



Business Proposition – Establishment of a Hot Water Supply Company

**Report prepared for
Energy Efficiency and Conservation Authority**

**by
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Executive Summary

Investment in solar water heating systems for commercial applications is often constrained because of limitations on users of investment capital. Yet commercial enterprises such as hotels, motels, restaurants, food processors and food take-away outlets may use large volumes of hot water that could make the economics of investment in solar water heating systems attractive if the capital cost could be modified to be an operating cost. As an operating cost the expenditure would move from the Balance Sheet to the Profit and Loss Account and is immediately tax deductible.

Many commercial enterprises do not own the buildings from which they operate and so investment in fixed assets is unlikely as there is a disconnect between the building owner and the beneficiary of any subsequent reduced cost of heating water. Many of the commercial enterprises are also not operated by the owners but have managers e.g. motels and hotels are often operated by managers. Such managers may only remain with a particular enterprise for say 5-7 years before they move on to more attractive enterprises.

A number of managers have however indicated that if the capital cost could be converted into an operating cost then they would be more attracted into entering into a commercial arrangement for use of solar heated water.

The proposal is to establish a hot water supply company which has access to financial capital and can invest in the solar water heating systems and sell hot water on an energy basis. The ownership of the water heating system equipment could remain permanently with the hot water supply company, or transfer after a specified period to the building owner. Other sources of energy for heating water such as from wood pellets or heat pump technology can be considered synonymous with solar systems for the purpose of contracting to supply hot water.

Heating water by solar, wood pellet or heat pump technology are all based on well proven technology and if installed properly are an effective means of heating water. A specialist hot water supply company would have the technical expertise to ensure that installations are properly scoped and installed. They would also ensure that proper maintenance of the heating system is undertaken.

Throughout many urban areas of the world it is very common in apartment blocks to have a central water heating system supplying metered hot water to users. These arrangements show that supply of hot water under contract is technically achievable.

The financial viability of establishing a Hot Water Supply Company depends on access to capital at an appropriate cost, and minimal overheads during the initial startup period.

An evaluation of the possible establishment of a Hot Water Supply Company by a finance institution with access to funds was undertaken as part of this study. The analysis showed that under all scenarios the proposal would not be financially viable at this point in time.

Currently the economics of installing solar hot water systems for many commercial scale applications is not cost effective compared to heating water using traditional means. The economics are reduced further when other financing, and staffing costs are added for a leasing arrangement. The proposal is therefore not likely to be economic, even for large hot water users, until the cost of conventional gas or electricity heating increases significantly compared to sourcing energy from solar, wood pellets or heat pump technology.

A further consideration which indicates that the proposal would not be financially viable is that the business risk to the Hot Water Supply Company is high in that the customers to whom contracts for the supply of hot water are entered into could become insolvent at any time and thus not be able to pay for hot water received. In some situations the water heating systems could become stranded. The risk is managed if the water heating systems are only installed on buildings where another manager would quickly replace an insolvent one e.g. a hotel is likely to keep operating with a replacement manager, whereas a restaurant is likely to close and could be used for another purpose. The risk could also be

managed if the host were an institution or government owned facility that was unlikely to become insolvent or renege on a contract.

While there are adequate opportunities to start a business selling hot water, and the opportunities will increase over time, the limitations brought about by the current relative economic costs of energy indicate that the establishment of a Hot Water Supply Company is not recommended at this point in time. It remains more cost effective for the hot water user to own and operate the water heating system directly.

The results of the study were compared to international experience with contracting for the supply of hot water. It was found that while in theory there is a strong international support for the concept of energy supply companies, in practice there are few examples other than from district heating schemes where hot water is sold to individual dwellings, or where there is an apartment block where hot water is supplied from a central boiler.

A review of energy supply companies (ESCo) who provide energy supply services under an energy performance contract has indicated that while there are a few who do this for energy efficiency equipment based on electricity there are none identified that do it for solar heated water.

Generally any scheme for the supply of hot water to others was only undertaken when there were economies of scale for supply from existing heat plant such as an electricity power station, or the supply of hot water was subsidized so as to achieve other public benefits.

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1. Introduction

Capital cost is a significant barrier to the investment in solar hot water supply systems for many commercial applications. This is particularly a problem for institutions, motels, restaurants and other commercial enterprises using large amounts of hot water where the owner of the building is not the operator using the hot water.

It is proposed that a hot water supply company with access to adequate funds be established to invest in solar water heating systems installed on the premises of large volume hot water users. The hot water supply company would install and maintain the heating equipment and sell hot water to the user. An option could be a lease to buy arrangement for those who wish to eventually own the equipment.

The evaluation undertaken to see if there is a viable business case was based on work previously undertaken by the authors with respect to installation of solar hot water systems in motels, and confirmed by contact with international parties pursuing similar concepts. The evaluation was undertaken by the authors with assistance from a financial entity interested in pursuing investment in commercial scale solar water heating if a business case could be seen to be positive.

Early in the evaluation it became clear that there was unlikely to be a positive business case worth considering in depth. The difference in financial benefits compared to financial costs and risks soon became obvious once a number of scenarios were put together. The authors then focused on the international experience to see if it confirmed the results of the financial analysis. Internationally there are no identified similar projects thus confirming the results of this analysis.

2. Business Proposition

2.1 Hot water users

2.1.1. Background

Investment in solar water heating systems for commercial applications is often constrained because of limitations on investment capital. Operators of a number of commercial enterprises who use extensive amounts of hot water have indicated that if they could overcome the up front cost barrier they would like to move to using low operating cost renewable energy sources such as from solar energy.

However many of the commercial applications have existing good operating water heating systems and thus have sunk costs with regard to capital investment, which means that investment in replacement equipment is unattractive. Alternatively they may have water heated directly by gas which on commercial tariff prices makes it difficult to beat financially by new investment.

Commercial enterprise operators are also generally risk averse with respect to entering into any arrangement that is outside their core business and which potentially could have an adverse effect on their business e.g. an adequate supply of hot water is critical to their customer's service satisfaction.

2.1.2. Large volume hot water users

The report *Developing the market for larger scale solar water heating applications in New Zealand*¹ summarized the reasons why there have been until recently few large volume water heating opportunities.

Many potential solar water heating applications have been identified, but there are significant barriers to be overcome, in particular the apparent cost gap between solar water heating and alternative energy sources. The cost comparisons presented in this report suggest that in many situations there is still a significant gap between the cost of solar water heating and the cost of using more traditional energy sources for hot water heating.

¹ *Developing the market for larger scale solar water heating applications in New Zealand*, Report to EECA, Ian McChesney in association with East Harbour Management Services Ltd. and Enercon Ltd, February 2005.

While there are clear economies of scale with larger solar water heating systems compared with smaller domestic size systems, the larger scale solar water heating applications are also competing against lower cost energy sources.

A strategic approach to developing the market was recommended, beginning by focusing on applications with the greatest solar water heating potential in the short term. It suggested that these applications will likely meet the following conditions:

- Have the most favourable energy conditions for solar water heating to compete
- Have the most favourable institutional conditions and/or management attitudes for solar water heating to be developed
- Are applications that allow repeatability (i.e. to allow maximum learnings, capacity development, and future economies of scale)

These market parameters in conjunction with the financial constraints lead one to consider the opportunity for leasing equipment and selling hot water.

2.1.3. Commercial drivers

Despite the barriers, commercial enterprises such as institutions, hotels, motels, restaurants, food processors and food take-away outlets generally use large volumes of hot water that could make the economics of investment in solar water heating systems attractive if the capital cost could be modified to be an operating cost. An operating cost means that the expenditure moves from the Balance Sheet to the Profit and Loss Account and is immediately tax deductible.

In addition many commercial enterprises do not own the buildings from which they operate and so investment in fixed assets is unlikely as there is a disconnect between the building owner and the beneficiary of any subsequent reduced cost of heating water. Many of the commercial enterprises are also not operated by the owners but have managers, or the buildings are leased to a third party. Such managers or lessees may only remain with a particular enterprise for say 5-7 years before they move on to more attractive enterprises.

Interview with a number of managers/lessees have however indicated that if the capital cost could be converted into an operating cost then they would be more attracted into entering into a commercial arrangement for use of solar heated water. Such operators are focused on their profitability and anything that will reduce enterprise operating costs is attractive.

2.2 An Energy Service Company (ESCO)

The concept of an Energy Service Company (ESCO) has been around for a number of decades. An ESCo is an entity established to sell the energy output from a facility they generally own under a long-term service agreement to a customer(s). This type of outsourcing allows the user to simply purchase the chilled water, hot water or steam without incurring the up-front capital costs normally associated with the installation of a new plant.

Under a long-term service agreement, the ESCo provides for a customer's heating or cooling needs over a multi-year period - typically 10 years. Charges are based on a fixed price per unit provided to the building, e.g., ton-hours of cooling, or kgs of steam or MMBTUs of heating. The agreement is similar to that of leasing a car - the customer can pay-as-they-go without incurring extensive up-front costs. Through the ESCo, the costs of the installation are amortized over the life of the 10-year agreement. Experience in Canada from installation of hot water supply has shown that the optimum installation would be in buildings with 50 or more units. In smaller, self-managed buildings, the volume might not be high enough to provide cost savings relative to the building plant's current operating costs.

The ESCo, which builds, owns, and maintains the new plant over the agreement term, will also guarantee performance of the plant. Typically, day-to-day operations of the plant continue to be performed by existing building personnel, although that responsibility can also be assumed by the ESCo.

The typical lifespan of a solar water heating system is 20 plus years; depending on the type of unit. After the 10-year lease agreement with the current ESCo expires, the customer can choose to renew the contract or buy out the equipment at its fair market value and choose another maintenance service provider.

There are benefits of outsourcing service equipment. Generally it may only be the maintenance that is outsourced. However outsourcing the ownership of the equipment can also be done. There are four ways that customers benefit by outsourcing the supply of chilled water, hot water, or steam services through long-term service agreements: plant performance, financial benefits, risk transfer, and overall management and execution of co-op responsibilities.

When a customer signs a long-term service agreement for the purchase of hot water, for example, the property receives new equipment, including a solar system, hot water storage tanks, pumps, and piping. Each element of the system is designed and installed according to the building's hot water requirements, physical space, and shareholder sensitivities concerning construction-related activity.

Outsourced cooling and heating also delivers a financial payoff because long-term service agreements require no up-front capital outlay. This eliminates the need for special assessments. Depending on the installation, properties can enjoy a net cash savings in comparison with the existing cost of plant operations.

Some customers will see significant savings; but some won't. It all depends on the volume or usage of the equipment by the customer. Typically, if the equipment is being operated 24/7 and for large hot water loads you will see some cost savings because of the volume of energy that's being generated. Some may just break even, though, if the installation costs run high.

Long-term service agreements transfer risk from the customer into the hands of the ESCo. The ESCo assumes responsibility for the design, construction, and maintenance of the equipment. The ESCo also retains ownership of the equipment for the term of the agreement. Under typical service agreements, the co-op no longer bears the burden of construction cost overruns, inconsistencies between engineering specifications and contractor interpretation, and change orders.

Service agreements also remove the risk of the typical design/bid/build process. Under standard practice, bidders focus almost exclusively on up-front, construction-related costs. Long term service agreements allow the customer to exercise control over the full range of costs relating to heating and cooling, and also improve the productivity and effectiveness of owners and managing agents by transferring responsibility for plant construction and plant maintenance. The customer's management becomes free to dedicate its time and energy to other duties.

Many facility owners can be the beneficiaries of this emerging trend in property management. By outsourcing heating and cooling plant responsibilities through long-term contracts, owners increase the value of the property and individual apartments by replacing old, unreliable equipment, without increasing outstanding debt, and as a result manage their heating and cooling plants more effectively. Lastly by outsourcing vital services to an expert provider that guarantees its services, overall hot water supply performance and satisfaction is improved.

2.3 Technology

2.3.1. Technologies

While this evaluation focuses on solar hot water heating systems the concept will also include heat pump and wood pellet water heaters as for some large scale applications these will be more applicable. Throughout this report solar, wood pellet and heat pump water heating should all be considered as synonymous.

2.3.2. Technical viability

Solar water heating systems are based on well proven technology and if installed properly are an effective means of heating water. The industry is however still early in its learning curve and there are few industry participants who have wide experience of applications and can install optimally performing systems. The industry is characterized by there being a number of small players chasing residential applications. Only recently has there been much development into commercial scale applications. There is therefore a shortage of practitioners with design capability beyond the standard residential application.

System capital costs are still higher than they could be because of the lack of economies of scale and because there is a lack of standardization of system design. Installation costs are higher than they could be because each installation is essentially still a one-off, and even

specialist suppliers do not have the sales volume from which they would achieve economies of scale.

The lack of economies of scale in the solar water heating industry generally arise because of the lack of volumes of sales and the cottage industry approach to individual sales. Where a specialist installer of solar systems can focus on a specific niche in the market and achieve a number of sales in that niche then economies of scale are potentially achievable.

System design tends to aim at minimising capital cost rather than achieving long term optimized cost for the hot water user. Few in the industry take much account of long term operating costs. Once they have made a sale and installed the system they rarely are seen again.

Where installations are focused on a particular type of application the installers will achieve experience and subsequently a competence which will reduce their costs of installation. There is also a greater chance of the energy performance of the solar system being optimized.

Individual hot water system owners often do not know whether their system is working satisfactorily or not. There is little monitoring of system performance and if the system is perceived to be under performing this tends to result in a dispute between the owner and the supplier.

2.3.3. Technology risks

Solar, wood pellet and heat pump water heating technologies are well proven and each industry is now well established in New Zealand. What is thin in each technology sector is the depth of experience of system suppliers to develop sustainable businesses and to install systems so that they perform optimally, particularly with regard to solar.

There are few system solar suppliers who have a depth of experience in designing commercial scale systems and then installing then for optimal performance. In addition the after installation maintenance and backup to ensure that systems are trouble free is even thinner.

There are opportunities in the market for entry of experienced technology business who can bring a corporate management that most of the smaller players lack. The entry of three corporate players: Righthouse, Vector and Nova Energy, have demonstrated the additional dimension that experienced corporate businesses can bring to the sector.

Solar technology is relatively simple in concept but like any technology it is the skill of application where cost savings arise and where economies of scale can be achieved. The larger companies have the benefits that they understand:

- Brand protection from quality
- The importance of quality systems throughout
- The importance of training and competence at all levels
- The value of good contract management
- The value of good customer service
- How satisfied customers become their best sales ambassador

With a hot water supply business as is proposed all the technology risks can be managed by attention to each of these points.

2.4 Contracting for the supply of hot water

It is proposed that a Hot Water Supply Company be established to design, install and own solar water heating systems installed on the building of a large volume hot water user. The hot water user would not pay for the capital cost of the system but would pay for the hot water delivered.

Internationally it is common for hot water to be delivered to users who pay for the heat received. The heat is more commonly delivered from district heating schemes however where an apartment block has a centralized hot water system the hot water is metered on delivery to individual users. The monitoring equipment is readily available and payment is often included with other utility or body corporate type payments.

With a hot water user contracting for the supply of hot water then there is an incentive for the supplier of the equipment to optimize design and ensure that it is installed for optimal long term operation. A supply contract would also provide a guarantee to the hot water user that the contracted amount of hot water is delivered.

Having a contractual relationship between the parties provides for continuous monitoring and ensures that any required remedial action is undertaken quickly.

The technologies for measuring the amount of heat in the hot water supplied are commonly available overseas where it is regularly used in district or apartment hot water supply schemes.

2.5 Modelling tools

A recent project undertaken in Europe has led to the development of software tools for the evaluation of ESCo solar water heating contracting opportunities.

The STESCo is a software tool developed in the framework of the ST-ESCo project², financed by the European Union. The tool has been developed with two objectives:

1. Develop and distribute an easy and friendly, but also precise, tool for the prediction of the energy output of solar thermal plants
2. Use the output of the previous objective to evaluate the economical viability of solar thermal projects for Energy Service Companies (ESCo).

The software is available free from the ST-ESCo website³.

The tool is a simulation tool based on TRNSYS and is structured in two main modules, one for the simulation of the thermal solar systems (Energy module) and another for the economical evaluation of the systems (Economical module).

The transient simulation tool allows the user to obtain an estimation of the likely solar energy production. Once the simulation is finished, the user may want to evaluate the economical benefits of the system through the economical module.

The input data includes:

1. Project data: General information about the project
1. Model input data: Data relating investment costs, operation and maintenance costs of the system, consumption and conventional energy system
2. Contract data: Billing method implemented in the contract

The user can use the Economical module to evaluate the financial viability of the project visualized in graphical and table form. There is also the possibility for the user to study different billing methods and undertake simplified sensitivity analysis by changing the parameters of the project and calculating how this change would affect the financial viability of the project.

2.6 Hot water supply company

2.6.1. Commercial structure

The proposal is to establish a hot water supply company which has access to financial capital and can invest in leased solar water heating systems and sell hot water on an energy basis to large volume hot water users. The solar water heating system equipment could remain permanently with the hot water supply company or transfer after a specified period to the building owner.

The specialist hot water supply company would employ the technical expertise to ensure that installations are properly scoped and installed. They would also ensure that proper maintenance of the solar system is undertaken.

Such a proposal is only likely to be economic for large hot water users. Under current relative energy costs the economics of installing solar hot water systems for many applications are very poor and it is generally more cost effective to heat water using traditional means. The

² www.stescos.org

³ [http://www.stescos.org/downloads/ Software.doc](http://www.stescos.org/downloads/Software.doc)

economics are also not attractive for applications which are based on replacement of existing effective operating water heating systems.

The financial viability of establishing a Hot Water Supply Company depends on access to capital at an appropriate finance cost, and minimal overheads during the initial startup period.

The business risk to the Hot Water Supply Company is high in that the customers to whom contracts for the supply of hot water are entered into could become insolvent at any time and thus not be able to pay for hot water received. In some situations the water heating systems could become stranded. The risk is managed if the water heating systems are only installed on buildings where another manager would quickly replace an insolvent one e.g. a hotel is likely to keep operating with a replacement manager, whereas a restaurant is likely to close and could be used for another purpose which did not use much hot water.

There are adequate opportunities in the market to establish a Hot Water Supply Company and the opportunities will increase over time. Currently there are no known competitors offering this service in New Zealand.

Motel and hotel proprietors approached for this study all indicated a high interest in the concept of using solar energy for the production of hot water. However in each case there were reasons why they would not install such a system themselves. The main reason being that they often did not visualise remaining as the proprietor for the time they perceived it would take to pay off the capital cost of installing a system. They did not see a solar water heating system as adding value to the infrastructure of the motel or hotel. In addition motels and hotels are often leased to managers who may not have an interest in adding capital improvements to the facilities.

It is believed that a similar situation would arise with many other types of large volume hot water users e.g. institutions, fast food outlets, food processors and restaurants.

2.6.2. Market opportunities

Motel managers often have a high churn rate with many being there for only around 5 years. This causes a barrier for capital investment if the pay back period for investment in a solar water heating system is perceived to be longer than 5 years.

Several motel managers indicated they would have a strong interest in solar water heating if they could convert the expense of installing a solar water heating system into an operating cost. This would then be a tax deductible business revenue expense. They considered that paying a hire fee and gaining the energy savings benefit would be very attractive. This is done in some overseas cities and is worthy of investigation within NZ.

Hotels spend approximately 19% of their electricity costs on producing hot water and motels an estimated 30%. Based on current energy costs a typical 54 bed motel installation of a 6 panel solar water heating system as a preheater to a conventional electric hot water system can reflect into savings of around \$1,200 per year from the motel energy cost. This could be a payback time for the capital cost of around 7-8 years. This would reduce as relative energy costs increase over the next few years.

The inclusion of solar water heating systems at the time of design and construction of new motels is clearly the most cost effective time for investment. The solar water heating equipment can reduce the need for conventional heating systems. However with the large volumes of hot water that motels use and the extreme fluctuations in demand the hot water heating system needs to have adequate capacity and flexibility. As a result the principal benefits of solar water heating in motels and hotels are not in the avoidance of otherwise conventional hot water heating equipment, but the replacement of the fuel source. Solar water heating can be installed as a preheater connected to otherwise conventional equipment.

There are currently 1,626 motels in NZ and most of these could have a solar water heating preheater added to their existing water heating system. This could be done relatively easily and with essentially only the cost of solar water heating solar collectors. The storage tanks or instantaneous heating systems would continue to be used.

In addition there are also 579 hotels that are very similar to motels in their need for large volumes of hot water. In this report motels and hotels will often be used interchangeably.

The national potential for installing solar water heating systems in hotels is estimated to be 50 GWh of energy per year, and 9GWh of energy per year for motels.

2.6.3. Market development

The market for hot water supply is currently undeveloped although the Meridian subsidiary Energy for Industry undertakes this at a number of industrial and hospital energy centres. At the low end of the market however many business are used to leasing equipment and paying for the output on a per unit basis.

An appropriate Hot Water Supply Company business development plan would have the following stages:

1. Establishment as an entity
2. Appointment of a champion
3. Development of Business Plan and Budget
4. Appoint technical support person
5. Secure the services of solar system providers, installers and maintainers
6. Develop model performance based contracts for supply of hot water
7. Secure initial contracts to test appropriateness of contracts from suppliers and for supply of hot water
8. Secure and develop show case demonstration contracted sites
9. Build the business

In addition a company entering this market needs to address the following:

- Develop a base of credible information
- Effectively disseminate information on the reliability of solar heating and the commercial value of having a third party take investment risk
- Build expertise in the design and installation of larger scale solar water heating systems
- Work to get solar water heating options considered at the start of design and decision processes
- Work to provide leadership through commitments to larger scale solar water heating where circumstances are appropriate
- Further develop appropriate contracts and financial packages, and monitor their acceptance in the market
- Investigate performance reporting mechanisms that provide customers surety of solar water heating performance

2.6.4. Contractual arrangements

The performance based contracts for the supply of hot water would be based upon:

1. Contract with building owner for Hot Water Company to install and operate solar water heating equipment for 20 year period. Ownership of the solar heating equipment to remain with the Hot Water Supply Company.
2. Contract with the commercial enterprise manager/operator for the supply of hot water:
 - a. Term of up to 20 years
 - b. Specified energy performance conditions
 - c. Maintenance and servicing conditions
 - d. Hot water supply fee based on amount of energy provided
 - e. Fee fixed for 5 years with renewal for further 5 year periods based on escalation clause

3. International experience

Throughout many parts of the world it is very common in apartment blocks to have a central water heating system supplying metered hot water to users. The hot water is often supplied from a municipal hot water supply scheme. In many eastern European, Russian and Mongolian cities considered as part of this project the municipal hot water supply derives from a nearby electricity generating power station. In other areas the apartment block has its own central hot water supply facility and the hot water is delivered to individual apartments. The delivered hot water is metered either on a simple volume basis or on an energy basis.

3.1 International programme initiatives

The area is of great interest in Europe and the United States of America. Government assisted programmes have been developed in both regions that are exploring the concept of ESCo and the contracted supply of hot water from solar energy.

3.1.1. ST-ESCo

ST-ESCos project⁴ was initiated by the European Union and coordinated by the Center for Renewable Energy Sources (CRES) based in Greece. The project was based on ESCo specialists coming from four European countries (Greece, Austria, Italy, Spain) who analysed Solar Thermal Energy Service Company (ST-ESCo) practices and developed a Guide for undertaking such projects.

The Guide⁵ refers to crucial aspects that have to be taken into account on ST-ESCo contracts. Financial, contractual, legal, marketing, technical aspects are included along with best practice examples and recommendations.

In addition the project produced a Policy Paper⁶ which includes and analyses current country and European legislation and addresses legislative and financial barriers.

The objective of the project is to promote the creation and development of (ST-ESCos) and, by this, to assist in accelerating the growth of the solar thermal market in Europe. One of the most important goals of the project is to prepare detailed, real cases of ST-ESCos agreements and try to implement them in practice.

The ST-ESCos base their business on selling the solar energy (and not the solar plant) at a competitive price and by carrying out the plant's operation and maintenance remove for customers barriers such as high initial investment cost, doubts as to the reliability and durability of solar installations and, by this, to open the way for a rapid expansion of solar thermal installations throughout Europe in all potential sectors (residential, services and industry), both private and public.

An obligation for all countries participating in the project was the undertaking of at least one pilot ST-ESCo agreement per country. In Austria two ST-ESCo agreements were implemented. The district heating network of Graz is fed in with hot water by a 6000 m², 3 MW_{th}, solar system, while the district heating network of Oberzeiring, a village in an alpine region, is fed by a 408 m² solar system. Furthermore, in the context of the project, two new ST-ESCos were founded in Austria. Solar.nahwaerme is a company specialized in applications combining biomass and solar thermal power. Solar.nahwaerme is the ST-ESCo in the Oberzeiring project. Solar.graz, a subsidiary company of Energie Graz, is specialized in combinations of solar thermal plants and district heating networks.



Figure 1: Solar panel arrays in Graz

⁴ www.stescos.org

⁵ <http://www.stescos.org/guide.htm>

⁶ <http://www.stescos.org/legislation.htm>

In Spain, one agreement for a solar system with a collector surface area of 202 m² was installed in a hospital in the region of Murcia. In addition and at the time of the completion of the project an agreement for a solar system with a collector area of 78 m² which would feed the swimming pool of the University of Murcia with hot water was under negotiations.

Several pre-feasibility studies were carried out both for Italy and Greece although no agreements had been signed by the end of the project.

In Greece, the most promising case for a pilot ST-ESCo agreement was for a 800 bed hospital in Thessalonica, Northern Greece. A solar system of 1225 m² that would supply the mean daily consumption of sanitary water of about 91800 litres was proposed.

The project ended in June 2007.

3.1.2. IEA Solar Heating and Cooling Programme

The International Energy Agency Solar Heating and Cooling Programme⁷ (IEA SHC) was established in 1977 and was one of the first programmes of the International Energy Agency. The Programme's work is unique in that it is accomplished through the international collaborative effort of experts from member countries and the European Commission.

Task 33 – Solar Heat for Industrial Processes which ran from November 2003 to October 2007 reported that the use of solar energy in commercial and industrial applications is currently insignificant compared to the use in swimming pools and the household sector. Most solar applications for industrial processes have been on a relatively small scale and are mostly experimental in nature. Only a few large systems are in use world-wide.

The IEA SHC programme has undertaken no work on ESCo type commercial arrangement.

3.1.3. National Association of Energy Service Companies

The National Association of Energy Service Companies (NAESCO) is a USA national trade association which has been promoting the benefits of the widespread use of energy efficiency for over 20 years. NAESCO represents every facet of the energy services industry and is the industry's advocate for the cost effective delivery of comprehensive energy services to all customer classes. It has over 30 members who are the most significant energy service companies in the USA.

NAESCO runs training and accreditation schemes for members focused on a wide range of energy services and energy efficiency equipment installation categories. The prime focus is electricity although heat equipment is covered. There appears to be no specific coverage of solar heated water contracting although it would fit under generic Guaranteed Energy Savings Agreements

3.2 Europe

In European countries, the most common applications for larger scale solar water heating include:

- Government and other public buildings – many countries have instituted policies to install solar water heating on public buildings, partly as a demonstration mechanism, and partly to indicate public policy intent. The capital costs are of course publicly funded, but conditions are often attached – one of the most interesting is the emergence from France of the Guaranteed Solar Results (see section 3.8.3).
- Apartments and multi-family/person housing – these can be considered to be a logical extension of the domestic-scale solar water heating, applied on a larger scale, and are a common form of larger scale solar water heating applications across most European countries, and in Israel. These larger scale applications offer some scale economies. Also, in some applications hot water use is being combined with a space heating application in solar combi-systems (although the solar contribution to space heating is relatively minor). The main drivers appear to be a combination of public housing policies, and the focus of incentives for solar water heating.

⁷ <http://www.iea-shc.org/>

- Hotels and other accommodation - hotels have proven to be a prime focus of larger scale solar water heating. The reasons are that accommodation trends tend to be seasonal i.e. highest accommodation over the summer when solar gain is at a maximum, large quantities of hot water are required for guests, laundry, kitchen etc, and a "green" image is also seen as an attractive marketing tool. Other applications include rest-homes, hostels etc.
- District heating schemes – there has been growing use of solar water heating particularly in the colder climates of northern Europe and Scandinavia. While this seems counter-intuitive, the basic rationale is the complementarity of solar with other energy sources. For example, in a number of Scandinavian countries, large scale solar collectors (>1,000m²) are providing spring/summer/autumn energy inputs into district heating schemes, complementing the supply of biomass which provides the core winter energy input. Again, these schemes rely heavily on various subsidies.
- Industrial applications, in particular low temperature water feed into boilers - a collection of industrial-process applications have been reported through the IEA Task 33/IV [ALTEN, 2002]. Most projects are in the food and beverage, textile, transport and chemistry sectors with a majority focused in food processes (e.g. fish, meat and olive processing). In some countries (e.g. Finland), solar water heating is focussed largely on agricultural drying applications.
- Applications for both industrial process cooling and heating continue to be developed. Both applications have been experimented successfully in Southern Europe, but they continue to find it difficult to compete with the lower prices which are typically paid for energy by industrial and commercial enterprises.

3.3 Italy

A market analysis⁸ of the potential for ESCo business in Italy was undertaken as part of the European Union ST-ESCo project. From that analysis the following picture of ESCo experience in Italy can be gleaned.

There has been only minor application of solar thermal technologies in the Italian energy service business. The lack of applications in this field has two main causes:

- The Italian solar thermal market that experienced significant growth rates during 2004-6 is still at a low level in absolute terms (number of installations).
- The new Italian ESCo's market (supported by the "white certificates"⁹ mechanism), apart from the big players active in the public sector for over two decades, is at the moment mainly focusing on electricity production.
- There is a general lack of knowledge and experience around solar thermal medium and large scale plant applications, including information about the benefits and economies of scale. This means a "young" solar thermal market which is still small size oriented.

The Italian yearly installed solar thermal capacity is still far lower than in the other European countries (about 4% of the European market). Nevertheless the growth rate of the last ten years is significant, and the capacity installed in 2006 was around 52.000 kW_{th}.

Most of the solar systems installed in Italy (more than 90%) are for small scale applications (below 21kW, 30 m²), used for single or multi-family houses. Among these, the most common ones are systems for the production of domestic hot water only. The market is dominated by flat plate solar collectors, but the evacuated tube collectors market share is growing.

There are about 50 - 60 distributors of solar thermal technologies in Italy. The eighteen national producers (small and middle enterprises) cover about 20% of the local market. The sector directly provides full time equivalent employment to about 300 people and, in 2000 had a

⁸<http://www.stescos.org/downloads/market/MA%20-%20WP1.2%20%20updated%20Apr%2006%20-%20IT.pdf>

⁹ The potential for ESCos to be established in Italy is large as a consequence of the law (DM 20/07/2004) which introduced the Energy Efficiency decrees (i.e., white certificates). In order to implement the decrees the Italian Authority for Electricity and Gas (AEEG) adopted a mechanism for recognition of the companies which could play the role of ESCo. However in practice and because of the criteria for registration the large number of companies registered by the AEEG are not all really acting as ESCos

turnover of 20 million euros. A greater share of the market is occupied by the Italian branches of foreign solar system manufacturers, coming mainly from Australia, Germany, Austria, Greece and Israel.

The reduction of prices (about 5% higher than European average) and higher technical quality both would contribute to enhance the feasibility and convenience of ST-ESCo projects. Large scale systems have to be installed using large collectors, which result in a better energetic performance and lower installation costs. However there are few distributors of such collectors. This issue is even more important for ST-ESCo applications where the economical efficiency of the project can be strongly influenced by the reduction of the cost of investment.

A survey of the Italian ESCo market showed that:

- The majority of the companies are small and medium enterprises:
 - about 70% has less than 15 employees. Many employ freelance professionals contracted on single projects. (considering freelancers and employees, 60% of ESCos has less than 30 workers);
 - the average turnover is below 2.500.000 €/ year for 80% of the recorded ESCos.
- Their customers are mainly Public Administrations (21%), Small and Medium enterprises (21%) and Industry (19%).
- Less than 50% of the Italian ESCos have already implemented projects dealing with renewable energies and about 10% have already realised some solar thermal installations (mostly little plants, less than 15 m²).
- Most of the ESCo applications are related to electricity, both end-use efficiency and generation.
- The main share of the heat energy services market are from large users (mostly public administration and hospitals), where the refurbishment of thermal plants and the installation of co-generators are the most implemented actions (due to high cost-efficiency).
- A great barrier for the ESCo market development is the definition of a minimum level of services provided by the ESCo. At the moment the AEEG authority has started a section dedicated to ESCos, as an action to support and develop the Energy Efficiency decrees (DM 20/07/2004).

3.4 Spain

A market analysis¹⁰ of the potential for ESCo business in Spain was undertaken as part of the European Union ST-ESCo project. The market analysis identified that despite Spain's high uptake of solar thermal opportunities the surface ratio of thermal solar collectors for every 1.000 inhabitants, was 8.7 m²/1,000 inhabitants in 1999, compared to the 19.9 m²/1,000 inhabitants across fifteen the European Union countries. This indicates that there have been very few commercial scale applications in Spain.

The market analysis shows that a 6-9 year payback for a commercial scale application requires a 20 % finance grant.

The ESCo market is not developed in Spain.

3.5 Greece

A market analysis¹¹ of the potential for ESCo business in Greece was undertaken as part of the European Union ST-ESCo project. The Greece Solar Thermal Systems market after almost 20 years of evolution and fluctuations could be considered as a developed market, at least regarding the residential sector. However almost 99% of systems are small scale thermosiphonic type for domestic hot water. The rest of the systems are forced circulation systems on mainly large scale applications for hot water in the tertiary (hotels, hospitals and swimming pools) and the industrial sectors.

¹⁰ <http://www.stescos.org/downloads/practices/ARGEM1.pdf>

¹¹ <http://www.stescos.org/downloads/market/MA%20-%20WP1.2%20%20updated%20%20Apr%2006%20-%20GR.pdf>

Although the industrial and tertiary sectors represent a high potential they have a negligible penetration of solar thermal systems. One of the main reasons for this unexploited potential is that end users (especially large ones) are still reluctant to face the high initial investment cost and are doubtful for the reliability and durability of solar installations.

Despite the possibilities, the development of ESCOs in general is still in its infancy and only sporadic (and not always successful) initiatives have been taken. There are very few ST-ESCO applications in Greece and there are no Energy Service Companies active in the market for the moment. Only a few ESCO attempts have been made in the past where Solar Thermal projects were involved. Apart from work undertaken by the Centre for Renewable Energy Sources (CRES), only two companies (Sole Ltd and Sol Energy Hellas Inc.) have made efforts in order to act as ESCOs. Some of their applications regarded a mixture of Energy Efficiency and Solar Systems, thus resulting in more financially attractive projects.

Additionally, some companies have expressed their interest to play a role in this field. These were mainly construction companies and suppliers of systems (Solar, CHP, Automations, etc) and their interest was mainly expressed within the framework of other CRES's projects regarding the development of the ESCo market. These projects were focused on the public sector where several Energy Efficiency measures were under consideration (including solar thermal supply).

Up to now, since financing institutions are not yet actively involved on ESCo schemes no specific financial schemes and requirements have been adopted.

Some reported barriers include:

- The missing of a legal consolidation of ESCOs.
- The project financing, investment, design, construction and insurance mechanism is not well defined.
- The direct economic benefits for the end-user become negligible if the ESCo needs high IRR or short contract duration.
- There is lack of technical knowledge and expertise between the possible ST-ESCOs developers in Greece. The same lack of awareness and credibility exist among the possible end-users in what concerns the economic and other benefits connected to the solar thermal plants implementation.

3.6 Austria

The review¹² of ESCo opportunities in Austria showed that although there are more favourable sites in Europe in terms of the climate (Spain, Italy, Greece, etc.) Austria leads the per capita solar statistics in Europe with an installed collector area of approximately 360m²/1000 inhabitants¹³ However as occurs elsewhere the majority of installations are for domestic applications.

There a number of commercial scale applications. The largest plants, with a collector area over 1000 square meters (the largest plant comprises 1,440m²) were installed as support for biomass local heating plants respectively to increase the backflow in district heating networks. Solar plants with an area larger than 200 m² (e.g. for multi family residences, hotels...) are considered especially suited for ST ESCO models but despite theoretical interest there has been little uptake.

Apart from extending applications in the construction of residential buildings, in tourism companies, in sports centres, in local and district heating networks, in hospitals, etc. the segments of „low temperature heat in industrial companies“ (solar process heat) and „solar cooling“ still only offer future potential for ST ESCOs.

3.7 Municipal hot water supply

The supply of hot water in urban areas is very common throughout many areas of the world. In countries such as Israel, Iceland and Armenia these have been extensively developed but as

¹² <http://www.stescos.org/downloads/market/MA%20-%20WP1.2%20%20updated%20%20Apr%2006%20-%20AT.pdf>

¹³ Data for 2004

municipal supply networks. This has generally been driven by central government policies. Often however an ESCo has been established to sometimes produce but generally always to distribute metered hot water to local users.

3.8 Overseas examples of hot water supply companies

It is common in Europe and elsewhere where apartment dwellers and others have a collective hot water system on the building that hot water is metered to each of the different hot water users in the building. The coverage to include industrial parties buying hot water from a third party is less common but work undertaken by the IEA Solar Heating and Cooling Task Group has identified a number where some experience is apparent.

Most examples investigated tended to be based on district heating schemes rather than an ESCo providing hot water directly to a customer under contract. Many of the hot water supply schemes were also highly subsidized by local or central government. While the concept of an ESCo has been popular for a number of years few have remained financially viable for very long.

3.8.1. Real Energy Management (REM)

Renewable Energy Management is an energy management company, ensures that renewable energy systems are maintained to the highest industry standards and are worry free to system owners. They maintain the equipment so as to achieve peak performance of the system, coordinate any necessary warranty work and manage billing for Energy Services Contracts or Power Purchase Agreements.

REM services include:

- Monitoring and assurance of optimal system performance
- Warranty and maintenance management
- Monthly billing to energy "off-takers"
- Quarterly and annual summaries of hot water usage
- Complete system documentation and archiving

3.8.2. ConEdison Solutions

ConEdison Solutions¹⁴ is a subsidiary of Consolidated Edison of the United States of America and is an energy services company providing electricity supply, renewable energy, sustainability services, and energy solutions to customers. ConEdison Solutions also supplies under contract electricity and other value-oriented energy efficiency services to residential and small business customers.

ConEdison Solutions contracts to business customers to supply green electricity from wind energy but doesn't contract for the supply of hot water. Contracts to residential customers can be based on either 100% from wind, or 35% from wind and 65% from small hydro sources. The latter costs 1 cent more per kWh. The energy- saving solutions are generally provided to public school districts, colleges, universities, and other public and private sector clients. These generally occur to upgrade facilities, reduce consumption, and lower energy bills. Hot water supply solutions have been included in some energy performance contracts but solar systems are not specifically referenced.

The Energy Savings Performance Contracts (ESPC) generally replace old, inefficient, high-maintenance equipment with new state-of-the-art energy-efficient equipment – with no capital outlay or budgetary risk.

ConEdison Solutions provides a total service:

- an initial assessment to determine the potential energy savings that can be achieved,
- an evaluation of the application of new energy-efficient equipment such as heating, cooling, ventilation, controls, lighting, and motors,
- a look at the building envelope, including windows and roofs, and, where possible, water savings opportunities.
- recommendations for the use of renewable energy sources.

¹⁴ www.conedsolutions.com

- an assessment of the environmental impact of each measure, and
- develop a strategy for the facility to be a leader in energy and environmental design.

With an ESPC project ConEdison Solutions guarantee the savings or they pay the customer the difference.

3.8.3. Guaranteed Solar Results (GSR)

The Guaranteed Solar Results concept¹⁵ (GSR) concept developed in France is a contractual arrangement between the client energy user and the solar water heating supplier/developer that seeks to guarantee the performance of a solar water heating installation.

GSR was used for the first time in 1988 for a hospital in the South of France and was developed as a response to a lack of confidence in solar water heating performance, caused by system malfunctions, under-delivery of results etc. GSR removes uncertainty for the client concerning solar water heating performance by guaranteeing that, over an agreed period, they will receive a given amount of heated water from their installation. If the installation does not perform to the standard set out in the guarantee, the client is compensated financially for the failure. This enables the client to calculate and organize financing for their scheme, as they can estimate with confidence the reduction they will see in their bills for other fuels for heating. A GSR contract also removes any anxiety about system maintenance and repair as the contract provider must maintain the system so that it will perform to the agreed standard.

The success of GSR depends on:

- A clear and unambiguous contract between the system client and a partnership of project developers, managers, equipment installers, and financiers
- Accurate predictions of system performance
- Accurate estimation of hot water demand profile

Over 150 installations using GSR are operating in European and other countries. Both France and Spain have used GSR effectively in hospitals and in buildings such as hostels, health centres, hotels and sport centres, all of which have a high demand for hot water throughout the year. There have also been important demonstrations in Germany, Austria and Greece, together with numerous initiatives to support the market for smaller-scale solar thermal installations. Some energy supply service companies (ESCOs) have been contracting for the supply of solar thermal energy as a product. The concept is that the ESCo purchases and installs the solar water heating system and sells the hot water to the client (solar results purchasing (SRP)).

In the UK take-up has been slow. Recent project work has assessed the potential for GSR with third party financing in a SRP package. It concluded that such mechanisms are not readily applicable to domestic solar water heating, but could work for large public buildings such as hotels or hospitals, where it would be cost-effective to establish and verify a system and install the necessary monitoring equipment. It may even be appropriate, under certain circumstances, in residential blocks. Some incentives may be needed (noting that most of the systems installed to date have received financial support (grants or subsidies)). It is not clear whether GSR can compete in the marketplace with other forms of energy. The project has identified a number of potential solar thermal demonstration projects in each country¹⁶.

Undoubtedly, GSR is a mechanism that has helped to overcome lack of confidence in energy delivery, but barriers associated with long payback periods and high initial capital costs of solar water heating may still remain.

3.8.4. Vital Energi

Vital Energi¹⁷ () is a design, build, own and operate company that enters into energy supply contracts throughout the United Kingdom. Vital Energi's experience has been to avoid providing Energy Services to system which they haven't designed, installed and implemented. This allows them to take complete responsibility for the quality and standard of their work.

Energy Services may be performed under an energy service agreement following capital works, or they can be provided as part of a more complete Energy Supply contract.

¹⁵ http://www.solarmed.net/GRS/Concept_Contract.pdf

¹⁶ (Source: <http://www.dti.gov.uk/energy/renewables/publications/pdfs/rps004.pdf>).

¹⁷ www.vitalenergi.co.uk

They generally supply hot water along with central heating to housing estates and large volume uses where there are economies of scale.

The energy services contracts are an extension of the cover provided by their operation and maintenance contracts for mechanical and electrical services in energy centres. These may also include heat and power distribution systems between, and within, connected buildings.

They see the key to energy services contracts is that clients can transfer risk and responsibility back to the service provider. This gives them greater certainty about future costs, as well as simplified budget and cash management. And in many cases it has allowed clients to dispense with significant overheads associated with managing energy systems.

Typically, significant savings can be passed on to clients as a result of:

- Greater economy in fuel purchase, achieved by the service provider buying from a position of strength
- Efficient plant management, procurement and replacement by the service provider
- Efficient redesign of system plant and controls
- Economies due to reduced overhead infrastructure

Vital Energi has moved to avoid these potential grey areas with a series of clear, concise contracts, in plain black and white, that mean clients know exactly what is covered.

Energy supply contracts confer a broader scope of responsibility on the service provider and usually cover fuel supply cost and plant replacement over a 15 to 25 year period, at a pre-arranged price.

Because of their broader scope they will often be financed by the service provider and repaid by the client through a standing or usage charge.

What's new is their application to developing markets, such as new build developments and urban regeneration. How well they transfer to the new markets depends on the expertise of the service provider and particularly their understanding of different client needs and the supply chain structure in these markets.

Vital Energi benefits from having a management team with a blend of experience of the construction industry, coupled with expertise working in a large range of energy supply businesses. This means they can ensure that contracts meet clients' requirements and expectations.

3.8.5. Solar water heating in Accor Hotels

The Accor Group has 3,700 hotels in 90 countries. Hotels in the group are expected to subscribe to an 'environment charter' that describes the commitments that should be made and actions undertaken concerning waste management, technical controls, architecture and landscape; it also involves the environmental awareness and training of the Group's staff. Solar hot water supply is part of this commitment¹⁸. Underpinning the commitment to SWH is the guaranteed solar results ('GRS') procedure. This provides certainty for the individual hotel managers' financial planning of the enterprise. The guaranteed results can be linked to the bank loan or leasing policy and the annual energy savings can be used to repay the investment loan in a structured way.

Since 1998 14 Accor hotels have installed SWH systems, typically in the size range of 50-150m² (including Ibis/Novatel in Homebush, Sydney). SWH has also become part of training within the Accor Group through integration into the Solar Academy training facility (located in Paris).

3.9 International summary

In Europe and the US in particular, government subsidies have been a vital ingredient in most circumstances of large scale solar developments.

In some applications the contracted supply of solar thermal energy based on the Guaranteed Solar Results concept has been used to underpin a wide range of large scale solar systems, and has provided customer surety of outcomes in the face of risks and uncertainty. While not

¹⁸ Source: [Catching the sun - Solar water heaters for hotels - full text article from News from Renewable Energy World Magazine September-October 2002](#)

commonly used, it provides a mechanism (together with Solar Results Purchasing) for overcoming capital funding constraints.

While a great diversity of large scale applications has been identified, the most common developments appear to be in the up-scaling of traditional hot water use applications – e.g. hot water use for facilities for people (hotels, apartments, rest-homes), rather than industrial processes.

Whole-system design expertise and thinking is vital on large systems – from the very beginning at the conceptual stage right through the design and analysis process.

The process of investment in large scale solar water heating, and the associated learnings and increase in knowledge, is helping to reduce unit costs of solar water heating over time.

4. Market Opportunities

The market for supply of hot water under contract has for this study been limited to those enterprises that use large volumes of hot water and have a security of demand. These are enterprises which are likely to continue even if current owners/operators leave the sector.

4.1 Accommodation sector

The accommodation sector is made up of hotel/resort, motel/motor inn/apartment, hosted accommodation, backpackers/hostels, and caravan parks/camping grounds.

Table 1 Accommodation statistics (March 2003)

	Number of establishments	Guest nights	Occupancy rate %	Stay nights
Hotel	579	930,000	66	1.8
Motel	1626	1,005,000	66	1.8

Source: Dept of Statistics¹⁹

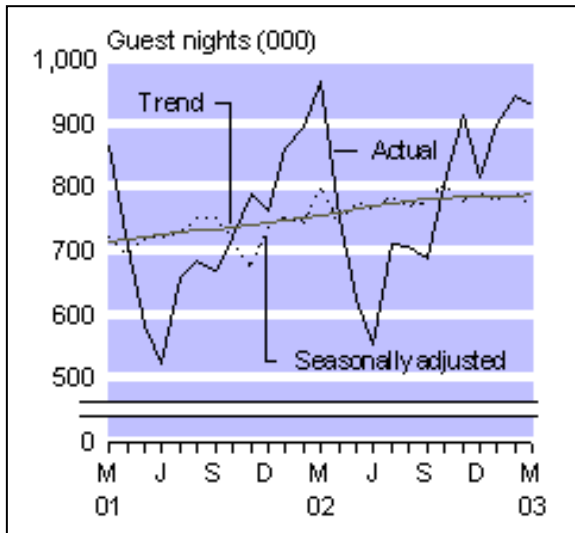


Figure 2 Hotel Guest Night Trends

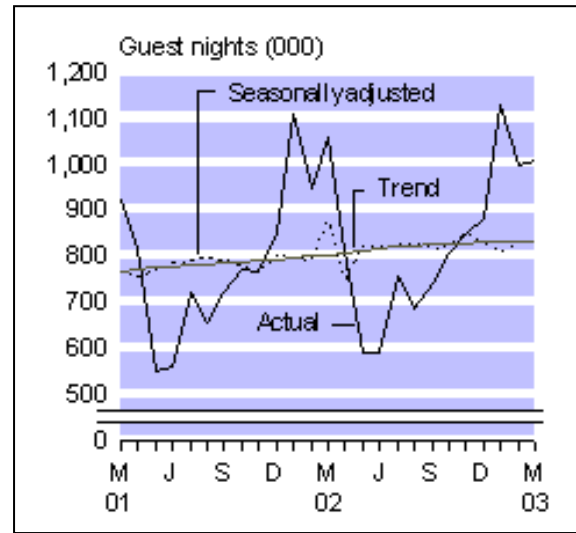


Figure 3 Motel Guest Night Trends

As can be seen from Figures 2 and 3 the monthly fluctuation of motel and hotel occupancy is very cyclical over a year. The marginal energy use per guest is therefore very difficult to clarify as there is expected to be a high fixed component through having to be available for guests. It is therefore necessary to use average information.

The accommodation sector has a benefit over other solar water heating uses in that the high occupancy periods coincide with the high solar energy periods. This means that system utilisation is maximised and costs are optimised.

¹⁹ Department of Statistics, Accommodation Survey, March 2003
 Proposition for a Hot Water Supply Company

4.1.1. Accommodation sector energy

A report prepared by Lincoln University²⁰ has highlighted the way in which hotels and motels use energy. The information in this section is taken from their survey and is partly based on an earlier EECA study²¹. The information on hotels is a useful guide to the larger motel / motor inn complexes.

In 2002 the total energy consumption in New Zealand was 462.9 PJ, of which 42.6 PJ were consumed by the commercial sector. The accommodation industry is part of the commercial sector and makes up 2.2 PJ of the 42.6 PJ. This equals 5.1 %.

As a result of the vast number of establishments, hotels and motels constitute the biggest piece of the pie in terms of total energy use in this industry.

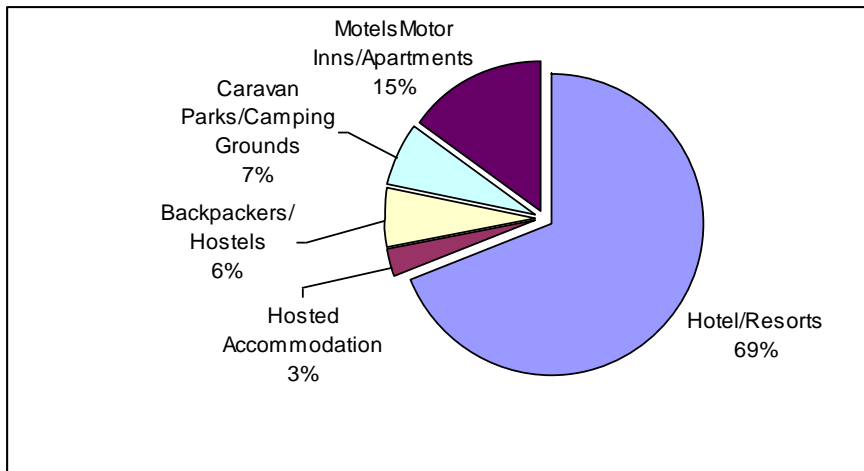


Figure 4: Energy Use by Category

The energy bill of larger hotel businesses makes up approximately 3% of total hotel operating expenditures. An average hotel spends most of its energy on heating (space and water) and refrigeration (Figure 5). Some operators already consider energy costs as the largest controllable expenditure.

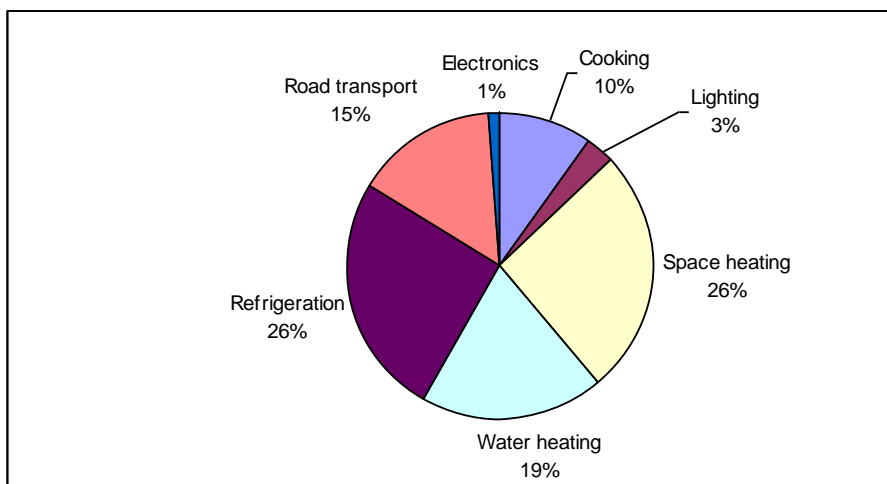


Figure 5: Hotel Energy Use

Bed and breakfast style accommodation is at the other end of the scale and is rather comparable to households, spending approximately half of their energy cost on water heating (30%)²² and 20% on space heating.

²⁰ Energy Use in the NZ Accommodation Sector – report of a survey, S Becken, Landcare Research and Tourism Research and Education Centre, September 2000.

²¹ Energy Efficiency and Conservation Authority (EECA)(1996): Energy-wise monitoring quarterly: hotel sector. Issue 4, June 1996.

²² BRANZ HEPP Year 6 study results

The Lincoln survey showed that there is no typical business in any of the accommodation categories: hotel/motor inn/lodge; motel; B&B/farmstay; backpacker/hostel; and campground.

Table 2 Average Characteristics for Accommodation Categories

Category	Capacity (available beds)	Guest nights/year	Occupancy %	Floor space (square metre)	Space per bed (m ²)
Hotel	199	29831	37.9	6722	34
B&B	8	835	26.0	319	34
Motel	54	6155	40.6	577	13
Backpacker	50	10258	52.6	453	11
Campground	173	11616	31.1	Not available	Not available

As Table 3 shows, businesses vary widely in their energy use, both in terms of total annual consumption and energy use per guest-night.

Table 3 Relevant Energy Data for Different Categories

Category	Average total energy use (GJ/a) ¹	Energy use / square metre and year (MJ/m ² *a)	Energy use / bed and year (MJ/a)	Energy use / guest night (MJ)	Min and Max energy use / guest night (MJ)
Hotel	5149	730	22167	183	35 -370
B&B	102	383	11200	128	30 - 280
Motel	257	323	5122	36	9 - 58
Backpacker	362	739	7613	48	8 - 195
Campground	303	NA	NA	28	5 - 61

1) GJ = Gigajoule = 1000 MJ = 1,000,000,000 Joule = 278 kWh

Energy use per guest night is useful for comparing different businesses and different categories. The Lincoln study calculated that the energy used by one hotel guest for one night equals the energy use for a 45-kilometre car drive. A backpacker-night is equivalent to 13 km with a car.

There are two major categories in relation to energy use per guest night:

- Service-orientated accommodation, offering luxury and comfort, which includes hotels, luxury lodges, motor inns, and B&Bs
- Basic or purpose-orientated accommodation, including backpackers, hostels, motels, and campgrounds

Figure 6 below shows the range of energy use per guest night resulting from the Lincoln survey data. Larger energy use per guest night does not necessarily result from poor energy management, as it may be affected by factors, such as location and climate. For example, the two Backpacker/Hostels with an energy use of more than 150 MJ per guest night mainly cater for winter tourists and therefore use more energy for heating and drying clothes.

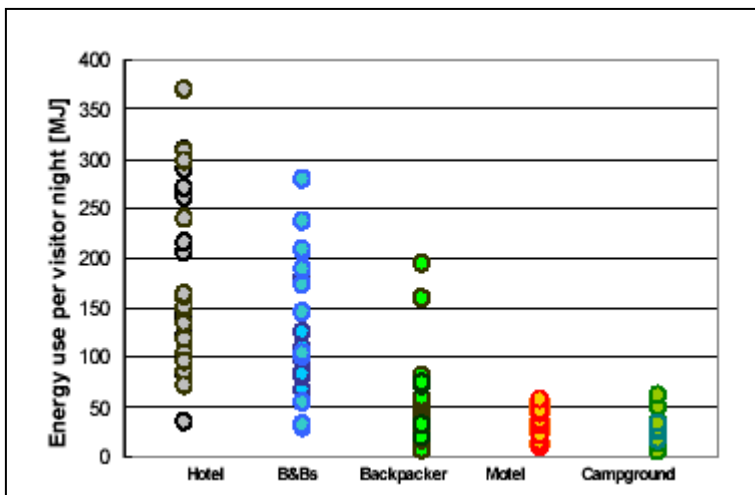


Figure 6: Range Of Energy Use Per Guest Night All Samples

Hotels are big energy users, both in terms of annual usage and use per visitor night. This suggests they may be able to make the greatest savings in energy expenditure. However, while

motels are more efficient in their energy use they may be able to make significant savings in the production of hot water.

The source of energy for each accommodation category is presented in Figure 7. This indicates that throughout the accommodation sector electricity is the most prominent energy source.

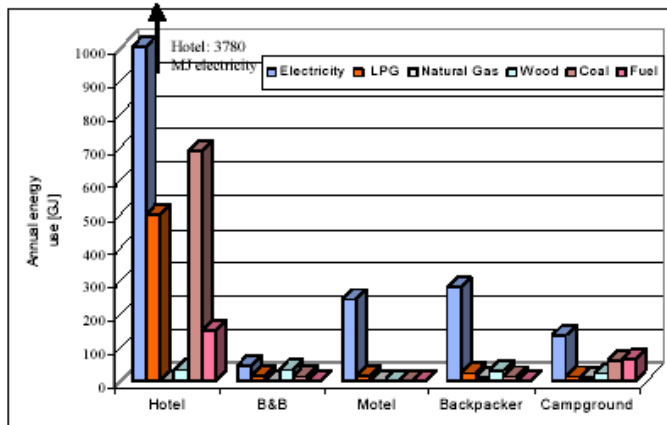


Figure 7: Average Energy Use Of A Business Broken Down By Fuel Type

The information on energy use for the production of hot water from the Lincoln study is shown in Table 3. This indicates that total energy for motels is 36MJ/guest night or 5,122 MJ/bed/year. Information from the motels included in this study report slightly higher readings, but it is assumed that a much greater sample would confirm the results from the Lincoln Study. The difficulty is in assessing the amount of hot water that is used in accommodation. Interpolation between the percentages used by a hotel and a residential dwelling indicates that motels probably have 30% of their energy cost on hot water production. This is consistent with the information obtained from two of the motels included in the previous East Harbour study²³ that had occupancy rates at 50-100% above the national average. One motel in this study had an average occupancy rate of approximately 92% which translated into higher costs on hot water production. These costs were comparable to the average domestic home of approximately 30% of total energy costs.

Assuming 30% of energy use is for the production of hot water this equates to around 21,500 kWh /year of energy for the Lincoln study average motel with 54 beds.

The annual energy consumption for hot water is about 950kWh/person; this is the energy needed to heat the daily consumption of 50 litres from 10°C to 55°C.

4.2 Restaurants and food outlets

The restaurant and food outlets are often proposed for installation of solar water heating systems. While they do use large amounts of hot water they are also less stable businesses and easily close and change ownership. This would likely leave a leased water heating system stranded with no one to honour hot water supply contracts. In terms of being a market for contracting to supply hot water the business risk is considered too great for the sector to be a target customer market.

4.3 Institutions

The institutions around education accommodation, prisons, or military facilities all use large volumes of hot water. However these institutions tend to be government owned and are more likely to install, own and operate their own hot water supply systems.

The only institutions that could be candidates for contracting for the supply of hot water are rest-homes, small private hospitals, and welfare homes. These tend to be designed as oversized

²³ The Potential for Use of Solar Water Heaters in Motels, report to EECA, by East Harbour Management Services, March 2009
 Proposition for a Hot Water Supply Company

residential applications and some of them would be attracted to entering into hot water supply contracts.

This sector would provide opportunities but can be considered as simply an extension of the accommodation sector referred to earlier.

5. Financial Viability

The accommodation hot water use data for this analysis was drawn from a previous study into the opportunity for solar water heating systems in motels.²⁴

5.1 Solar water heating system costs

A core difficulty with defining costs at present is the relative lack of experience with larger scale solar water heating systems in New Zealand to date - hence there is a paucity of reliable, long-run information. The cost/volume profile (Figure 8) developed in the previous East Harbour study has been reviewed and appears to still be appropriate. While there have been some equipment cost increases the means of project implementation have reduced with experience.

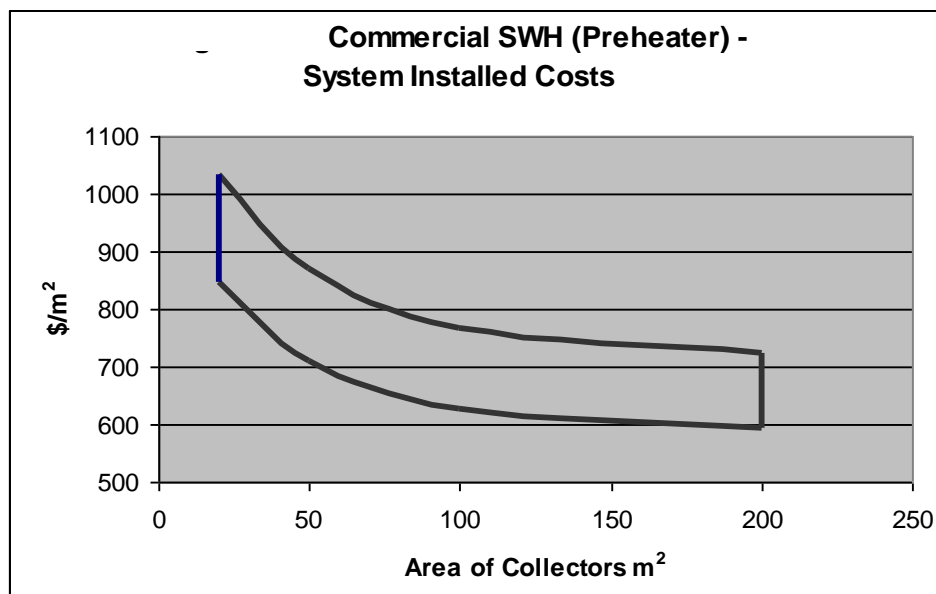


Figure 8: Commercial SWH (preheater) system installed costs

A number of points to note related to this analysis are:

- There are many cost variables including design, consents, collector type, the need for collector framing and structural supports, heat exchangers, piping, hot store tanks and installation that will affect the overall system cost.
- There appear to be clear economies of scale up to about 150m² as a result of spreading tendering, design and installation costs over greater sized systems and the discount that applies to large purchases.
- Smaller commercial systems may most economically be simply multiples of a standard domestic system including multiples of domestic storage tanks. This utilises the economies of scale of bulk manufacture and simplified design and installation. These may be open loop but most likely closed loop systems.

A key additional aspect relating to the sale of hot water from a leased system is the monitoring, maintenance and management costs. These are generally operating expenses but do entail the cost of monitoring equipment. The costs of meters with electronic data output has been assumed to be \$400 per installation.

²⁴ The Potential for Use of Solar Water Heaters in Motels, report to EECA, by East Harbour Management Services, March 2009
Proposition for a Hot Water Supply Company

Table 4. Indicative cost* of energy from larger scale solar water heating

	Panel area (m ²)		
	20	50	100
Est cost/m ²	850-1000	700-850	625-750
Total installed cost (\$)	\$17-20,000	\$35- 43,000	\$62-75,000
O&M (1% of capital) – annual	239	494	961
Solar water heating energy production for storage systems @700kWh/m ²	14,000	35,000	70,000
Cost of solar water heating energy c/kWh	14.4 - 16.9	11.8 - 14.5	10.5 - 12.7
Solar water heating energy prodn- estimate for continuous flow systems @900kWh/m ²	18,000	45,000	90,000
Cost of solar water heating energy c/kWh	11.2 - 13.1	9.2 - 11.3	8.1 - 9.8

* costs are exclusive of GST and tax and include cost of design, collector panels, framing, installation, pumps, heat exchanger and controllers. Continuous flow applications exclude storage tanks but include heat exchangers.

Aspects of commercial scale applications include:

- Larger systems are generally specifically designed and often used as a pre-heater to a larger conventional heat system. These will generally be closed loop systems with a heat exchanger heating feed or make-up water to the larger system. They may have direct heating of continuous flow water, or indirectly heat a make-up water storage tank. Once-through systems rely on continuous hot water demand, such as process heating which suggests the competing fuel will often be coal or natural gas. Where there is a periodic hot water use, which requires storage, the solar system will heat the water via a heat exchanger in the storage tank.
- Larger scale pre-heater applications may have a larger effective utilisation of solar energy than normal domestic heat storage applications as the large hot water draw-off can be set so that the collectors operate at their most efficient temperature.
- To date it is unclear what panel yield is applicable for larger scale applications. A standard yield of 700kWh/m² was used in Table 4, but there may be the potential for a higher efficiency of solar conversion because solar water heating can be specifically designed as a pre-heater to operate in the lower temperature range, thus increasing overall efficiency. The estimated cost effectiveness of a higher efficiency pre-heater option is also included in Table 4 and has been used in this analysis. It should also be noted that regional location will affect solar water heating yield.

5.2 The cost of competing energy sources

Table 5 summarises current competing energy costs based on an assumed conversion efficiency when used for water heating. The most attractive proposition for solar water heating will likely be when competing against commercial rate electricity and LPG. Competition against lower priced fuels such as fuel oils and coal will lessen the economic viability considerably. Businesses that have access to coal, diesel and reticulated natural gas (with long term contracts) have relatively low cost energy choices, and which until recently have been relatively stable in price. This creates a very difficult environment for solar water heating to compete.

Table 5. Comparative energy prices.

Fuel	Cost*	Conversion efficiency**	c/kWh effective
Electricity (Commercial)	\$40/GJ	100%	14.4
Electricity (Industrial)	\$26/GJ	100%	9.4
LPG	\$30/GJ	85%	12.7
Natural Gas (Commercial)	\$19/GJ	85%	8.0
Fuel Oils	\$19/GJ	75%	9.1
Diesel	\$27/GJ	75%	13.0
Coal – average NI & SI	\$6/GJ	70%	3.1

* Based on Ministry of Economic Development Energy Data file

** Estimates from the authors

Note: Energy costs are quality and location specific. The costs shown are indicative only.

However the potential for energy price increases in the future needs to be considered. Government policy relating to carbon charges or similar are still being developed but assumptions of up to \$25/t CO₂ are assumed by industry and if this were to come about this will increase the price of competing fuels (typically by \$2-3/GJ). There may also be price increases (and price instability) associated with further electricity capacity (generation and transmission), especially if electricity growth rates continue at their recent level. Solar and wood pellet water heating may have considerable value to some customers as a way of “future-proofing” against unpredictable electricity prices.

Overall, further efforts to quantify the potential value of solar water heating compared with other energy sources will be very worthwhile and will add to a fuller picture of benefits of solar water heating.

5.3 Attraction of leasing

Motel proprietors approached during the period of this study all indicated a high interest in the concept of using solar energy for the production of hot water. However in each case there were reasons why they would not install such a system themselves. The main reason being that they often did not visualise remaining as the proprietor for the time they perceived it would take to pay off the capital cost of installing a system. Hotel managers tended to have a longer time horizon but their situation was similar.

Except for a couple of proprietors they generally did not see a solar water heating system as adding value to the accommodation facility. In addition motels are often leased to managers who may not have an interest in adding capital improvements to the facilities.

The high churn rate of accommodation managers (often being there for only around 5 years) causes a barrier for capital investment if the pay back period for investment in a solar water heating system is perceived to be longer than 5 years.

Several managers indicated they would have a strong interest in solar water heating if they could convert the expense of installing a solar water heating system into an operating cost. This would then be a tax deductible business revenue expense. They considered that paying a hire fee and gaining the energy savings benefit would be very attractive.

In the early days of the Quantum hot water heat pump units such an arrangement was investigated. In that case the suppliers of Quantum considered supplying hot water to clients on a metered basis whilst owning the plant themselves. The idea was the client (the motel owner/lessee) didn't outlay any capital for water heating equipment and the company (Hot Water Solutions Ltd) providing the hot water would guarantee a minimum amount per day and charge a set fee per litre used. The idea was this set fee was a little less than it would cost the owner to make hot water but significantly more than it was costing the company to produce the hot water due to their efficient technologies. The difference paid the interest and principal of the finance on the equipment plus a profit.

This never got off the ground and one of the main reasons was that leasing is still difficult in NZ because of the relatively cheap costs of energy. However leasing is possible and may suit new applications where a purpose built system can be designed.

5.4 Availability of finance

The business rationale is that the Hot Water Supply Company has access to finance and is an investor and operator of hot water plant while the hot water user pays for the hot water as a direct expense of the business.

The Hot Water Supply Company could be established by a solar system supplier as a means of generating additional sales, an energy supply company (ESCo) established for that purpose, or a finance company wanting to establish a new product line for its finance funds.

If the company was established by an entity without access to its own finance funds then it would need to establish a relationship with such a financier.

From a financier's point of view the security of the investment would be in bricks-and-mortar assets albeit to a party contracting for the output who may not own the building on which the system is installed. The security for the asset has to be agreed with the building owner while there would be a separate contract to the facility operator for the purchase of output from the water heating system. This complexity of relationships could be difficult but from discussion with building owners they see that having a solar water heating on their building as a benefit when attracting new operator/managers.

6. Business Plan

6.1 Business development

The business opportunities are technically available to establish a Hot Water Supply Company. The difficulty will be in identifying and securing financial arrangements including secure contracts for the purchase of hot water from the Supply Company.

The theoretical analysis shows that commercial scale solar water heating projects would principally proceed for new build applications rather than for applications based on modification of existing heating equipment. Even then the cost penalty of going solar is such that in today's economic environment conventional means of heating water are likely to be chosen by the majority of hot water users.

Other reasons for going solar will relate to having a "green image" and supporting renewable.

A hot water supply business would focus on commercial users of hot water as they will always be more significant than the mass residential hot water market because of the large volumes of hot water used. In addition the accommodation market which provides opportunities for installation of wood pellet, solar and heat pump equipment to heat water is very large, and because of the volumes of hot water used the benefits of even getting a small % of users to move from their current heating methods will be significant in total energy terms, thus providing economies of scale.

Longer term the financial viability of contracting for the supply of hot water could extend to other sectors. A key aspect of business development will be the desire of an enterprise with access to capital funds to enter the market and be ready to secure greater levels of contracting as the market evolves. The problem of having an early low level entry strategy is that there are start up costs which do not get recovered until greater volumes of hot water are contracted for.

For a hot water supply company to enter it needs to be very focused on target areas so as to develop the systems and skills to develop the business. Ideally if it could be developed by a business development person assisted by a technical person, both of whom may have this as just one of their work activities. The project would not financially justify appointment of full time staff.

To reduce overheads and development costs it is recommended that the Hot Water Supply Company limit its target area for operation to a contained region around its home base. The principles of the project apply regardless of region. The target group would be:

- all in the commercial scale hot water use market
- new build opportunities
- where the users of the hot water are not likely to invest in equipment as they do not own the buildings from which they operate

6.2 Financing

The concept of a Hot Water Supply Company is that it has access to finance funding and that this is an investment opportunity. The ability to invest in a project depends on the expected financial return and the risk on security underpinning the investment. The financial return from a high risk project will be greater than for a low risk investment.

In a volatile finance market there are opportunities and increased risks for investors.

At the time of undertaking this study the availability of finance is extremely uncertain.

6.3 Business Risk

The areas of business risk are:

- Customers defaulting
- Systems stranded when enterprise reduces need for hot water
- Faulty solar system
- Poor performance of solar system
- Capital cost increases
- Management costs are greater than assumed
- Monitoring, operating and maintenance costs are greater than assumed

Many of these risks can be individually managed and collectively they are probably no greater than normal business risks. However with say \$1.5million of capital at risk of becoming stranded this takes the risk above that of a normal business.

There is currently little experience in contracting for the installation, operation and maintenance of solar water heating systems. With the entry of a business such as Electra this would force the solar water heating industry to lift its performance in these areas. A commercial hot water supply company would establish quality control standards that are currently rarely insisted upon. However the need for such effort increases the startup costs of the enterprise.

6.4 Business Plan

To demonstrate the commercial viability of the business proposition the following Business Plan Table 6) is assumed. This is based on achieving over a period of 10 years 50 customers purchasing an average of 45,000 kWh pa of hot water at 15 cents/kWh. This would have a capital cost of \$1.5million.

Table 6. Business Plan – base case

Year	0	1	2	3	4	5	6	7	8	9	10
Number of systems installed	4	8	10	15	20	25	30	35	40	45	50
kWh pa	180000	360000	450000	675000	900000	1125000	1350000	1575000	1800000	2025000	2250000
Income	27000	54000	67500	101250	135000	168750	202500	236250	270000	303750	337500
Expenditure											
Capital	120000	120000	60000	150000	150000	150000	150000	150000	150000	150000	150000
Business development costs	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000
Technical support	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000
Monitoring, operating and maintenance	2800	5600	7000	10500	14000	17500	21000	24500	28000	31500	35000
Depreciation	14400	28800	36000	54000	72000	90000	108000	126000	144000	162000	180000
Finance costs	8400	16800	21000	31500	42000	52500	63000	73500	84000	94500	105000
Expenditure	85600	111200	124000	156000	188000	220000	252000	284000	316000	348000	380000
Profit	-58600	-57200	-56500	-54750	-53000	-51250	-49500	-47750	-46000	-44250	-42500
(Cumulative profit)	-58600	-115800	-172300	-227050	-280050	-331300	-380800	-428550	-474550	-518800	-561300

Base Assumptions

Capital \$30,000 / system
 Depreciation 12% SL
 Cost of finance 7%
 Hot water sale price 15cents/kWh

A sensitivity analysis of this base case provides the information shown in Figure 9 that under all scenarios the proposal is never financially viable.

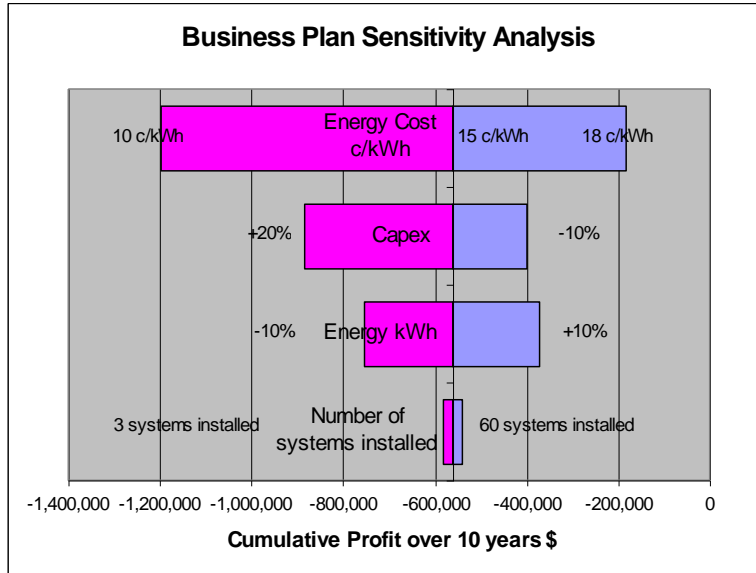


Figure 9: Sensitivity analysis of Business Case

7. Conclusion

Analysis of the proposal for establishment of a Hot Water Supply Company shows that the proposal is only likely to be economic for very large hot water users where the capital cost per kWh pa of systems can be minimised. Under current relative energy costs the economics of installing solar hot water systems for many applications are very poor and it is more cost effective for hot water users to heat using traditional means. The economics are also not attractive for applications which are based on replacement of currently effective water heating systems.

The financial viability of establishing a Hot Water Supply Company depends on access to capital at an appropriate finance cost, and minimising overheads during the initial startup period. Unfortunately the start up costs of a Hot Water Supply Company are likely to be higher during the startup phases because of the need to develop contracts and monitoring and billing systems. There is also a steep learning curve because of the business being of a new type.

The business risk to the Hot Water Supply Company is high in that the customers to whom contracts for the supply of hot water are entered into could become insolvent at any time and thus not be able to pay for hot water received. In some situations the water heating systems could become stranded. The risk is managed if the water heating systems are only installed on buildings where another manager would quickly replace an insolvent one e.g. a hotel is likely to keep operating with a replacement manager, whereas a restaurant is likely to close and could be used for another purpose. However many of these energy users already have access to relatively cheap energy.

Despite the limitations brought about by the current relative economic costs of energy the establishment of a Hot Water Supply Company could become economic in the future as relative energy costs change and renewable energy becomes more economic. There are adequate opportunities to start such a business, and the opportunities will increase over time however the time is not yet here and the business is not recommended.

This result is confirmed when comparison is made to overseas situations where hot water is sold to users. In most cases this is from traditional heating sources such as a municipal heating scheme using traditional fossil fuels. It also occurs where energy costs are relatively high. The sale of hot water is often an adjunct to other heating activities and generally not the main driver. Where solar water heating technology is utilized the project is generally subsidized. There are few international examples of where a proposal such as is proposed here have been established. Parts of the proposal are drawn on but not as a complete package.

Appendix 1: Installing solar systems in existing accommodation enterprises.

Domestic solar water heating systems are generally sized with collector areas that produce approx 70% of energy requirements. This is a guide that has arisen over the years as being about the most effective balance between capital expenditure and captured solar energy. It also allows for the summer period when the quantity of solar energy received is not all able to be used, compared to wintertime when solar energy may only be meeting about 30% of hot water energy requirements. Such sizing puts the solar collectors into a state whereby there are often high operating temperatures, increased losses and low efficiencies. A solar collector operates most efficiently at the lower temperatures up to around 45°C. At higher temperatures the system will be less effective in turning solar energy into heat energy.

Using solar system as a preheater into a larger heating system allows lower temperature water to be heated. It also allows a smaller collector area as the collectors are operating at their best efficiency temperature. The smaller collector thus results in lower capital costs and a higher percentage of the solar contribution is used.

Systems designed to preheat water for conventional accommodation hot water systems have the following advantages

- Lower heat losses and higher collector efficiency
- Longer working life because of the lower operating temperatures
- No danger of collector overheating
- High solar contribution

One of the keys to the installation of commercial scale solar hot water systems is not trying to design a system that tries to do too much with solar. If a modest preheater system that happily toils away at the lower temperature range where efficiencies are maximised then it will pay for itself quicker than an 'all singing dancing unit' that tries to heat all the water to the desired temperature and costs a lot of money. This means that solar energy can provide base energy while peak hot water requirements and fluctuations can be met by use of responsive gas or electricity heaters. This means that the gas or electricity units can be smaller as they are only for top up. There is no necessity to have expensive quick response units being used to provide base energy. Solar preheating in conjunction with appropriate storage can also overcome some part of peak demand periods without hitting the peak tariffs, but it requires careful design and attention to detail.

Figures A1 and A2 show typical solar / gas hot water heating arrangements. The ideal is an appropriate sized thermal store tank or tanks which feed a continuous flow gas or electric system. A properly sized and designed system will give great running costs savings and little or no likelihood of hot water shortage.

A solar collector may be connected directly into an existing conventional water heating system with no intermediate solar store. This is often referred to as a conventional system with an auxiliary solar heater.

An alternative option is to install a solar system with thermal store pre-heating for standard commercial storage cylinders in gas or electric. Storage to meet the peak morning and evening draw-offs is essential.

The solar collectors can be either flat plate or evacuated tube. The evacuated tube technology can provide a higher level of annual output per surface area taken up and are ideal if high temperature hot water is required for motel kitchens or laundries. Either type of collector can be operated with controllers which may have additional functions to cope with commercial applications. There are also some very quick response continuous flow electric water heaters available that could be used commercially.

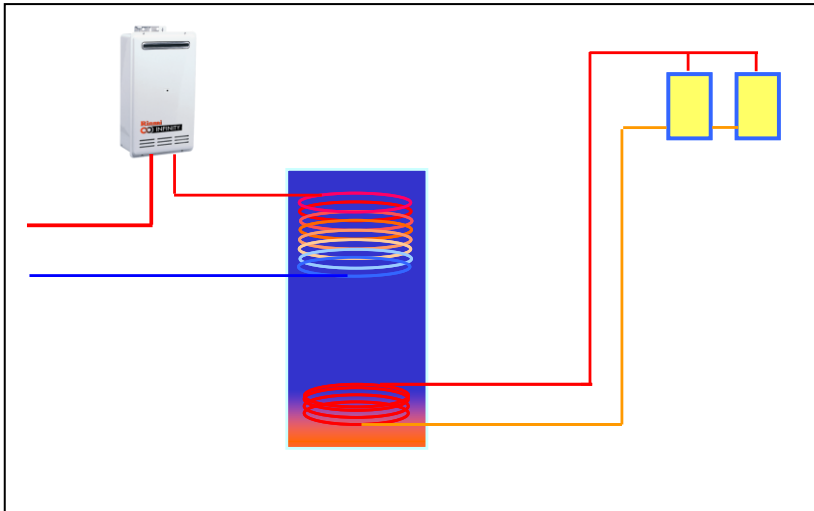


Figure A1: Closed Loop Solar/Gas System

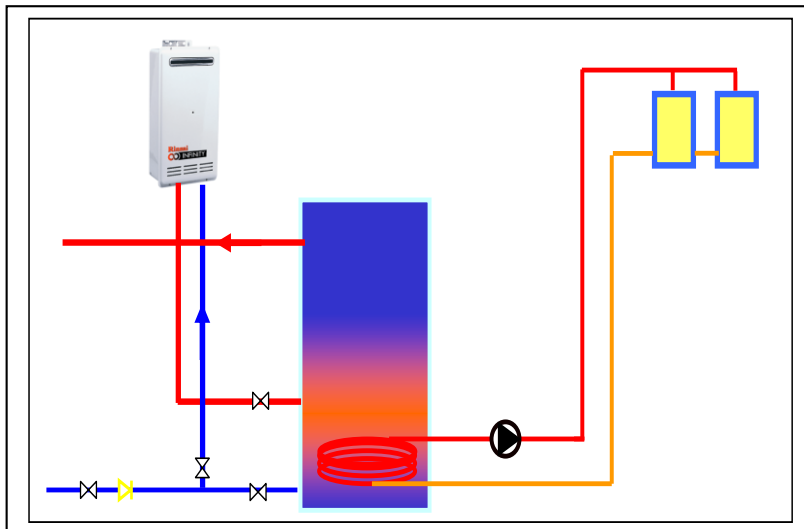


Figure A2: Solar / Gas Boosted System

In this study it is assumed that accommodation supplied solar water heating systems operate at only 30% solar contribution and are therefore drawing on a high percentage of cold water. Their efficiency is therefore at an estimated 85%.