideration because it is useful to locate strategic positions for display areas. New equipment e.g. bar coding, scanners and computer systems have changed the data collection remarkably. Hidden cameras are used as recording device technique and in laboratory psychogalvanometer is used to check the reactions to selected advertisements. (Chisnall 2005, 54-55.)

Watching people's behaviour can be used instead of questionnaires. Although video cameras were introduces in stores to prevent shop lifting, those are used to study the way people shop. Analysing body language or the time which is used for selection, how many approach shop assistants for help or how carefully customers read labels can be compared with answers received from questionnaires. (Chisnall 2005, 55-56.)

Apart from shoppers, shop assistants can be observed too. Mystery shopping was dismissed by market researchers but now it is rapidly growing. Interviewers playing as shoppers are trained to observe customer service in clients' and competitors' stores. This technique has also spread into catering and hotel industries, travel organizations and financial services. Mystery shopping has attracted criticism of the sample sizes, privacy and ethics. Also little is known for its accuracy, reliability and validity. (Chisnall 2005, 56-57.)

2.5.2 Primary data; Experimentation

The object of market experimentation is to compare the responses to several alternatives in the marketing mix and to evaluate information so that the most effective method of marketing can be found. Packaging, advertising and sales are some factors affecting market efficiency that can be experimented. (Chisnall 2005, 57-58.)

Experiments are often focused on short-term studies and may lead to wrong assumptions. It could be advisable to extent testing beyond the actual period to ensure satisfying long-term effects. (Chisnall 2005, 58.)

Differently from other sciences, laboratory testing is almost impossible in the field of marketing because it is highly linked with human behaviour. Many factors affecting product sales cannot be controlled by the marketer. Market experimentation is difficult to plan and execute although it is the only research method for verifying cause and effect relationships. It also remains fairly expensive and the potential should be evaluated against the cost. Laboratory testing is still a valuable method because it provides information collected in real-life conditions. (Chisnall 2005, 57-62.)

There are four main types of experimental designs; time series analysis, multiple variables, factorial designs and Latin square designs. These designs range from simple to complex, concerning with single to multiple variables. (Chisnall 2005, 59-62.)

2.5.3 Primary data; Questionnaires

A questionnaire is a method of getting specific information about a specific problem. Most market investigators use some form of questionnaire. It can be postal, face-to-face, by telephone or computer based methods such as fax or Internet. Questionnaires and interviewing are virtually inseparable and face-to-face interviewing is the most commonly used method. However the telephone interviewing has replaced other methods because of increasing costs and declining response rates. (Chisnall 2005, 62-63, 134-135.)

The strength of questionnaires is its flexibility and the possibility of acquiring wide range of new data compared to observation and experimentation. It however requires careful planning and execution. The questions must be designed to attract respondents to give honest and valid information and to do this without bias or distortion. Type of a questionnaire depends on sample population, sample size, method of sampling and nature of problem. (Chisnall 2005, 62-63, 134-135.)

Personal interviewing is widely used in market research but it requires trained and specially selected interviewers. Interviewing may take place in households, organizations or shopping malls. Sometimes it can include tasting or watching presentations. Postal or mail questionnaires are posted to selected population. Personal interviewing is attractive because of its inexpensiveness but usually it has relatively low response rate. Those who respond may not be the representative of the population and the answers must be accepted as written. This method doesn't either gather observational data. (Chisnall 2005, 63.)

Telephone surveys are popular both in consumer and industrial fields. They are valuable in forming sampling lists and during early stage of research. Panel research is useful in tracing movements in buying behaviour. Problem is that after a while, panel members begin to behave non-typical way after becoming more self-conscious of their buying behaviour. (Chisnall 2005, 64.)

Group interviews use psychological methods and free discussion is encouraged. The scaled-down version of this is focus groups. Special survey techniques like television measurement can also be used as well as Internet research which is a cheap and speedy method. (Chisnall 2005, 64.)

2.5.4 Secondary data; Internal

Like was mentioned earlier, secondary data is already existing data which may be available internally or externally. Internally it means that the organization already has the material inside the organization and it just has to be gathered and analysed. (Chisnall 2005, 65.)

Secondary data, also known as library or desk research is non-reactive method of collecting secondary data. It is economical, quite speedy and has complete confidentiality. It can be used to almost all research problems and will help developing research strategy. (Chisnall 2005, 65.)

Many companies don’t use enough the information that is routinely collected. Production, costs, sales and distribution can be designed in a form that it gives information to researchers. Sales analysis, advertising expenditure and other promotional expenses should also be available for market researchers. (Chisnall 2005, 65.)

2.5.5 Secondary data; External

External sources of data include statistics and reports by governments, trade associations and other reputable organizations. Also research companies circulate useful information with each other. External data can be also found by using guides, directories and indexes, books, newspapers, magazines and periodicals. Syndicated sources are companies that collect and sell data to various customers. This information is not collected for market research problem but might give needed information. (Malhotra 1996, 125, 130; Chisnall 2005, 66.)

2.6 Qualitative research

The objective of a qualitative research is to understand the reasons and motivations for people’s attitudes or behaviour. It is used to define the problem or to develop an approach and to generate hypotheses and identify variables that should be included in the research problem. (Malhotra 1996, 161-162.)

Qualitative research provides insights and understanding of the problem setting. The sample is small number of non representative cases, data collection is unstructured and data analysis is non statistical. It helps to develop an initial understanding and guidance in the development of marketing strategy and tactics. (Malhotra 1996, 164; Chisnall 2005, 216.)

Qualitative research contributes to several areas of marketing responsibilities such as exploratory research, new product development, creative corporate development, diagnostic research and tactical research projects. (Chisnall 2005, 217.)

Under the heading of qualitative research can be listed for example, exploratory research, unstructured research, motivation research, depth interviewing, attitude research and opinion research. Qualitative research has grown significantly and it is prominent in new product development, concept research and advertising pretesting. Qualitative research is a major methodology used in exploratory research. (Malhotra 1996, 165; Chisnall 2005, 215-216.)

A classification of qualitative research procedures is divided into direct approach and indirect approach, based on whether the true purpose of the project is known to the respondents. The purpose of a direct approach is known to the respondents or is otherwise obvious from the questions asked. The major techniques are focus groups and depth interviews. Indirect approach disguises the true purpose of the project. The commonly used projective techniques are association, completion, construction and expressive techniques. (Malhotra 1996, 165.)

2.6.1 Focus group

A focus group is an interview conducted by a trained interviewer with a small group of respondents. It is a non-structural and natural mannered group discussion which is led by the interviewer. The main purpose is to gain information by listening to a group from the appropriate target market. It is the most widely adopted method and the most important qualitative research procedure. (Malhotra 1996, 166; Chisnall 2005, 218.)

The group size is typically between 8 to 12 people. This amount is more likely to generate free-flowing group discussion and have good group dynamics. The group should be homogenous in terns of demographic and socioeconomic characteristics and the participants should have experience with the issue being discussed. Also so called professional respondents, people who have participated in numerous focus groups, should not be included because it leads to validity problems. Typically focus group lasts for 1,5 to two hours. In this time, the interviewer should establish an idea of the participants' feelings, ideas and attitudes regarding the topics discussed. These interviews are often videotaped for analysis but it can increase the costs significantly. (Malhotra 1996, 166-168.)

Advantages are for example security, spontaneity, stimulation and speed. Disadvantages are misuse of the data, the unskilled interviewer and the unstructured nature. Also focus groups have attracted some critical views because those have tended to be closely linked with political policies. (Malhotra 1996, 172; Chisnall 2005, 221.)

Focus groups have been widely used in the study of customer loyalty research, obtaining impressions of new product concepts or generating new ideas about old products. Focus groups can use several variations such as two-way focus group, client-participant group, dual-moderator group and mini groups. (Malhotra 1996, 171-174.)

2.6.2 Depth interviews

Depth interviews are conducted on one-to-one basis in which a single respondent is interviewed to uncover motivations, feelings and attitudes to a topic. The respondents are encouraged to talk instead of answering “yes” or “no”. Like focus groups, it is also unstructured and direct way of obtaining information. The interviewer attempts to follow an outline but the question order is influenced by the respondent’s replies. Usually an interview takes from 30 minutes to one hour. (Malhotra 1996, 174; Chisnall 2005, 219.)

There are three popular depth interviewing techniques; laddering, hidden issue questioning and symbolic analysis. Laddering is a technique in which the line of questioning proceeds from product characteristics to user characteristics. Hidden issue questioning attempts to locate personal sore spots related to deeply felt concerns. Symbolic analysis analyzes the symbolic meaning of objects by comparing them with their opposites. (Malhotra 1996, 175-176.)

Depth interviews have some advantages compared to focus groups; depth interviews can reveal the respondent’s opinions directly, unlike focus groups where it is difficult to determine which respondent had a particular opinion. Also depth interviews are free from social pressure. However it has some disadvantages; skilled interviewers are hard to find and are expensive, and the results depend heavily on the interviewer’s skills. (Malhotra 1996, 177.)

2.6.3 Projective techniques

Projective technique is indirect and unstructured form of questioning. Projective techniques try to attempt to disguise the purpose of the research. The respondents are asked to interpret the behaviour of others instead to tell about their own. In interpreting, the respondent indirectly projects their own motivations and feelings to that situation. The reacts are then analyzed with unstructured scenarios. (Malhotra 1996, 178.)

There are four different techniques; association, completion, construction and expressive.

In association technique an incentive is shown to the respondent and asked to respond with the first thing that comes to mind. Word association is the best known technique, in which a list of words is presented and shown one word at a time to the respondent. After each word the respondent has to answer with the first thing that comes to mind. The assumption is that respondents reveal their true opinions of the topic. Responses are analyzed by calculating the frequency of words, the time taken for the respond and the number of respondents who do not answer at all. The associations are often classified as favourable, unfavourable or neutral. (Malhotra 1996, 178, 184.)

In completion techniques, respondents are asked to complete an incomplete incentive. The best known techniques are sentence completion and story completion. In sentence completion, respondents are asked to fill incomplete sentences with the first thing that comes to mind. In story completion, a part of a story is given and respondents are asked to give the conclusion in their own words. These provide more information about the research than word association and usually respondents can guess the purpose. (Malhotra 1996, 180.)

In construction techniques the respondent is asked to construct a response in the form of story, dialogue or description. It is closely linked to completion techniques but the researcher gives less structured form. In picture response technique, a picture is shown of which a respondent should tell a story describing it. In cartoon test, cartoon characters are shown in a specific situation related to the problem.

Respondents should imagine what a cartoon character would say to another character. (Malhotra 1996, 181-182.)

In expressive techniques, a verbal or visual situation is presented to respondents and asked to relate the feelings of other people. Main techniques are role playing and third-person technique. In role playing the respondents should play a role or to express the feelings of others. In third-person technique, respondents should relate the feelings of a third person, this friend may be a friend or a colleague. In expressive techniques researchers assume to get personal beliefs while playing a role of others. (Malhotra 1996, 183.)

2.6.4 Qualitative versus Quantitative research

Primary data can be qualitative or quantitative. Qualitative provides understanding of the problem whereas quantitative tries to quantify the data and can apply some form of statistical analysis. Sometimes qualitative research is conducted to explain the findings of quantitative research. The sample is from large number of representative cases and data collection is structured. This research recommends the final course of action. It is vital to see both qualitative and quantitative research together rather than in competition together. (Malhotra 1996, 163-164.)

3. CASE PRESENTATION: POWER MORTAR™

3.1 PowerMortar

PowerMortar is a product developed for repairs to stone and concrete structures. It is a tough, firm, water-insoluble mortar. PowerMortar doesn't release harmful substances into the environment and is totally inorganic material. It neither contains plastic compounds. PowerMortar withstands the most severe conditions; it sets at low temperatures and resists erosion caused by freezing. (Ruuti 2000a.)

PowerMortar was developed in Finland's largest concrete research laboratory in Imatran Voima's, now Fortum's, technology centre for the company's own needs. All its properties have been tested by the laboratory. PowerMortar has an excellent adhesion to stone, concrete and steel and it has high compression strength. It does not shrink or contain any water-soluble materials and has resistance to freezing, salt and chemicals. PowerMortar is not carbonised. PowerMortar's temperature coefficient of expansion is the same as of concrete. It has low water permeability and is alkaline which both prevents steel of rusting. More information about technical characteristics of PowerMortar can be found in APPENDIX 1. (Ruuti 2000b.)

The first repair was done in 1989 at Imatra power plant in Finland. After that nearly 200 projects have been completed in Finland, Sweden, Russia and USA. PowerMortar was granted a European patent in 2003. Some repairs done with PowerMortar are collected to APPENDIX 2. (Ruuti 2000a; Ruuti 2007.)

3.2 Variations of PowerMortar

There are five different types of PowerMortar:

- Underwater PowerMortar™
- Above-water PowerMortar
- PowerGrout ™

- Anchoring mortar
- PowerShotcrete™

Underwater PowerMortar is a mortar developed for underwater repairs to stone and concrete structures. Before repair work had to be carried out by drying the area with the aid of coffer dams. This can cause loss of power generation and therefore loss of money. Using PowerMortar the repair is now done by divers and even in rapidly flowing water. (Ruuti 2000a; Ruuti 2007.)

Because damage often extends above the water surface as well, PowerMortar can be used also to fix these damages. Typical examples for Above-water PowerMortar are weather damage, cracks and joints. No moulds are needed. Because the product doesn't release any chalk, the sites remain clean. (Ruuti 2000a.)

PowerGrout is used for injection. This means that e.g. in a hydropower plant a hole is drilled to the ground and PowerGrout is pumped into the plant so that the leakage can be blocked. The consistency can be changed according to the place of work. For large fractures in rock, the PowerMortar's viscosity and adhesiveness mean that only moderate quantities are needed. (Ruuti 2000b; Ruuti 2007.)

Anchoring mortar is an effective mortar used for anchoring heavy structures. It can be pumped into wet or even water-filled boreholes. (Ruuti 2000b.)

PowerShotcrete is used in the so-called wet method for sprayed concrete. Applications include rock caves, where the product can be injected or drained. PowerShotcrete can achieve tremendously high strength in sprayed concrete. (Ruuti 2000b.)

Basically PowerMortar is a one product with different variations. All above types can be used for example:

- Hydropower plants
- Dams
- Canals

- Bridges
- Harbours
- Anchorages
- Tunnels
- Caves

PowerMortar can be used to repair for example following damages:

- Stone masonry joints
- Cracks in concrete
- Cracks in stone
- Weather damage
- Breakage
- Joint failures
- Defects during construction
- Grizzly sides
- Erosion damage

(PowerMortar 2007.)

3.3 Work progress

The working team comprises of four people; a diver and his assistant, a mortar mixer and a supervisor who manages the work on a platform. First at underwater sites, a diver examines the damage and films it using a camera on a helmet. A team above water can follow it live or burn it on DVD. An operational plan is made using the video and pre-cost estimate can be told to customer. The goal of the inspection is to define the type of equipment and methods, to locate cables, pipes and other structures at repair area and notify waterborne and road traffic. The mortar is prepared at a mixing and pumping station placed ashore or on a floating platform. The distance between the pumping station and repair site shouldn't be more than 50 meters. Typical mixing time varies from 20 to 30 minutes. The mortar must be in motion all the time either in the mixer or in the pump. (Ruuti 2000b; Ruuti 2007.)

The actual repairs are then done by divers. Impurities and crumbling mortar are removed with a water chisel or a high-pressure water jet. After this, PowerMortar is used to repair the damages by pumping the mortar from above-water platform to the diver through a hose. The diver will inject the mortar into the repaired area. The nozzle has to be pushed to the bottom and be kept constantly in the mix preventing air bubbles getting inside the mortar. After this the surface of the mortar is smoothed. (Ruuti 2000b; Ruuti 2007.)

PowerMortar is a quicker method compared to others used in the same field. Work can be done in flowing water and moulds are not usually needed for repairs. Weather damage at water surface level can be repaired at the original surface. Hydropower plants don't have to be shut down or coffer dams to be built. Also diversion discharges are not needed and so money is saved. Because drivers perform the operation, reservoirs don't have to be pumped out or dry any of the damaged area. Even large repair jobs can be done quickly and easily with the help of a shutter mesh. If moulds are used, they are lightweight and quick to install. PowerMortar has a wide range of uses; it is suitable for all types of concrete and masonry structures and can repair even vertical joints underwater. (Ruuti 2000b; Ruuti 2007.)

3.4 Matti Ruuti Oy

Matti Ruuti is an entrepreneur who has worked with PowerMortar since 1997. He was the manager of PowerMortar activities in Fortum. Matti Ruuti Oy is situated in Lahti centre after being several years in Lahti Science and Business Park. The company has one employee but uses a diver company as a subcontractor at construction sites. (Ruuti 2007; PowerMortar 2007.)

Matti Ruuti Oy bought marketing, product development, sales and contracting rights for PowerMortar 1.4.2001 from Fortum. These rights were valid in Finland and Sweden. In a transaction completed on November 11th, 2004, all rights were transferred to Matti Ruuti Oy and are valid in every country. (Ruuti 2007; PowerMortar 2007.)

Matti Ruuti Oy has operations in Finland, Sweden, Portugal and Spain. It has consultants in Portugal and Spain and is planning to have consultants in Sweden and Norway in the near future based on the recommendations of this thesis. Also construction sites in Venice in Italy are possible. (Ruuti 2007.)

In this chapter, both desk research and field research were used by interviewing professionals and gathering secondary data internally. Theories of product research and sales and distribution research were also used.

3.5 SWOT of PowerMortar

The strengths and weaknesses of PowerMortar are explained in the following figure 3.

PowerMortar has more strengths than weaknesses. The uniqueness is definitely strength but at the same time it's so unique that designers don't know about it or how to use it. Even though the costs are a bit higher than using other methods, the electricity that the plant can produce during PowerMortar repair covers costs. Also price is agreed separately with every customer.

Climate change is a huge opportunity for PowerMortar when power companies have to start repairing their hydropower plants. Climate change can cause floods and hydropower plants or dams have to be repaired in near future to prevent possible damages. Already the big plant sizes back up the selection of PowerMortar when other methods require coffer dams etc. Also Dam Safety Law requires plant owners to act. CE marking is vital for development of operations and in near future it should be obtained.

Strengths	Weaknesses
• Unique product • Patented • Underwater work without moulds • Quicker way • No cofferdams needed • Many repair sites and possibilities • Cheaper in some cases because no dams are needed • No production or operating interruptions • No need to repair again	• More expensive than other methods • Product have to be produced at the construction site • Product needs high expertise • Production process doesn't produce big quantities • Only one man has the know-how • The designers' education teaches old methods
Opportunities	**Threats**
• Expanding of market area • Amount of repairs will increase • Dam Safety Law requires new criteria • Climate change	• Drivers are responsible for successful work • Competitors' lower prices • Designers don't know how to repair using PowerMortar • Difficult to get a CE marking because of the unique product

FIGURE 3. SWOT of PowerMortar.

4. HYDROPOWER

4.1 Hydropower in a nutshell

The word “hydro” is a Greek word for water. Of the world’s water resources 80 % are untouched and seven pre cent of world’s energy is produced by hydropower. Hydro power is an emission-free and renewable source of energy and it is very economical way of producing electricity because water can be stored in man-made reservoirs to be utilized when needed. Once a dam has been built and the equipment installed, the water is free. (Vattenfall 2005, 27; Kemijoki Oy 2007a; Energiaa Länsi-Suomessa 2007.)

Hydro plants are dependable and long-lived, up to 100 years, and their maintenance costs are low compared to coal or nuclear plants. In the production stage its efficiency may exceed as much as 90%. Hydropower also has a big meaning because it can be used to shave strongly changing power consumption peaks quickly and profitable way. (Vattenfall 2007a; Energiateollisuus 2007.)

Hydropower plant consists of a dam which holds the water, penstock which is a pipeline that leads to turbines, intake which is a gate that controls the water flow, turbines which are turned by the moving water, a generator and tailraces which lead the used water to the lower stream. Water is directed from top to bottom to spin the turbines. The amount of water which comes through can be conditioned by regulating the amount of water in the top side waters. Most plants rely on dam that holds back water, creating a large reservoir. Water in the reservoir is considered stored energy. The cross section of hydropower plants is shown in APPENDIX 3. (Bonsor 2007; Vattenfall 2007b.)

During its normal circulation, water vaporizes into the air, falls back on the ground in the form of rain and starts flowing in rivers from higher areas towards the sea. The most common type of hydropower plant has a dam on a river to store water in a reservoir. Water is released from the reservoir and flows through a turbine and spins it, which activates a generator to produce electricity. The distance between the water surfaces is called a head. All hydropower plants don’t necessarily require a large dam; some just use a small canal to channel the water through a turbine. A variant is a pumped storage hydroelectricity plant which produces electricity to match periods of high and low demand, by moving water between reservoirs at different elevations. The production is at its highest in the morning and evening and during the nights, when consumption isn't big; energy supply can be lowered or close completely when needed. Power changes are big and hydropower can react to those quickly. (Kauppa- ja Teollisuusministeriö 2005, 10; Bonsor 2007; Kuhlin 2007.)

Hydropower doesn't pollute and it is domestic. Generation of hydropower does not cause atmospheric emissions or releases into the water or soil. It decreases significantly greenhouse gas emissions. (Energiateollisuus 2008.)

Still hydropower does present a few environmental problems. Damming rivers may destroy wildlife and natural resources. Fish has to be restocked and the change in water level can cause some disadvantage to people living next to the plant. The harmful effects caused by hydropower production are alleviated by various environmental management measures. The full utilization of hydro potential is restricted mainly on the grounds of nature conservation. (Energiateollisuus 2008.)

Tightening taxation, control of the natural resources and construction permissions can slow down or even prevent the new hydropower utilization. Same reasons can cause reduction in the existing hydropower. (Energiateollisuus 2008.)

In the field of renewable energy sources, three types of generation can be regarded as mature technologies: hydropower, bio fuelled thermal power and wind power. Other production types like solar power, wave power and geometrical power are struggling to reach affordable cost levels for the public. (Vattenfall 2005, 35.)

In this chapter primary and secondary data were used. Many of the tables are primary data. Domestic and international market research were the basis of this chapter.

4.2 Hydropower in Finland

Finland's electricity production is decentralized which increases the steadiness of electricity availability. At this moment Finland has 140 electricity companies and around 400 power plants of which half are hydropower plants. Electricity is also imported from Russian and Nordic electricity markets. Finland has very high per capita electricity consumption, 16,600 kWh per head per year. Some of it comes from hydropower, much of it is either imported or generated from imported fuels. (E.ON 2007a; Energiateollisuus 2008.)

Hydropower is the most important renewable energy source in Finland together with the forests. Almost two thirds of Finland's hydropower is used by industries and most of it comes from Kemi, Oulu and Ii rivers. Studies show that hydropower is the most accepted energy production form in Finland. The harmful effects for nature are local and can be diminish or prevent using the environment conservation. All damage should be prevented or compensated with money. (Kauppa- ja Teollisuusministeriö 2005, 12; Energiaa Länsi-Suomessa 2007; Energiateollisuus 2008.)

There are 207 hydropower plants in Finland, having a total power of 2 997 MW. 67 of these are mini hydropower plants which mean the capacity is under 1 MW, 83 are small hydropower plants of 1-10 MW and 57 plants have over 10 MW capacity. See APPENDIX 4. for hydropower plant locations. (Kauppa- ja Teollisuusministeriö 2005, 17; Takala, 2006.)

The biggest hydropower plants in Finland are introduced in the following Table 1. Kemijoki Oy owns most of the biggest hydropower plants but Fortum owns the biggest, Imatra hydropower plant. The 12 biggest plants produce together 1 392 MW of Finland's total 2 997 MW.

TABLE 1. The biggest hydropower plants in Finland

	Hydropower plant	**Owner**	**MW**	**Head (meters)**
1.	Imatra	Fortum	178	25
2.	Petäjäskoski	Kemijoki Oy	172	20,5
3.	Taivalkoski	Kemijoki Oy	133	14,5
4.	Seitakorva	Kemijoki Oy	130	24
5.	Pyhäkoski	Fortum	122	32,4
6.	Pirttikoski	Kemijoki Oy	110	26
7.	Isohaara	Pohjolan Voima	106	12,2
8.	Valajaskoski	Kemijoki Oy	101	11,5
9.	Ossauskoski	Kemijoki Oy	93	15
10.	Pamilo	Vattenfall	83	49
11.	Vanttauskoski	Kemijoki Oy	83	22
12.	Nuojua	Fortum	81	14

The total production average reached 12,9 TWh in 2006 of which the mini hydropower amounted 1 %, small hydropower 8 % and the bigger plants had 91 % share. (Takala 2006.)

The main increase of capacity took place after the wars in the 1950's and 1960's when the share of hydropower of the country's electricity generation was 90 % at the highest. Hydropower plants are very long-lived. After 1970, six hydropower plants have been decommissioned. These had a total power of 5 MW. (Kauppa- ja Teollisuusministeriö 2005, 8.)

Rain has a great influence on hydropower. In 2004 the production was 14,7 TW which was 14 % more than on average year. In 2003 the production however was 25 % lower than on average year. The production hasn’t been this small since the 1970’s when the amount of hydropower stations was dramatically smaller than today. (International Small-Hydro Atlas 2007a.)

The most profitable hydropower locations in Finland have already been built or protected against new hydropower projects. Finland has 2,130 MW of remaining hydropower potential in which 663 MW are in unprotected or built waterways. Protected waterways could give as much as 1 467 MW. The opportunities to increase new hydropower production capacity are also limited especially because of reasons of environmental protection. These reasons may also restrict the use of existing capacity. The profitability of increasing the hydropower capacity varies greatly depending of the size category and type of project. Vattenfall predicts that in the next ten years small increases to hydropower will be made in Finland. (Vattenfall 2005, 41; Kauppa- ja Teollisuusministeriö 2005, 4.)

TABLE 2. Finland's hydropower power potential by waters.

Waters	**Built-up**	**Unprotected**	**Protected**	**Together:**
Vuoksi	444	50	27	521
Kymijoki	260	19	43	322
Kokemäenjoki	269	82	4	355
Lapuanjoki	14,5	7	0	21,5
Ähtävänjoki	-	1	7	8
Perhonjoki	-	8	7	15
Lestijoki	-	0	23	23
Kalajoki	-	8	8	16
Oulujoki	638	73	7	718
Iijoki	186	58	250	494
Kemijoki	1 084	308	373	1 765
Tornionjoki	14	1	468	483
Tenojoki	-	0	38	38
Others	102	48	212	469
Together:	**3 011,5**	**663**	**1 467**	

From table 2. can be concluded that more than 2100 MW hydropower could be produced in the future but because of the protected waterways, only 663 MW could be taken into use. Many of the possible hydropower plant sites are still too expensive to construct so increasing renewable energy production can be made by increasing power generation in existing plants. APPENDIX 5. presents the protected waters in Finland.

Hydropower is included in the European Union's renewable energy sources target levels; this means that in 2010 the renewable energy sources should make a certain percentage of the gross consumption. For Finland the target is 31,5 % as it now is 25 %. (Vattenfall 2006, 28.)

4.3 Hydropower in Sweden

Hydropower is the main source of electricity of Sweden. Sweden also has one of the world's highest individual levels of electricity consumption: about 18,000 kWh/head and it's still rising. (International Small Hydro Atlas 2007b; World Nuclear Association 2007.)

Hydropower's share was 47 % in 2006, nuclear power had 45 % share. There are about 1800 hydropower plants in Sweden but around 1600 of these are smaller than 10 MW plants. 14 plants have capacity more than 200 MW. The biggest hydropower plant is Harsprånget in Lule älv which has 977 MW. There are only two pumped storage plants and no more are foreseen in the near future. (Rundqvist 2007; Kuhlin 2007.)

Hydropower plants produce 16 200 MW. Most plants are in the northern part of the country in the rivers of Lule älv, Indalsälven, Ångermanälven and Ume älv. 70 % of hydropower electricity comes from these rivers. Table 3. shows the effect of the biggest rivers in Sweden. Lule älven has almost 2 000 MW more installed capacity than the second biggest. Lule älv is the northernmost river in Sweden. See APPENDIX 6. for hydropower production in Sweden by rivers. (Vattenfall 2006; Statistics Sweden 2007; Kuhlin 2007.)

TABLE 3. Installed capacity in the biggest rivers 2006.

Installed capacity in the biggest rivers	**MW**
Luleälven	4 350
Ångermanälven	2 581
Indalsälven	2 094
Umeälven	1 753
Skellefteälven	1 026
Piteälven	50

Table 4. introduces the biggest hydropower plants in Sweden. Matti Ruuti Oy has done repairs in many plants in Sweden with PowerMortar. Clients have been e.g. Sydkraft AB, Stockholm Energi and Gullspång Kraft AB. (Ruuti 2007.)

TABLE 4. The biggest hydropower plants in Sweden (effect, MW)

	Hydropower plant	**River**	**MW**
1.	Harsprånget	Luleälven	977
2.	Stornorrfors	Umeälven	591
3.	Messaure	Luleälven	452
4.	Porjus	Luleälven	440
5.	Letsi	Luleälven	440
6.	Ligga	Luleälven	343
7.	Vietas	Luleälven	325
8.	Ritsem	Luleälven	320
9.	Trängslet	Dalälven	300
10.	Porsi	Luleälven	275
11.	Kilforsen	Ångermanälven	275
12.	Krångede	Indalsälven	245
13.	Seitevare	Luleälven	225
14.	Harrsele	Umeälven	223
15.	Trollhättan	Göta älv	220

See APPENDIX 7. for hydropower plant location in Sweden.

The production of hydropower is divided between the Government which owns Vattenfall AB and power companies owned by industries, municipalities and other non-governmental bodies. All power companies are part in the Swedish Power Association. The government owns about 48 %, of the generating capacity, with overseas owners holding approximately 25 %, the municipalities 20 % and others 7 %. (International Small Hydro Atlas 2007b.)

In a normal year hydropower gives about 64 TWh of electricity, in a very rainy year it can raise up to 75 TWh while during a really dry year the electricity supply can be as low as 50 TWh. (International Atomic Energy Agency 2007; Vattenportalen. 2007.)

The first hydropower plants were built in 1880's. The stations were small and supplied power only to industries and close habitats. During the end of the nineteenth and the beginning of the twentieth century, hundreds of similar small hydropower plants were built. In the beginning of the 20th century power transfer technique developed and it soon came possible to exploit the large rivers. Many of the big Swedish electricity companies were founded at this time. Also the Government took part in the electric power production because it was the owner of many suitable locations. The first Government owned hydropower plant was built on 1906. Differently from other countries the Government doesn't own the waterways. In Sweden they are owned by the owners of the river banks which sometimes might be the Government. This is also why several power companies have hydropower stations along the same river. (International Small-Hydro Atlas 2007b.)

In the 1940's the development reached the Lule River and other northern rivers. However the power had to be transferred about 1000 km from the hydropower area in north to the consumption area in the south. From the 40's to the 60's hydropower was developed together with the increasing consumption of electricity. 1967 the power supply was almost entirely based on hydropower. During the 60's the attitudes towards conserving the environment changed and hydropower was looked in a very different way. Also the development of nuclear power raised a question if hydropower was necessary anymore. (International Small-Hydro Atlas 2007b.)

Hydropower is highly regulated. Almost half of the hydropower produced comes from water stored in reservoirs. The production in winter is ten times more compared to the natural runoff of the rivers. If topography and runoff are taken into consideration the total natural potential could be as high as 200 TWh. Reaching 95 TWh per year could be economically profitable. 64 TWh is developed already so there could be additional resource of 31 TWh. Most of this is located in the northern Sweden. In Table 5. is summarised the biggest heads in Sweden in meters. (Eikeland 2006; International Small Hydro Atlas 2007b.)

TABLE 5. Highest head in Sweden.

	Hydropower plant	River	Meters
1.	Stensjöfallet	Indalsälven	318
2.	Tåsan	Klarälven	269
3.	Gejman	Umeälven	251
4.	Olden 1	Indalsälven	250
5.	Långa Mittån	Ljusnan	216
6.	Duved	Indalsälven	210
7.	Olden 2	Indalsälven	200

The opinions of increasing hydropower vary, the biggest argument in favour is that utilization of hydropower is an economic way of generating electricity and it doesn't cause pollution. It is also a domestic way of producing electricity. On the other hand nature conservancy authorities say that further increase of hydropower will destroy wildlife and exploitation of the remaining untouched rivers will ruin Sweden's nature as it has been for ages. (International Small Hydro Atlas 2007b; International Atomic Energy Agency 2007; Vattenportalen 2007.)

The Swedish Government and Parliament have decided that major of the untouched rivers will remain undeveloped. Surprisingly the four biggest untouched rivers Vindelälven, Pite älv, Kalix älv and Tornio-Muonio älv are excluded from this decision. It is questioned if Sweden can leave one-third of its hydropower potential unexploited even though the opinions are disputable. More potential can be got from increasing the capacity of many hydropower plants. Vattenfall expects that in the next ten years hydropower generation in existing plant will increase. This means that the existing plants have to be repaired and possibly enlarge so that the expanding production could be possible. (Vattenfall 2005, 41; Eikeland 2006; International Small Hydro Atlas 2007b.)

The development of small hydropower in Sweden has slowed down during the last years. In 2003 less than 5 new plants were commissioned except some very small plants, which were re-commissioned after earlier shut down. The reason is a combination of low buy-back rates and legal barriers. (International Small Hydro Atlas 2007b.)

As mentioned in Hydropower in Finland, hydropower is included in the European Union renewable energy sources target levels. For Sweden the target is the second highest in the EU, 60 % as it now is 50 %. (Vattenfall 2005, 28; Eikeland 2006.)

4.4 Hydropower in Norway

Norway's consumption is 26 300 kWh and it has one of the highest rates of per-capita consumption of electricity in the world. Norway covers this consumption with its hydropower production which is 99 %. (Energiateollisuus 2004.)

Norway is the sixth largest producer of hydropower in the world even thought it is only 61st biggest country. Hydropower has been an important basis for the industrialization of the country. Norway has around 250 electricity providers selling hydropower services. (Wikipedia 2007b; Energilink 2008.)

In 2005 Norway had 651 hydropower stations which produced 28 743 MW. Of those 330 are small hydropower stations under 10 MW, 241 are 10-99 MW, 47 plants are 100-199 MW and 30 plants are over 200 MW. 469 of the hydropower plants are owned by the country or municipalities, Central Government owns 98 plants and 84 are private owned. Most of the hydropower plants are in Hordaland community where are 75 plants. In Nordland there are 71 and in Telemark 66 plants. APPENDIX 8. (Statistics Norway 2007a; Statistics Norway 2007b; Eikeland 2006; Stensby & Pedersen 2007.)

Table 6. shows the biggest hydropower plants in Norway. It can be noticed that the biggest plant produces only 150 MW less than all Finland's 12 biggest hydropower plants together.

TABLE 6. Biggest hydropower plants in Norway.

	Hydropower plant	**Community**	**Effect (MW)**
1.	Kvilldal	Rogaland	1 240
2.	Sima	Hordaland	1 120
3.	Tonstad	Vest-Agder	960
4.	Aurland I	Sogn og Fjordane	675
5.	Saurdal	Rogaland	640
6.	Rana	Norldland	350
7.	Tokke	Telemark	430
8.	Svartisen	Nordland	350
9.	Brokke	Aust-Agder	330
10.	Evanger	Hordaland	330

In 2007 Norway's electricity production was 137,3 TWh which was 13 % more than previous year. This increase in explained by heavy rains because 99 % of Norway's electricity is hydropower. This year made Norway a net exporter by 10 TWh. (Energiateollisuus 2008.)

Norway uses almost exclusively hydropower and consumes all this power themselves, while Sweden and Finland use also nuclear power, fossil fuels, hydropower and other renewable energy. Norway other hand sells its oil and natural gas to international markets. Norway has largely based its power production on hydropower which might cause problems. The unpredictability of the weather makes them vulnerable in contrast to other Nordic countries, which use a broader variety in their power production. (Statistics Norway 2003; Norges Vasdrags- og energidirektorat 2006; Statkraft 2006; MSN Encarta 2008.)

Norway hasn't originally been constructed with sufficient reservoirs, with the capacity to hold sufficient volumes of water and now they have to re-build the hydropower infrastructure. Norway is linked by cables to neighbouring countries, and is an integrated part of the thermal power system in Europe. This provides security for the power supply, even though their power production is dependent on the weather. The best solution for Norway would have involved a hydroelectric infrastructure with greater storage capacity combined with wind power production, to cover normal annual consumption. (Statistics Norway 2002; Norges Vasdrags- og energidirektorat 2006; Statkraft 2006; MSN Encarta 2008.)

Hydropower was behind the Norwegian economic growth. 1906-1920 was the biggest boom period ever and the power production rose from about 200 GWh to 4500 GWh. The largest development projects were carried out between 1970 and 1985, when installed capacity increased by 4.1 % per year. Since the end of the 1980's, Norway's rate of hydropower development declined. In 2000 large scale hydropower operations were over. Capacity increased by 800 MW from 1993 to 2005. The increase was primarily due to refurbishment and upgrading of old power stations. About 36 per cent of the hydropower potential has not been developed, and rather more than half of this is permanently protected. (Mikkelsen 2003; Ministry of Petroleum and Energy 2007a; Energilink 2008.)

Norway's energy markets were the first one which opened up to general competition. It is divided between competitive and monopolistic sectors where production and sales are free for competition and grid activities are operated by Statnett. (Mikkelsen 2003.)

Norway's long term target of productions from renewable energy sources and energy savings per year in 2016, compared to the 2001 level is 30 TWh. (Stubholt 2007.)

Table 7. introduces ten Norwegian communities which have the most hydropower plants in their fjords and rivers and the overall effect.

TABLE 7. Hydropower plants by community.

	Community	Number of hydropower plants	Effect (MW)
1.	Hordaland	75	3 956
2.	Nordland	71	3 255
3.	Telemark	66	2 554
4.	Sogn og Fjordane	55	3 374
5.	Møre og Romsdal	47	1 309
6.	Buskerud	47	1 899
7.	Sør-Trøndelag	44	968
8.	Oppland	42	1 537
9.	Rogaland	34	3 315
10.	Nord-Trøndelag	32	778

4.5 Hydropower in other Nordic countries

Hydropower is the most important renewable source of energy in the Nordic energy system. In 2005 hydropower in the Nordic market was significant, 57 % of the whole electricity production. The biggest producer is Norway where hydropower counted almost all production, 99%. Sweden covered 47 % of its electricity by hydropower while in Finland the same amount was 18 %. Denmark doesn't have any hydropower and is concentrating on thermal power. Iceland's amount was 81 %. (Vattenfall 2005, 42; Takala 2006.)

The Nordic countries except Iceland form an electricity market called Nord Pool. It determines the electricity price in which the hydropower has a great influence. Hydropower accounts 57 % of the Nordic generation capacity in a normal year. In dry years the hydro capacity can decrease 17 TWh. Large reservoirs in Sweden and Norway are used for such occasions. The price of electricity will be higher in a dry year but still have a comfortable capacity margin for meeting energy demand. If another dry year would follow, hydropower generation could be as much as 40 TWh lower because the reservoirs would be used already in the earlier year. This would increase the electricity prices dramatically. (Kauppa- ja Teollisuusministeriö 2005, 11; Vattenfall 2005, 40, 42-43; Takala 2006.)

4.5.1 Denmark

Denmark is a very flat country, and hydropower provides only 0,1 % of the electricity production. This hasn't changed for the past twenty years. Most of it comes from a 70 year old hydropower plant Gudenå-vaerket situated between Silkeborg and Viborg, in the middle of Jutland. (Inforse 2008.)

Denmark's energy consumption per capita was 6 700 kWh in 2004. In 2006 Denmark produced 84 TW which is 9 MW from hydropower. Since 1990 the drop has been -16,4 %. (Danish Energy Authority 2006.)

Hydropower is still decreasing in Denmark and there are only few plants left. Only large hydropower will survive although with restricted water flow. The reason of this downward trend is environmental restrictions related to fish population and ecological status. Denmark is a net exporter of electricity in dry years and a net importer in wet years. (Eikeland 2006.)

4.5.2 Iceland

Energy consumption per capita in Iceland is among the highest in the world like in other Nordic countries, 28 200 kWh per head. Energy supply is based on geothermal power, hydropower and imported fossil fuels. In 2006, hydropower produced 1 162 MW which is 68,5 % of the total production. Hydropower generated 7 289 GWh which is 73,4 % of the total. Iceland has 33 hydropower stations and the ten biggest are shown in Table 8. APPENDIX 9. shows the locations of hydropower plants. (Orkustofnun 2007.)

TABLE 8. Biggest hydropower plants in Iceland.

	Hydropower plant	Capacity MW
1.	(Kárahnjúkar)	690
2.	Búrfellsstöð	270
3.	Hrauneyjafosstöð	210
4.	Blöndustöð	150
5.	Sigöldustöð	150
6.	Sultartangastöð	120
7.	Vatnsfellsstöð	90
8.	Sogsstöðvar	89
9.	Kröflustöð	60
10.	Straumsvík	35
11.	Laxárstöðvar	28

The majority of the country's electricity is generated using hydropower and the remaining using geothermal power. About 90% of all housing in the country is heated with geothermal energy. (Iceland Trade Directory 2007; Gagnavefsjá 2008; Orkustofnun 2007; Energy Statistics in Iceland 2007.)

The first hydropower plant was constructed in 1904, generating 9kW. The largest single hydropower plant has production power capacity of 270 MW but in 2009 a new Kárahnjúkar hydropower plant is completed, generating 690 MW for a new aluminium smelting plant. (Energy Statistics in Iceland 2007; Wikipedia 2007a.)

Iceland produces more greenhouse emissions per capita than any other country. To reduce emissions and eliminate the country's reliance on imported oil, it is now studying alternative methods of energy supply. Only 20% of Iceland's hydropower has been utilized. There are no available studies of how much hydropower can still be exploited with regard to what is technically possible, cost-efficient, and environmentally desirable. The estimated hydropower potential is 30 TWh annually. In future there will be an increase in hydropower production for about 700 MW. (Energy Statistics in Iceland 2007; Encyclopedia Britannica online 2008.)

4.6 Conclusion of Nordic hydropower

Hydro power is emission-free and very economical way of producing electricity. Hydro plants are long-lived and the maintenance costs are low compared to coal or nuclear plants. Hydropower may cause some environmental problems which may destroy wildlife and natural resources. Other renewable energy sources are bio fuelled thermal power and wind power.

Seven per cent of world's energy is produced by hydropower. It is also the main electricity source of Sweden, Iceland and Norway. Denmark other hand is concentrating on wind power.

Scandinavian countries consume a lot of energy due to their climate, distances and forest industry. The high consumption per head is explained by small population. In Finland the electricity consumption per head per capita is 16 600 kWh compared to Sweden where it is 18 000 kWh. Iceland has the biggest consumption, 28 200 kWh. Norway uses 26 300 kWh but Denmark only 6 700 kWh.

Most of hydropower comes from the northern parts of the countries, in Finland from Kemijoki, Oulujoki and Iijoki rivers and in Sweden from Lule älv, Indagsälven, Ångermanälven and Ume älv rivers. In Norway water comes from the mountains and most hydropower plants are situated in Nordland, Hordaland and Telemark of which Hordaland and Telemark are in Southern Norway and Nordland in Northern Norway. In Iceland hydropower can be obtained from around the country.

There are 207 hydropower plants in Finland, Sweden has around 1800. In Finland 57 plants are over 10 MW, Sweden has about 200 plants in same category. In Finland hydropower produces 2 997 MW, in Sweden it produces 16 200 MW. It can be noticed that one hydropower plant in Sweden, Harsprånget's potential is 1/3 of Finland's all hydropower plants' potential. Lule älv river (4350 MW) has more power than the whole Finland's waters together.

651 hydropower stations in Norway produces 28 743 MW. 571 plants are smaller than 100 MW, 47 plants are 100-199 MW and 30 plants are over 200 MW. Iceland has 33 hydropower plants generating 1 162 MW but the next plant will increase the production by almost 700 MW.

The biggest hydropower plant in Sweden is Harsprånget with 977 MW capacity, Finland's biggest is Imatra hydropower plant with 178 MW. The plant in Imatra has head 25 meters when in Harsprånget it is 107 meters. In table 8. seven biggest heads in Sweden are shown. Norway has hydropower plants which head is over 1000 meters and the biggest plant, Kvilldal has 1240 MW. The plants in Norway however compete in a different league. Iceland's biggest plant now is 240 MW but in a year a new plant will provide 690 MW for aluminium industry's needs. This defines well how much bigger plants Sweden has compared to Finland but Finland is also a flat country and doesn't have the same opportunities than Sweden and Norway.

Table 9. summarises the hydropower capacity between different Nordic countries. As has been mentioned, Norway is the biggest producer and consumer of hydropower because it uses all hydropower by itself. Sweden, in the other hand, has the biggest future potential available.

TABLE 9. Summary of hydropower in Scandinavia.

	Finland	Sweden	Norway	Denmark	Iceland
Number of hydropower plants	207	1800	651	below 10	33
Production (MW)	2 997 MW.	16 200 MW.	28 743 MW	9 MW	1 162 MW
Amount of hydropower % in 2005	18 %	47 %	99 %	0,1 %	81 %
Biggest hydro-power plant	Imatra 178 MW	Har-språnget 977 MW	Kvilldal 1240 MW	Gudenå-vaerket	Kárahnjúkavirkjun 690 MW (completed in 2009)

5. DAM SAFETY LAW

5.1 Dams

A dam is a barrier across flowing water that obstructs, directs or slows down the flow. Dams can be man-made, born by natural causes or by the intervention of wildlife such as beavers. Man-made dams are typically classified according to their height, purpose or structure. Dams often create reservoirs or lakes. (Patoturvallisuustyöryhmän loppuraportti 2007, 3-5.)

Dams serve two purposes: they increase the height from which the water falls, and they trap and store water in reservoirs. Dams are used for hydropower plants but also for water supply for cities and industry, habitats for fish and wildlife and flood controlling. Based on structure and material used, dams are classified as timber dams, embankment dams or masonry dams, with several subtypes. International standards define large dams as higher than 15 meters and major dams as over 150 meters in height. The tallest dam in the world is the 300 meters high Nurek Dam in Tajikistan. APPENDIX 10. (Patoturvallisuustyöryhmän loppuraportti 2007, 3-5.)

Hydropower potential can be described well by comparing it to the amount of large dams. The classification of large dams is 15 meters high or it has more than 1 billion cubic metre water behind it. In Finland there are 54 dams in that classification, In Sweden 834 and in Norway 326. (The International Journal on Hydropower & Dams 1997; Ruuti 2007.)

Because of the possible progress of global warming, a new Dam Safety Law in Finland is needed which would take into consideration all the possible new threats that might occur due the changing environment. It has been estimated that the mean temperature in Finland will rise 2-7 degree by the year 2100. Mean rainfall will increase 5-40 % and storms will multiply. This might lead to increase of floods. The impact of global warming will cause pressure to dams and the usage.

The higher the pressure would be the better for PowerMortar because it's designed to work in demanding circumstances. Also Matti Ruuti Oy has the know-how for inspections and repairing of the possible damage. (Patoturvallisuustyöryhmän loppuraportti 2007, 3-5, 40.)

In this chapter secondary data was used.

5.2 Finland

In Finland dams are divided into three groups according to their altitude and dangerousness. The dam safety is defined by the Dam Safety Law from 1984. It concerns mainly the dams over three metres high but as far as the amount of water in the reservoir is so remarkable that it can cause probable danger to people or environment, health or property, the Dam Safety Law is applied to these dams too. In Finland the amount of these kinds of dams is around 500. The law doesn't concern so called temporary cofferdams nor mine dams. (Patoturvallisuuslaki 1.6.1984/413; Patoturvallisuustyöryhmän loppuraportti 2007, 5-7.)

Channels also belong to Dam Safety Law. Finnish Maritime Administration owns and monitors 39 channels and two museum channels. There are also few smaller boat sluices which are owned by private parties. The head changes from half a meter to 12 meters. Finnish Maritime Association is in charge of the maintenance and safety. (Patoturvallisuustyöryhmän loppuraportti 2007, 4-5.)

The dam safety law (413/1984) came in force 1.8.1984. The law was aimed at heighten the security arrangements of the dams and authority control of possible construction flaws, environmental and maintenance errors or deliberate damage. The law was legislated due to international development. Also International Commission of Large Dams (ICOLD) and UNESCO recommended actions for improvements. (Patoturvallisuustyöryhmän loppuraportti 2007, 5.)

The owner of the dam is responsible for its condition. Every dam has to have a special security file and a security check-up program. The check-up program is controlled by the local environment centre excluding the possible rescue action.

Ministry of agriculture and forestry acts as the topmost supervisor. (Patoturvallisuustyöryhmän loppuraportti 2007, 11-13.)

The local environment centres perform dam safety check-ups in most cases every five years. Inspects are usually done rough above the water surface. This doesn't however reveal the frost damages or other under water damage. These inspections should therefore be done by divers. (Patoturvallisuustyöryhmän loppuraportti 2007, 14-15.)

Ministry of agriculture and forestry set up a team which left a closing report in the beginning of 2007. Their task was to renew dam safety taking into consideration the changing environmental circumstances and readjust the legislation to others. Furthermore the team gave special attention to the control of flood risks and the possibility to insure the dams. (Maa- ja metsätalousministeriö 2007.)

The recommendations were that a new Dam Safety Law should be legislated and connections to other laws should be brought up to date. The responsibilities between different parties should be clarified and mine dams should be included in Dam Safety Law. Also aging, renovation and global warming have to be taken into consideration in the future. (Maa- ja metsätalousministeriö 2007.)

5.3 Sweden

The Swedish dam safety legislation is based primarily on one law, called Miljöbalk (MB 1998:808). It came in force in the beginning of 1999. It consists of all environmental affairs, including all relating to water. Dam safety has been enacted in the chapter of water (Vattenverksamhet, chapter 11). Also chapter 26 has rules concerning monitoring and controlling dams. (Patoturvallisuustyöryhmän loppuraportti 2007, 25.)

In Sweden dams are classified by their consequence. They are divided into four categories 1A, 1B, 2 and 3 of which group 1A has the most severe consequence dams. Table 10. shows the biggest dams in Sweden. (Patoturvallisuustyöryhmän loppuraportti 2007, 25.)

TABLE 10. Biggest dams in Sweden

Dam	Height (meters)
Trängslet	125
Seitevare	106
Messaure	101
Letsi	85
Höljes	80

One principle in Swedish Dam Safety law is the transparency of informing the citizens of dam safety. The most important aspects of the legislation are avoiding the serious accidents and the mitigation of the impacts. The law also monitors the owner's acts. (Patoturvallisuustyöryhmän loppuraportti 2007, 25.)

The dam owners are responsible for the dams they own and are obliged to compensate the possible damages. The owner also has to have a continuous program for supervising the dams and documents showing the risk control. Miljöbalk requires the owners to have the necessary know-how and to use the best possible technology. (Patoturvallisuustyöryhmän loppuraportti 2007, 25.)

Commercial organization SwedEnergy has published a safety guide of which their member enterprises must obey. They also contain recommendations of supervision, maintenance and security planning. These instructions however are not judicially binding. (Patoturvallisuustyöryhmän loppuraportti 2007, 25.)

Svenska Kraftnät which is owned by the Swedish state owns and operates the national electricity network and has been the corresponding authority concerning dam security since 1998. (Patoturvallisuustyöryhmän loppuraportti, 2007 s. 25.)

5.4 Norway

In Norway, the Water Resources Act came in force in 2001. This law contains general rules about the use of rivers, lakes and ground water and water construction including the safety of dams. The law emphasizes the use and administration of dams more than building and designing. (Patoturvallisuustyöryhmän loppuraportti 2007, 26.)

The legislation determines the rules and obligations of the owners and officials and rules about maintenance, surveillance, internal control, warning systems, safety plans and punishments. Dam classification is also determined. (Patoturvallisuustyöryhmän loppuraportti 2007, 26.)

Dam classification is based on the consequences of dam breakage considering the population and habitats close to the dam. There are about 2500 dams in Norway, 355 are large dams over 15 meters. (Patoturvallisuustyöryhmän loppuraportti 2007, 27.)

Norges vassdrags- og energidirektorat (NVE) is the official responsible of Norway's dam safety. It is subordinate of Ministry of Oil and Energy. Its main tasks are the supervision of dam construction, maintenance and use of dams, safety actions and consultation. The public supervision of dam safety is organized in geographical regions. The main goal of the public supervision is to ensure that dams and other structures are not posing a threat to life, property or the environment. It also makes new proposals of Dam Safety Law and accepts construction plans. (Patoturvallisuustyöryhmän loppuraportti 2007, 26-27.)

The owner of a dam is responsible for the safety and getting ready for accidents. The owner is also responsible of the possible damage and continuous check-up system. (Patoturvallisuustyöryhmän loppuraportti 2007, 27.)

6. POWER COMPANY PRESENTATIONS

6.1 Nordic power companies

Many of the power companies were formed at the beginning of 20^{th} century when the power supply technique was developed further. Also the Governments became interested in the production and distribution of power at this time. (International Small-Hydro Atlas 2007b.)

Norway restructured its electricity market in 1991, Sweden and Finland followed in 1995. In 1999, competition on the market increased more than it had done during the three previous years. A good availability of electricity and low prices on the electricity exchange forced the power companies to keep their prices down. (Energiamarkkinavirasto 2002; Ministry of Petroleum and Energy 2007b)

Since the restructuring of the industry, a number of changes in ownership happened in the Nordic countries. Mergers have reduced the number of large producers during the last 20 years. The Nordic market still has several power companies that compete. Swedish Vattenfall, Norwegian Statkraft and Finnish Fortum all want to be leading companies in Northern European electricity market and are investing in facilities in their neighbouring countries, purchasing shares of other companies and establishing subsidiaries. All these companies have Government as their biggest owner. (Energiamarkkinavirasto 2002; Fingrid 2007.)

The six largest powers companies accounted for 146,2 TWh, or 92,6 percent of Sweden's overall electricity generation, during 2001. The Nordic countries have around 350 power operators of which Vattenfall, Fortum, Statkraft, E.ON and Dong account for 60 % of the market. (E.ON 2007c.)

In Finland, there is only one national grid operator, Fingrid. It owns 99,5 % of the transmission network and is owned by several insurance companies, State, Fortum and Pohjolan Voima. There are also about 100 distribution companies, 20 are owned by municipalities, 30 are private companies and the rest are limited companies. The biggest companies in Finland are Fortum with 18 % share and Vattenfall with 11%. (Energiamarkkinavirasto 2002; Fingrid 2007; Lemstöm 2008.)

Companies' basic information is collected to tables. The focus is on hydropower operations. Also their biggest hydropower plants are summarised. Next Figure 4. shows how fragmented the Nordic electricity market is. The number of companies is high and the level of centralisation is low compared to the rest of Europe.

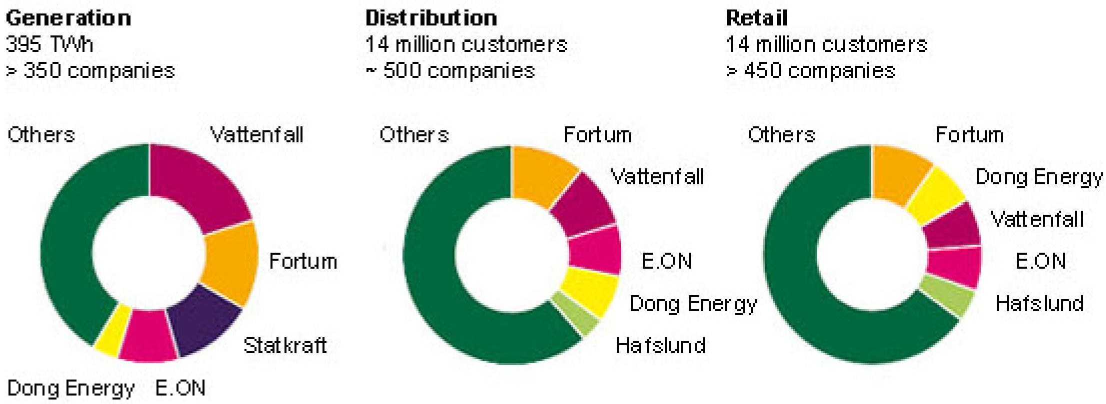

FIGURE 4. Fortum. Highly fragmented Nordic electricity market 2005.)

In this chapter problem identification research has been used to solve the market shares of companies. Data has been collected using both primary and secondary data. Also customer research has been taken into consideration.

6.2 Fortum

TABLE 11. Fortum's operations

Sales, EUR million (2006)	4 491
Employees	8 134
Year of foundation	1998 (Imatran Voima Oy & Neste Oy)
Owners	Listed in Helsinki Exchange, Finnish Government owns 50 %
Number of hydropower plants	260 plants, 211 in Sweden, 49 in Finland
Biggest hydropower plant	Trängslät (275 MW)
Customer base	electricity customers 1,3 million electricity distribution customers 1,6 million
Market area	Nordic & Baltic countries, North-West Russia, Poland

Fortum has 260 wholly or partially owned hydropower plants in Sweden and Finland. 211 of the hydropower plants are located in central Sweden. In Sweden the largest power plants in terms of capacity are at the Ljusnan, Indalsälven and Dalälven rivers. In Finland the 49 power plants are mainly located at the Oulujoki River and the waterways of Vuoksi. In addition, Fortum owns shares in Kemijoki Oy. (Fortum 2007; Fortum 2008.)

In 2006, Fortum generated 37% of its Nordic power by hydropower. In 2005 the amount was 41%. The share of hydropower varies according to the hydrological situation. (Fortum 2007; Fortum 2008.)

In 2000 Fortum bought all Stora Enso's hydropower plants in Sweden. Fortum gained a big part of Sweden's renewable energy markets. (Ruuti 2007.)

TABLE 12. Fortum's biggest hydropower plants.

	Hydropower plant	River	Capacity MW	Year of completion
1.	Trängslet	Dalälven	275	1960
2.	Krångede	Indalsälven	222	1936
3.	Imatra	Vuoksi	178	1928
4.	Pyhäkoski	Oulujoki	129	1951
5.	Höljes	Klarälven	120	1962
6.	Avesta Storfors	Dalälven	100	1931
7.	Blåsjön	Ångermanälven	98,5	1957
8.	Krokströmmen	Ljusnan	94	1952
9.	Långå G2	Ljusnan	94	1973
10.	Nuojua	Oulujoki	81	1954

6.3 Vattenfall

TABLE 13. Vattenfall's operations.

Sales, EUR million (2006)	16,112 (about 5,3 million EUR in Nordic countries)
Employees	32 308
Year of foundation	1909
Owners	Swedish public limited liability company, owned by the Swedish state
Number of hydropower plants	112
Biggest hydropower plant	Pamilo (in Finland 83 MW),
Customer base	1.3 million network customers in Sweden and Finland
Market area	Nordic countries, Germany, Poland

The main forms of power of Vattenfall are nuclear power and hydropower. In 2006 34, 3 TWh came from hydropower which is about 21 % of their whole electricity production. Vattenfall generates roughly 20 per cent of the electricity consumed in the Nordic countries and about 50 per cent of Sweden's electricity production. Vattenfall is the main regional and local network operator in Sweden with 900,000 customers. Finland is part of the Nordic market, which comprises approximately 19 million people. (Vattenfall 2006; Vattenfall 2007a.)

Vattenfall has 10 hydropower plants in Finland of which the biggest is Pamilo power plant in Eno, Northern Karelia. The plant's specialty is that it is designed by Alvar Aalto. In Sweden it has 92 hydropower plants, the biggest are in the rivers of Lule, Ume and Ångermanälven. They also have smaller hydropower plants in the Southern parts of Sweden. (Vattenfall 2006; Vattenfall 2007a.)

TABLE 14. Vattenfall's biggest hydropower plants.

	Hydropower plant	**River**	**Effect MW**	**Year of completion**
1.	Harsprånget	Lule älv	977	1951
2.	Stornorrfors	Ume älv	590	1958
3.	Porjus	Lule älv	465	1975
4.	Letsi	Lule älv	456	1967
5.	Messaure	Lule älv	442	1963
6.	Ligga	Lule älv	324	1954
7.	Ritsem	Lule älv	320	1977
8.	Vietas	Lule älv	320	1971
9.	Kilforsen	Ångermanälven	288	1953
10.	Porsi	Lule älv	280	1961

6.4 Pohjolan Voima

TABLE 15. Pohjolan Voima's operations.

Sales, EUR million (2006)	888
Employees	1 032, of which 4,9 % in hydro power production
Year of foundation	1943
Owners	The Finnish forest industry is the biggest with 62,8 % share
Number of hydropower plants	12
Biggest hydropower plant	Isohaara (106 MW)
Customer base	mainly industries and households in Northern Finland
Market area	Finland

At the beginning Pohjolan Voima was in charge of building new hydropower plants. In the 60's when the possibilities of building new hydropower plants diminished, it started to build thermal power plants. (Pohjolan Voima 2006; Pohjolan Voima 2007b.)

In 2006, 18 % of Pohjolan Voima's total production consisted of hydro power. Its hydropower plants are situated in the rivers Iijoki, Kokemäenjoki, Tengeliönjoki and the waters of Kemijoki. The total power output is 477 MW of which 411 MW are Pohjolan Voima's share. In 2004, the company produced 1,4 TWh which is 87 % of a normal year's production. (Pohjolan Voima 2003; Pohjolan Voima 2007d.)

In 2006 and 2007 Pohjolan Voima made repairs in Kierikki and Haapakoski hydropower plants which could be possible construction sites for PowerMortar. The company also plans to build new reservoir and hydropower plant to Pudasjärvi. (Pohjolan Voima 2007b; Pohjolan Voima 2007c.)

In Finland it also has one nuclear power plant, wind power and thermal power. (Pohjolan Voima 2007c.)

TABLE 16. Pohjolan Voima's biggest hydropower plants.

	Hydropower plant	River	MW	Year of completion
1.	Isohaara	Kemijoki	106	1949 & 1993
2.	Melo	Kokemäenjoki	67	1971
3.	Raasakka	Iijoki	58	1971
4.	Kierikki	Iijoki	38	1965
5.	Pahkakoski	Iijoki	34	1961
6.	Maalismaa	Iijoki	33	1967
7.	Jumisko	Kemijoki	30	1954
8.	Haapakoski	Iijoki	28	1963

6.5 Kemijoki Oy

TABLE 17. Kemijoki Oy's operations.

Sales, EUR million (2006)	39
Employees	280
Year of foundation	1954
Owners	The Finnish state with 50 % share, Fortum 63,74 % of hydro power shares
Number of hydropower plants	20
Biggest hydropower plant	Petäjäkoski (172 MW)
Customer base	Mainly industries and households in Northern Finland
Market area	Northern Finland

Kemijoki Oy is the Finland's most significant hydropower and hydropower related service producer. In 2006 Kemijoki Oy's share of hydropower production in Finland was 36 %. The company owns 20 hydropower plants of which 16 is situated in Kemijoki area, two in Lieksa River and two in Kymijoki. It also controls few reservoirs. The total effect of Kemijoki Oy's hydropower plants is over 1 000 MW. (Kemijoki-Yhtiöt 2007a; Kemijoki-Yhtiöt 2007b.)

Kemijoki Oy is supporting the construction of Vuotos reservoir which would help Finland reach the European Union renewable energy targets. Although this reservoir has once been buried because of the strong protests it raised, the possibility of re-opening the conversation has again emerged. This reservoir would produce 35 MW from a new plant and raise the capacity of other plants so that extra 50-100 MW could be produced. (Ruuti 2007.)

TABLE 18. Kemijoki Oy's biggest hydropower plants.

	Hydropower plant	Effect MW	Year of completion
1.	Petäjäskoski	172	1957
2.	Taivalkoski	133	1976
3.	Seitakorva	130	1963
4.	Pirttikoski	110	1959
5.	Valajaskoski	101	1960
6.	Ossauskoski	93	1965
7.	Vanttauskoski	83	1972
8.	Porttipahta	35	1981
9.	Kurkiaska	27	1992
10.	Kokkosniva	25	1990

6.6 E.ON

TABLE 19. E.ON's operations.

Sales, EUR million (2006)	67 759
Employees	80 612
Year of foundation	2000
Owners	VEBA and VIAG, two of Germany's largest industrial groups
Number of hydropower plants	115 in Sweden
Biggest hydropower plant	Harrsele, 223 MW
Customer base	35 million in the world
Market area	Central Europe, the United Kingdom, Northern Europe, and the Midwestern United States

E.ON is the biggest private owned electricity company in the world and Sweden's second largest electricity company. In 2006, E.ON generated 7,9 % of its electricity by hydropower. In 2006, the Nordic hydroelectric power system amounted slightly more than 180 TWh, which is almost 50 TWh lower than in the preceding year and 15 TWh lower than the average level over the past ten years. The company has 5 506 MW of hydroelectric capacity and seven pumped-storage hydro plants. E.ON Nordic generated fully 37 percent of its electricity at hydro plants. (E.ON Sverige AB 2007b; Mutikainen 2008.)

E.ON Wasserkraft is currently the largest supplier of hydropower in Central Europe. In the United Kingdom, E.ON is becoming the leading supplier of renewable energy. The company generates almost half of its power in the Nordic market with environmentally friendly hydropower technology. In northern Europe, E.ON is represented by E.ON Nordic in Sweden and Finland. The operative business here is run by E.ON Sverige and E.ON Finland. It is also planning significant expanding of its operations in Finland. Now the operations comprehend of E.ON Finland and Kainuun Energia Oy and its subsidiaries. (E.ON 2007c; Mutikainen 2008.)

E.ON has 54 hydropower plants in Northern Sweden, 8 in Central Sweden and 53 in South of Sweden. In Finland they don't have hydropower plants at the moment. (Mutikainen 2008.)

TABLE 20. E.ON's biggest hydropower plants.

	Hydropower plant	River	Capacity MW	Year of completion
1.	Harrsele (50 %)	Umeälven	223	1957
2.	Hjälta	Faxälven	178	1952
3.	Ramsele	Faxälven	157	1958
4.	Moforsen	Ångermanälven	135	1968
5.	Korsellbränna	Fjällsjöälven	130	1961
6.	Olden	Indalsälven	112	1975
7.	Storfinnforsen	Faxälven	112	1953
8.	Bålforsen	Umeälven	88	1958
9.	Bjurfors Nedre	Umeälven	78	1959

6.7 Statkraft

TABLE 21. Statkraft's operations.

Sales, EUR million (2006)	200
Employees	2 100
Year of foundation	1992
Owners	Norwegian State
Number of hydropower plants	156
Biggest hydropower plant	Kvilldal 1 240 MW
Customer base	400 000 household customers.
Market area	Norway, Sweden, Finland, Germany, the Netherlands and the UK

Statkraft produces hydropower, wind power and builds gas-fired power plants. The group plans to invest in hydropower, wind power and gas power generation both in Norway and abroad. Major of Statkraft's electricity output comes from hydropower. Production takes place at 133 hydropower plants in Norway, 19 in Sweden and 4 in Finland. The biggest plant in Finland is Kolsi, 45 MW, in Sweden Lövön 36 MW and in Norway Kvilldal 1240 MW. (Statkraft 2007a; Statkraft 2007b.)

The company is the third largest producer of power in the Nordic region and the second largest producer of power based on renewable energy sources in Europe. In the future Statkraft wants to be a European leader in environment-friendly energy. Nowadays it has environment-friendly generation 42 TWh. The company produces 35% of Norway's power generation, 12% of Nordic power generation and 1% of Europe's power generation. (Statkraft 2007b.)

TABLE 22. Statkraft's biggest hydropower plants.

	Hydropower plant	Community	Capacity MW	Year of completion	Head (meters)
1.	Kvilldal	Rogaland	1240	1986	538
2.	Rana	Nordland	500	1980	520
3.	Saurdal	Rogaland	470	1986	465
4.	Tokke	Telemark	430	1980	394
5.	Sysima	Hordaland	403	1981	899
6.	Langsima	Hordaland	325	1980	1 152
7.	Skjomen	Nordland	313	1980	610
8.	Vinje	Telemark	300	1965	222
9.	Aura	Møre og Romsdal	290	1956	784
10.	Jostedal	Sogn og Fjordane	290	1990	1 186
11.	Nedre Røssåga	Nordland	260	1958	246
12.	Svartisen	Nordland	257	1993	-

6.8 Dong Energy

TABLE 23. Dong Energy's operations.

Sales, (DKK) million (2006)	357 DKK = 48 million EUR (7.1.2008 /7,4498)
Employees	4 585
Year of foundation	2006 (The merger of Dong, Elsam, Energi E2, Nesa, Copenhagen Energy and Frederiksberg Forsyning)
Owners	Danish state owns 73 %
Number of hydropower plants	14 partially owned
Biggest hydropower plant	-
Customer base	about 1 million
Market area	Denmark, Sweden, Germany, the Netherlands, UK

Dong Energy is Denmark's largest energy company. It is the leader in the European wind energy market, operating more than 500 wind-generating facilities but the company also produces hydropower. The company is active in Sweden's and Norway's hydropower sector but doesn't have any own hydropower plants. In addition, Dong Energy also utilizes geothermal heat. Dong Energy 2007; Dong Energy 2008.)

Don Energy owns own 25.7% of Kraftgården AB in Sweden, which draw a total 205 MW of seven hydroelectric stations along the River Indal in central Sweden. In addition they own 33.3% of the shares in the Norwegian company Narvik Energy, which in 2006 generated 886 GWh. It also owns 20% of Salten Kraftsamband AS, which in 2006 generated 1 737 GWh. (Dong Energy 2007; Dong Energy 2008.)

In 2006 Dong Energy generated 0,2 MW by hydropower in Sweden and Norway. (Dong Energy 2007.)

6.9 Conclusion of hydropower companies

A number of changes in power companies' ownership have happened in the Nordic countries. Mergers have reduced the number of companies and plants have been sold. That is the reason why ownerships of hydropower plants are difficult to find. Vattenfall, Statkraft, Fortum and Dong Energy are biggest in their own countries but all are investing in their neighbouring countries.

From the above company operations tables companies' biggest hydropower plants, market area, owners and number of hydropower plants is the most important information. These express the importance in hydropower markets and help Matti Ruuti Oy to aim the selling operations to the right companies.

The most important information for Matti Ruuti Oy is power companies' hydropower plants, their locations, construction years and sizes. Due to mergers and selling-operations, hydropower plants change owners rapidly and up-to-date information has to be searched from various locations. Sometimes companies share the ownership of plants and each has their own share of production. This again makes selling operations more difficult.

Location of course effects the transportation. Many of the Swedish hydropower plants are situated in the Northern part of the country and this enables land transportation. Differently from Sweden, Norway's hydropower plants are located mainly on the Southern part of the country. Construction years can give a guideline which plant could be a possible target for PowerMortar. Many of the Finnish and Swedish plants have been constructed after the wars and are in the need of repairs. Norwegian capacity is a little bit younger.

Knowing the sizes of hydropower plants is important for sales operations. Concentrating to small plants is not usually profitable even though the amount of these plants is big. These plants however can be stopped or build a cofferdam without dramatic consequences and other methods are suitable for these repairs. Companies budget more money to bigger plants because those produce more electricity thus money. Also bigger plants require larger repairs so the income from these could be bigger.

From above information can be concluded that all other companies except Dong Energy are possible customers for Matti Ruuti Oy. Kemijoki Oy and Pohjolan Voima are operating only in Finland but have some bigger plants to concentrate on. Fortum and Vattenfall are the biggest operators in Finland and also have big plants in Sweden. Fortum’s hydropower plants 2/3 are in Sweden. Vattenfall owns the biggest hydropower plants in Sweden, Harsprånget. Statkraft is the biggest company in Norway and also has hydropower plants in Sweden. E.ON is also a big operator in Sweden. Dong Energy is Denmark’s biggest company but the hydropower operations are so non-existing that the company will be excluded.

7. RECOMMENDATIONS

During the research the biggest hydropower plants, biggest owners, construction years, locations and the size of plants have been found out and based on this information, the focus of future operations has been found out. No other source has this information summarised and books cannot be used usually because the information changes rapidly.

Fortum, Vattenfall, Statkraft, E.ON, Kemijoki Oy and Pohjolan Voima all are big companies in hydropower sector but Dong Energy doesn't offer anything for Matti Ruuti Oy as it produces only 0,2 MW with hydropower. Kemijoki Oy and Pohjolan Voima have plants only in Finland but are strong companies in Finnish hydropower market. Statkraft is a big company in Norway and Sweden and doing business with it when entering to Norway is a must. Fortum, Vattenfall and E.ON can give a lot of opportunities for PowerMortar both in Sweden and in Finland.

During the research has been found out that PowerMortar should not concentrate on small companies even thought there are many. Repairs in small plants are also possible to carry out as dry work and there are plenty of owners who are also hard to find. PowerMortar should now on concentrate on big hydropower companies because the owners and decision-makers are easier to be found, they have plenty of money, they budget beforehand to repair operations and in Sweden most of them a located in the northern part and so on the land transportation is possible. Also sales and marketing operations are easier when the owners are known.

Owners have changed rapidly; big power companies have bought for example small, community owned hydropower plants. The companies have bought new plants all over; Finnish companies from Sweden and the other way round. At the same time, maintenance, design etc. has been outsourced and of those have been made own companies in which the biggest power companies act as owners. Sweden is the pioneer in outsourcing. Also separate grid companies have been established which control the electricity distribution. Now power companies only deal with electricity production. This has led to point where employees have retired or moved to other companies and it is always harder to find out who is in charge of decisions.

PowerMortar is more expensive as a material compared to other methods and access of materials in foreign countries is more difficult but by using PowerMortar diversion can be avoided. The expenses are compensated with the hydropower the plant can produce during repairs. In these cases PowerMortar is a very economical solution. Besides, there isn't another product in the market which could be used in great depths.

Because the hydropower plants are bigger in Sweden than in Finland and produce a lot more electricity, and under the circumstances more money, the owners are unwilling to shut them down even for a short time or dry the plants. Plants over 10 MW cannot actually even be dried. This is good for PowerMortar because repairs have to be done by divers in flowing water which is a specific feature of PowerMortar. Also the divers trained by Matti Ruuti Oy can fix other underwater problems like screens or gates. Actually, the worse place, the better for PowerMortar because other products are not able to operate there.

Renewable energy production is living a time of rapid change. Especially hydropower as an emission-free source on energy is wanted. European Union has announced new renewable energy level targets and hydropower production should be increased to reach the target. Hydropower is also popular because it can be used to control high consumption peaks. This means that the higher consumption, the higher electricity prices.

The alleged global warming and the new dam safety decrees resulted by it bring demand of more durable materials and repair methods. Due to that PowerMortar is also very suitable for new construction.

Sweden is highly potential market area for several reasons. Swedish power companies, some of which also have operations in Finland, are wealthy and own about 1800 hydropower plants around Sweden. Compared to Finland's 207 hydropower plants, Sweden has almost nine times more hydropower plants than Finland.

Both in Sweden and in Finland the hydropower plants are old. The new dam safety regulations will demand actions in repairs of hydropower plants’ dams and structures. In the last decade hydropower plants’ turbines’ power raise has been very popular what makes the plant produce more electricity. Many hydropower plants in Sweden and Finland are cultural milieu and using PowerMortar the old surroundings can be preserved.

Also the cultural facts back up the expanding; Swedish language isn’t a problem, the business culture is similar and legislation close to Finnish and easy to determine. Sweden is also neighbouring country and quite easy to reach by boat and car. This facilitates the transportation of the materials, machines and labour.

Norway is a potential customer with its 99 % share of hydropower. As was found out it hasn’t been constructed with sufficient reservoirs and now the hydropower infrastructure has to be rebuilt. Many power companies which operate in Sweden have plants also in Norway and after working for them in Sweden, it is easier to work for them in Norway.

Norway is also quite easy to access by boat or driving by north but in the country many fjords make travelling time consuming. The language barrier isn’t big; what cannot be conducted in Swedish can be done in English. Also business culture doesn’t vary from Finnish too much.

Denmark doesn’t offer anything for PowerMortar. It doesn’t have big hydropower plants and only few small. In the future Denmark is concentrating on wind power and isn’t going to build any new hydropower plants. The country itself would have quite similar business culture and could be accessed via Sweden but the language differs too much from Swedish and so English would be used.

Iceland has hydropower about 81 % and is building a new big hydropower plant. The biggest problem for Iceland is its long distance from Finland and the transportation there. By boat it takes time and by plain it is really expensive. At this moment Iceland isn’t the market area where Matti Ruuti Oy should expand.

Marketing and selling operations should be directed to the biggest power companies in Nordic countries which have operations also in other Scandinavian countries. This cannot be done by normal marketing ways because the product is unique and the customer base very limited. PowerMortar has already been marketed by using questionnaires and sending information to municipalities but this hasn't turned out very profitable with this product. The final sales operations will take place personally.

The next step is to find all contacts from the biggest companies and their biggest budgeted repair sites. It is vital to find out which hydropower plant already has been accepted as repair site and has been mentioned in the budget so that time and money are not wasted to plants which are in need of repair but the owners haven't budgeted any money for it.

Attending ferias is a considerable option in Finland, Sweden and Norway. Another way is to find out those who are responsible for budget and approach them by email and market this product directly to them who decide the future operations. Because Matti Ruuti Oy has good web pages in several languages, the email only has to attract attention and direct to the web pages where information is found.

New consultants in Sweden and Norway could help the business dramatically. The consultant should have a good know-how of the electricity market in the target country and have relationships with the power companies. The contract should be similar than what Matti Ruuti Oy has already made to Spain and Portugal. As Matti Ruuti Oy already has a person in mind, it could be wise to start negotiations so that the possible benefit could be gained already next summer. Also promotion research could be conducted in next phase.

As was found out, Sweden and Norway are recommended market areas but they still don't solve one problem; winter. Like Finland, Sweden and Norway are Scandinavian countries and have short summers and long winters. PowerMortar can be used even during the winter but it's more expensive and difficult. Mortar has to be mixed in warm place and divers' tools can freeze. Also mortar hardens slower when it's too cold. These of course complicate work.

Energy consumption is bigger during winters and that’s why energy companies aren’t willing to shut down or even slow down the stream so that it would be possible for drivers to stay underwater. Some repairs can be done during the winter e.g. injection because the ductility of the mortar is more important in injection than the rate of strength gain.

Because winter is main element in Scandinavia, future market areas should be in countries where winter isn’t as hard as here. Matti Ruuti Oy already has consultants in Portugal and Spain and should aim to work in those countries when it is almost impossible in Nordic countries. Next market research should be made of Spain and Portugal.

Although Spain and Portugal are members of European Union, the business culture and culture by itself are very different for Scandinavian. Doing business in Spain and Portugal would be a lot bigger step for Matti Ruuti Oy than business in Sweden and Norway.

8. SUMMARY

This thesis examines possible new market areas for PowerMortar which is a unique product developed for underwater repairs. The owner of all rights of PowerMortar is Matti Ruuti Oy. The emphasis is on the Nordic markets, especially on Sweden and Norway.

This thesis answers questions such as which are the biggest power companies that operate in Scandinavia, what is the amount of hydropower in every country and in each power company, what is the legislation that controls construction in hydropower plants and dams and what should be done next in order to reach new customers for PowerMortar.

The theoretical part is concentrating on main features of market research. Material was mostly collected from various sources in the Internet because due to rapid changes in ownerships of hydropower plants and mergers, books are soon outdated. Interviews were a vital part in this research.

Based on the findings of the biggest hydropower plants, biggest owners, construction years, locations and the size of plants, the future operations can be focused to selected companies. Also has been found out that hydropower production in Sweden is 5,5 times bigger in Sweden than in Finland. Norway's production is 9,6 times bigger than Finnish and 1,7 times bigger than Swedish hydropower production.

During research has been found out that Norway is also considerable market area for PowerMortar. Norway produces its electricity 99 % by hydropower and has 651 hydropower stations. Denmark and Iceland are excluded due to their small amount of hydropower or difficult transportation routes. Sweden will be the main market area for PowerMortar in the near future and Matti Ruuti Oy is planning to find a consultant in Sweden to help marketing and selling operations.

First Matti Ruuti Oy will concentrate to Swedish markets and its biggest hydropower companies. The target is to repair hydropower plants for a company first in Sweden and then move to the company's plants to Norway. Matti Ruuti Oy aims to concentrate on bigger hydropower plants because of the possibilities PowerMortar's characteristics can offer for them and also because power companies easily budget money for their bigger plants. Also decision-makers are easier to be found.

SOURCES

Printed Sources

Chisnall, Peter. 2005. Marketing Research. 7th edition. Berkshire. England: McGraw-Hill Education.

Hirsjärvi, S., Remes, P. & Sajavaara, P. 2004. Tutki ja kirjoita. 10th edition. Helsinki: Tammi

Malhotra, Naresh. K. 1996. Marketing Research: An Applied Orientation. Second edition. New Jersey. USA: Prentice Hall Inc.

Patoturvallisuuslaki 1.6.1984/413. Helsinki.

Ruuti, Matti. 2000a. PowerMortar brochure. Vantaa: Fortum Technology

Ruuti, Matti. 2000b. PowerMortar Technical Specification. Vantaa: Fortum Technology

Suurpadot – Suomen Osasto Ry. 1997. Teknillinen Patosanasto 1997. Rovaniemi.

The International Journal on Hydropower & Dams. 1997. Water Power & Dam Construction. 1997 Yearbook. The Status of Water Development in 1994; u.a.

Interviews

Kuokkanen, Juhani. 2007, Director, Global Research and Data Services, interview, 10.11.2007

Mutikainen, Mirja, 2008, Director, Strategy and Business Development, E.ON Suomi Oy, interview, 2.1.2008

Ruuti, Matti. 2007. Managing Director, Matti Ruuti Oy, interview, during practical training

Electronic sources

Bonsor, Kevin. 2007. How Hydropower Plants Work.
http://people.howstuffworks.com/hydropower-plant.htm 14.10.2007

Danish Energy Authority. Energy Statistics 2006.
http://www.ens.dk/graphics/UK_Facts_Figures/Statistics/yearly_statistics/Energy%20Statistics%202006.pdf 15.11.2007

Danish Energy Authority. http://www.ens.dk/sw11492.asp 15.11.2007

Dong Energy. 2008. Hydro.
http://www.dongenergy.com/EN/business+activities/generation/electricity+generation/hydro.htm 14.1.2008

Dong Energy. 2007. Annual report 2006.
http://www.dongenergy.com/NR/rdonlyres/5BDF40E7-E5E8-4BEA-B1FD-EEF42276A6C8/0/annual_report_2006.pdf 22.11.2007

Eikeland, Per Ove. 2006. Renewable energy in Norway and the Nordic energy system: Drivers and Effects.
http://www.ren21.net/pdf/WorkShop_Presentations/Eikeland_Presentation%20REN21%20Renewable%20energy%20policies%20in%20Norway.ppt#271,14,International commitments 7.11.2007

Energiaa Länsi-Suomessa. 2007. ABC: Vesivoima.
http://www.energiaalansisuomessa.fi/tmp_els_site_8.asp?lang=1&s=86&sua=1 12.9.2007

Energiamarkkinavirasto. 2002. Sähkömarkkinat.
http://www.energiamarkkinavirasto.fi/select.asp?gid=30 14.1.2008

Energiateollisuus. 2004. Consumption and consumption per capita in Europe
http://www.energia.fi/fi/tilastot/sahkotilasto/kaytto/sahkonkokonaiskayttojakayttopercapitaeuroopassa 9.1.2008

Energiateollisuus. 2007. Vesivoima.
http://www.energia.fi/fi/sahko/sahkontuotanto/vesivoima 9.1.2008

Energiateollisuus. 2008. Norjan sähkövuosi 2007.
http://www.energia.fi/fi/ajankohtaista/energiauutisia/norjan%20s%c3%a4hk%c3%b6vuosi%202007.html 20.1.2008.

Energilink. http://www.energilink.no/no/default.aspx 11.1.2008.

Energy Statistics in Iceland. 2007.
http://www.os.is/Apps/WebObjects/Orkustofnun.woa/swdocument/20644/Energy_Statistics_2007.pdf 17.12.2007

E.ON. 2007a. Energiantuotanto Suomessa.
http://www.eon.fi/templates/InformationPage.aspx?id=74021 13.11.2007

E.ON Sverige AB. 2007b. E.ON's vattenkraftverk i Umeälven.
http://www.eon.se/templates/InformationPDF.aspx?id=39118 13.11.2007

E.ON. 2007c. Annual Report 2006.
http://www.eon.com/en/downloads/GB_E_komplett_geschuetzt_2006.pdf 5.1.2008

Encyclopedia Britannica online. 2008. Iceland; Resources and power. http://www.britannica.com/eb/article-10077/Iceland 14.1.2008

Fingrid. 2007. Sähkömarkkinat. http://www.fingrid.fi/portal/suomeksi/sahkomarkkinat/ 5.12.2007

Fortum Company data. 2005. Highly fragmented Nordic electricity market. Shares of the largest actors, 2005. http://www.fortum.com/document.asp?path=14022;14024;14026;14043;14070;14071;14079;41961 17.1.2008

Fortum 2007. Annual Report 2006. http://www.fortum.com/gallery/Investors2007/Annual_Reports_2006/Fortum_AR06_fin.pdf 15.1.2008

Fortum. 2008. Vesivoima. http://www.fortum.fi/dropdown_document.asp?path=14020;14028;14029;14055;14244;14248;41108;41109 15.1.2008

Gagnavefsjá – Map server. 2008. http://gullhver.os.is/website/hpf/orkustofnun_english/viewer.htm 18.1.2008

Iceland Trade Directory. Energy in Iceland. http.//www.icelandexport.is/english/industry_sectors_in_iceland/energy_in_iceland/ 15.12.2007.

INFORSE. 2008. Europe Sustainable Energy Study Tours in Denmark http://www.inforse.dk/europe/word_docs/study_tours_DK06.doc 4.1.2008

International Atomic Energy Agency. 2007 Sweden. http://www.pub.iaea.org/MTCD/publications/PDF/cnpp2003/CNPP_Webpage/PDF/2002/Documents/Documents/Sweden%202002.pdf 14.11.2007

International Small Hydro Atlas. 2007a. Finland. http://www.small-hydro.com/index.cfm?Fuseaction=countries.country&Country_ID=29 20.11.2007

International Small-Hydro Atlas. 2007b. Sweden. http://www.small.hydro.com/index.cfm?Fuseaction=countries.country&Country_ID=74 20.11.2007

Kauppa- ja Teollisuusministeriö, Energiaosasto. 2005. Vesivoimatuotannonmäärä ja lisäämismahdollisuudet Suomessa. http://julkaisurekisteri.ktm.fi/ktm_jur/ktmjur.nsf/all/6638E6EBAA886908C225701900465F55/$file/334642004.pdf 10.9.2007

Kemijoki Oy. 2007a. http://www.kemijoki.fi/ 4.10.2007

Kemijoki- Yhtiöt. 2007c. Vuosikertomus 2006. http://www.kemijoki.fi/Kemijoki/kemijoki.nsf/TD/CAA482C0955EE9C642256D1D003EDBE3/$File/KeJoVK06Web.pdf?OpenElement 4.10.2007

Kemijoki- Yhtiöt. 2007b. Taskuesite.
http://www.kemijoki.fi/Kemijoki/kemijoki.nsf/TD/CAA482C0955EE9C642256D1D003EDBE3/$File/KeJoTaskuesite_fin2.pdf?OpenElement 4.10.2007

Kuhlin, Leif. 2007. Vattenkraften i Sverige. http://www.kuhlins.com/ 11.11.2007

Lemström, Bettina. 2008. The Impact of Electricity Network Organisation, Regulation and Pricing on Renewables and Distributed Generation - Inventory of the situation in Finland. VTT
http://www.iea.org/Textbase/work/2001/redg/REDGFIN1.PDF 4.1.2008

Maa- ja metsätalousministeriö. 2007. Uusi patoturvallisuuslaki tarpeen
http://www.mmm.fi/fi/index/ministerio/tiedotteet/070124_patoturvallisuus.html 10.10.2007

Mikkelsen, Bård. 2003. Statkraft. Norwegian hydropower; nationally and locally. Driving force of welfare.
http://www.statkraft.com/Images/BM_hydropower_force_welfare_050603_tcm4-3034.pdf 17.11.2007

Ministry of Petroleum and Energy. 2007a. Electricity generation.
http://www.regjeringen.no/en/dep/oed/Subject/Energy-in-Norway/Electricity-generation.html?id=440487 21.1.2008

Ministry of Petroleum and Energy. 2007b. Norway's Energy Profile.
http://www.regjeringen.no/en/tidligere_statsraader/Minister-of-Petroleum-and-Energy/Speeches-and-articles/2007/Norways-Energy-Profile.html?id=459272 14.1.2008

MSN Encarta. 2008. Encyclopedia article. Norway.
http://encarta.msn.com/encyclopedia_761556517/article.html 14.1.2008

Norges Vasdrags- og energidirektorat. 2006. Vasskraftverk - konsesjonsplikt og sakshandsaming.
http://www.nve.no/modules/module_109/publisher_view_product.asp?iEntityId=8656&noscript= 6.11.2007

Orkustofnun. 2007. National Energy Authority of Iceland.
http://www.os.is/page/english/ 7.12.2007

Patoturvallisuustyöryhmän loppuraportti. 2007. Helsinki.
http://www.mmm.fi/attachments/5lW4u4FlL/5n2tNmFoZ/Files/CurrentFile/trm2007_3.pdf 29.10.2007

Pohjolan Voima Oy. 2007a. http://www.pvo.fi/fi-FI/pohjolanvoima/ 5.12. 2007

Pohjolan Voima. 2007b. Pohjolan Voiman sidoryhmälehti 1.2.2007.
http://www.pvo.fi/File/ae425c0e-19f2-4b84-afd5-5ab7e6f5df8f/2007-1-Pohjolan+Voima.pdf 5.12.2007

Pohjolan Voima. Virtaviesti. 2/2007. 2007c. http://www.pvo.fi/File/f01b3fdb-dcb1-4a09-855e-d836fc64a9ed/Virtaviesti-2-2007.pdf 5.12.2007

Pohjolan Voima. 2007d. Vuosikertomus 2006. http://www.pvo.fi/File/32644923-546e-48bb-ae79-7c4f3144c12a/Pohjolan+Voima+Vuosikertomus+2006.pdf 5.12.2007

Pohjolan Voima. 2003. Yleisesite. http://www.pvo.fi/File/74313c0e-1a19-420b-a160-155e1b9bd21b/Pohjolan+Voiman+yleisesite.pdf 5.12.2007

PowerMortar. 2007. www.powermortar.fi 10.10.2007

Rundqvist, Jonas. 2007. ISAB Dammar & Kraft. Dags att renovera? Dags att kolla grunderna. http://isab-hydro.com/artikel.pdf 13.9.2007

Statistics Norway. 2007a. Power stations, by size (maximum output).1974- 2005 http://www.ssb.no/english/subjects/10/08/10/elektrisitetaar_en/tab-2007-05-24-06-en.html 16.10.2007

Statistics Norway. 2007b. Hydro-electric power stations, by size (maximum output) and county/ownership group, 2005. 16.10.2007 http://www.ssb.no/english/subjects/10/08/10/elektrisitetaar_en/tab-2007-05-24-07-en.html

Statistics Norway. 2003. Natural Resources and the Environment 2003, Les greenhouse gases – more waste. 30.11.2007 http://www.ssb.no/english/magazine/art-2003-12-12-01-en.html 30.11

Statistics Sweden. 2007. Electricity supply and use 1994 - 2005 (GWh). http://www.scb.se/templates/tableOrChart____24271.asp 3.10.2007

Statkraft. 2006. Power criss-crossing the Nordic region. 20.10.2006 http://www.statkraft.com/pub/power_market/features/power_criss_crossing_the_nordic_region.asp 3.12.2007

Statkraft. 2007a. Hydropower. http://www.statkraft.com/pub/hydropower/index.asp 3.12.2007

Statkraft. 2007b. Annual report 2006. http://www.statkraft.com/Images/%C3%A5rsrapport%20eng%20ny_tcm4-6924.pdf 3.12.2007

Stensby, Kjell Erik & Pedersen, Tor S. 2007. Role of Hydropower in Norway. Norwegian Water Resources and Energy Directorate. 15.12.2007

Stubholt, Liv Monica Bargem. 2007. Ministry of Petroleum and Energy. 2007. Global and European Energy Challenges: Viewpoints from Norway. http://www.regjeringen.no/nn/dep/oed/Om-departementet/Anna-politisk-leiing/Liv-Monica-Bargem-Stubholt/Talar-og-artiklar/2007/Global-and-European-Energy-Challenges-Vi.html?id=485747 21.1.2008.

Takala, Aimo. Energiakongressi 2006. Kemijoki Oy.
http://www.veko.fi/Kemijoki/kemijoki.nsf/TD/E49D3BD965842E17C22572120018B21A/$File/Energiakongressi.pdf?OpenElement 9.9.2007

Vattenfall. 2005. Vattenfall's views on the electricity market 2006.
http://www.vattenfall.com/www/vf_com/vf_com/Gemeinsame_Inhalte/DOCUMENT/360168vatt/397946elec/P02.pdf 30.9.2007

Vattenfall. 2006. Miljörenovisning 2006.
http://www.vattenfall.se/www/vf_se/vf_se/Gemeinsame_Inhalte/DOCUMENT/196015vatt/815691omxv/819774vxrx/876156vxrx/876172omxv/P02.pdf 30.9.2007

Vattenfall. 2007a. Annual Report 2006. http://www.vattenfall.com/annual-reports/vf_com/2006/web-content/pdf/vattenfall_annual_report_2006.pdf 30.9.2007

Vattenfall. 2007b. How a hydropower plant works.
http://www.vattenfall.com/www/vf_com/vf_com/365787ourxc/368021about/368053howxt/395991techn/397347hydro/index.jsp 30.9.2007

Vattenportalen. 2007. Vattenkraft och stora dammar.
http://www.vattenportalen.se/fov_problem_vattenkraft.htm#Vattenkraften 9.12.2007

Wikipedia. 2007a. Kárahnjúkar Hydropower Project. 2007.
http://en.wikipedia.org/wiki/K%C3%A1rahnj%C3%BAkavirkjun 7.12.2007

Wikipedia. 2007b. List of countries and outlying territories by total area.
http://en.wikipedia.org/wiki/Country_size 11.12.2007 1.12.2007

World Nuclear Association. 2007. Nuclear Energy in Sweden. http://www.world-nuclear.org/info/inf42.html?terms=sweden 10.10.2007

APPENDIX