# DEVELOPMENT OF AN AREA BASED ENERGY SERVICE COMPANY (ESCO) MODEL FOR SOLAR WATER HEATING IN INDIA

## FINAL REPORT

Prepared for:

Government of India

UNDP India

GEF

Project Management Unit, UNDP/GEF Assisted Global Solar Water Heating Project

Ministry of New and Renewable Energy, Government of India

Prepared by:

**MERCADOS – ENERGY MARKETS INDIA PVT. LTD.**

DATE: 20 September 2010

MADRID
ROME
ANKARA
MOSCOW
NEW DELHI
BEIJING

# AREA BASED ENERGY SERVICE COMPANY (ESCO) MODEL FOR SOLAR WATER HEATING IN INDIA

## TABLE OF CONTENTS

# ABBREVIATIONS

| | |
|---|---|
| ANEEL | National Electricity Regulatory Agency |
| BEE | Bureau of Energy Efficiency |
| BHEL | Bharat Heavy Electrical Limited |
| BIS | Bureau of Indian Standards |
| CDM | Clean Development Mechanism |
| CER | Carbon Emission Reduction |
| CETP | Common Effluent Treatment Plant |
| ECBC | Energy Conservation Building Code |
| ECS | Electronic Clearing System |
| ESCO | Energy Service Company |
| ETC | Evacuated Tube Collector |
| FPC | Flat Plate Collector |
| FY | Financial Year |
| GHG | Green House Gases |
| HSD | High Sulphur Diesel |
| IREDA | Indian Renewable Energy Development Agency |
| IRR | Internal Rate of Return |
| JNNSM | Jawaharlal Nehru National Solar Mission |
| LNG | Liquified Natural Gas |
| LPD | Litres Per Day |
| LPG | Liquified Petroleum Gas |
| MLP | Million Litres Per Day |
| MNRE | Ministry of New and Renewable Energy |
| MOU | Memorandum of Understanding |
| MW | Megawatt |
| NAPCC | National Action Plan on Climate Change |
| NERSA | National Energy Regulator South Africa |
| NSM | National Solar Mission |
| ORER | Office of Renewable Energy Regulator |
| PA | Program Administrator |
| POA | Program of Activities |
| PSU | Public Sector Utility |
| PV | Photo Voltaic |
| REC | Renewable Energy Certificate |
| RESCO | Renewable Energy Service Company |
| RFA | Request for Accreditation |
| RFP | Request for Proposal |
| RFS | Request for Selection |
| RWA | Resident Welfare Association |
| SIDCUL | State Infrastructure and Industrial Development Corporation of Uttarakhand |
| SNA | State Nodal Agency |
| SWH | Solar Water Heater |
| SWHS | Solar Water Heating System |
| TOR | Terms of Reference |
| TPD | Tons Per Day |
| WCS | White Certificate Scheme |
| WhC | White Certificates |

## WEIGHTS AND MEASURES

| | | |
|---|---|---|
| BU (billion unit) | – | Unit of energy, equal to $1x10^9$ |
| kWh (kilowatt-hour) | – | Unit of energy, equal to 1 unit |
| MW (megawatt) | – | Unit of power, equal to $1x10^6$ |
| GW (gigawatt) | – | Unit of power, equal to 1 billion ($10^9$) watts |
| MT (metric ton) | | Unit of weight, equal to 1,000 kg or 2,204.6 pounds |

Conversion:

| | | |
|---|---|---|
| Rs1 million | – | Equal to $Rs1x10^6$ |
| Rs1 billion | – | Equal to $Rs1x10^9$ |
| Rs1 lakh | – | Equal to $Rs1x10^5$ |
| Rs1 crore | – | Equal to $Rs1x10^7$ |

# EXECUTIVE SUMMARY

Internationally, solar water heating has been identified as one of the most promising decentralized solar applications, having significant potential to reduce electricity consumption and consequent emissions reduction. It is being increasingly recognized as an application that can help urban areas and industries in reducing their dependence on grid and reducing diesel/gas consumption.

India has been bestowed with abundant solar energy, available almost around the year. The **gross potential for solar water heating systems in India has been estimated at 140 million sq. m. of collector area. Of this, 40 million sq. m. has been estimated as the realizable techno-economic potential at this stage**. All over the world, high initial cost of the Solar Water Heating System (SWHS) has been found to be the major hurdle for large-scale deployment of SWHS. In India, a total of 3.53 million sq. m of collector area has been installed so far in the country, for SWH. The achievement so far has been modest compared to the overall potential. However, a reasonable infrastructure has emerged and experience is available for manufacture and installation of SWHS.

Several schemes for promotion of solar water heaters have been in operation in the country. While most of these schemes were developed and coordinated by Ministry of New and Renewable Energy (MNRE), some schemes were developed at the State level. Some of the incentives from the central government included provision of soft loans to the users under the interest subsidy scheme through a network of financial institutions, public/private sector banks, scheduled co-operative banks, RBI approved non-banking financing companies. In addition, capital subsidy has been made available to builders and developers/ development authorities/ housing boards/ cooperatives/ Group Housing Societies for providing solar water heating systems in new buildings and housing/ commercial/institutional complexes.

The Energy Conservation Act 2001 authorises the Bureau of Energy Efficiency (BEE) to prescribe guidelines for Energy Conservation Buildings Code (ECBC). BEE has developed ECBC, which sets minimum energy efficiency standard for design and construction. **ECBC is expected to impact and promote market development of various energy efficient products including solar water heaters. SWHS are included among the building components covered under ECBC. SWHS are required to meet at least 20% of the design capacity for water heating.**

In view of the high solar radiation over the country and with the twin objective of contributing to India's long-term energy security and its ecologically sustainable growth, the Prime Minister launched the Jawaharlal Nehru National Solar Mission (JNNSM) on January 11, 2010. The Mission will constitute a major contribution by India to the global effort to meet the challenges of climate change. This Mission is one of the eight key National Missions, which comprise India's National Action Plan on Climate Change (NAPCC). The objective of the National Solar Mission is to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible. **The Mission includes a major programme titled 'The Below 80$^0$C Challenge – Solar Collectors' for Solar Thermal Technology**.

**A target of 7 million sq. m. has been set by the JNNSM by the end of the first phase of the Mission (2010-13) and a goal of 20 million sq. m by the end of the third phase of the Mission (2017-22)**. As mentioned earlier, the MNRE has been at the forefront of devising promotional measures for greater off-take of SWH. However, in order to achieve scalability in these measures and to achieve the objectives of SWH penetration in the JNNSM period and beyond, there is a need to extend the existing schemes and design innovative service delivery mechanisms to leverage SWH investments. One such model is the **Fee-for-Service model where people buy a service, in this case hot water, from an energy services company (ESCO)**, rather than energy to perform the service (e.g. purchasing electricity so it can be used to heat water).

**An ESCO is defined as a company that would install, own and operate RE systems**, which in this case would be SWH systems **and provide energy services to consumers**. Such companies are characterized by the following features:

- It guarantees the energy savings and/or provision of the same level of energy service at lower cost
- Its remuneration is directly tied to the energy savings achieved
- It can either finance, or assist in arranging financing for the installation of an energy project they implement by providing a savings guarantee.

Internationally, SWH is a mature, well-developed technology and numerous manufacturers of high quality SWH products exist in many countries. Solar Water Heating is widely applied for domestic and industrial hot water and pool heating. In South Africa, for instance, although the Government support for SWH has generally been limited, there exist innovative programs to stimulate markets for SWH. One such program is the ESCO model or 'fee-for-service' mechanism suggested by Renewable Energy and Energy Efficiency Partnership (REEEP) and Sustainable Energy Africa (SEA) for large-scale deployment of SWHS in South Africa. The Implementing Agent/ESCO plays a key role in co-coordinating the model in its area of jurisdiction. It could be a public/private company that puts together a suitable SWHS financing package, drawing on the Eskom DSM incentive, carbon funding and/or bulk financing deals. The ESCO is also able to negotiate a reduction in current SWHS unit costs through mass purchase of systems. It enters into a contract with the SWHS users and thereafter gets the SWHS installed and maintains it in individual households at its own cost. ESCO retains ownership of the system and sells hot water to the owner/business in any of the following ways:

- Metering the hot water/volume
- A lease or hire/purchase agreement for a fixed period
- A fixed monthly fee

An example of this model is an existing SWH ESCO program in Pretoria. Power cuts resulting in increased dissatisfaction among tenants led a private retirement centre in Pretoria to convert its water heating system from a conventional electric system to a solar heating system with an electric back-up, in 2005. The retirement centre is home to 100 residents. The solar water heating system has been fitted by an ESCO. The retirement centre leases the system and only pays for the energy consumed during the month. Solar panels with a collector surface area of 120 sq. mtrs were installed with a maximum demand control unit built into the circulation unit. The storage capacity of the system is 9000 Litres. The system uses a forced pump circulation, and has a differential thermostat control together with antifreeze protection. The savings accrued at this centre are:

- Energy savings (90 panels) = 197.1MWh per year
- Financial Savings: USD7,745 – USD8,298 per year
- Environmental Saving: 18tons of coal, 90 tons annual CO2 emissions avoided

**Emerging markets for international trade in GHG reduction credits offer important opportunities to overcome barriers and help advance SWH technology**. For developing nations, the Kyoto Protocol's Clean Development Mechanism (CDM) provides the opportunity for carbon trading to support environmental protection and economic development. Emission reduction revenue can help to surmount a multitude of barriers for SWH technology. Foremost, carbon finance can help to increase system affordability to end-users and enhance the viability of SWH projects and businesses. Financial arrangements that address constraints on SWH affordability, such as third-party financing and fee-for-service operations, could gain substantially by leveraging

underlying and additional finance where project participants establish emission reduction purchase agreements with creditworthy CER buyers.

Carbon trading can also help to overcome institutional, technical and other barriers to the development of SWH markets. In this context, SWH projects could potentially use carbon reduction revenue for market development, training, awareness raising and other activities to overcome barriers that constrain broader SWH dissemination, such as the establishment and enforcement of quality standards. SWH systems can also be eligible for market based mechanisms such as renewable energy certificates and/or energy saving/white certificates. There are various examples of countries that are successfully operating such mechanisms. Such mechanisms alleviate the cost burden of these systems by providing an additional stream of revenue to the energy service company/utility/user depending on the obligated entity.

Internationally, there are **standard ESCO contracting models**. The two predominant types of contracting models are, (i) energy performance contracting models and (ii) energy supply contracting models.

i. **Energy Performance contracting models**- Energy Performance Contracting (EPC) can be defined as 'a form of 'creative financing' for capital improvement which allows the funding of energy efficiency upgrades from cost reductions'. Performance guarantees are given by the ESCO in terms of the level of energy service or the level of cost and/or energy savings. The savings are then split between the ESCO and the client who could potentially reinvest this into more improvements. The two types of EPC models are:

   a. **Shared savings**- Under this model, the ESCO finances the project either through its own funds or by borrowing from a third party. The **ESCO takes on the performance risk of the project. The cost savings are divided between the ESCO and customer at a prearranged percentage for an agreed length of time**.

   b. **Guaranteed savings**- In this case, **the customer finances the design and installation of the project by borrowing funds from a third party** such as a bank or through leasing the equipment. The ESCO has no contractual arrangement with the bank but does assume the project risk and guarantees the energy savings made. If the savings do not reach agreed minimums the ESCO covers the difference; if they are exceeded then the customer agrees to share the savings with the ESCO.

ii. **Energy supply contracting models**- This type of service tends to be delivered on a low risk – low margin basis with suppliers' business models often focusing on developing long term operation and maintenance contracts. The two types of energy supply contracts are:

   a. **The Chauffage contract**- This **contract provides a structure in which end users are sold energy**. The contractor charges agreed rates for providing required energy services to a guaranteed level and has the freedom to act and make decisions on the installation of energy efficiency measures to reduce their own operating costs. The contractor provides all associated maintenance and operations support throughout the duration of the project.

   b. **The Build-Own-Operate-Transfer (BOOT) contract**- In this contract model, **the ownership of equipment is transferred from the ESCO to the client at the end of a long term contract with the BOOT operator**, before which the ESCO may have designed, built, financed and operated the equipment. The charge incurred by the client includes the recovery of operating costs, capital and project profit.

A detailed assessment of these contracting models was carried out during the course of this assignment. Along with this, a fairly detailed stakeholder consultation was carried out among

existing SWH based hot water service providers in India. Based on this, various types of business models for operation of SWH ESCOs in India have been proposed in this assignment.

**From MNRE's perspective, this study is intended to draw out a set of implementation guidelines for facilitating service based delivery of hot water through SWH systems**. As mentioned earlier, such a delivery model has the potential to scale solar water heating development in the country. This study is intended to address the above objective of MNRE and frame a set of implementation guidelines in this regard.

The limited experience in SWH ESCO models reveals that,

- **Monitoring and verification of hot water service is critical in an SWH ESCO model** even though metering of hot water in some applications may be a challenge

- **Commercial operation risks** – it is extremely important to address payment default risks by certain category of end-users

- **ESCO model is techno-economically more efficient to cater to large volumes of hot water**, typically in industries and large institutions

- Rather than catering to individual demand segments, **an area based approach comprising of a cluster of different types of demand segments can reduce the risks for an ESCO**

- Given the nature of business and the type of risks involved, the **ESCO will need necessary support from the Government and will be accountable for any kind of financial incentive that is provided**

Subsequent to the announcement of the National Solar Mission, in order to give practical shape to the vision and objectives outlined in the Mission, two sets of guidelines were announced by MNRE on June 16, 2010. These are **Guidelines for**, (i) **Off-grid and Decentralized solar applications** and (ii) Rooftop and other small solar power plants. The scope of the guidelines for off-grid and decentralized solar applications includes off-grid solar photovoltaic systems/applications up to a maximum capacity of 100kWp per site and off-grid and **decentralized solar thermal applications**, to meet/supplement lighting, electricity/power, **heating** and cooling **energy requirements**, and, mini-grids for rural electrification up to a maximum capacity of 250kW per site.

**The provisions of the off-grid solar guidelines provide a channel for mainstreaming the ESCOs as important players in the implementation of the off-grid program under the Mission**. The provisions of these guidelines have been assessed in detail in order to dovetail these with the implementation guidelines for the area based ESCO program in order to harmonize some of the common features of the two schemes.

Our assignment has evaluated international and national experience in the development of SWH ESCO projects, carbon financing and market based instruments and provided an integrated financial and business model with guidelines for implementation in four types of demand clusters:

- Remote or Hilly region

- Industry cluster

- Residential cluster

- Religious township/tourist centre

As we have mentioned, the ESCO model of operation for SWH would not be without risks. Hence it would be important to assess each model on merits in terms of end-user payment default risk, ESCO non-performance risk and Bank's loan repayment default risk. These risks would need to be

appropriately addressed in order to ensure successful operation of the program. Considering the significant SWH potential in the country, a properly designed area-based ESCO program will contribute significantly in scaling-up solar water heating development in the country.

< This space intentionally left blank>

# I. OBJECTIVE OF THE STUDY

**The objective of this assignment is to develop an Area Based Energy Service Company (ESCO) Model for Solar Water Heating (SWH) and to assess the potential of Carbon Financing in order to achieve scale in SWH development in the country**. In the recent years, India has witnessed considerable progress in SWH development. A total of 3.53 million sq. m. of SWH collector area has so far been installed in the country, of which about 1.55 million sq. m. has been installed since 2005-06. Several initiatives taken in the last few years have resulted in acceleration in the pace of development. These measures include capital and interest subsidies, promotion of local manufacturing, and other measures. These have resulted in a virtuous development cycle.

However, in-spite of the progress, a large proportion of the potential remains under-achieved. The gross potential for SWH systems in India has been estimated at 140 million sq. m. of collector area. Out of this, 40 million sq. m. has been estimated as the realizable techno-economic potential at this stage. A target of 7 million sq. m. has been set by the Jawaharlal Nehru National Solar Mission (JNNSM) by the end of the first phase of the Mission (2010-13) and a goal of 20 million sq. m by the end of the third phase of the Mission (2017-22). The Ministry for New and Renewable Energy (MNRE) has been at the forefront of devising promotional measures for greater offtake of SWH. However, in order to achieve scalability in these measures and to achieve the objectives of SWH penetration in the JNNSM period and beyond, there is a need to extend the existing schemes and design innovative service delivery mechanisms to leverage SWH investments. One such model is the **Fee-for-Service model where people buy a service, in this case hot water, from an energy services company (ESCO)**, rather than energy to perform the service (e.g. purchasing electricity so it can be used to heat water).

From MNRE's perspective, this study is intended to draw out a set of implementation guidelines for facilitating service based delivery of hot water through SWH systems. Such a delivery model has the potential to scale solar water heating development in the country. This study is intended to address the above objective of MNRE and frame a set of implementation guidelines in this regard.

The limited experience in SWH ESCO models reveals that,

- Monitoring and verification of hot water service is critical in an SWH ESCO model even though metering of hot water in some applications may be a challenge
- Commercial operation risks – it is extremely important to address payment default risks by certain category of end-users
- ESCO model is techno-economically more efficient to cater to large volumes of hot water, typically in industries and large institutions
- Rather than catering to individual demand segments, an area based approach comprising of a cluster of different types of demand segments can reduce the risks for an ESCO
- Given the nature of business and the type of risks involved, the ESCO will need necessary support from the Government and will be accountable for any kind of financial incentive that is provided

Our assignment with MNRE is primarily intended to evaluate international and national experience in the development of SWH ESCO projects, carbon financing and tradable market based certificates and provide an integrated financial and business model with guidelines for implementation in the following demand clusters:

- Remote or Hilly area / region
- Industry cluster
- Residential cluster
- Religious township/ tourist centre

The specific objectives are as follows:

- To develop a clear understanding of the ESCO based service delivery model in the context of the SWH sector
- To understand the success factors behind major international best practices and study their applicability in Indian market conditions in the areas of,
    - ESCO based service delivery model for SWH
    - Applicability of Carbon Financing
    - Applicability of other Market based Instruments such as Renewable Energy Certificates, Energy Saving Certificates
- To develop an integrated business and financial model along with guidelines for implementation in the identified demand clusters

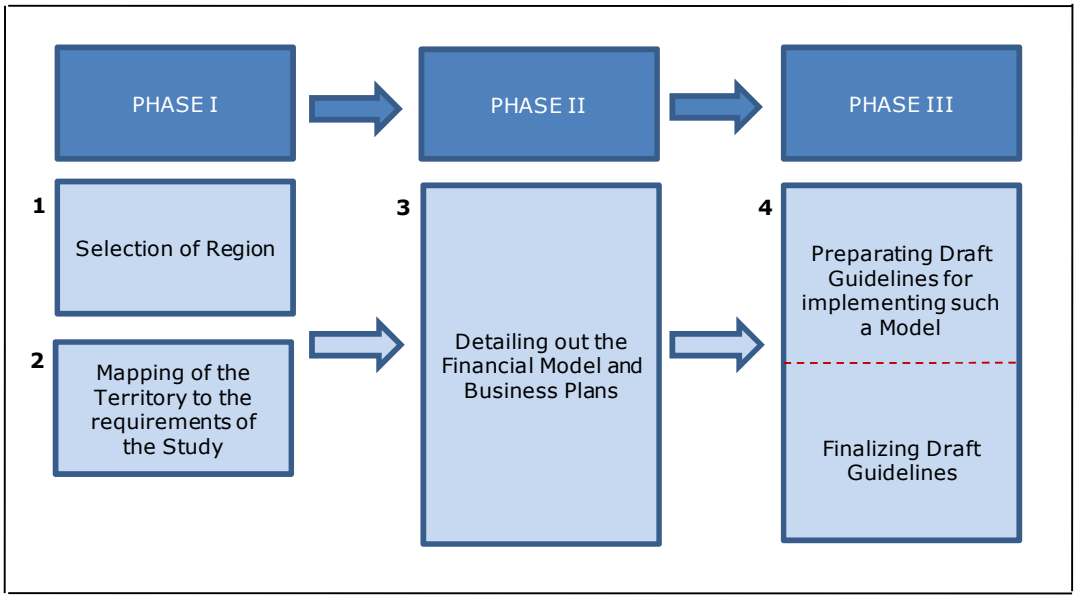
The report is organised as follows:

- Chapter II discusses the broad approach and methodology of the assignment outlining the various activities that were involved in each phase of the assignment
- Chapter III provides a snapshot of international experience in solar water heating development models
- Chapter IV provides an overview of the solar thermal sector in India, some of the key developments, programs and initiatives of the Government and achievements till date
- Chapter V sets the context for the need to assess an area based energy service company (ESCO) model for solar water heating in India and how such a model can provide a means to scale further development of this sector
- Chapter VI discusses the approach followed for selection of the four areas and summarizes some of the key results of the market assessment carried out in the identified areas
- Chapter VII provides a detailed description of the ESCO business models and summarizes the approach and results of the area specific financial models
- Chapter VIII outlines the key features of the implementation guidelines for the area based ESCO program for SWH

# II. BROAD APPROACH AND METHODOLOGY

The figure below illustrates the **approach/ methodology** that has been adopted for undertaking the proposed study.

**Figure 1:** Approach/ methodology




As illustrated, the assignment has been undertaken in three phases:

i. Selection of regions/areas/demand segments and mapping of territories

ii. Analytical framework for the financial and business model

iii. Preparation of implementation guidelines

The activities that have been followed in each of these phases have been provided below.

**Phase I – selection of regions/areas/demand segments and mapping of territories**

As per the TOR (terms of reference) of this assignment, the selection of an area/ region has been based on the potential of implementing a viable ESCO based Solar Water Heating Model in close consultation with MNRE. The proposed ESCO Model has been assessed for areas/ regions representing different types of demand segments given below:

- Remote or Hilly area / region
- Industry cluster

- Residential cluster
- Religious township/ tourist centre

In this phase, the following activities have been undertaken:

- Stakeholder Meetings/Interactions
- Market Assessment of four identified demand clusters
    - Residential Cluster – Gurgaon
    - Religious Township – Haridwar
    - Industry Cluster – Coimbatore
    - Hilly Region – Leh
- Assessment of International Experience- the following four countries were studied – (i) South Africa, (ii) Caribbean and Brazil, (iii) Australia and (iv) Italy.

**Phase II – detailing out the financial and business models**

In this phase, the following activities were undertaken:

- Extrapolation of the market assessment data to the universe in order to arrive at the segment-wise demand for hot water
- Expert consultation with MNRE, IREDA, BEE, ESCOs and manufacturers to ensure the findings are harmonized effectively
- Region/cluster specific financial modelling
- Evaluating existing ESCO models and developing SWH specific business models for service delivery

**Phase III – preparing draft guidelines for implementing the model**

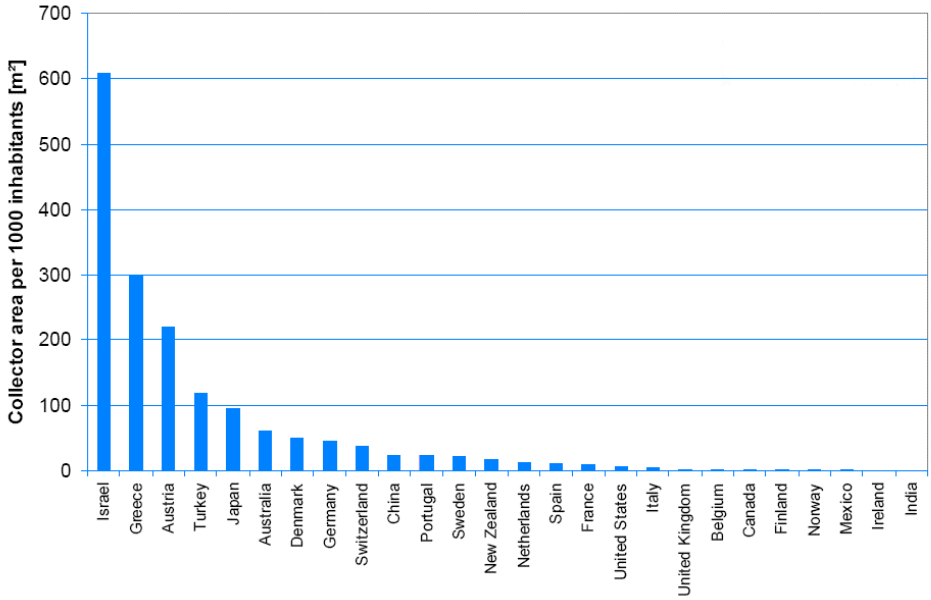
In this phase, draft guidelines for implementation of the area based ESCO model in the four identified regions have been prepared. Along with the draft guidelines, templates have been prepared for the ESCO standard contract requirements.

# III. INTERNATIONAL EXPERIENCE

Internationally, SWH is a mature, well-developed technology and numerous manufacturers of high quality SWH products exist in many countries. Solar Water Heating is widely applied for domestic and industrial hot water; and pool heating. A SWH system can typically displace 30-50% of the domestic water heating energy use in most latitudes, including much of northern Europe. In Europe, the market has grown by 18 percent per year throughout the 1990s and is expected to increase further.

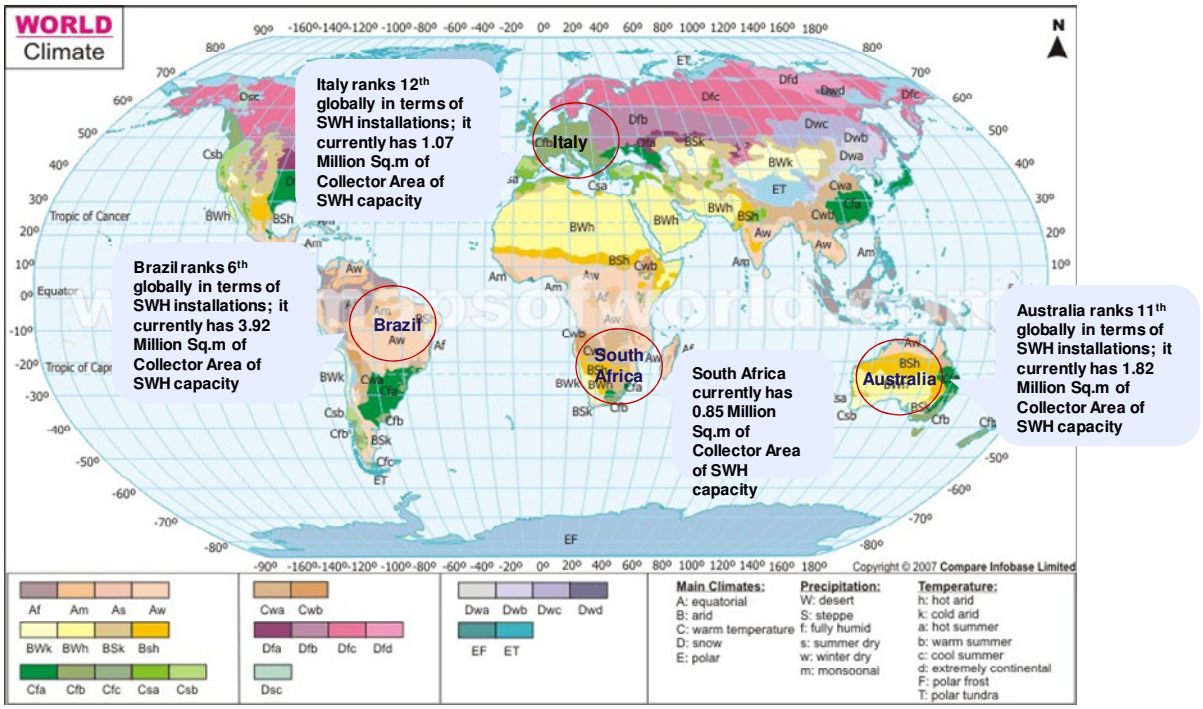
The graph below highlights the collector area of solar water heaters per 1000 inhabitants globally.

**Figure 2: SWH Collector Area per 1000 inhabitants [m2]**




There exist several SWH success stories internationally particularly because of the innovative financing schemes that have been adopted. In this assignment, SWH development models have been studied in four countries across four different continents across four different climate zones. These countries have been illustrated in the world map below.

**Figure 3: Countries assessed**




The detailed country-specific SWH development models have been elaborated in Annex 4. As illustrated in the figure, the four countries that have studied are – Caribbean region and Brazil, Italy, South Africa and Australia.

Box 1 provides a conceptual outline of an innovative SWH financing mechanism called the **Fee-for-Service Model** which was pilot tested in the Caribbean Region and Brazil.

**Box 1:** Fee-for Service Model in the Caribbean and Brazil

For **solar water heating fee-for-service programs**, the two main options are sale-of-energy programs and system leasing or rental programs.

**Sale of energy programs** can be applied to any type of water heating customer. Applications can include residential, commercial and industrial users of hot water. A sale-of-energy program does not require capital investment by the customer. The **utility company** or another energy service provider owns, installs and services the solar water heating system. **A third party might also own the equipment, with the utility or energy service company managing the administration**. The owner/utility sells the energy generated by the solar thermal system to the customer. These arrangements can be structured as a "shared savings" or "performance" contract whereby the utility will charge a rate lower than the conventional electricity costs for the solar energy generated and supplied to the customer. For example, the charge to the customer might range from 90% of current electricity costs to as low as 75% of current rates to heat the hot water. In that case, the customer would realize a 10-25% savings for water heating. The rate the utility charges for the energy sales can be fixed or tied to a percentage of the prevailing conventional electricity rates. The rates can be adjusted periodically, or it could be fixed for the term of the contract.

Under the **leased and rental options** the solar water heating systems are owned by the utility company or energy service provider, though the fee structure is not based on the metered sale of energy. Leasing equipment is common in the business sector and is used as a method of financing equipment purchases. A leased item is owned or financed by a third party who will typically realize a tax advantage by depreciating the item while receiving a fair price for the use of the product being leased by the customer. The value of a product both at the beginning of the lease term and the remaining value after the lease has expired are used to determine the cost of the lease. The consumer's payments cover the declining value of the product and a margin of profit for the leasing company. A solar water heater lease program operated by a utility company would work in a similar fashion.

## *1.1. BEST PRACTICES IN CARBON FINANCING FOR SOLAR WATER HEATING*

Some of the countries that are using CDM revenues to promote SWH are Brazil, China and South Africa. Box 2 below briefly summarizes the experience in South Africa.

**Box 2:** South Africa – Solar Water Heating and Carbon Financing

The total SWH installed capacity in South Africa is around 500,000 m2 including all types. For the domestic (non-swimming pool) SWH market, South African manufacturers produce a wide range of systems, from very basic integral systems that require little plumbing to more elaborate active, split collector systems. The up-front cost of typical residential SWH systems are on par with the worldwide average, with prices ranging from $5.50 to $9 per liter of capacity.

The institutional inertia in South African government and society perpetuates the dominance of electric water heating systems. Prevailing practices in government, energy utilities, building industries, and other institutions all contribute to the tilt toward electric systems.

Government support for SWH has generally been limited, but there are a few programs to stimulate markets for SWH and other small-scale renewable energy technologies. The city of Cape Town has committed to ensuring that 10% of households have SWH systems by 2010, and it has initiated a number of activities to promote the technology. For example, it recently launched a CDM project that involves the installation of SWH coupled with energy efficiency enhancements in low-income areas. Other municipalities have experimented with installing SWH systems in city-owned apartment buildings. Details of the program has been provided in Annex 5

In South Africa, for instance, although the Government support for SWH has generally been limited, there exist innovative programs to stimulate markets for SWH. One such program is the ESCO model or 'fee-for-service' mechanism suggested by Renewable Energy and Energy Efficiency Partnership (REEEP) and Sustainable Energy Africa (SEA) for large-scale deployment of SWHS in South Africa. The Implementing Agent/ESCO plays a key role in co-coordinating the model in its area of jurisdiction. It could be a public/private company that puts together a suitable SWHS financing package, drawing on the Eskom DSM incentive, carbon funding and/or bulk financing deals. The ESCO is also able to negotiate a reduction in current SWHS unit costs through mass purchase of systems. It enters into a contract with the SWHS users and thereafter gets the SWHS installed and maintains it in individual households at its own cost. ESCO retains ownership of the system and sells hot water to the owner/business in any of the following ways:

- Metering the hot water/volume
- A lease or hire/purchase agreement for a fixed period
- A fixed monthly fee

An example of this model is an existing SWH ESCO program in Pretoria. Power cuts resulting in increased dissatisfaction among tenants led a private retirement centre in Pretoria to convert its water heating system from a conventional electric system to a solar heating system with an electric back-up, in 2005. The retirement centre is home to 100 residents. The solar water heating system has been fitted by an ESCO. The retirement centre leases the system and only pays for the energy consumed during the month. Solar panels with a collector surface area of 120 sq. mtrs were installed with a maximum demand control unit built into the circulation unit. The storage capacity of the system is 9000 Litres. The system uses a forced pump circulation, and has a differential thermostat control together with antifreeze protection. The savings accrued at this centre are:

- Energy savings (90 panels) = 197.1MWh per year
- Financial Savings: USD7,745 – USD8,298 per year
- Environmental Saving: 18tons of coal, 90 tons annual CO2 emissions avoided

## *1.2. INTERNATIONAL EXPERIENCE IN TRADABLE MARKET BASED CERTIFICATES*

Market based instruments such as renewable energy certificates and energy savings certificates have been used in some countries to promote solar water heating. Countries where white certificates have been used to promote end-use efficiency measures at the utility and consumer level are UK and Italy, and in Australia, renewable energy certificates are used to meet the mandatory renewable energy target through the renewable energy purchase obligation.

Box 3 provides a brief snapshot of the experience in Australia.

**Box 3:** Key Features of Australia's REC Program for SWH

- Regulations adopted in 2001 enable solar water heaters to generate RECs for compliance with Australia's Mandatory Renewable Energy Target (MRET) which requires 2% of electricity generation by renewables though 2010.
- SWH systems must either be installed in a new building, or it must replace an electric water heater or an electric-boosted solar water heater that has been installed for over 1 year.
- RECs anticipated over 10 years are credited to SWH system buyers upon registration. Typical SWH systems are eligible for between 10 and 64 RECs depending on the user's location and system type.
- Registering a Solar Water Heater to obtain RECs costs A$20 (US$15) and must be done within 1 Year of SWH installation
- Agents provide SWH REC registration services and buy RECs from SWH owners, which eases market participation
- REC prices have reportedly ranged from nearly US$40 (the cost of the fine charged to parties not meeting REC obligations) for the first few years to the mid-US$20's more recently
- Australia's SWH REC program has boosted Australia's solar water heating market considerably, especially during the first few years of the program when REC prices were higher

The details of the Australian REC experience have been elaborated in Annex 4.

**Elements of a White Certificate Policy Portfolio – issues and experiences in Italy**

This section describes the mechanism of operation of the white certificate mechanism and provides an illustration of the system that is presently followed in Italy.

A white certificate is an instrument issued by an authority or an authorized body providing a guarantee that a certain amount of energy savings has been achieved. Each certificate is a unique and traceable commodity that carries a property right over a certain amount of additional savings and guarantees that the benefit of these savings has not been accounted for elsewhere. Such a system of obligations and energy saving certificates may refer to:

- A system of imposing energy saving obligations and verifying compliance via certification of savings or via other methods (e.g. ex-post program evaluation), or

- A system of imposing energy saving obligations and allowing the trade of obligations (in which case the money will flow from the party 'selling' its obligation to the party 'buying' it) and/or of certified savings

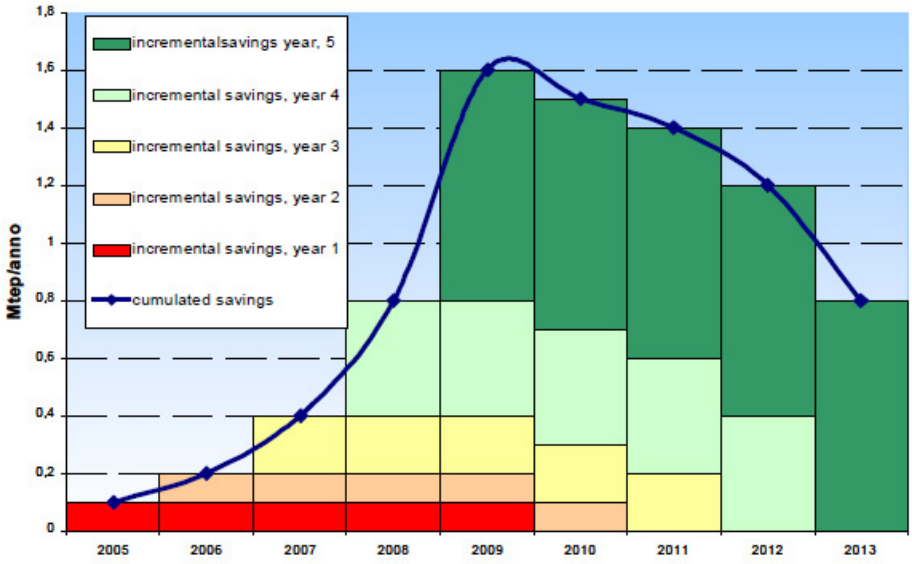
- Only savings certification that is applied to guarantee that a certain amount of energy savings has been achieved and can be used also for demonstrating eligibility, for e.g. tax relieves or subsidies or carbon offset programs

The Italian White Certificate System represents the first market mechanism experience to enhance efficiency in final energy uses. In Italy command-and-control measures (energy savings targets in primary energy consumption for electricity and gas grid distribution companies with more than 100,000 customers as of end of 2001) are combined with market instruments (tradable certificates for energy savings issued to distributors and energy service companies), as well as with elements of tariff regulation (a cost recovery mechanism via electricity and gas tariffs and multiple driver

tariff schemes to reduce the disincentives for regulated electricity and natural gas companies to promote end-use energy efficiency among their customers) or dedicated funds in some circumstances. Over the 5 years of the current phase of the scheme 3 million tons of oil equivalent (Mtoe) of cumulative primary energy savings are projected to be realised, of which 1.6 Mtoe by electricity distributors and 1.3 Mtoe by natural gas distributors.

The Italian white certificate scheme became operational in January 2005. Figure 4 below provides details on target formation and evolution of savings over the 5 years of the current phase. At least half of the target set for each single year is to be achieved via a reduction of electricity and gas end-use consumption (referred to as the "50% constraint" to which each distributor is subject). The remaining share can be achieved via primary energy savings in all the other end-use sectors. Energy savings projects contribute to the achievement of targets for up to five years.

**Figure 4: Electricity Sector Energy Savings Target, Italy**




Some of the key features of the White Certificate Scheme that is operational in Italy have been summarized below.

***a) Definition of target***

The target has been set for the first 5 years (2005-09) and increases with time. There is a specific energy efficiency target on electricity and a specific one on natural gas final uses.

The target is set in Mtoe. The conversion factor chosen for electricity efficiency measures is 1kWh = 0.22*10^-3 toe. Table 1 provides the energy efficiency targets set in the electricity sector.

**Table 1: Energy efficiency target in the electricity sector, Italy**

| | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|
| Mtoe target electricity | 0.1 | 0.2 | 0.4 | 0.8 | 1.6 |
| GWh target electricity | 455 | 909 | 1818 | 3636 | 7273 |
| Gross national electricity consumption | 332100 | 337800 | 342867 | 348010 | 353230 |
| Energy efficiency percentage | 0.1% | 0.3% | 0.5% | 1.0% | 2.1% |

***b) Identification of players***

- The obligated entities under this system are electricity distribution companies and natural gas companies.

- In the current period, the players under the obligation are companies with at least 100,000 final customers.

***c) Meeting the target***

The target may be achieved by-

- Directly by the distribution companies through the realization of energy efficiency projects and measures, and/or

- Through projects/measures implemented by private energy service companies (ESCOs)

Each energy efficiency project/measure is assigned a number of white certificates proving the energy savings.

The electricity and gas authority assigns and evaluates the certificates. Each white certificate indicates the achievement of energy efficiency projects able to save 1toe.

A distribution company may choose either to directly put in place energy efficiency projects or to buy from third parties (other distribution companies or ESCOs) white certificates corresponding to all or part of its quota obligation.

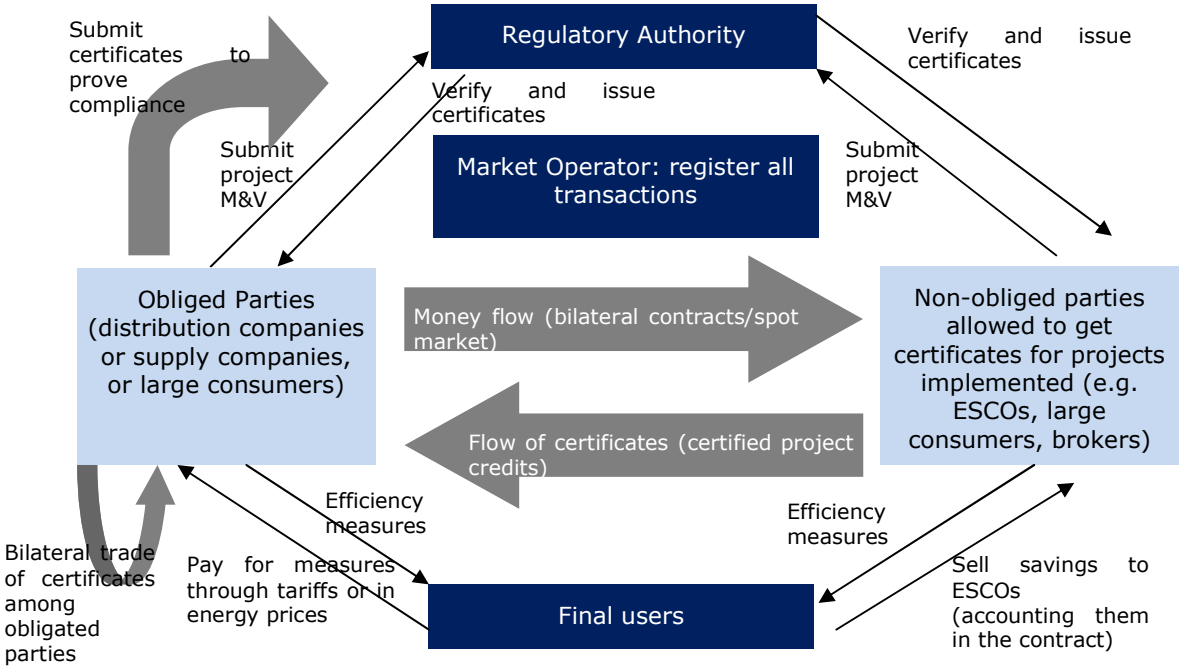
Constraint – at least 50% of the projects and measures need to be achieved in the same energy sector that the company operates.

### *d) Exchange of white certificates*

The white certificate can be exchanged on the market or by bilateral contracts.

A department within the electricity market operator has been opened that is dedicated to the sale of white certificates.

**Figure 5: Illustration of the operation of the white certificate system in Italy**




### *e) Energy efficiency projects and evaluation of savings*

White certificates are issues for the following types of projects:

i. for energy efficiency measures realised in the electricity sector

ii. for energy efficiency measures realised in the natural gas sector

iii. for energy efficiency measures realised in other energy sector (oil, coal, etc)

The Electricity Authority calculates and redeems the white certificates. The number of certificates issued depends on the evaluation of the amount of energy savings achieved. To evaluate energy efficiency achieved by projects, the Authority has classified energy efficiency projects into three main categories:

i. standard evaluation (ex-ante evaluation)

ii. analytic evaluation

iii. measured evaluation (ex-post)

There is a minimum size limit for the project to be approved. The limit is set at least at 25toe for standardised methodology projects, 100toe for analytic evaluation and 200toe for ex-post measured evaluation. Smaller projects can be put together into a larger one to qualify for the minimum size.

***f) Duration of white certificates and bankability***

Each project realised is granted white certificates for 5 years. White certificates are bankable and expire after 5 years, i.e. an unsold white certificate issued in 2005 can be used to fulfil the obligation up to 2009.

Table 2 provides a summary of the SWH development models across the four identified countries.

**Table 2: Summary of SWH experience in South Africa, Brazil, Italy and Australia**

| Countries | SWH Installation – Global Ranking | Existence of Energy Service Companies | SWH ESCO models | Regulatory and Policy Framework | Incentives for SWH Projects | Market based Mechanisms (REC /ESC) | Other Interesting Features |
|---|---|---|---|---|---|---|---|
| South Africa | 13th | √ | Operation of SWH specific ESCO model | National SWH Strategy<br><br>Target for SWH installations = 1mn systems by 2014; 4mn systems by 2020 | Tax rebate | - | City of Cape Town has committed to ensuring that 10% of households have SWH systems by 2010. |
| Brazil | 6th | √ | No specific SWH ESCOs operating | Plan for SWH installations for 1,00,000 new low income homes | Capital subsidy | - | Established SPE Project Financing Model |
| Australia | 11th | √ | No specific SWH ESCOs operating | National Strategy for Energy Efficiency<br><br>Target for SWH installations | Rebates, special grants, RECs | RECs | SWH mechanisms - Central govt monitored and State driven |
| Italy | 12th | √ | No specific SWH ESCOs operating | National Energy Efficiency Policy<br><br>Target for SWH installations (2.9 MTOE) | Capital Subsidy (30%) | ESCs/ White Certificates | TWC's linkage with EU ETS under draft condition |

# IV. OVERVIEW OF THE SOLAR WATER HEATING SECTOR IN INDIA

## 1. POTENTIAL AND ACHIEVEMENT OF SWHS

The gross potential for SWHS in India has been estimated to be 140 million sq. m. of collector area. Of this 40 million sq.m. has been estimated as the realizable techno-economic potential at this stage. A total of 3.53 million sq. m. of collector area has so far been installed in the country for solar water heating, of which about 1.55 million sq. m. has been installed since 2005-06. The achievement so far has been modest compared to the overall potential. However, a reasonable infrastructure has emerged and experience is available for manufacture and installation for SWHS. A target of 5 million sq. m. has been set for the 11th Plan (2007-12) and a goal of 20 million sq. m for 2020. Recently the National Solar Mission has been announced, and as per the mission, the deployment of SWHS has been divided into three phases. Target of 7 million sq. m. has been set for phase I i.e. FY 2010-13, 15 million sq. m. for phase II i.e. FY 2013-17 and 20 million sq. m. for phase III covering period FY 2017-22. The year wise achievement of SWHS has been shown below:

**Table 3: Year-wise achievement of SWHS**

| Year | Achievements (in sq. Mtr. of collector area) |
|---|---|
| Upto 2002-03 | 6,50,000 |
| 2002-03 | 1,00,000 |
| 2003-04 | 1,50,000 |
| 2004-05 | 2,00,000 |
| 2005-06 | 4,00,000 |
| 2006-07 | 4,00,000 |
| 2007-08 | 4,50,000 |
| 2008-09 | 5,60,000 |
| 2009-10 | 6,20,000 |
| Total | 35,30,000 |

Source: Ministry of New and Renewable Energy, Government of India

# 2. BENEFITS OF INSTALLATION OF SOLAR WATER HEATING SYSTEMS

Solar water heating systems can easily heat water to temperature of 60-80° C. A 100 litres capacity SWHS can replace an electric geyser of 2 KW capacity for residential use and may save upto 1500 units of electricity annually depending upon the location of the SWHS. The result of Market Assessment Survey carried out by 'Greentech Solutions' brings out diversity in requirement of hot water across different parts of the country. **While in some parts of the country where hot water requirement is for 9 months or more, the SWHS may save about 1400-1500 units of electricity, the systems in other parts such as Rajasthan/ Delhi may save only 600-800 units per annum**. Typically, SWHS of 100-300 litres capacity are suitable for domestic applications. The use of 1000 SWHS of 100 litres capacity each can contribute to a peak load shaving of approximately 1 MW while one SWHS of 100 litres capacity can prevent emission of up to 1.5 tons of CO2 per year.

The following table provides the number of months for which electrical geysers are used by domestic category consumers in the urban centres where the Market assessment study was carried out by Greentech Knowledge Solutions for MNRE in 2009.

**Table 4: Hot water demand in different districts**

| District | Hot water demand for bathing in households (months/year) |
|---|---|
| Shimla | 9 |
| Gurgaon | 4-5 |
| Agra | 4-5 |
| Ludhiana | 4-5 |
| Delhi | 4-5 |
| Haridwar | 4-5 |
| Coimbatore | 8 |
| Bangalore | 9 |
| Chennai | 8 |
| Pondicherry | 9 |
| Hyderabad | 9 |
| Kochi | 8 |
| Thane | 8 |
| Ahmedabad | 4-5 |
| Indore | 5-6 |
| Jaipur | 4-5 |
| Nagpur | 5-6 |
| Pune | 8 |
| Patna | 4-5 |
| Ranchi | 5-6 |
| Bhubaneshwar | 5-6 |
| Sambalpur | 5-6 |
| Raipur | 4-5 |
| Guwahati | 9 |
| Darjeeling | 7 |
| Kolkata | 6 |
| Shilong | 9 |
| Agartala | 4-5 |

Source: Greentech Knowledge Solutions, January 2010

# 3. COST OF SOLAR WATER HEATING SYSTEMS

The cost of solar water heater consists of cost of collector, tank and brackets for supporting Piping etc. As per MNRE upper limit of cost of solar water heating system (both Evacuated Tube Collectors and Flat Plate Collectors) with 5 years warranty is as provided below:

**Table 5: Cost of different capacities of ETC based SWHS**

| System Capacity in LPD | ETC based system (in Rs.) | |
|---|---|---|
| | No. of tubes (min) | Upper cost Limit |
| 50 | 7 | 7125 |
| 75 | 11 | 10875 |
| 100 | 14 | 13500 |
| 200 | 28 | 26250 |
| 250 | 34 | 31875 |
| 300 | 40 | 37500 |
| 400 | 52 | 48750 |
| 500 | 64 | 60000 |
| 600 to 2000 LPD | 12 tubes per 100 LPD | Rs 905 per tube |
| 2100 and above | 12 tubes per 100 LPD | Rs 750 per tube |

Source: Ministry of New and Renewable Energy, Government of India

**Table 6: Cost of different capacities of FPC based SWHS**

| System Capacity in LPD | FPC based system (in Rs.) Rate contract amount with 5 years CMC in Rs. per no. | |
|---|---|---|
| | Soft Water | Hard Water |
| 125 | 24411 | 25564 |
| 250 | 41275 | 42835 |
| 375 | 57574 | 59841 |
| 500 | 87185 | 89339 |
| 1000 | 161642 | 163160 |
| 1500 | 236607 | 244740 |
| 2000 | 308020 | 326320 |
| 2500 | 379433 | 407900 |
| 3000 | 451580 | 489480 |

Source: Ministry of New and Renewable Energy, Government of India

Mercados has used these costs while developing the ESCO financial models.

# 4. PROMOTIONAL SCHEMES FOR DEVELOPMENT OF SOLAR WATER HEATING SYSTEMS

Several schemes for promotion of solar water heaters have been operation in country. While most of these schemes were developed and coordinated by MNRE, some schemes were developed at the State level. These schemes have been briefly described below.

## 4.1. FINANCIAL ASSISTANCE THROUGH INTEREST RATE / CAPITAL SUBSIDY

In mid-nineties, Ministry of Non-Conventional Energy Sources, predecessor of MNRE established a programme for promotion of solar water heating systems. Since then MNRE has been refining promotional schemes for SWHS. As a part of its scheme, MNRE provides soft loans to the users under the interest subsidy scheme through a network of financial institutions, public/private sector banks, scheduled co-operative banks, RBI approved non-banking financing companies. Indian Renewable Energy Development Agency (IREDA) operates as a Nodal Agency for the scheme. Interest subsidy is provided to the consumers through various financial intermediaries so that effective interest rate works out to 2% for domestic users, 3% for institutional users and 5% for industrial/commercial users. Interest free loans are available to domestic users in the North-Eastern States, Sikkim, Himachal Pradesh, Islands, J&K, Uttarakhand, Chattisgarh and Jharkhand. Overall fund management has been entrusted to IREDA. The banks/FIs are required to provide loans at prescribed rates to beneficiaries and claim interest subsidy (difference between the lending rate of banks/FIs and MNRE prescribed interest rates) from IREDA. As on date, 31 banks and financial institutions are participating in the scheme through their branch network in different parts of the country. In addition, capital subsidy is available to builders & developers/ development authorities/ housing boards/ cooperatives/ Group Housing Societies for providing solar water heating systems in new buildings and housing/ commercial/institutional complexes. The Capital Subsidy is operated by MNRE through State Nodal Agencies.

## 4.2. BUILDING BYE-LAWS AMENDMENT TO MANDATE SWHS INSTALLATION

In a separate initiative, a model regulation / building bye-law for mandatory installation of SWHS in new buildings was circulated by the Ministry of Urban Development to all States and Union Territories with a request for onward circulation to all local bodies for incorporation in their building bye-laws. Necessary orders have been issued in 19 States and 41 Municipal Corporations/Municipalities have so far amended their building bye-laws. A few municipal corporations such as Thane, Amravati, Nagpur and Durgapur are providing 6-10% rebate in the property tax for users of solar water heaters.

## 4.3. UTILITY REBATES FOR SWHS INSTALLATIONS

Rebate in Utility bills is a simple way of providing incentive for installation of SWHS. Utilities are being encouraged to provide rebates in electricity tariff to SWHS users. The Utilities in Haryana, Rajasthan, West Bengal, Assam, Haryana, Uttarakhand and Karnataka are already providing monthly rebates in electricity tariff for domestic systems.

### 4.4. STANDARDISATION OF SOLAR COLLECTORS

BIS standards have been established for flat plate solar collectors along with appropriate test facilities. ETC based systems are also being promoted, though the tubes used in them are being imported at present. There are 63 BIS approved manufacturers of SWHS of flat plate collectors and 71 MNRE approved suppliers of evacuated tube collector based systems. They are eligible to supply solar water heating systems under the interest subsidy scheme.

### 4.5. INCLUSION OF SOLAR ENERGY IN ECBC

The Energy Conservation Act 2001 authorises the Bureau of Energy Efficiency (BEE) to prescribe guidelines for Energy Conservation Buildings Code (ECBC). BEE has developed ECBC, which sets minimum energy efficiency standard for design and construction. ECBC is expected to impact and promote market development of various energy efficient products such as solar water heaters. SWHS are included among the building components covered under ECBC. SWHS are required to meet at least 20% of the design capacity for water heating.

## 5. NATIONAL SOLAR MISSION

The National Solar Mission is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge. It will also constitute a major contribution by India to the global effort to meet the challenges of climate change. This Mission is one of the eight key National Missions, which comprise India's National Action Plan on Climate Change (NAPCC). The objective of the National Solar Mission is to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible. The Mission includes major programme titled 'The Below $80^0$C Challenge – Solar Collectors' for Solar Thermal Technology. Key provisions of the National Solar Mission in this regard are provided below.

***The below 80°C challenge – solar collectors***

*The Mission in its first two phases will promote solar heating systems, which are already using proven technology and are commercially viable. The Mission is setting an ambitious target for ensuring that applications, domestic and industrial, below 80 °C are solarised. The key strategy of the Mission will be to make necessary policy changes to meet this objective:*

- *Firstly, make solar heaters mandatory, through building byelaws and incorporation in the National Building Code,*
- *Secondly, ensure the introduction of effective mechanisms for certification and rating of manufacturers of solar thermal applications,*
- *Thirdly, facilitate measurement and promotion of these individual devices through local agencies and power utilities, and*

- *Fourthly, support the upgrading of technologies and manufacturing capacities through soft loans, to achieve higher efficiencies and further cost reduction."*

**Targets under the Mission**

National Solar Mission has outlined targets for solar generated power for grid connected as well as the distributed and decentralized off-grid commercial energy services. These have been summarized in the table below.

**Table 7: NSM Targets**

| S.No. | Application Segment | Target | | |
|---|---|---|---|---|
| | | Phase-1 (2010-13) | Phase-2 (2013-17) | Phase-3 (2017-22) |
| 1. | **Solar thermal collectors** | **7 million sq. mtrs** | **15 million sq. mtrs** | **20 million sq. mtrs** |
| 2. | Off grid solar applications | 200MW | 1000MW | 2000MW |
| 3. | Grid power, including roof top and small plants | 1,100MW | 4000-10,000MW | 20000MW |

In order to give practical shape to the vision and objectives outlined in the NSM, two sets of guidelines were announced by MNRE on June 16, 2010. These are **Guidelines for**, (i) **Off-grid and Decentralized solar applications** and (ii) Rooftop and other small solar power plants.

The scope of the guidelines for off-grid and decentralized solar applications includes off-grid solar photovoltaic systems/applications up to a maximum capacity of 100kWp per site and off-grid and **decentralized solar thermal applications**, to meet/supplement lighting, electricity/power, **heating** and cooling **energy requirements**, and, mini-grids for rural electrification up to a maximum capacity of 250kW per site. The objectives of the guidelines for off-grid and decentralized solar applications are:

- **To promote off-grid applications of solar energy (both solar PV and solar thermal) for meeting the targets set in the JNNSM for Phase-1**
- To create awareness and demonstrate effective and innovative use of solar systems for individual/community/institutional/industrial applications
- To encourage innovation in addressing market needs and **promoting sustainable business models**
- **To provide support to channel partners and potential beneficiaries, within the framework of boundary conditions and in a flexible demand driven mode**

- To create a paradigm shift needed for commoditization of off-grid decentralized solar applications

- To support consultancy services, seminars, symposia, capacity building, awareness campaigns, human resource development, etc

- To encourage replacement of kerosene and diesel, wherever possible

Some of the interesting features of these guidelines are summarized below:

- Channel partners would be used for implementation of the scheme and will include-
    - **Renewable Energy Service providing Companies (RESCOs)**
    - Financial Institutions including microfinance institutions acting as Aggregators
    - Financial Integrators
    - System Integrators
    - Programme Administrators

- The **Programme Administrators** would include Central and State Government Ministries and Departments and their organizations, State Nodal Agencies, Utilities, Local bodies, PSUs and reputed Non-Governmental Organizations. These entities **would directly implement the scheme and access capital subsidy from MNRE**

- Funding under the scheme would be in Project mode

- MNRE will provide financial support through a **combination of 30% subsidy and 5% interest bearing loans**. For funding solar thermal systems in special category states, the subsidy would be limited to 60% for all categories of beneficiaries.

- There will be provision for **channel partners operating in the market mode to access a combination of capital subsidy and a low cost interest for the end-consumer, provided they can tie-up with a lending institution**. These lending institutions could then enter into an agreement for refinance/interest subvention with IREDA.

The provisions of the off-grid solar guidelines provide a channel for mainstreaming the ESCOs as important players in the implementation of the off-grid program under the NSM. The provisions of these guidelines will be dovetailed with the implementation guidelines for the area based ESCO program in order to harmonize some of the common features of the two schemes.

# 6. NATIONAL MISSION ON ENHANCED ENERGY EFFICIENCY

The draft outline of the National Mission on Enhanced Energy Efficiency (NMEEE) was endorsed by the Steering Committee of Ministry of Power in September 2008 and submitted to the Prime Minister's Office (PMO). After a detailed discussion of stakeholders on the draft outline of the NMEEE, an implementation plan for the Mission was incorporated in December 2008. This section summarizes the key provisions of the NMEEE in the light of its relevance to SWH.

The NMEEE contains four new initiatives to enhance energy efficiency, in addition to the existing programs on energy efficiency being pursued by MOP and BEE:

i. A market based mechanism to enhance cost effectiveness of improvements in energy efficiency in energy intensive large industries and facilities, through certification of energy savings that could be traded. (**Perform Achieve and Trade (PAT)**)

ii. Accelerating the shift to energy efficient appliances in designated sectors through innovative measures to make the products more affordable (**Market Transformation for Energy Efficiency (MTEE)**)

iii. Creation of mechanisms that would help finance demand side management programs in all sectors by capturing future energy savings (**Energy Efficiency Financing Platform (EEFP)**)

iv. Developing fiscal instruments to promote energy efficiency – **Framework for Energy Efficient Economic Development (FEEED)**

NMEEE sets out a comprehensive strategy that **aims at promoting ESCOs,** preparing structured programs to leverage international financing instruments including the Clean Development Mechanism (CDM), **promotion of energy efficiency financing platform, setting up of partial risk guarantee funds** and adoption of **robust and credible monitoring and verification protocols** to capture energy savings from all energy efficiency activities in a transparent manner.

All these four programs are important in the context of SWH from an energy efficiency and DSM perspective. For instance, the PAT scheme is a market based mechanism to enhance cost effectiveness of improvements in energy efficiency in energy-intensive large industries and facilities through certification of energy savings that could be traded. The Government in March 2007 notified 9 energy intensive industrial sectors as Designated Consumers (DCs) under this scheme. This included – Aluminium, Cement, Chlor-Alkali, Pulp & Paper, Fertilizers, Power Generation Plant, Steel, Railways and Textiles. The PAT mechanism would provide energy efficiency improvement targets (specific energy consumption, SEC norm) for each industrial unit of the DC and this target would need to be achieved over a 3-year period. This target could be achieved by the DCs through an energy efficiency or DSM measure that it undertakes. **Hence, for a DC such as the textile units, it could use SWH systems to meet their process heat requirement which would help them achieve their SEC target.**

BEE has initiated an 'Energy Efficiency Financing Platform' for promoting financing of EE projects. This program seeks to encourage banks and FIs willing to take up ESCO based projects by enabling the following risk mitigation measures:

- Capacity building and awareness of the personnel in banks and FIs on performance contracting issues

- Aggregation of energy efficiency projects as a result of BEE schemes in different sectors

- Experience sharing and dissemination of national and international best practices in the field of energy efficiency financing

The framework for energy efficient economic development envisages design of fiscal instruments to address the following key issues:

- Provision of comfort to lenders by provision of a risk guarantee for performance contract, and

- Provision of a venture capital fund from the Government to provide equity for energy efficiency projects

The partial guarantee is a risk-sharing mechanism that will provide commercial banks with partial coverage of risk exposure against loans made for energy efficiency projects to mitigate the risk perception associated with the lending for new technologies and new business models associated with energy efficiency projects.

**Schemes such as PAT and the partial risk guarantee fund will have a significant role to play in promotion of SWH ESCOs.**

# V. NEED FOR AREA BASED ENERGY SERVICE COMPANY MODEL FOR SOLAR WATER HEATING

In the recent years, India has witnessed considerable progress SWH development. A total of 3.53 million sq. m. of SWH collector area has so far been installed in the country, of which about 1.55 million sq. m. has been installed since 2005-06. Several initiatives taken in the last few years have resulted in acceleration in the pace of development. These measures include capital and interest subsidies, promotion of local manufacturing, and other measures. These have resulted in a virtuous development cycle.

However, in-spite of the progress, a large proportion of the potential remains under-achieved. The gross potential for SWH systems in India has been estimated at 140 million sq. m. of collector area. Out of this, **40 million sq. m. has been estimated as the realizable techno-economic potential at this stage**. A target of 7 million sq. m. has been set by the Jawaharlal Nehru National Solar Mission by the end of the first phase of the Mission (2010-13) and a goal of 20 million sq. m by the end of the third phase of the Mission (2017-22). MNRE has been at the forefront of devising promotional measures for greater offtake of SWH. However, in order to achieve scalability in these measures and to achieve the objectives of SWH penetration in the mission period and beyond, there is a need to extend the existing schemes and design innovative service delivery mechanisms to leverage SWH investments.

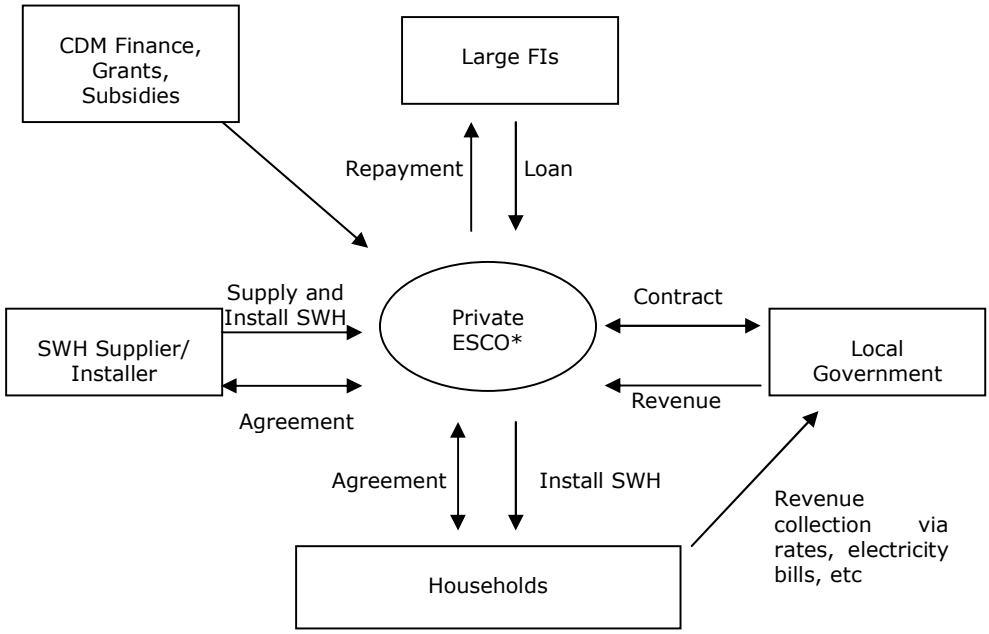
Certain key barriers that hold back large scale deployment need to be specifically addressed. **Lack of affordability, inadequate access to finance, and weak channels are among the key barriers affecting deployment**. One of the ways in which all these barriers can be addressed together is through an innovative service delivery mode, internationally known as the ***Fee-for-Service model***. The idea behind this mechanism is that people buy a service, in this case hot water, from an **energy services company (ESCO)**, rather than energy to perform the service (e.g. purchasing electricity so it can be used to heat water). The ESCO buys and installs the solar water heater(s) at their own cost. They retain ownership. They can then sell the hot water to the owner / business in the following ways, (i) metering the hot water / volume, (ii) a lease or hire/purchase agreement over a fixed period for the SWH equipment, (iii) a fixed monthly tariff - which is ideally comparable to the monthly electricity saving from a solar water heater.

Emerging markets for international trade in GHG reduction credits offer important opportunities to overcome barriers and help advance SWH technology. For developing nations, the Kyoto Protocol's Clean Development Mechanism (CDM) provides the opportunity for carbon trading to support environmental protection and economic development. Emission reduction revenue can help to surmount a multitude of barriers for SWH technology. Foremost, carbon finance can help to increase system affordability to end-users and enhance the viability of SWH projects and businesses. Financial arrangements that address constraints on SWH affordability, such as third-party financing and fee-for-service operations, could gain substantially by leveraging underlying and additional finance where project participants establish emission reduction purchase agreements with creditworthy CER buyers.

Carbon trading can also help to overcome institutional, technical and other barriers to the development of SWH markets. In this context, SWH projects could potentially use carbon reduction revenue for market development, training, awareness raising and other activities to overcome barriers that constrain broader SWH dissemination, such as the establishment and enforcement of

quality standards. SWH systems can also be eligible for market based mechanisms such as renewable energy certificates and/or energy saving/white certificates. There are various examples of countries that are successfully operating such mechanisms. Such mechanisms alleviate the cost burden of these systems by providing an additional stream of revenue to the energy service company/utility/user depending on the obligated entity. The figure below provides a simplified illustration of an Energy Service Company based Solar Water Heating Model existing internationally.

**Figure 6: Simplified Institutional Framework of ESCO based SWH Model**




Note: *The ESCO could be a private firm contracted by city, or a city owned SWH utility

This mechanism is attractive because the hot water user (house/ hospital etc) bears no capital costs and does not have to worry about the maintenance of the system. Although in the long run users will pay more than if they bought and installed a system themselves, this mechanism works well as it avoids prohibitive capital costs and is relatively 'hassle free' (no maintenance, repair, responsibility etc). This provides a useful mechanism for cities to consider implementing within their own facilities (council housing schemes, public facilities, large buildings, etc). Within the residential or commercial sector, cities could play a role in supporting fee for service mechanisms through administering and collecting the monthly tariff (service fee) on the ESCO's behalf, through their established rates collection process.

Some of the benefits of using an energy service company have been summarized below:

- **Technical capacity and capability**

    - Energy services are provided by an organisation or partnership of organisations for which the relevant activity is core business. This has a number of benefits including the availability of technical and commercial expertise, manpower and experience.

- With regard to operation and maintenance, routine activity such as cleaning and any system problems that arise can be dealt with quickly and efficiently, generally with little effort or involvement from customers.

- Customers have only one point of contact for bills, complaints and maintenance.

- **Performance risk management**

  - ESCOs have an incentive/commitment to reduce either energy costs or energy usage and this should be backed up with the resources to achieve these improvements. As a result the incentive is of value and therefore effective in increasing efficiency. Often internal energy managers have an objective to reduce costs but do not have the resources to do so; this can result in de-motivation and failure to consider major changes.

  - It is in an ESCO's interest to identify and document energy savings accurately. This benchmarking provides a level of understanding that helps guard against unexpected costs.

  - The upgrading of equipment must meet industry-wide measurement and verification protocols providing reassurance to customers.

- **Flexibility** – an ESCO may provide the opportunity to bundle projects thereby creating economies of scale and possibly enabling projects to be realized that otherwise would not have been viable.

- **Financing benefits**

  - An ESCO with experience and expertise, either by virtue of its balance sheet or its joint venture partners may be able to access finance more easily than the client organisation.

  - Legal and financial processes and costs may be improved by working with an organisation that has previous experience and established processes and documentation in place.

**Therefore, such a model assumes priority in the context of achieving scale in SWH development in the country**. The overall objective of the 'Global Solar Water Heating Market Transformation and Strengthening Initiative' is *to accelerate and sustain the SWH market growth in India and to use the experiences and lessons learnt in promoting similar growth in other countries*. **The outcome of developing an ESCO-based service delivery model will clearly integrate the outcomes of the Global Assignment.**

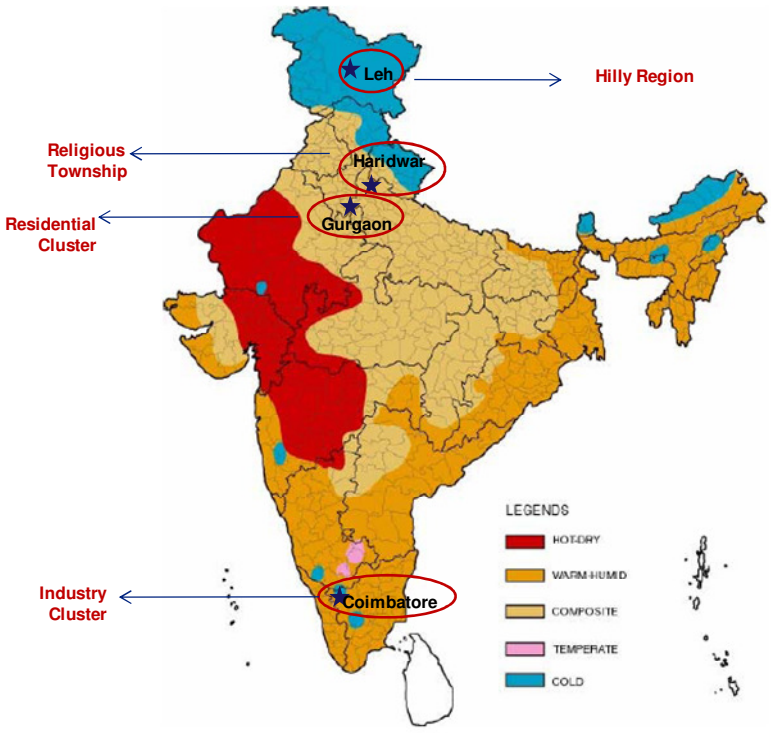
# VI. SELECTION OF AREA, DEMAND SEGMENTS AND MARKET ASSESSMENT

## 1. SELECTION OF AREA AND MAPPING OF REGIONS

Given the current status of SWH development in the country, as discussed in the earlier chapters, an area based ESCO model has significant scope of scaling further development. However, before developing such a model it is essential to assess the market potential for the ESCO model across various demand segments. In our assignment, four types of demand segments have been identified for carrying out the market assessment. The first task was to select the different areas/clusters within each of these demand segments.

The four regions that have been selected for the purpose of the market assessment are illustrated in the figure below, which have been mapped in the Climatic Zone Map provided in the ECBC (energy conservation building code) issued by the BEE (bureau of energy efficiency). These regions have been finalized in discussion with MNRE.

**Figure 7: Selection of regions**




The key climatic features of these four regions have been summarized in the table below.

**Table 8: Key climatic features of the selected regions**

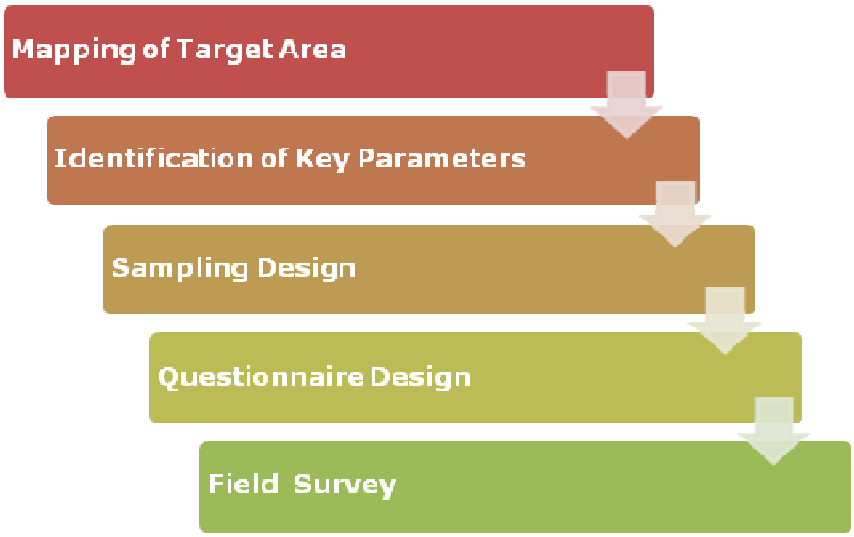
| Selected Regions | Type of Cluster | Features |
|---|---|---|
| **Leh, Jammu & Kashmir** | Remote or Hilly area | • Leh falls under cold climate, receives a solar radiation of about 5.4 kWh/m2/day.<br>• The potential for SWH is good and has been estimated at about 9.4 lakhs lpd.<br>• Almost 40% of the total potential falls under the residential sector, hotels/guest houses have 35% share in the overall potential. |
| **Gurgaon, NCR** | Residential cluster | • Gurgaon falls under composite climate and receives good solar radiation (5.5 kWh/m2/day).<br>• Hot water in the residential sector is required for 4-5 months in a year.<br>• The construction of houses is a mix of independent bungalows and apartments |
| **Haridwar/Rishikesh, Uttarakhand** | Religious township/tourist centre | • Haridwar falls under composite climate and receives good solar radiation (5.4 kWh/m2/day).<br>• Hot water is required for a period of upto 5 months in a year.<br>• Hot water demand is mainly from the residential sector and hotels. |
| **Coimbatore, Tamil Nadu** | Industrial cluster | • Coimbatore falls under warm humid climate and receives good solar radiation (5.6 kWh/m2/day).<br>• Industrial segment (mainly textile) may offer good potential |

After identification of the regions that were to be studied for developing the ESCO model, the next task was to undertake a market assessment to assess the demand for hot water and the willingness of end-users to purchase hot water from a service company. The outcomes of the market assessment that was carried out in the four regions have been provided in the subsequent section.

# 2. OUTCOMES OF MARKET ASSESSMENT

Studying the market's needs and how it is currently serviced, provides with key information that is essential in developing a product/service and its marketing plan. Demand for a particular product/ service differs across different demand segment and depends on the characteristics of the end user. A detailed market assessment was undertaken in the identified four regions assessing the segment-wise (domestic, institutional, commercial, industrial) demand for hot water and the willingness to pay an ESCO for the hot water service. The approach and methodology followed for conducting the market assessment has been presented in the figure below.

**Figure 8: Approach and methodology for conducting market assessment**




Some of the key parameters that were assessed across segments include:

- **Hot water demand** - House hold and commercial demand for hot water vary significantly in summers and winters. Efforts were made to understand the demand trends among various sectors in the identified demand segment.

- **Fuel/energy source and technology used and related cost implications** - Fuel/ energy source and technology used for heating water vary across different sectors and demand segments. Efforts were made to understand the present system in place for heating water and the associated cost propositions.

- **Willingness to convert to SWH at different price levels** - Willingness to convert to SWH largely depends on the consumption pattern, fuel/energy source, technology used and related cost implications across different demand segments. The study has captured willingness to convert to SWH at various price points.

- **Willingness to avail hot water supply services through an ESCO** – the concept of a service company providing hot water is relatively new among certain categories of users and the survey attempted to capture the willingness of users to avail such a service.

- **Quality of hot water used for different process/functions** - Quality of hot water required varies across different sectors and demand segments. The study has adequately captured the use of hot water by different demand segments for various processes/ functions.

- **Importance of hot water across demand segments** - Significance of hot water also varies across different sectors, demand segments depending on the process and application of hot water

- **Availability and willingness to spare space for installing SWH systems** - The study also focused on assessing availability of space and willingness to spare necessary space required for installing SWH systems.

The market assessment provided interesting insights into the willingness of consumers to switch to SWH systems and avail hot water services from an ESCO. The predominant demand segments that expressed a keen desire to switch over to solar water heating and avail the services of an ESCO are the domestic households, hotels and hospitals. The detailed steps followed in the market assessment including the sampling design and questionnaire design have been provided in Annex 1 and 2. This section of the chapter summarizes some of the key highlights of the market assessment outcomes in the four regions.

## *2.1. RESIDENTIAL CLUSTER – GURGAON*

In Gurgaon, a mix of households (row/independent households and high rise apartments), hotels, hospitals, Resident Welfare Associations and builders were surveyed. The results of the survey in each of these demand segments in Gurgaon have been briefly summarized below.

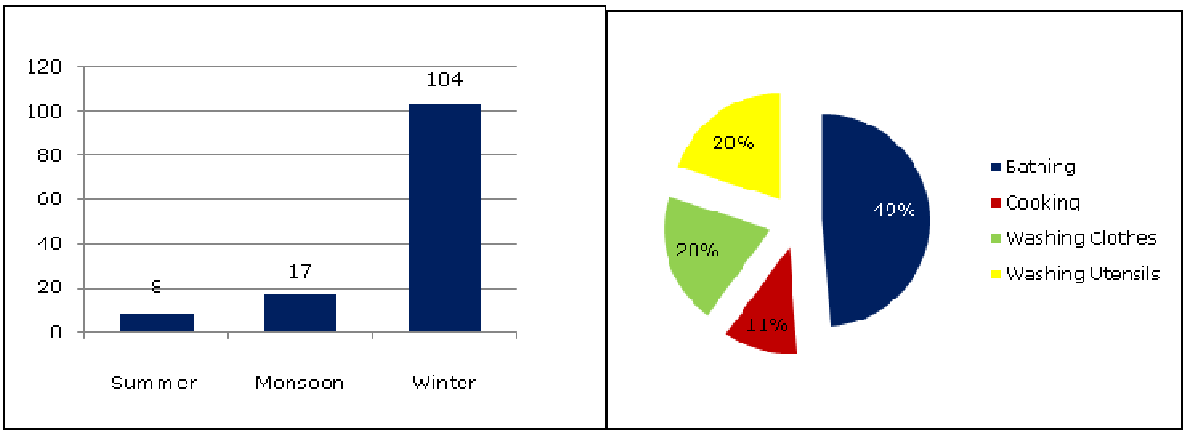
### 2.1.1. HOUSEHOLDS

**Hot water demand and usage pattern**

The results demonstrate a significant seasonal shift in hot water requirement i.e. on an average a household requires 100 LPD of hot water in winters whereas the requirement in summers and monsoon is merely 8 LPD and 17 LPD of hot water respectively. Based on the demand pattern drawn out of 100 representative households, urban population of Gurgaon requires almost 90 lakh LPD of hot water in winters. Out of the 100 sample residential units, none is using solar water heating system at present, clearly indicating a significant untapped potential for SWH in this sector.

Hundred percent of the households surveyed use hot water predominantly for bathing. The demand and usage of hot water in the households surveyed in Gurgaon have been illustrated in figure 9.

**Figure 9: Demand for and usage of hot water in Gurgaon households**




**Average Hot Water Requirement (in lpd/HH)**

**Usage of hot water**

**Fuel/energy used for heating water**

In Gurgaon, currently, electricity is the only major source for heating water. More than 80 percent households use electric appliances for heating water; these appliances majorly include geysers and immersion rods. Around 17 percent households use LPG for heating water. Availability of electricity is a major problem in the area, except for apartments with 24 hours power backup.

Most of the high rise apartments have provision for installing solar water heaters; a particular area on the terrace has been allocated for each household for installing solar water heaters.

Taking into account the poor power supply, high electricity bill, criticality of hot water and availability of space, SWH systems will have a potential market in this area.

**Willingness to switch**

There is significant ambiguity and uncertainty regarding SWH systems among the households that were surveyed. However, 95 percent of the sample households are willing to switch to SWH, given the fact that the system will be installed and operated by a third party. Out of this 95 percent, only 88 percent households are willing to pay for hot water services. The willingness to pay for hot water mainly ranges between Rs.0.25 - 0.50 per litre.

### 2.1.2. HOTELS

**Hot water demand and usage pattern**

Usage of hot water is extremely critical for the hotel industry. In the hotels surveyed, hot water consumption including steam ranges from 1,500 LPD to 35,000 LPD depending on the size and processes. Maximum amount of hot water is required for bathing and laundry (including steam). Apart from these, hot water is also required in kitchen and for washing utensils, however to a large extent utensils are washed in dishwashers.

**Fuel/energy used for heating water**

All the hotels surveyed have a centralized system for heating water. Most of these hotels have separate boilers for producing hot water and steam. Almost 80 percent of these hotels use boilers which are operated by High Speed Diesel (HSD). Only one hotel uses an LPG operated hot water boiler, since their consumption is only 1,500 LPD. The other big hotels are using SWH systems with capacity in the range of 5,000 - 10,000 LPD. Almost 20-25 percent of their hot water requirement is met through these systems.

**Willingness to switch**

Sixty percent of the respondents are highly satisfied with their current system for heating water and the remaining forty percent are adequately satisfied with their systems. However there is a unanimous willingness to switch over to SWH systems provided the ESCO is able to provide an uninterrupted supply of hot water as per requirement.

**Availability of space**

Availability of adequate space for installing SWH systems is a matter of concern, as none of the hotels covered under the assessment have adequate space for installing SWH systems which can completely fulfil their hot water requirement. However, for small hotels with limited hot water requirement the condition may be different. Apart from the terrace, there is no alternate space available with these hotels for installing SWH systems. This may be a major challenge for the ESCO.

### 2.1.3. HOSPITALS

**Hot water demand and usage pattern**

Usage of hot water is extremely important in the hospitals. In hospitals, hot water is majorly used for basic purpose like bathing, washing clothes and utensils, cleaning floor and washing equipments. Maximum amount of the hot water is used for bathing, washing utensils and equipments. For all major purposes like bathing, cooking, washing utensils and clothes, hot water ranging between 45$^{o}$C – 55$^{o}$C is used. In some hospitals boiling water is used for washing equipments. Steam is required only for steam sterilization of surgical and other equipments.

**Fuel/energy used for heating water**

All the hospitals surveyed have a centralized hot water supply system. Some of the hospitals have electric boilers/geysers for heating water, whereas others have boilers operated on HSD. Only one hospital surveyed is using a SWH system (capacity is approx 14,000 litre).

**Willingness to switch**

Sixty percent of the respondents are highly satisfied with their current system for heating water and the remaining forty percent are adequately satisfied with their systems. However, all of them are willing to switch-over to SWH system if competent private players enter the market with better quality of service.

**Availability of space**

Availability of adequate space for installing SWH systems is a matter of great concern, none of the hospitals covered under the assessment have adequate space for installing SWH systems which can completely fulfil their hot water requirement. Some respondents have expressed their willingness to spare 50 percent of their available terrace area for SWH.

Apart from households, hotels and hospitals, the market assessment in Gurgaon also covered resident welfare associations (RWAs) and builders with an objective to understand their current water heating system, fuel used and related cost implication. None of these associations have centralized system for hot water supply. Residents have made their own arrangements for hot water. From the discussion it was very evident that these societies have never ever thought about the possibility of installing a centralized hot water supply system. This clearly highlights the lack of knowledge at the RWA level and calls for significant efforts to educate RWA's towards this end. This can be a major focus area for ESCO, to develop market for its services.

## 2.2. *HILLY REGION – LEH*

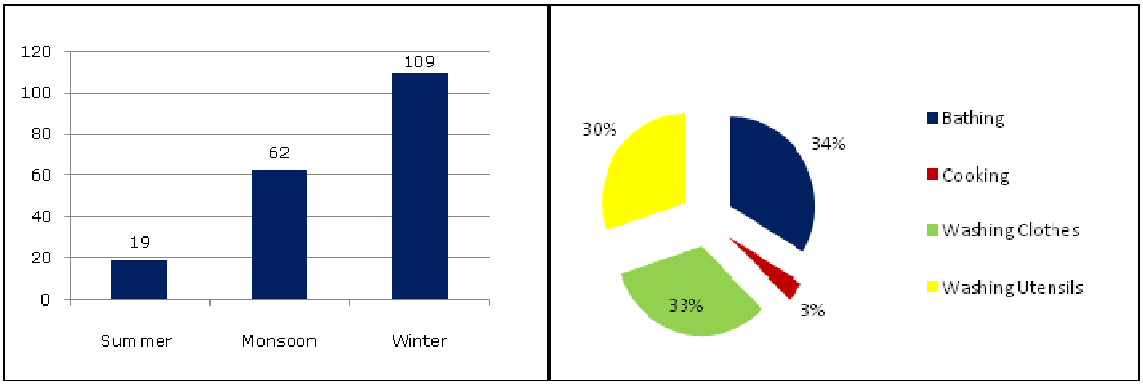
### 2.2.1. HOUSEHOLDS

**Hot water demand and usage**

According to the primary survey results, hot water usage is very critical for almost 89 percent households covered under the study. Looking at the extreme cold climatic condition in Leh, this may not seem realistic. However, local people in the area have adapted their lifestyle to those extreme conditions, thus hot water requirement for household purpose in Leh is more or less similar to the requirement of any other region. The results also demonstrate a significant seasonal shift in hot water requirement i.e. on an average a household requires 110 LPD of hot water in winters whereas the requirement in summers is merely 19 LPD.

Hot water is required for bathing, washing clothes, washing utensils and drinking hot water particularly during the winter season. The demand and usage of hot water in households surveyed in Leh has been illustrated in the figure below.

**Figure 10: Hot water demand and usage in Leh households**



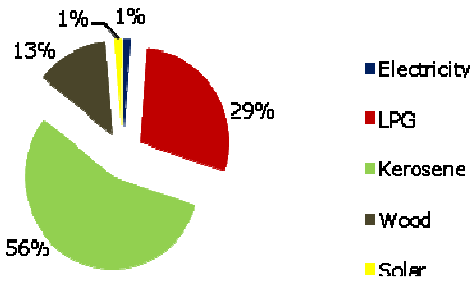

**Average Hot Water Requirement (in lpd/HH)**

**Usage of hot water**

According to the above figure every household needs hot water on a daily basis almost equally for bathing, washing clothes and washing utensils, however the frequency of bathing is low in winters as compared to other season. These figures also establish a strong demand for hot water in the area.

### Fuel/energy used for heating water

**Figure 11: Fuel used for heating water**




In the present scenario kerosene is the major fuel used for heating water. More than 50 percent households are using kerosene for heating water. Around 30 percent households use LPG for heating water. Some people also use locally collected fire wood for heating water for household consumption. Due to the geographic locations and climatic conditions, Leh is approachable by road only from mid April to mid October. Thus, all supplies for rest of the year need to be stocked during this period. This limited window of accessibility, however offers, a significant market for SWH systems in the region.

### Willingness to switch

Although the respondents do not expect SWH systems in the area to operate successfully, they are all willing to switch to such systems, provided that the system will be installed and operated by a third party. Hundred percent households are also willing to pay for hot water services. However willingness to pay for hot water service is largely around Rs.0.50 per litre.

### 2.2.2. HOTELS

**Demand and usage of hot water**

In Leh, 85% hotels operate from May to September with maximum tourist inflow during this period. In hotels and guest houses requirement of hot water is largely for bathing. Hot water consumption varies from 200 LPD to 5,000 LPD depending on the size of hotel/ guest house. Majority of hotels and guest houses are midsized i.e. 15-20 rooms.

Maximum amount of hot water is required for bathing. However at few places hot water is also required for washing utensils and washing clothes. There is not much deviation in usage pattern between hotels and guest houses.

**Fuel/energy used for heating water**

Most of the hotels in Leh have a centralised hot water supply system comprising of boilers for producing hot water. Fire wood is the major fuel in the area as there is restriction in use of electricity for heating water and availability of other fuel sources is limited in the area.

**Willingness to switch**

Seventy percent of the respondents are satisfied with their current system for heating water. However, despite this, hundred percent respondents have expressed their willingness to switch over to SWH systems, provided the ESCO brings in appropriate technology and supplies hot water as per requirement.

**Availability of space**

Availability of adequate space for installing SWH systems may not be a challenge. Sixty five percent of the respondents have expressed their willingness to spare enough space for installing SWH systems which can adequately fulfil their hot water requirement.

Apart from households, guest houses and hotels, as part of the market assessment exercise in Leh, the team met army representatives to understand their hot water requirement, existing mechanisms, challenges and willingness to switch to SWH systems. There is a strong willingness to switch to a service model based hot water supply arrangement, provided that the ESCO is able to provide hot water year-round, even during harsh winter conditions.

## *2.3. INDUSTRIAL CLUSTER – COIMBATORE/TIRUPUR*

Tirupur is a district in the state of Tamil Nadu. It is located around 50 km east of Coimbatore and about 495 km south-west of Chennai. Tirupur is one of the fastest developing districts in the state. Although Tirupur is a small town, it is the centre of Tamil Nadu's cotton knitwear industry and successfully markets its products in India and overseas. It is called the **Knits Capital of India** as it caters to famous brands and retailers from all over the world.

Tirupur is known for the cluster activity and each activity of garment making is being carried out by a different unit. Major units in and around Tirupur are Knitting Units, Dyeing and Bleaching Units, Fabric Printing, Garmenting, Embroidery, Finishing Units, Compacting and Calendaring and other ancillary units.

**Challenges in the area**

Even though the city is very prosperous, the infrastructure is very minimal. Availability of good quality water was a major problem for wet processing applications until a few years back. However, this has been taken care of by the "New Tirupur Area Development Corporation Ltd." a public-private partnership project for supplying good quality water from the river Bhavani which is around 55 km from Tirupur. Availability of electricity is still a major challenge and there is no LNG supply in the area which results in very high consumption of agri-wastes and fire wood for industrial purpose in the area. Supply of fire wood is also declining steadily in the area.

**Hot water demand**

**Dyeing and bleaching units are the major consumers of hot water/ steam in the area**. Some other units also require hot water; however their requirement is minimal as compared to the dyeing and bleaching units. In Tirupur and adjoining areas, more than 700 such units are operational with their installed capacity ranging from 1 ton per day to 50 ton per day (TPD). Majority of these units falls in the capacity range of 3 - 5 TPD.

In the dyeing and bleaching industry, requirement of hot water/ steam varies significantly depending on the type/ quality of dye. The following table demonstrates the processes where hot water is required for dyeing knitted fabric.

**Table 9: Dyeing processes which require hot water**

| Type of Dye | Process which require hot water | Temperature Required for the Process |
|---|---|---|
| **Cold Brand Dye** | i. Soaping (only required for some dark colours) | 70° C |
| **Hot Brand Dye** | i. Pre-treatment | 80° C |
| | ii. Dye Bath | 90° C |
| | iii. Soaping | 70° C |
| | iv. Hot Wash (only for dark colours) | 60° C |

Almost every unit in the area uses both cold and hot brand dyes. On an average 30-35 percent water consumed in dyeing and bleaching industry is used for hot water processes. Based on the design capacity of CETP's (common effluent treatment plant) and independent ETP's (effluent treatment plant), dyeing and bleaching industry in Tirupur requires approximately 35 MLD (million litres per day) hot water. The current requirement of hot water is extremely high and is expected to rise further with the fast pace of industrial development in the area. In view of the large demand and high significance for hot water in Tirupur, the area should offer a huge market for SWH.

**Current fuel used for heating water**

Fire wood is the major source of industrial fuel in the area. As majority of dyeing and bleaching units are small, they are still using the traditional boilers, installed years back. According to them, most of these boilers are not very energy efficient as compared to the advanced boilers available in the market these days.

In Tirupur, usage of hot brand dyes is more than cold brand dyes. On an average a 2 TPD dyeing unit consumes around 2.5 - 3 TPD fire wood. Market price of fire wood is around Rs. 3.2 – Rs 3.6 per kg depending on the quality of wood. A steady downfall has been witnessed in the area in availability of fire wood, which is resulting in rise of fire wood price. Rising fire wood price has a direct impact on the competitive position of these units in the international and domestic market.

With the technological advancement, majority of units have started using soft flow machines for dyeing, replacing the traditional winches. In the overall process of dyeing soft flow machines consumes almost 40-50 percent less water as compared to the traditional winches. Introduction of soft flow machines have also contributed towards quality improvement to a great extent. More advanced technology is also available which consumes only 20-25 percent water as compared to traditional winches. These technological advances are expected to impact requirement of water in the long run.

**Willingness to switch**

Almost hundred percent representatives from the industry have expressed their keenness to switch to SWH system, as their existing system is not very economical. Industries would be more than happy if the ESCO can replace their existing boilers by directly supplying steam/ hot water for the dyeing process. The current systems in place produce steam which is used to heat water with the use of heat exchangers. Thus, some configuration changes would be needed for introduction of SWH systems.

Industries are open to the idea of a centralized or modular system for hot water supply however, taking into consideration the geographical distance between these units, modular systems would be preferable. Availability of space should not be a major challenge in this area.

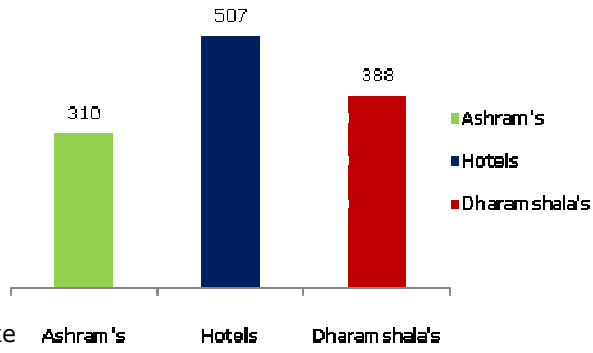
## 2.4. RELIGIOUS/ TOURIST TOWNSHIP – HARIDWAR/RISHIKESH

The market assessment in the religious/tourist cluster was carried out for three sub-clusters: (i) Haridwar – ashrams, dharamshalas, residential households, (ii) Rishikesh – hotels, ashrams, residential households and (iii) Ranipur industrial cluster. The summary of results in the different demand segments in this cluster has been summarized below.

### 2.4.1. ASHRAMS/DHARAMSHALAS IN HARIDWAR

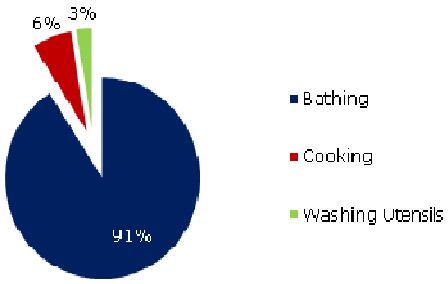
**Hot water demand and usage pattern**

**Figure 12: Hot water demand**




In Haridwar maximum inflow of pilgrims is witnessed in summers, except at the time of Kumbh and other religiously important days. Requirement of hot water is largely for bathing in winters which is an off-season period for tourists in Haridwar. In the sample surveyed, hot water consumption varies from 20 LPD to 5,000 LPD depending on the size and nature of institution. Thus, usage of hot water is moderately critical for these institutions. In few ashrams and dharamshalas, there is a restriction in usage of hot water by the management as they expect pilgrims staying with them to undertake "Gangasnan". Requirement of hot water is lower in dharamshalas and ashrams as compared to hotels.

**Figure 13: Hot water usage**




Maximum amount of hot water is required for bathing. However at few units, hot water is also required for washing utensils and cooking. Requirement and usage pattern of hot water in hotels/guest houses of Haridwar is very different from the pattern in Gurgaon, reason being, maximum hotels/guest houses in the region cater to the budget traveller, largely from low and middle income group. A limited number of hotels target the high income group traveller.

**Fuel used for heating water and willingness to switch**

Nineteen percent of the units covered had centralized hot water supply systems and majority of these are hotels and guest houses. The predominant source of heating water currently is electricity followed by firewood, LPG and kerosene.

Forty five percent of the respondents expressed their willingness to switch over to SWH systems, provided the ESCOs are able to provide an uninterrupted supply of hot water as per requirement. The 45 percent respondents who have expressed their willingness to switch to SWH are willing to pay Rs.0.50 per litre of hot water.

### 2.4.2. HOTELS IN RISHIKESH

**Hot water demand and usage pattern**

In the hotels surveyed, hot water consumption ranges from 1,500 LPD to 20,000 LPD depending on the size and processes. Maximum amount of hot water is required for bathing and cooking. Apart from these, hot water is also required in the kitchen and for washing utensils, however to a large extent utensils are washed in dishwashers in the bigger hotels.

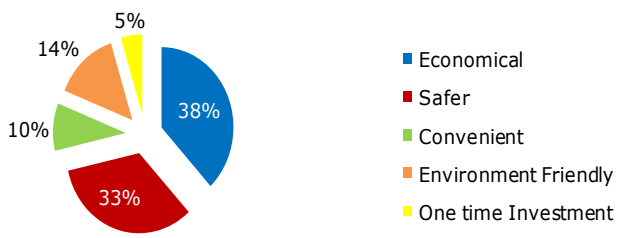
**Fuel/energy used for heating water**

Very few hotels surveyed have a centralized system for heating water. Most of these hotels have decentralized modes of heating water. Electricity is the predominant source of heating water (through geysers) in the hotels surveyed. Some hotels in Rishikesh use LPG for heating water.

**Willingness to switch**

Eighty percent of the respondents are adequately satisfied with their current system for heating water. However there is a unanimous willingness to switch over to SWH systems provided the ESCO is able to provide an uninterrupted supply of hot water as per requirement. The influencing factors for this willingness to switch to SWH systems and hot water provision through an ESCO have been attributed to two key factors – more economical than current system and greater safety.

**Figure 14: Influencing factors for switching to ESCO based SWH**




**Availability of space**

Availability of adequate space for installing SWH systems is a matter of concern, as none of the hotels covered under the assessment have adequate space for installing SWH systems which can completely fulfil their hot water requirement. However, for small hotels with limited hot water requirement the condition may be different. Apart from the terrace, there is no alternate space available with these hotels for installing SWH systems. This may be a major challenge for the ESCO.

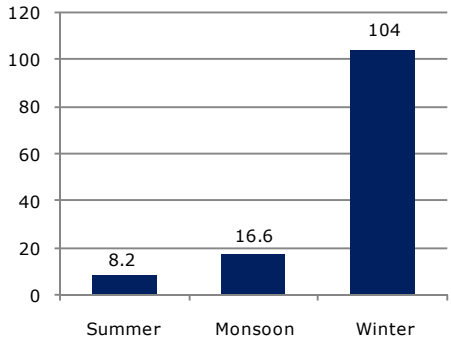
### 2.4.3. DOMESTIC HOUSEHOLDS IN HARIDWAR AND RISHIKESH

**Hot water demand and usage pattern**

Domestic households that were surveyed in both Haridwar and Rishikesh demonstrate a significant seasonal shift in hot water demand, similar to that observed in the households surveyed in Gurgaon i.e. on an average a household requires 104 LPD of hot water in winters whereas the requirement in summers and monsoon is merely 8 LPD and 17 LPD of hot water respectively.

Usage of hot water is predominantly for bathing, followed by washing clothes, cooking and washing utensils.

**Figure 15: Average Hot Water Consumption (In lpd/HH) - Haridwar**



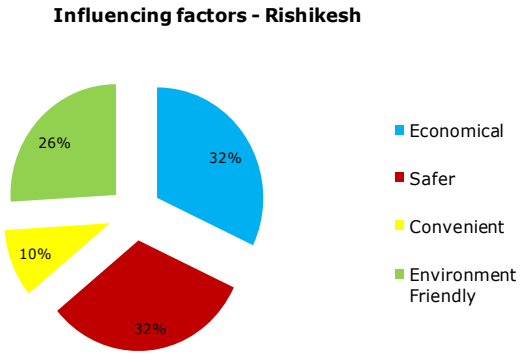

**Fuel used for heating water**

In Haridwar and Rishikesh, currently, electricity is the only major source for heating water. More than 80 percent households use electric appliances for heating water; these appliances mainly include geysers and immersion rods. Around 17 percent households use LPG for heating water.

**Willingness to switch**

In Haridwar and Rishikesh, fifty percent of the respondents are adequately satisfied and forty percent of the respondents are partially satisfied with their current system for heating water. However there is a unanimous willingness to switch over to SWH systems provided the ESCO is able to provide an uninterrupted supply of hot water as per requirement. The influencing factors for this willingness to switch to SWH systems and hot water provision through an ESCO have been attributed to – more economical than current system, greater safety, environment friendly and convenience.

**Figure 16: Influencing factors**




### 2.4.4. RANIPUR INDUSTRIAL CLUSTER

In the tourist cluster of Haridwar-Rishikesh, there are some industrial belts that use hot water for process heat and boiler pre-heat purposes. The nature of such industries is predominantly pharmaceuticals. One such industrial belt, Ranipur, is a town in Haridwar district and was built around the Ranipur plant of Bharat Heavy Electricals Limited (BHEL). There are several types of industries in the SIDCUL (State Infrastructure and Industrial Development Corporation of Uttarankhand) industrial area. The Integrated Industrial Estate of SIDCUL was an attractive



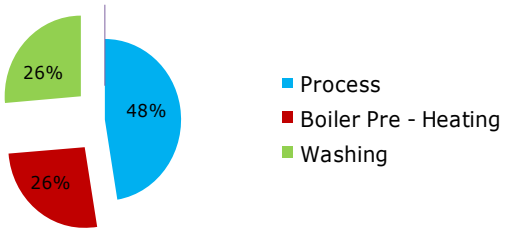
**Figure 13: Hot water usage**

proposition promoted by the Uttarakhand government whereby various financial incentives such as Central Excise duty (100% for 10 years), Income Tax (100% for 5 years) are being granted. During the market assessment exercise of the region, a cluster of pharmaceutical industries in the SIDCUL industrial area were surveyed. A summary of the survey results have been provided below.

**Hot water demand and usage pattern**

The demand for hot water in the surveyed industries varies between 1,500 – 30,000LPD. The usage of hot water is for process heat, boiler pre-heat and washing.

**Figure 17: Hot water usage**

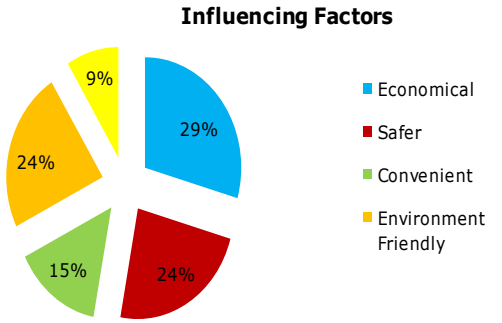



**Fuel used for heating water**

In Ranipur, the industries that were surveyed use electricity, furnace oil, HSD and LPG as current fuels for heating water.

**Willingness to switch**

**Figure 18: Influencing factors - Ranipur**




Among the industries that were surveyed, fifty percent of the respondents are highly satisfied, thirty percent adequately satisfied and twenty percent of the respondents are dissatisfied with their current system for heating water and there is a unanimous willingness to switch over to SWH systems provided the ESCO is able to provide an uninterrupted supply of hot water as per requirement. The influencing factors for this willingness to switch to SWH systems and hot water provision through an ESCO have been attributed to – more economical than current system, greater safety, environment friendly and convenience.

Table 9 provides a summary of the hot water demand (in LDP) across different demand segments in the four regions based on the survey results.

**Table 10: Summary of hot water demand (in LPD) across different demand segments**

| Cluster | Region | Demand Segments | | | | |
|---|---|---|---|---|---|---|
| | | Hot water demand per establishment (in LPD) | | | | |
| | | Households | Hotels | Hospitals | Ashrams/ Dharamshalas | Industry |
| Domestic | Gurgaon | 100 | 1500 | 1500 | - | - |
| Hilly | Leh | 100 | 1000 | 700 | - | - |
| Industrial | Tirupur | - | - | - | - | 46,500 |
| Religious/ tourist | Haridwar & Rishikesh | 100 | 700 | - | 500 | 4000 |

Based on the results of the market assessment and detailed stakeholder consultation regarding the existing ESCO models of hot water service delivery for SWH being followed by some players in India (case-studies of such models have been provided in Annex 3) detailed financial and business models of operation of the ESCO were developed. These models have been described in the subsequent chapter.

# VII. INTRODUCTION TO ENERGY SERVICE COMPANY BUSINESS MODELS FOR SOLAR WATER HEATING

Internationally, there are standard ESCO contracting models. The two predominant types of contracting models are, (i) energy performance contracting models and (ii) energy supply contracting models.

i. **Energy Performance contracting models**- Energy Performance Contracting (EPC) can be defined as 'a form of 'creative financing' for capital improvement which allows the funding of energy efficiency upgrades from cost reductions'. Performance guarantees are given by the ESCO in terms of the level of energy service or the level of cost and/or energy savings. The savings are then split between the ESCO and the client who could potentially reinvest this into more improvements. The two types of EPC models are:

   a. **Shared savings**- Under this model, the ESCO finances the project either through its own funds or by borrowing from a third party. The ESCO takes on the performance risk of the project. The cost savings are divided between the ESCO and customer at a prearranged percentage for an agreed length of time.

   b. **Guaranteed savings**- In this case, the customer finances the design and installation of the project by borrowing funds from a third party such as a bank or through leasing the equipment. The ESCO has no contractual arrangement with the bank but does assume the project risk and guarantees the energy savings made. If the savings do not reach agreed minimums the ESCO covers the difference; if they are exceeded then the customer agrees to share the savings with the ESCO.

ii. **Energy supply contracting models**- This type of service tends to be delivered on a low risk – low margin basis with suppliers' business models often focusing on developing long term operation and maintenance contracts. The two types of energy supply contracts are:

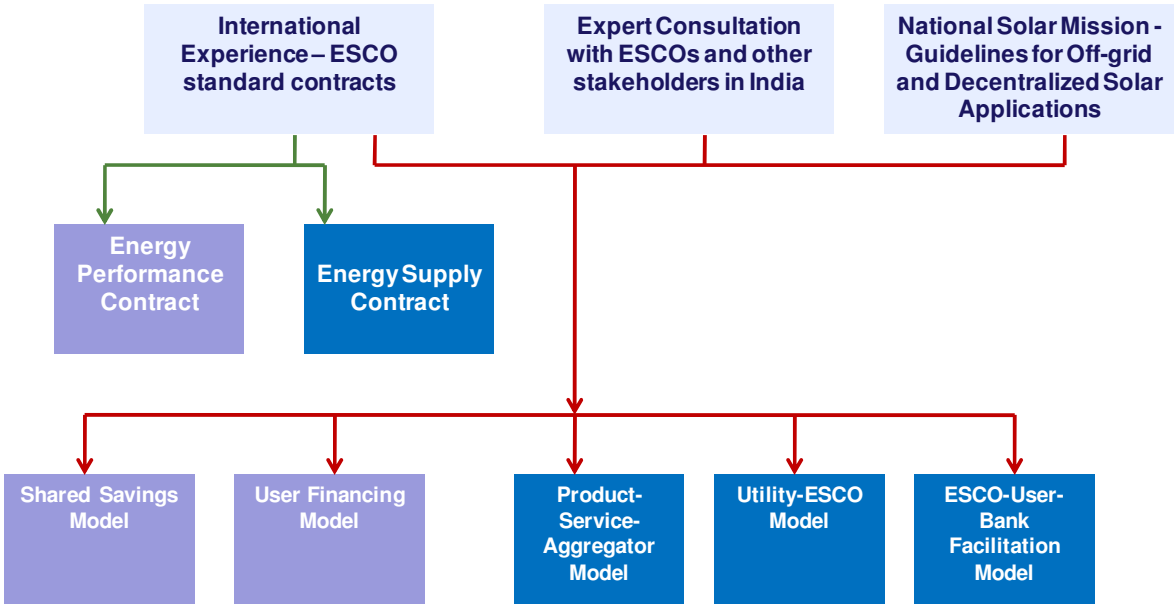
   a. **The Chauffage contract**- This contract provides a structure in which end users are sold energy. The contractor charges agreed rates for providing required energy services to a guaranteed level and has the freedom to act and make decisions on the installation of energy efficiency measures to reduce their own operating costs. The contractor provides all associated maintenance and operations support throughout the duration of the project.

   b. **The Build-Own-Operate-Transfer (BOOT) contract**- In this contract model, the ownership of equipment is transferred from the ESCO to the client at the end of a long term contract with the BOOT operator, before which the ESCO may have designed, built, financed and operated the equipment. The charge incurred by the client includes the recovery of operating costs, capital and project profit.

A detailed assessment of these contracting models was carried out during the course of this assignment. Along with this, a fairly detailed stakeholder consultation was carried out among existing SWH based hot water service providers in India.

The approach that has been followed for developing business models for SWH ESCO in India has been illustrated in the figure below.

**Figure 19: Approach for developing SWH ESCO Models in India**




The business models for SWH ESCOs fall under two types of ESCO contracting models as described in the earlier section of the chapter:

1. Energy Performance contract

1.1. Shared Savings Model

1.2. User Financing Model

2. Energy Supply Contract

2.1. Product Service Aggregator Model

2.2. Utility-ESCO Model

2.3. ESCO-User-Bank Facilitation Model

In hot water service provision through a SWH system, the key difference between the two types of ESCO contracting models is that under the energy performance contract model, the end-user owns the back-up system for water heating, whereas, in a energy supply contracting model, the ESCO owns the back-up system used for water heating.

This chapter provides a detailed description of these ESCO business models, highlighting its pros and cons and describing the roles and responsibilities of various entities involved in the model. The chapter also summarizes the approach and results of the area specific financial models.

# 1. BUSINESS MODELS

As discussed earlier, there are various ESCO models prevailing internationally. An analysis of these and other development models has been undertaken and various possible ESCO business models have been developed. These are discussed in the following section of the report.

## *1.1. SHARED SAVINGS MODEL*

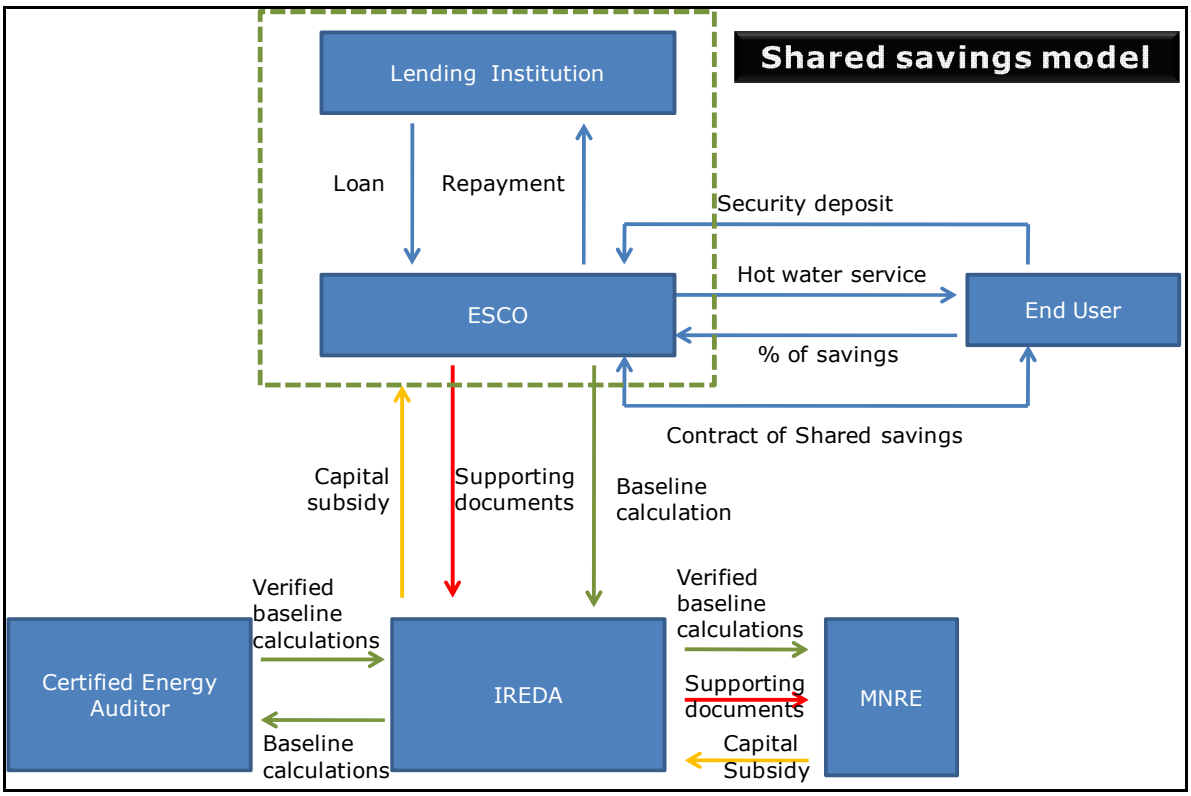
### 1.1.1. DESCRIPTION OF THE MODEL

As the name indicates this is a shared savings model in which the energy saved due to the installation of the solar water heating equipment is shared between the ESCO and the end user.

In this model the ESCO will get funding from any lending institution. This funding will be in form of a loan which will have to be paid back to the lending institution on mutually agreeable terms and conditions. The ESCO will carry out a baseline survey for all the consumers for whom it intends to install the solar water heating system. The ESCO will then submit the baseline calculations to IREDA for evaluation and verification. The IREDA will ask a certified energy auditor to evaluate and verify the baseline calculation for all or for a sample of consumers. The certified energy auditor will submit its report to IREDA. On a written approval from IREDA, the ESCO will install solar water heating equipment in the consumer premises and supply hot water to the end consumer. The end user will pay one time refundable security deposit to the ESCO. The ESCO will install solar water heating system in the consumer premises within the area specified as "designated area" as discussed in the later part of this report.

Upon successful installation, the ESCO, on a monthly basis will submit the proof of installation along with the details of the energy being saved by installing the solar water heating system to IREDA. IREDA will pass on these documents and request any certified energy auditor to verify the baseline calculations. The certified energy auditor will submit the verified baseline calculations to IREDA. IREDA will submit a request to MNRE for disbursement of capital subsidy. The capital subsidy will be passed on to the aggregator/lending institution which in turn will pass the subsidy to the ESCO. The payment of the monthly bill will be a percentage of the total bill that is determined based on the baseline survey. This percentage will be less than 100% and will be defined in the contract that will be executed between the ESCO and the end user. The following figure depicts the details of the shared savings model.

**Figure 20: Illustration of the Shared Savings Model**




### 1.1.2. RISK MITIGATION IN CASE OF DEFAULT

In case of any default in the payment of the monthly bill by the consumer, the ESCO based on the clause of the contract can retain the refundable security deposit.

### 1.1.3. PROS AND CONS OF SHARED SAVINGS MODEL

The table below summarizes the pros and cons of the Shared Savings Model.

**Table 11: Pros and cons of the shared savings model**

| *Pros* | *Cons* |
|---|---|
| Simple model can be used for domestic segment | Estimation of baseline data could be a point of debate |
| | Does not protect the end user in case of default by the ESCO company |

### 1.1.4. ROLES AND RESPONSIBILITY OF VARIOUS ENTITIES IN THE ESCO MODEL

**MNRE**

1. MNRE will be responsible for selection of ESCOs
2. MNRE will select the area as mentioned in detail in the subsequent chapter on implementation guidelines for area based ESCO for solar water heating
3. MNRE will evaluate the request for selection (RFP) submitted by the various ESCOs. This has been explained in detail later in the report
4. MNRE will prepare framework for a sample standard contracts between the ESCO and the end user
5. MNRE will disburse capital subsidy to ESCOs on submission of the relevant documents
6. MNRE will endeavour to provide assistance on carbon finance
7. Awareness creation of the end users

**ESCO**

1. The primary responsibility of the ESCO will be to provide hot water service to the end user based on the terms and conditions of the contract
2. The ESCO will endeavour to ensure system availability at the guaranteed levels
3. The ESCO will take care of the operations and maintenance of the system
4. The ESCO will submit all the relevant and supporting documents to the IREDA for applying for the capital subsidy and baseline calculation verification

**End user/ consumer**

1. The consumer will pay security deposit to the ESCO on mutually agreed terms and conditions
2. The consumer will pay monthly bills directly to the ESCO as per the terms and conditions of the contract executed between ESCO and the end user

**IREDA**

1. IREDA on case to case basis may provide loan to the ESCO company on mutually agreeable terms and conditions
2. Routing of capital subsidy will be done through IREDA

3. IREDA will review the Periodic monitoring and evaluation reports of the ESCO

**Lending Institution/Aggregator**

*These would be institutions which are involved in consumer finance and have an established based of customers in rural/urban areas and outreach through self help groups, etc. These would typically access interest subsidy through refinance facility as also credit linked capital subsidy on behalf of their borrowers from IREDA (section 4.1 (b) of Guidelines for Off-grid and Decentralized Solar Applications)*.

Role in this Model - Acting as aggregators and assisting ESCOs in accessing the capital subsidy from MNRE

**Certified energy auditor**

1. The role of a third party energy auditor will be to review the supporting documents as provided by ESCO and the consumer complaints and submit the reports to IREDA

#### 1.1.5. CONTRACTS TO BE EXECUTED IN THE SHARED SAVINGS MODEL

Only one contract will be executed in this model. This contract will be executed between the ESCO and the end user and will feature the clauses on key points such as percentage of savings to be shared between the ESCO and the end user, minimum guaranteed system availability and clause on defaults in case of both the parties entering the contract.

## *1.2. USER FINANCING ESCO MODEL*

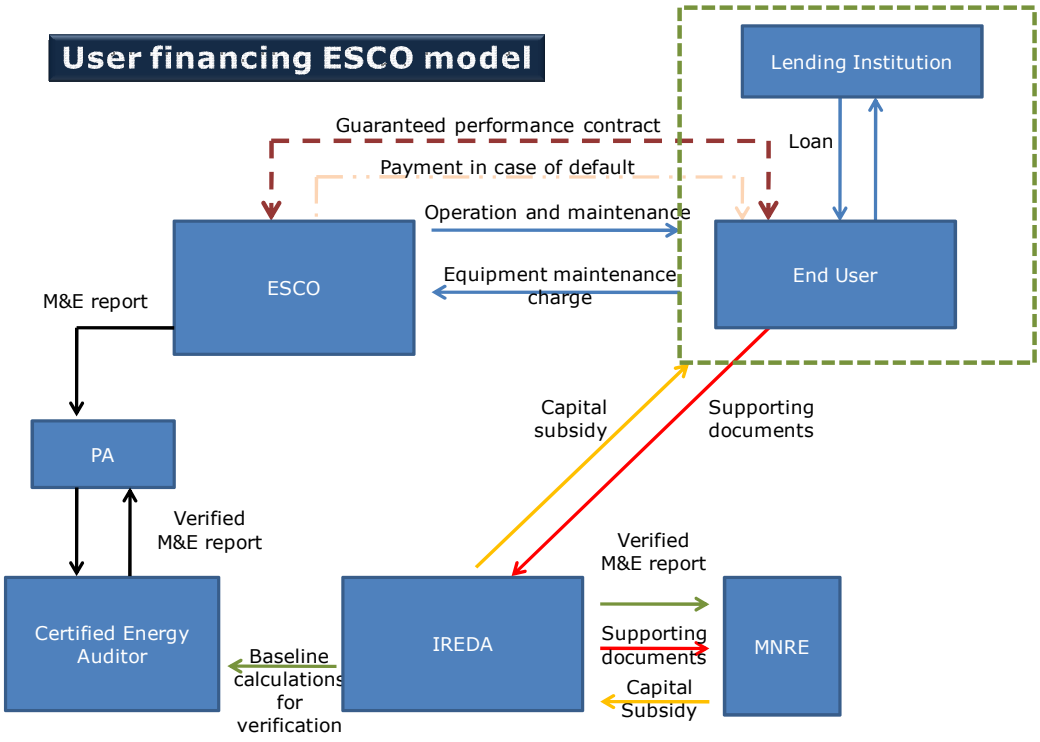
#### 1.2.1. DESCRIPTION OF THE MODEL

In this model the financing will be arranged by the end user. The end user will submit the proof of installation along with the relevant supporting documents to IREDA. On review of these documents, IREDA will forward these documents to MNRE for disbursement of capital subsidy. The end-user will enter into a tie-up with a lending institution for accessing the capital subsidy. The capital subsidy will be passed on to the lending institution which will then pass on the same to the end-user.

The ESCO will be responsible for operation and maintenance of the system. The end user will pay operation and maintenance charge to the ESCO on a monthly basis. The ESCO will enter into a guaranteed performance contract with the end user. A BTU meter will be installed in the premises of the ESCO for monitoring the performance of the system. If the ESCO is not able to perform as per the terms and conditions of the guaranteed performance contract, the ESCO would compensate the end user as per the contract. The ESCO will submit its periodic M&E reports to the PA. In case of a default, the PA will request the certified energy auditor to verify the ESCO's M&E report. The certified energy auditors will submit a report to the PA. On review of the verified M&E reports, if the

ESCO is found guilty, the PA will take necessary action against the ESCO and may also cancel the ESCO's accreditation The following figure depicts the working of the user financing ESCO model.

**Figure 21: Illustration of the user financing model**




### 1.2.2. RISK MITIGATION IN CASE OF DEFAULT

In case of any default by the ESCO, the ESCO will pay an amount agreed as per the guaranteed performance contract.

### 1.2.3. PROS AND CONS OF USER FINANCING ESCO MODEL

The table below summarizes the pros and cons of the user financing ESCO Model.

**Table 12: Pros and cons of the user financing ESCO model**

| *Pros* | *Cons* |
|---|---|
| Less chances of default as monitoring of performance will be done on regular basis by the ESCO. In case of default, a certified energy auditor would verify the M&E report of the ESCO and if the ESCO is found to be guilty, the PA may cancel the ESCO's accreditation. | Arranging finance could be an issue for the end user |

### 1.2.4. ROLES AND RESPONSIBILITY OF VARIOUS ENTITIES IN THE ESCO MODEL

**MNRE**

1. MNRE will be responsible for selection of ESCOs
2. MNRE will select the area as mentioned in detail in the subsequent chapter on implementation guidelines for area based ESCO for solar water heating
3. MNRE will evaluate the request for selection (RFP) submitted by the various ESCOs. This has been explained in detail later in the report
4. MNRE will prepare framework for a sample standard contracts between the ESCO and the end user
5. MNRE will disburse capital subsidy to ESCOs on submission of the relevant documents
6. MNRE will endeavour to provide assistance on carbon finance
7. Awareness creation of the end users

**ESCO**

1. The ESCO will guarantee performance of the system as per the guaranteed performance contract
2. The ESCO will endeavour to ensure system availability at the guaranteed levels
3. The ESCO will take care of the operations and maintenance of the system

**End user/ consumer**

1. The end user will submit all the relevant and supporting documents to IREDA for applying for the capital subsidy
2. The consumer will pay monthly operation and maintenance charge to the ESCO

**IREDA**

1. Routing of capital subsidy will be done through IREDA

**Lending Institution/Aggregator**

*These would be institutions which are involved in consumer finance and have an established based of customers in rural/urban areas and outreach through self help groups, etc. These would typically*

*access interest subsidy through refinance facility as also credit linked capital subsidy on behalf of their borrowers from IREDA (section 4.1 (b) of Guidelines for Off-grid and Decentralized Solar Applications)*.

Role in this Model - Acting as aggregators and assisting the end-user in accessing the capital subsidy from MNRE

**Certified energy auditor**

1. The role of a third party energy auditor will be to review the M&E reports as provided by the ESCO and submit the verified reports to the PA on request for the same

**Program Administrator**

*The Program Administrator (PA) would include, inter alia, Central and State Government Ministries and Departments and their organizations, State Nodal Agencies, Utilities, local bodies, PSUs and reputed Non-Governmental Organizations (section 4.1 (e) of Guidelines for Off-grid and Decentralized Solar Applications).* Role in this model:

1. The PA will review the consumer complaints and request the certified energy auditor to submit the verified M&E reports of the ESCO

2. On review of the M&E reports, if the ESCO is found guilty, the PA will take necessary action against the ESCO and may also cancel the ESCO's accreditation

### 1.2.5. CONTRACTS TO BE EXECUTED IN THE USER-FINANCING MODEL

The following contracts will be executed between various entities in the model.

- Guaranteed performance contract between the ESCO and the end user

## *1.3. PRODUCT SERVICE AGGREGATOR MODEL*

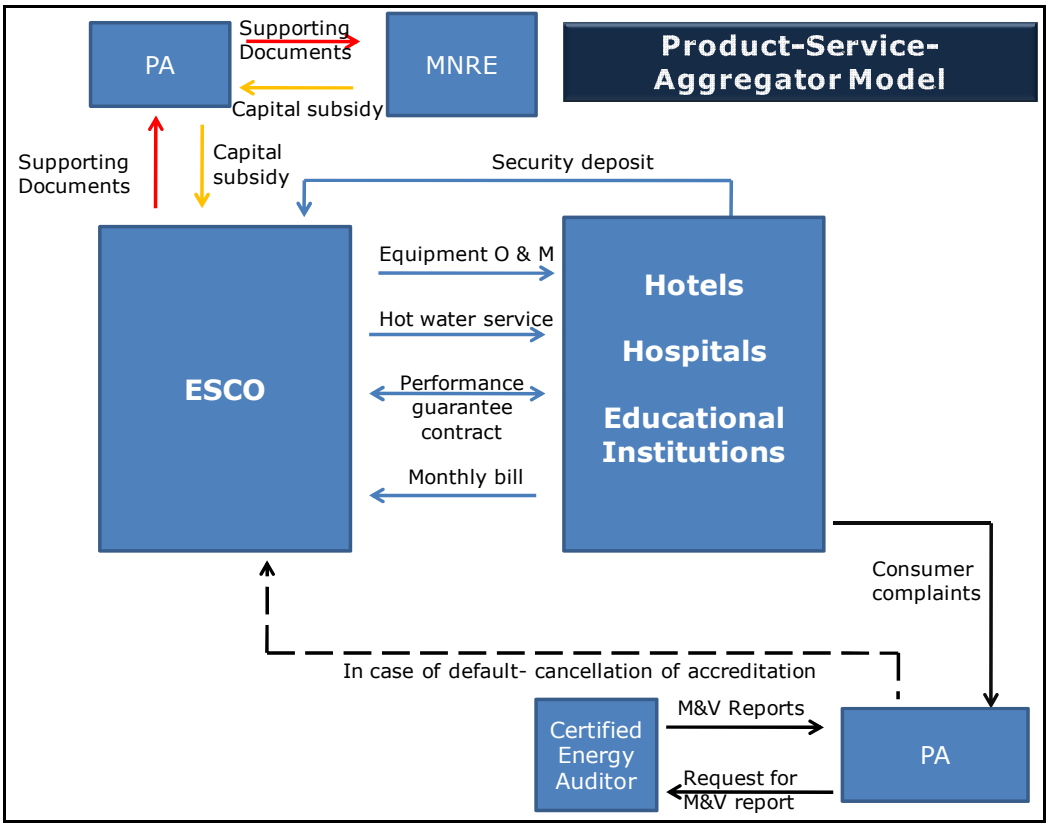
### 1.3.1. DESCRIPTION OF THE MODEL

This is called the product service aggregator model because in this model the ESCO is an aggregator of the product which is the "solar water heater" and the service which is "hot water service" in this case. The following paragraph describes the model.

In this ESCO business model, the ESCO will act as a project developer. The financing will be arranged by the project developer itself. The ESCO will enter into a performance guarantee contract with the end user. The project developer will install the equipment in the consumer premises and provide hot water service to the consumer based on the terms and conditions of the contract

between the ESCO (project developer) and the consumer. The ESCO will endeavour to operate and maintain the solar water heating system. The consumer will pay one time refundable security deposit to the ESCO. The ESCO will install solar water heating system in the consumer premises within the area specified as "designated area" as discussed in the later part of this report. Upon successful installation, the ESCO, on a monthly basis will submit the proof of installation along with the details of the energy being saved by installing the solar water heating system to the PA. PA upon verification will pass on these documents to MNRE and request MNRE for disbursement of capital subsidy. The capital subsidy will be passed on to the ESCO by the PA. The payment of the monthly bill will be done directly to the ESCO by the end user/ consumer. The following illustrates the working of the product service aggregator model.

**Figure 22: Illustration of the Product-service aggregator model**




### 1.3.2. RISK MITIGATION IN CASE OF DEFAULT

- In case of any default in the payment of the monthly bill by the consumer, the ESCO based on the clause of the contract can retain the refundable security deposit.

- In case of any default by the ESCO in providing hot water service as per the contract, the consumer can lodge a complaint to the PA. The PA will request a certified energy auditor to verify the complaint. If the ESCO is found guilty, then the PA will take necessary action against the ESCO.

### 1.3.3. PROS AND CONS OF PRODUCT-SERVICE AGGREGATOR MODEL

The table below summarizes some of the key pros and cons of the product-service aggregator model.

**Table 13: Pros and cons of the product-service aggregator model**

| *Pros* | *Cons* |
|---|---|
| Simple model | High dependence on ensuring performance of the ESCO |
| No dependence on lending institutions | Difficult to implement in the domestic and very large industrial segments |
| Can be easily implemented for small scale of operations | |

### 1.3.4. ROLES AND RESPONSIBILITY OF VARIOUS ENTITIES IN THE ESCO MODEL

**MNRE**

1. MNRE will be responsible for selection of ESCOs
2. MNRE will select the area as mentioned in detail in the subsequent chapter on implementation guidelines for area based ESCO for solar water heating
3. MNRE will evaluate the request for selection (RFP) submitted by the various ESCOs. This has been explained in detail later in the report
4. MNRE will prepare framework for a sample standard contracts between the ESCO and the end user
5. MNRE will disburse capital subsidy to ESCOs on submission of the relevant documents
6. MNRE will endeavour to provide assistance on carbon finance
7. Awareness creation of the end users

**ESCO**

1. The primary responsibility of the ESCO company will be to provide hot water service to the end user based on the terms and conditions of the contract

2. The ESCO will endeavour to ensure system availability at the guaranteed levels

3. The ESCO will take care of the operations and maintenance of the system

4. The ESCO on a monthly basis will submit monitoring and evaluation report to the PA in the prescribed format

5. The ESCO company will submit all the relevant and supporting documents to the state nodal agency for applying for the capital subsidy

**End user/ consumer**

1. The consumer will pay security deposit to the ESCO on mutually agreed terms and conditions

2. In case of non performance by the ESCO the user can lodge a complaint to the PA

3. The consumer will pay monthly bill directly to the ESCO monthly as per the terms and conditions of the contract executed between ESCO and the end user

**Program Administrator**

*The Program Administrator (PA) would include, inter alia, Central and State Government Ministries and Departments and their organizations, State Nodal Agencies, Utilities, local bodies, PSUs and reputed Non-Governmental Organizations. These entities would directly implement the scheme and access capital subsidy from MNRE (section 4.1 (e) of Guidelines for Off-grid and Decentralized Solar Applications).* Role in this model:

1. Channelling the capital subsidy to the ESCO

2. The PA will review the consumer complaints and request the certified energy auditor to submit the verified M&E reports of the ESCO

3. On review of the M&E reports, if the ESCO is found guilty, the PA will take necessary action against the ESCO and may also cancel the ESCO's accreditation

**Certified energy auditor**

1. The role of a third party energy auditor will be to review the supporting documents as provided by ESCO and the consumer complaints and submit the reports to the PA.

### 1.3.5. CONTRACTS TO BE EXECUTED IN THE PRODUCT-SERVICE-AGGREGATOR MODEL

This is a relatively simpler model and hence only a performance contract will be executed between ESCO and consumer and a copy of this contract will be submitted to the PA.

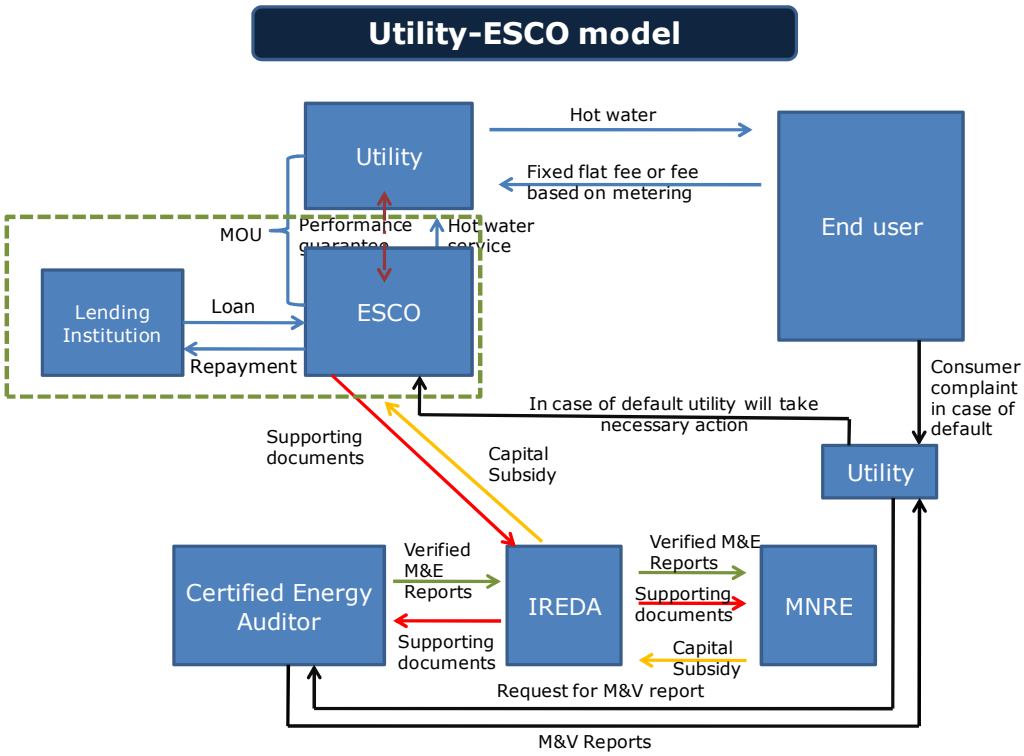
## 1.4. UTILITY-ESCO MODEL

### 1.4.1. DESCRIPTION OF THE MODEL

In this model the ESCO along with the utility will offer solar water heating service to the consumer. The ESCO would promote the solar water heating concept through the utility.

The ESCO will install the solar water heater in the consumer premises and would provide hot water service to the consumer. The utility would collect the monthly usage charge which could be a fixed fee (ideally suited for domestic consumers) or fee based on metered hot water supplied to the consumers. The ESCO will also enter into contract with the consumer for guaranteed performance of the system. The ESCO will install solar water heating system in the consumer premises within the area specified as "designated area" as discussed in the later part of this report. Upon successful installation, the ESCO, on a monthly basis will submit the proof of installation along with the details of the energy being saved by installing the solar water heating system to IREDA. IREDA will pass on these documents and request any certified energy auditor to verify the M&E reports of the ESCO. The certified energy auditor will submit the verified M&E reports to IREDA. IREDA will submit a request to MNRE for disbursement of capital subsidy. The capital subsidy will be passed on to the aggregator which in turn will pass the subsidy to the ESCO. The ESCO will also submit on a periodic basis supporting documents for monitoring and verification in the format as prescribed by IREDA. The ESCO will have an MOU with the Utility and the ESCO will pay a facilitation charge to the Utility for collecting the monthly bills from the end user. In future if solar water heating application qualifies under the mandatory renewable purchase obligation then the ESCO would be eligible to receive renewable energy certificates which it may further sell to the utility to meet its RPO targets. The following figure depicts the working of this model.

**Figure 23: Illustration of the utility-ESCO model**



### 1.4.2. RISK MITIGATION IN CASE OF DEFAULT

In case of any default by the ESCO the customer will lodge a complaint to the PA. The PA will ask a certified energy auditor to review the complaints and submit a report. Based on the report the PA would take necessary action against the ESCO.

### 1.4.3. PROS AND CONS OF UTILITY-ESCO MODEL

The table below summarizes the pros and cons of the utility-ESCO Model.

**Table 14: Pros and cons of the lease rental model**

| *Pros* | *Cons* |
|---|---|
| Fixed flat fee model can be used for domestic consumers | Does not protect the ESCO in case of default in case of default by the consumer |
| Administration of monthly bills through utilities is easier | |
| Will take off some load from the utility and could lead to lower amount of load shedding | |

### 1.4.4. ROLES AND RESPONSIBILITY OF VARIOUS ENTITIES IN THE ESCO MODEL

**MNRE**

1. MNRE will be responsible for selection of ESCOs
2. MNRE will select the area as mentioned in detail in the subsequent chapter on implementation guidelines for area based ESCO for solar water heating
3. MNRE will evaluate the request for selection (RFP) submitted by the various ESCOs. This has been explained in detail later in the report
4. MNRE will prepare framework for a sample standard contracts between the ESCO and the end user
5. MNRE will disburse capital subsidy to ESCOs on submission of the relevant documents
6. MNRE will endeavour to provide assistance on carbon finance
7. Awareness creation of the end users

**ESCO**

1. The primary responsibility of the ESCO will be to provide hot water service to the end user based on the terms and conditions of the contract

2. The ESCO will endeavour to ensure system availability at the guaranteed levels

3. The ESCO will take care of the operations and maintenance of the system

4. The ESCO will submit all the relevant and supporting documents to IREDA for applying for the capital subsidy

**Utility**

1. The utility on behalf of the ESCO will collect the monthly charge from the end user.

2. The utility will pass on the monthly charge collected from the consumer to the ESCO based on the terms and conditions of the MOU/contract.

**End user/ consumer**

1. The consumer will pay monthly bill to the utility as per the terms and conditions of the contract executed between ESCO and the end user

**IREDA**

1. IREDA on case to case basis may provide loan to the ESCO company on mutually agreeable terms and conditions

2. Routing of capital subsidy will be done through IREDA

3. IREDA will review the Periodic monitoring and evaluation reports of the ESCO

**Lending Institution/Aggregator**

*These would be institutions which are involved in consumer finance and have an established based of customers in rural/urban areas and outreach through self help groups, etc. These would typically access interest subsidy through refinance facility as also credit linked capital subsidy on behalf of their borrowers from IREDA (section 4.1 (b) of Guidelines for Off-grid and Decentralized Solar Applications)*.

Role in this Model - Acting as aggregators and assisting ESCOs in accessing the capital subsidy from MNRE

**Certified energy auditor**

1. The role of a third party energy auditor will be to review the M&E reports as provided by ESCO and submit the verified reports to IREDA and the PA on request for the same

**Program Administrator**

*The Program Administrator (PA) would include, inter alia, Central and State Government Ministries and Departments and their organizations, State Nodal Agencies, Utilities, local bodies, PSUs and reputed Non-Governmental Organizations (section 4.1 (e) of Guidelines for Off-grid and Decentralized Solar Applications).* Role in this model:

1. The PA will review the consumer complaints and request the certified energy auditor to submit the verified M&E reports of the ESCO

2. On review of the M&E reports, if the ESCO is found guilty, the PA will take necessary action against the ESCO and may also cancel the ESCO's accreditation

### 1.4.5. CONTRACTS TO BE EXECUTED IN THE UTILITY-ESCO MODEL

The following contracts will be executed between various entities in the model.

- Performance guarantee contract between the ESCO and the consumer

- MOU/contract between the ESCO and the utility for using the service of the utility for collection of the bills

## *1.5. ESCO -USER - BANK FACILITATION MODEL*

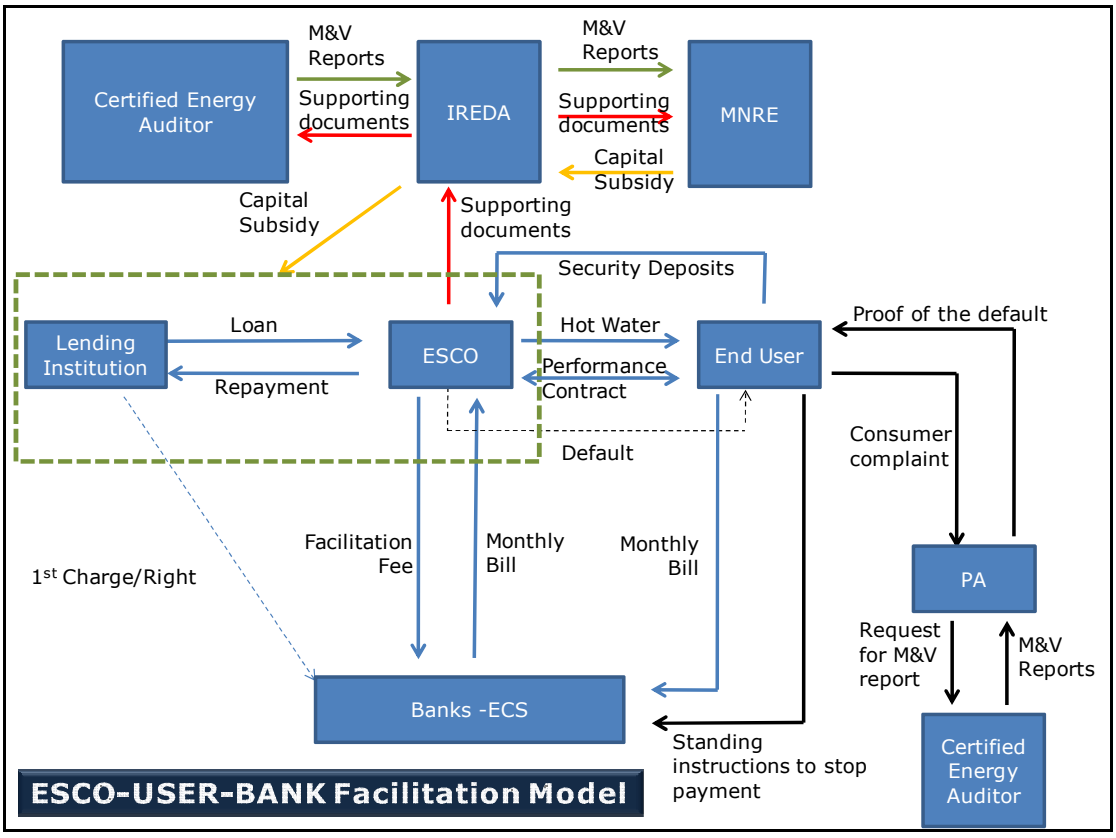
### 1.5.1. DESCRIPTION OF THE MODEL

This is called the ESCO-USER-BANK facilitation model because in this model the "BANK" acts as a facilitator between the "ESCO" and the "USER". The working of this model is described in this section.

In this model, the ESCO will get funding from any lending institution like a commercial bank or IREDA. The funding will be in from of a loan which will have to be paid back to the lending institution on mutually agreeable terms and conditions. The ESCO will install solar water heating equipment in the consumer premises and supply hot water to the end consumer. The end user will pay one time refundable security deposit to the ESCO. The ESCO will enter into a performance contract with the end user. The ESCO will install solar water heating system in the consumer premises within the area specified as "designated area" as discussed in the later part of this report. Upon successful installation, the ESCO, on a monthly basis will submit the proof of installation

along with the details of the energy being saved by installing the solar water heating system to IREDA. IREDA will pass on these documents and request any certified energy auditor to verify the M&E reports of the ESCO and submit these to IREDA. IREDA will submit a request to MNRE for disbursement of capital subsidy. The capital subsidy will be passed on to the aggregator which in turn will pass the subsidy to the ESCO. The payment of the monthly bill for the hot water service will be done through a bank in which the consumer has an account. The consumer will have an electronic clearing system "ECS" arrangement with the bank. The bank will automatically clear the bill every month as the ESCO raises the bill against the hot water service. ESCO will pay a facilitation charge to the bank using the ECS service. The following figure depicts the ESCO- USER - BANK facilitation model.

**Figure 24: Illustration of the ESCO-USER-Bank Facilitation Model**



### 1.5.2. RISK MITIGATION IN CASE OF DEFAULT

- In case of default by the ESCO in repayment of the loan, the lending agency will have a first right on the ESCO account in the bank apart from any collateral which it might take for providing loan.

- In case of any default in the monthly bill by the consumer, the ESCO based on the clause of the contract can retain the refundable security deposit.

- In case of any default by the ESCO the end user will have a right to lodge a complaint with the programme administrator (PA)[1]. The PA will review the complaint and then ask the certified Energy Auditor to provide verified M&E reports of the ESCO. Based on the report the PA will issue a authorization letter to the consumer to stop payment to the ESCO.

### 1.5.3. PROS AND CONS OF ESCO-USER-BANK FACILITATION MODEL

The following table summarizes the Pros and Cons of the ESCO-User-Bank facilitation model.

**Table 15: Pros and cons of the ESCO-USER-BANK facilitation model**

| *Pros* | *Cons* |
|---|---|
| Mechanism for addressing every entity's risk<br>• ESCO - Security deposit from the consumer<br>• Consumer - Proof of default certificate from PA<br>• Lending institution - First right on the ESCO account in the bank | This model is difficult to apply in case of domestic customer as monitoring and verification in case of these users would be an issue |
| Consumer/ end user does not have to directly deal with the ESCO | |

[1] *The Program Administrator (PA) would include, inter alia, Central and State Government Ministries and Departments and their organizations, State Nodal Agencies, Utilities, local bodies, PSUs and reputed Non-Governmental Organizations (section 4.1 (e) of Guidelines for Off-grid and Decentralized Solar Applications).*

### 1.5.4. ROLES AND RESPONSIBILITY OF VARIOUS ENTITIES IN THE ESCO MODEL

**MNRE**

1. MNRE will be responsible for selection of ESCOs
2. MNRE will select the area as mentioned in detail in chapter VIII on implementation guidelines for area based ESCO for solar water heating
3. MNRE will evaluate the request for selection (RFP) submitted by the various ESCOs. This has been explained in detail later in the report
4. MNRE will prepare framework for a sample standard contracts between the ESCO and the end user
5. MNRE will disburse capital subsidy to ESCOs on submission of the relevant documents
6. MNRE will endeavour to provide assistance on carbon finance
7. Awareness creation of the end users

**IREDA**

1. IREDA on case to case basis may provide loan to the ESCO on mutually agreeable terms and conditions
2. Routing of capital subsidy will be done through IREDA
3. IREDA will review the Periodic monitoring and evaluation reports of the ESCO

**Lending Institution/Aggregator**

*These would be institutions which are involved in consumer finance and have an established based of customers in rural/urban areas and outreach through self help groups, etc. These would typically access interest subsidy through refinance facility as also credit linked capital subsidy on behalf of their borrowers from IREDA (section 4.1 (b) of Guidelines for Off-grid and Decentralized Solar Applications)*.

Role - Acting as aggregators and assisting ESCOs in accessing the capital subsidy from MNRE

**ESCO**

1. The primary responsibility of the ESCO will be to provide hot water service to the end user based on the terms and conditions of the contract
2. The ESCO will endeavour to ensure system availability at the guaranteed levels

3. The ESCO will take care of the operations and maintenance of the system

4. The ESCO on a monthly basis will submit monitoring and evaluation report to IREDA in the prescribed format

5. The ESCO will submit all the relevant and supporting documents to IREDA for applying for the capital subsidy

6. The ESCO will pay the loan amount back to the lending agencies on mutually agreed terms and conditions

**End user/ consumer**

1. The consumer will pay security deposit to the ESCO on mutually agreed terms and conditions

2. In case of non performance by the ESCO the user can lodge a complaint to the program administrator

3. The consumer will endeavour to keep enough amount in the bank account linked through ECS for payment of monthly bill to the ESCO

**Program Administrator**

*The Program Administrator (PA) would include, inter alia, Central and State Government Ministries and Departments and their organizations, State Nodal Agencies, Utilities, local bodies, PSUs and reputed Non-Governmental Organizations (section 4.1 (e) of Guidelines for Off-grid and Decentralized Solar Applications).* Role in this model:

1. The PA will review the consumer complaints

2. If the ESCO is found guilty the PA will issue an authorization letter to the consumer to stop payment to the ESCO and later the PA will take necessary action against the ESCO

**Certified energy auditor**

1. The role of a third party energy auditor will be to review the supporting documents as provided by ESCO and the consumer complaints and submit the reports to IREDA

**Bank**

1. The bank will act as an intermediary between the ESCO and the consumer. The bank may collect a facilitation charge from the ESCO for providing the ECS service.

### 1.5.5. CONTRACTS TO BE EXECUTED IN THE ESCO-USER-BANK FACILITATION MODEL

It is imperative to understand the key drivers of any ESCO business model. As discussed earlier, contracts among various entities forms a vital part of the ESCO business model. The following contracts will be executed between various entities.

1. A performance contract will be executed between ESCO and consumer and a copy of this contract will be submitted to the state nodal agency

2. A standard contract will be executed between the lending agency and the ESCO

3. A standard contract will be executed between the bank and the ESCO

# 2. AREA-SPECIFIC APPLICABILITY OF MODELS

The market assessment that was carried out in the four identified areas revealed area specific drivers for implementing an ESCO model for servicing the hot water demand of the different demand segments in the identified areas. These drivers have been mapped against the four areas to highlight the enablers for implementing a SWH ESCO model in these regions.

**Table 16: Region specific enablers for implementing a SWH ESCO model**

| Location | Awareness /usage | Extent of real estate development | Affordability – initial cost of ownership (income levels) | Usage-months in the year used/ application areas | Cost effectiveness of usage Vs. alternatives | Mandatory / regulatory regime | Back-up and system integration costs | Requirement for metering and quantification of benefits | Market potential for SWH ESCO | Key drivers |
|---|---|---|---|---|---|---|---|---|---|---|
| **Religious /Tourist cluster – Haridwar Rishikesh** | Low | Medium | High | Medium (4-5 months) | Medium | Medium | Medium | High | Medium | Catering to a mixed demand cluster |
| **Residential – Gurgaon** | Medium | High | High | Medium (4-5 months) | High | High | Medium | High | High | Cost effectiveness, affordability |
| **Industrial-Tirupur** | High | Low | High | High (8 months) | High | Low | High | High | High | Hot water demand and usage |
| **Hilly /remote area - Leh** | Low | Low | Low | High (9 months) | High | High | High | High | High | Climatic conditions |

Based on this assessment of region-specific enablers and the business models that have been described in the earlier section, specific business models may be adapted by different ESCOs to cater to different demand segments within each area. A mapping of the likely business models that may be used by ESCOs to service the various demand segments in each of the four identified areas have been summarized in the figure below.

**Figure 25: Summary of Area-specific Business Models**

| Regions/ Models | ESCO-USER-BANK Facilitation | Product-Service Aggregator | Shared-Savings | Utility-ESCO | User-Financing |
|---|---|---|---|---|---|
| **LEH** | | | | | |
| Army | √ | √ | | | |
| Hospitals | √ | √ | | | |
| Hotels | √ | √ | | | |
| Educational Institutions | √ | √ | | | |
| Govt. Housing societies | | | | | √ |
| Non Govt. Independent Houses | | | | | √ |
| Places of Worship | | | | | |
| | | | | | |
| **GURGAON** | | | | | |
| Hotels | √ | √ | | √ | √ |
| Hospitals | √ | √ | | √ | √ |
| Educational Institutions | √ | √ | | √ | |
| Industry | √ | | | √ | |
| RWAs | √ | | | √ | |
| New High Rise Buildings | | | √ | √ | |
| Govt. Housing societies | | | | √ | √ |
| Non Govt. Independent houses | | | | √ | √ |
| | | | | | |
| **HARIDWAR/RISHIKESH** | | | | | |
| Dharamshalas | | | √ | √ | |
| Ashrams | | | √ | √ | |
| Hotels | | √ | | | √ |
| Govt. Housing societies | | | | | √ |
| Non Govt. Independent houses | | | | | √ |
| Industry units | √ | √ | | | |
| | | | | | |
| **TIRUPUR** | | | | | |
| Textile Industry | √ | | | | |

**In each of the four identified areas,**

- **One or more ESCOs will be allowed to operate, and**
- **Within the designated area, the minimum capacity to be served by an ESCO (in Litres Per Day) on a non-exclusive basis will be specified by MNRE as a threshold volume.**

## *2.1. LEH*

In Leh, the demand segments that use hot water are army establishments, hospitals, hotels, and education institutions, government housing societies, non-government independent houses and places of worship. The business models through which the ESCOs may service the hot water demand of these segments and related issues have been summarized below.

### A. ESCO-user-bank facilitation and Product-service-aggregator models

To service the hot water demand of army establishments, hotels, hospitals and education institutions, ESCOs may operate through the ESCO-User-Bank facilitation model and/or as a Product-Service-Aggregator. However, it would be difficult for the ESCO to operate through the ESCO-User-Bank facilitation model to service the hot water demand of domestic households as monitoring and verification in case of these users would be an issue.

### B. Shared-savings model

For servicing hot water demand in army establishments, hotels, hospitals and education institutions: since metering of hot water service is not mandatory in this model, the model will not work in commercial institutions.

For servicing hot water demand in households: in Leh, since electricity is not the alternate fuel for heating water, the shared-savings model will not be financially viable for the ESCO.

### C. Utility-ESCO model

Since the utility model involves marketing the ESCO concept to the end-users, the success of this model will depend on the pro-activeness of the utility in implementing innovative models. This model may not work in J&K.

### D. User-financing model

The success of operating through this model depends on the willingness of the end-user to own the system and its ability to arrange for financing. The model may be applicable for servicing hot water needs of certain army establishments and government housing colonies in Leh.

## *2.2. GURGAON*

In Gurgaon, the demand segments that use hot water are hospitals, hotels, education institutions, industry units, high-rise housing and office complexes (existing and new), government housing societies and non-government independent houses. The business models through which the ESCOs may service the hot water demand of these segments and related issues have been summarized below.

### A. ESCO-user-bank facilitation and Product-service-aggregator models

To service the hot water demand of hotels, hospitals and education institutions, ESCOs may operate through the ESCO-User-Bank facilitation model and/or as a Product-Service-Aggregator. However, it would be difficult for the ESCO to operate through the ESCO-User-Bank facilitation model to service the hot water demand of independent domestic households as monitoring and verification in case of these users would be an issue. However, if the ESCO services the hot water needs of households through an RWA, then the ESCO-user-bank facilitation model would be a viable option. The product-service aggregator model of operation would encourage small (ESCO)

players with limited financing capability to service hot water demands of a particular demand segment.

**B. Shared-savings model**

For servicing hot water demand in army establishments, hotels, hospitals and education institutions: since metering of hot water service is not mandatory in this model, the model will not work in commercial institutions.

This model of operation will work in Gurgaon for servicing hot water demand of new residential complexes. With the mandatory requirement of solar water heating facilities in new buildings, this will be a viable model. Further, these new buildings may use hot water service provision as a marketing tool for its customers along with uninterrupted power supply 24x7 gas supply.

**C. Utility-ESCO model**

The utility-ESCO model has a significant potential of servicing hot water needs across all demand segments in Gurgaon. This is because the city has huge power shortage problems and if the utility is offered an alternate mode to bring down its load, it will be willing to implement the model. An ESCO that services hot water demand of all the electricity consumers in Gurgaon will offer a significant load-shaving opportunity for the electricity utility.

Further, in the future if solar water heating application qualifies under the mandatory renewable purchase obligation then the ESCO would be eligible to receive renewable energy certificates which it may further sell to the utility to meet its RPO targets.

**D. User-financing model**

The success of operating through this model depends on the willingness of the end-user to own the system and its ability to arrange for financing. In Gurgaon, this model may be applicable for servicing hot water needs of certain independent households, government housing colonies, industrial applications, large hotels and hospitals.

## *2.3. HARIDWAR & RISHIKESH*

In Haridwar and Rishikesh as a tourist and religious cluster, the demand segments that use hot water are dharamshalas, ashrams, hotels, government housing societies, non-government independent houses and industry units in the neighbouring Ranipur district. The business models through which the ESCOs may service the hot water demand of these segments and related issues have been summarized below.

**A. ESCO-user-bank facilitation and Product-service-aggregator models**

These two models of operation may be used by the ESCO to service hot water needs of the industrial clusters in the neighbouring district of Ranipur and big hotels in Rishikesh. However, it would be difficult for the ESCO to operate through the ESCO-User-Bank facilitation model to service the hot water demand of independent domestic households as monitoring and verification in case of these users would be an issue.

**B. Shared-savings model**

For servicing hot water demand in big hotels and industries: since metering of hot water service is not mandatory in this model, the model will not work in such institutions.

This model of operation will work in Haridwar for servicing hot water demand of ashrams and dharamshalas. This is because if there is a demand for hot water in these institutions, then offering a discount in their current electricity bill as shared savings would be attractive for these institutions.

**C. Utility-ESCO model**

The utility-ESCO model will have a good potential of catering to the hot water demand of the ashrams, dharamshalas and independent domestic households.

**D. User-financing model**

The success of operating through this model depends on the willingness of the end-user to own the system and its ability to arrange for financing. In Rishikesh, this model may be applicable for servicing hot water needs of certain independent households and large hotels.

## *2.4. TIRUPUR*

In Tirupur, the only demand segment for hot water requirement comprises of the dyeing units of the textile industry. The business models through which the ESCOs may service the hot water demand of these segments and related issues have been summarized below.

**A. ESCO-user-bank facilitation and Product-service-aggregator models**

The ESCO-user-bank facilitation model would be the most viable option of servicing the hot water demand of the dyeing units in Tirupur. The product-service aggregator model may not work in the region because of the volume of demand which would necessitate a significant investment by the ESCO on size of equipment to service the demand. As discussed earlier, the product-service aggregator model would be the preferred option of service delivery by an ESCO which is a relatively small player with limited financing capability, and hence would not be applicable for servicing the hot water requirement of the dyeing units of Tirupur.

**B. Shared-savings model**

As explained earlier, since metering of hot water service is not mandatory in this model, the model will not work in servicing the hot water demand of the dyeing units in Tirupur.

### C. Utility-ESCO model

Since electricity is not the alternate fuel for heating water in Tirupur, the role of utilities in promoting hot water service provision through an ESCO would be limited. This model may not work for servicing the hot water demand of the dyeing units in Tirupur.

### D. User-financing model

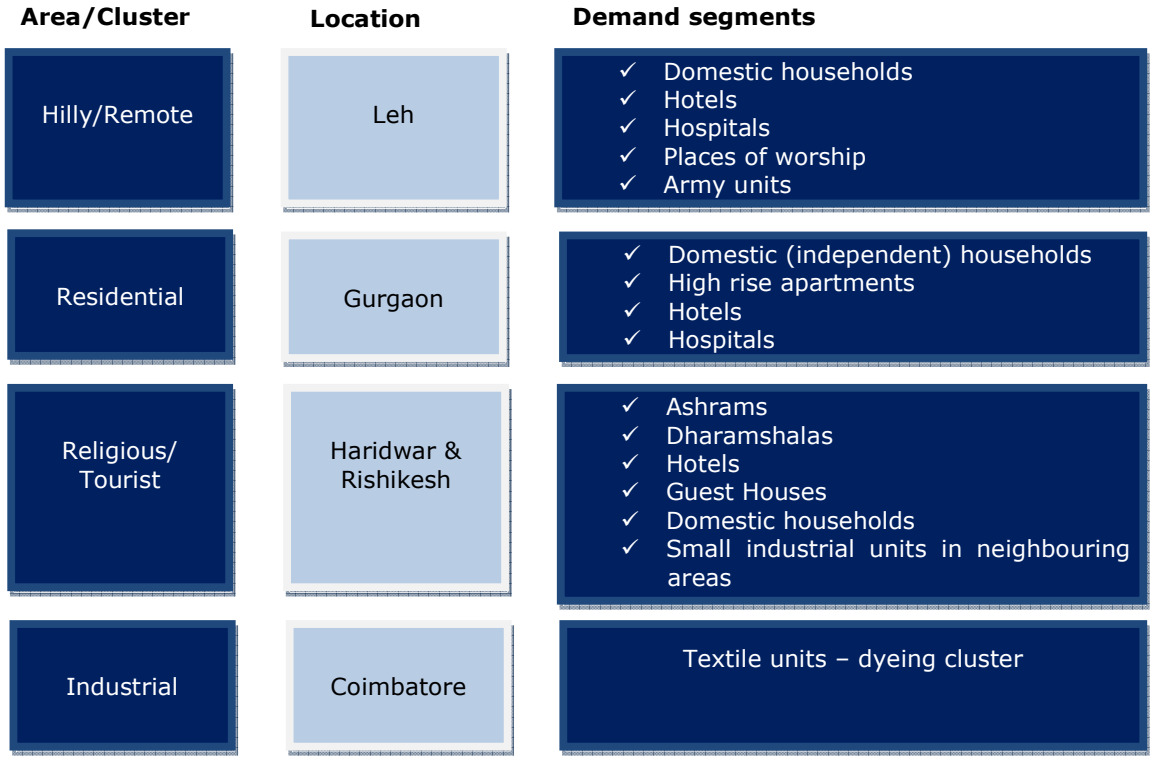
The success of operating through this model depends on the willingness of the end-user to own the system and its ability to arrange for financing. In Tirupur, this model may not be applicable for servicing hot water needs of the dyeing units.

# 3. FINANCIAL MODELLING APPROACH AND RESULTS

As discussed in the previous chapter a market assessment was undertaken to assess the demand for hot water and the willingness of end-users to purchase hot water from a service company. Based on the results from the market assessment financial models have been developed for all the four areas. This section of the report discusses the financial modelling approach, assumptions that are used for developing the area specific financial model and the results from these models.

The figure below illustrates the demand segments in each of the four areas that have been considered.

**Figure 26: Demand segments assumed to be catered by the ESCO**




Area/cluster specific financial models have been designed for each of the four identified clusters. It has been assumed that the ESCO is servicing the hot water requirements of all the demand segments as illustrated in the figure. The period of the hot water service being provided by the SWH ESCO has been assumed as 10 years. Since the current Renewable Energy Certificate regulatory framework in India does not permit solar water heating as an eligible resource, these certificates have not been factored into the financial model.

*As per section 2.1 of the REC regulation, this procedure shall be applicable to all the generating companies engaged in* ***generation of electricity from renewable energy sources*** *such as small hydro, wind, solar including its integration with combined cycle, biomass, bio fuel cogeneration, urban or municipal waste and such other sources as recognised or approved by Ministry of New and*

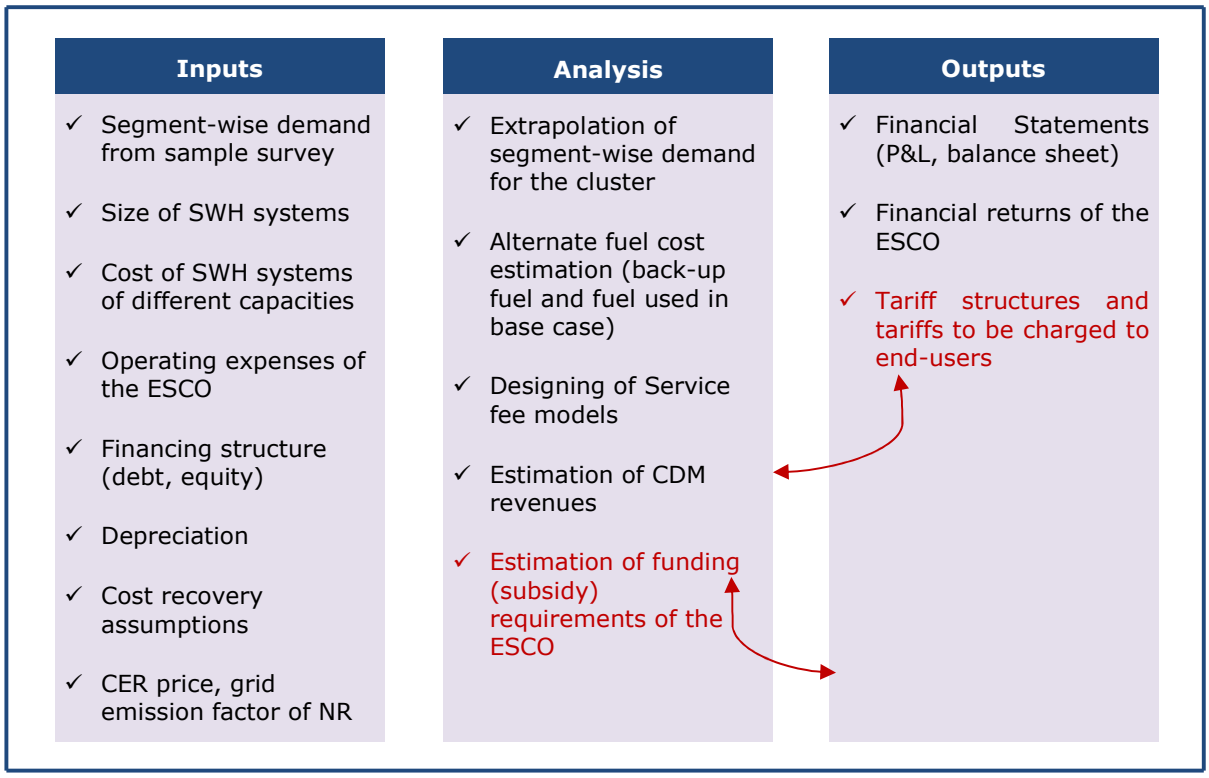
*Renewable Energy for their Renewable Energy Power Projects subject to fulfilment of eligibility conditions for participating in REC mechanism on or after April 1, 2010 in accordance with the provisions stipulated under the CERC REC Regulations.*

If solar water heating qualifies as an eligible technology under the REC regulations in the future, SWH ESCO will be eligible for receiving the certificate revenues and will need to be factored into the ESCO business and financial model. To that extent, the capital subsidy applicable for the ESCO will need to be relooked into.

Further, since there is no current framework for white certificates in the country, as and when this mechanism develops in the near future, the additional revenues from this source will need to be factored into the ESCO's business and financial model

The approach of designing the financial model in terms of defining the inputs, types of analysis and outputs from the model has been illustrated in the figure below.

**Figure 27: Structure of the SWH ESCO financial model**




As illustrated in the above figure, the financial model has three parts:

- **Inputs** – this part of the model comprises of the key assumptions and inputs from the market assessment that was carried out

- **Analysis** – this forms the core of the financial model where different types of analysis such as demand extrapolation, structuring of the fee model along with design of the subsidy levels suitable for the ESCO has been carried out

- **Outputs** – this is in the form of financial statements, financial ratios and charges for the hot water service

There are some components in the model such as per litre hot water charges and subsidy requirements of the ESCO that have been kept as dynamic variables which may be changed to determine the returns of the ESCO at different levels. The different components have been briefly described below.

**Inputs**

The key input components for the model have been described below.

**Table 17: Model input components**

| Inputs | | Description |
|---|---|---|
| **Demand components** | • Segment-wise demand from sample survey | • The segment-wise demand for hot water (in LPD) has been taken as an input from the **area based survey** that was carried out in phase 1 |
| | • Willingness to use SWH systems | • This has been captured through the **area based sample survey** that was carried out (in %) and has been used as an input in the model. The willingness varies across segments |
| | • Ability to convert | • Although there is a willingness to use SWH systems, it may not be technically feasible to convert all current water heating devices to SWH systems.<br>• Based on the location and expert consultation, a relevant percentage has been assumed as the ability to convert to SWHS |
| | • Willingness to pay to the ESCO | • This has once again been captured through the **area based sample survey** that was carried out (in %) and has been used as an input in the model. |
| | • Size of the SWH system | • The size of the SWH system segment-wise has been **derived from the demand** (in LPD) |
| **Cost elements** | • Cost of the system | • The costs have been assumed for a **ETC based system**.<br>• The costs of different capacity systems has been assumed keeping in mind the **MNRE prescribed the upper limit cost of SWHS** |

| Inputs | | Description |
|---|---|---|
| | | for the purpose of extending loans by Banks/ FIs.<br>• The system cost includes the **cost of collectors, insulated hot water storage tank, system piping, instrumentation, electrical back up, controls, installation, and five year warranty** |
| | • Operating expenses of the ESCO | • The Opex of the ESCO has been assumed to include **back-up costs, manpower costs, cost of spares and rent for office space**. |
| | • Financing structure | • Debt: Equity Ratio = 4<br>• Cost of short-term debt = 12.0%<br>• Cost of short-term debt = 12.5%<br>• Repayment of debt over 5 years |
| **Cost recovery** | | • Apart from the per unit usage charges, the ESCO will charge (a) **one-time refundable security deposit** and (b) a **percentage of the installation charge** from the end-user |
| **CDM assumptions** | | • CER Price @ Euro 10<br>• Crediting period = 10 years (fixed) |

**Analysis**

The various analysis methods that have been used in the model have been described below.

**Table 18: Description of Analysis**

| Inputs | Description |
|---|---|
| **Segment-wise demand estimation for the cluster** | • The demand as obtained in the sample survey has been extrapolated to the entire cluster's demand for hot water<br>• The total number of households, hotels, hospitals, ashrams, places of worship (wherever relevant) of year 2009-10 has been taken as base[2]<br>• If A = total no. of households, hotels, hospitals |

[2] An exception to this is in the case of Leh, where the total no. of households, hotels, hospitals and places of worship has been taken from the Ladakh Solar Energy Master Plan

| Inputs | Description |
|---|---|
| | B = actual units to be served by the ESCO<br>W = Willingness to use SWH<br>X = Ability to convert<br>Y = Penetration level<br>Z = Willingness to pay to the ESCO, Then<br>• B = A*W*X*Y*Z<br>• The total hot water demand (in LPD) from a particular segment in a cluster has been computed by multiplying the actual number of units to be served by the ESCO by the system size (input) |
| **Alternate fuel cost estimation** | • For every demand segment, 2 options of servicing hot water has been factored – with back-up and without back-up<br>• While computing the back-up costs, depending on the base fuel which is used to heat water, e.g. electricity, gas, LPG, firewood, the per unit cost of the alternate fuel has been computed<br>• The number of days of usage of back-up fuel varies according to the location of the cluster |
| **Sources of revenue for the ESCO** | • Per litre charge for hot water service<br>• CDM revenues – the base fuel for heating hot water has been assumed as LPG or electricity depending on the actual usage (as captured in the survey), the tCO2eq. has been computed and depending on the location of the area, the corresponding grid emission factor has been used to arrive at the CERs. The CDM revenues have been computed by multiplying the price of CERs (input) with the total number of CERs.<br>• Capital subsidy for the ESCO as a percentage of the total cost of equipment has been considered as 30%. This factor has been kept as variable for assessing the financial viability. |

**Outputs**

The key outputs of the financial model are:

- Financial statements of the ESCO
    - Profit and Loss Statement

- Balance Sheet
- Cash Flows

- Financial Ratios
  - Project Returns
  - Equity Returns

- Tariffs to be charged to the end-user
  - Fixed monthly charge and
  - Variable per litre charge

The following sub-sections elaborate the region-specific assumptions and results of the financial models.

## 3.1. LEH

The segments captured for hot water service in the Leh region are domestic, places of worship, hotels, hospitals and army establishments. The following table provides the assumption used for developing the financial models for Leh region.

**Table 19: Assumptions used for Leh- ESCO model**

| Description | Domestic | Place of worship | Hotels | Hospitals | Army |
|---|---|---|---|---|---|
| Total Units/ Establishments | 6064 | 544 | 209 | 28 | 621 |
| Units that could convert based on willingness and ability to convert | 4245 | 381 | 146 | 20 | 435 |
| Antifreeze considered | Yes | No | No | Yes | Yes |
| Project life considered (Years) | 10 | 10 | 10 | 10 | 10 |
| Total collector area (Sq. Mtrs) | 8490 | 762 | 2926 | 274 | 8694 |
| Number of days | 300 | 175 | 175 | 300 | 300 |

| Description | Domestic | Place of worship | Hotels | Hospitals | Army |
|---|---|---|---|---|---|
| of operation | | | | | |
| Back-up considered | No | No | Yes | Yes | Yes |
| Back-up used | NA | NA | LPG | LPG | LPG |
| Back-up days | NA | NA | 50 | 50 | 50 |
| Average size considered (LPD) | 100 | 100 | 1000 | 700 | 1000 |
| Cost (Rs. Per Ltrs.) | 180 | 200 | 200 | 180 | 180 |
| CDM revenues considered | Yes | Yes | Yes | Yes | Yes |
| CER rate (Eur/CER) (*last two years average) | 10.40 | 10.40 | 10.40 | 10.40 | 10.40 |

Based on the assumptions as discussed in the table above the following the following results have been arrived at for a ESCO model operating in Leh

**Table 20: Results of Leh ESCO model**

| Description | Units | Results |
|---|---|---|
| Hot water charge | Rs./Ltrs | 0.28 |
| Project IRR (Post tax) | % | 20 |
| Payback (Post tax) | Year | 5 |
| DSCR (Average) | # | 1.03 |

## *3.2. GURGAON*

The segments captured for hot water service in the Gurgaon has a mix of high rise and independent domestic households, hospitals, hotels and guest houses. The following table provides the assumption used for developing the financial models for Gurgaon.

**Table 21: Assumptions used for Gurgaon- ESCO model**

| Description | Independent | High rise | Hospitals | Hotels | Guest houses |
|---|---|---|---|---|---|
| Total Units/ Establishments | 23336 | 35004 | 80 | 54 | 2000 |
| Units that could convert based on willingness and ability to convert | 15311 | 17863 | 41 | 28 | 1166 |
| Antifreeze considered | No | No | No | No | No |
| Project life considered (Years) | 10 | 10 | 10 | 10 | 10 |
| Total collector area (Sq. Mtrs) | 30622 | 35725 | 816 | 386 | 6998 |
| Number of days of operation | 210 | 210 | 300 | 300 | 270 |
| Back-up considered | No | No | Yes | Yes | Yes |
| Back-up used | NA | NA | Electricity | Electricity | Electricity |
| Back-up days | NA | NA | 50 | 50 | 50 |
| Average size considered (LPD) | 100 | 100 | 1500 | 1500 | 300 |
| Cost (Rs. Per Ltrs.) | 180 | 180 | 180 | 180 | 180 |
| CDM revenues considered | Yes | Yes | Yes | Yes | Yes |
| CER rate (Eur/CER) (*last two years average) | 10.40 | 10.40 | 10.40 | 10.40 | 10.40 |

Based on the assumptions as discussed in the table above the following the following results have been arrived at for a ESCO model operating in Gurgaon.

**Table 22: Results of Gurgaon ESCO model**

| Description | Units | Results |
|---|---|---|
| Hot water charge | Rs./Ltrs | 0.59 |
| Project IRR (Post tax) | % | 20 |
| Payback (Post tax) | Years | 5 |
| DSCR (Average) | # | 1.08 |

## *3.3. TIRUPUR*

Tirupur is an industrialised town near Coimbatore. Tirupur is well known for its dying units. As discussed in the earlier section of this report a market analysis has been done for identifying the hot water demand in this region. Owing to the nature of industries Tirupur has a very high demand of hot water demand. The following table provides the assumptions used for developing the financial model for Tirupur.

**Table 23: Assumptions used for Tirupur- ESCO model**

| Description | Dyeing units |
|---|---|
| Total Units/ Establishments | 799 |
| Units that could convert based on willingness and ability to convert | 291 |
| Antifreeze considered | No |
| Project life considered (Years) | 10 |
| Total collector area (Sq. Mtrs) | 270849 |
| Number of days of operation | 300 |
| Back-up considered | No |
| Back-up used | NA |
| Back-up days | NA |
| Average size considered (LPD) | 46500 |
| Cost (Rs. Per Ltrs.) | 180 |
| CDM revenues considered | Yes |
| CER rate (Eur/CER) (*last two years average) | 10.40 |

Based on the assumptions as discussed in the table above the following the following results have been arrived at for a ESCO model operating in Tirupur.

**Table 24: Results of Tirupur ESCO model**

| Description | Units | Results |
|---|---|---|
| Hot water charge | Rs./Ltrs | 0.21 |
| Project IRR (Post tax) | % | 20 |
| Payback (Post tax) | Year | 4 |
| DSCR (Average) | # | 1.07 |

## 3.4. HARIDWAR- RISHIKESH

The segments captured for hot water service in the Haridwar are primarily ashrams, dharamshalas, and residential segments. The segments captured for hot water service in Rishikesh are hotels, ashrams and residential segments. Ranipur is an industrialised town near Haridwar and has is famous for the BHEL establishment. The following table provides the assumption used for developing the financial model for Haridwar-Rishikesh and Ranipur together.

**Table 25: Assumptions used for Haridwar-Rishikeh and Ranipur ESCO model**

| Description | Residential | Ashrams | Daramshalas | Hotels | Industries |
|---|---|---|---|---|---|
| Total Units/ Establishments | 54993 | 350 | 340 | 152 | 25 |
| Units that could convert based on willingness and ability to convert | 11087 | 102 | 99 | 28 | 23 |
| Antifreeze considered | No | No | No | No | No |
| Project life considered (Years) | 10 | 10 | 10 | 10 | 10 |
| Total collector area (Sq. Mtrs) | 22,173 | 612 | 1,388 | 277 | 1,800 |
| Number of days of operation | 300 | 300 | 300 | 300 | 300 |
| Back-up considered | No | No | Yes | Yes | Yes |
| Back-up used | Electricity | Electricity | Electricity | Electricity | Electricity |

| Description | Residential | Ashrams | Daramshalas | Hotels | Industries |
|---|---|---|---|---|---|
| Back-up days | NA | NA | 50 | 50 | 50 |
| Average size considered (LPD) | 100 | 300 | 700 | 500 | 4000 |
| Cost (Rs. Per Ltrs.) | 180 | 180 | 180 | 180 | 180 |
| CDM revenues considered | Yes | Yes | Yes | Yes | Yes |
| CER rate (Eur/CER) (*last two years average) | 10.40 | 10.40 | 10.40 | 10.40 | 10.40 |

Based on the assumptions as discussed in the table above the following the following results have been arrived at for a ESCO model operating in Haridwar

**Table 26: Results of Haridwar ESCO model**

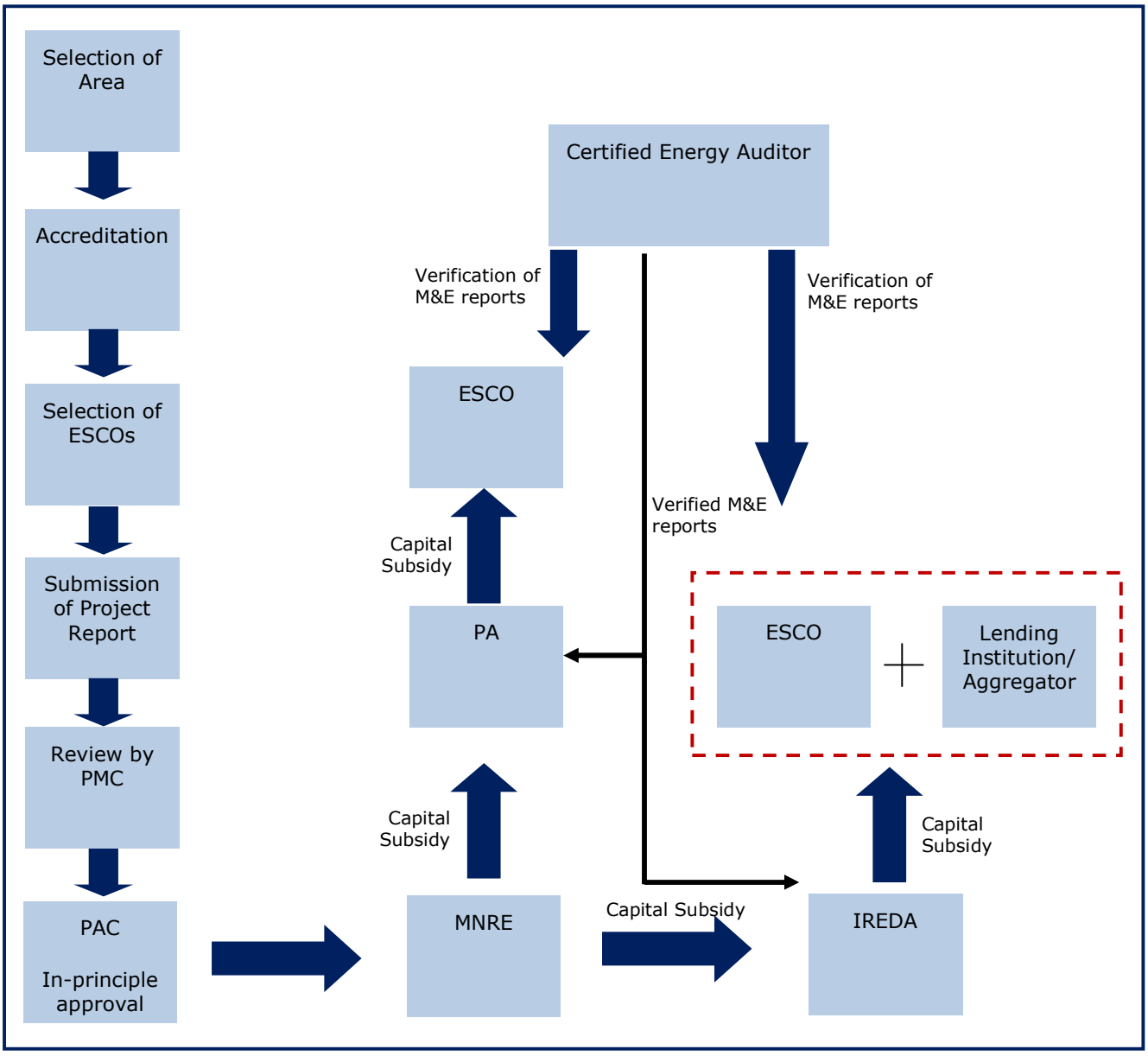
| Description | Units | Results |
|---|---|---|
| Hot water charge | Rs./Ltrs | 0.85 |
| Project IRR (Post tax) | % | 20 |
| Payback (Post tax) | Year | 5 |
| DSCR (Average) | # | 0.99 |

# VIII. IMPLEMENTATION GUIDELINES

This chapter provides some of the key elements of the implementation guidelines that will be developed for implementing the area based ESCO model. A detailed note on these guidelines is provided in annex 6.

A simplified illustration of the implementation model has been provided in Figure 28.

**Figure 28: Illustration of implementation model**



Some of the key aspects of the implementation guidelines have been elaborated below. The detailed implementation guidelines have been provided at Annex 6.

**1. Selection of area**

The ESCO will be required to service the hot water requirements based on a solar water heating system of a particular area. The selected area will be known as *'Designated Area'*. This area will be selected

- By MNRE or
- Programme Administrator (PA) or
- On suo-moto basis by the ESCO

In any of the above mentioned cases, the selected area has to be approved by MNRE

**2. Accreditation of ESCOs**

For participating in the Area based ESCO Model for Solar Water Heating program, the ESCOs need to directly approach certified accreditation agencies (CRISIL, ICRA, CARE, etc) for getting accredited. These accreditation guidelines are to be outlined by September 2010.

**3. Selection of ESCOs**

A two stage selection process will be followed for selection of accredited ESCOs – Request for Proposal (RfP) and Evaluation of RfPs.

**3.1 Floating of RfP and Submission of Proposal by ESCOs**

- For the first four pilot projects the selection is to be done by MNRE and subsequently the selection of the ESCOs will be done by the PAs
- At the time of submission of proposals, the ESCO will be required to submit the following supporting documents/information to MNRE
    - Accreditation certificate
    - Commercial, Financial and Business model details
    - Relevant MOU/Contract with the appropriate channel partner (PA/IREDA/Scheduled Commercial Bank)

**3.2 Evaluation of RfP**

- The RfP will be evaluated based on certain technical and financial criteria.

- Only accredited ESCOs will be eligible for the capital subsidy

**4. Funding pattern**

Funding under the scheme would be in project mode i.e. there must be a project report which would include client details, technical and financial details, O&M and monitoring arrangements.

- MNRE will provide capital subsidy directly to the ESCO provided they can tie up with a lending institution. These lending institutions could then enter into an agreement for refinance/interest subvention with IREDA. MNRE will provide IREDA fund handling charges at the rate of 2% for the capital subsidy/interest subvention portion.

- MNRE will provide capital subsidy to the PA and PA shall enter into Memorandum of Understanding (MoU) with the ESCO for disbursement of capital subsidy

- Carbon financing – MNRE will facilitate access to carbon finance

**5. Monitoring and evaluation**

The performance of the ESCO needs to be monitored on a regular basis to avoid instances of default by the entity. Some of the aspects that have been incorporated in the guidelines have been highlighted below.

- The ESCO will submit the report as per approved performance formats. These formats to include:
    - Basic data on number of installations and system capacities
    - Account of complaints and redressal of the same
    - Utilization of MNRE approved subsidy
- It is envisaged that certified energy auditors would be empanelled for certifying whether the outputs of the system correspond to the parameters laid down in the in-principle approval for non credit linked projects
- This verified M&E report of the ESCO will be submitted by the certified energy auditors to the MNRE either through IREDA or the PA, as the case may be

**6. Consumer protection**

The following key points with respect to consumer protection have been incorporated in the guidelines

- **Performance obligation and guarantee to customer** – this is to be assured through

- Number of days of assured availability of the hot water service – this will be separate in case of back-up vs. no back-up cases

- **Area coverage** – ESCOs should endeavour to cater to all demand segments in an identified cluster which will enable in scaling of SWH usage

- **Redressal mechanism**

  - PA will act as a nodal agency for receiving complaints against the ESCO

  - In case of a genuine default by the ESCO, the accreditation may be withdrawn

- **Contractual documentation**

  - The framework for the contract that the ESCO will be entering into with the end-user has been included in the implementation guidelines. The ESCO standard contract will be lodged with the PAs.

### 7. Awareness creation of end-users

Since provision of hot water as a service is a new and innovative concept in India, there will be a need for an extensive awareness creation of the end-users of this service.

For this, standard communication regarding solar water heating and ESCO model of serving hot water will be prepared by MNRE/IREDA and circulated to ESCOs who will then communicate this to the end-users.

### 8. Capacity building of ESCOs by MNRE on implementation of the model

As mentioned earlier, since hot water provision through a solar water heating device by an ESCO is a relatively new concept, an extensive capacity building of existing ESCOs will be undertaken by the MNRE on implementation of the model.

The table below provides a summary of the roles and responsibilities of the various entities involved in the implementation of this model.

**Table 27: Summary of roles and responsibilities of different entities**

| S.No. | Agencies | Roles and responsibilities |
|---|---|---|
| 1 | Ministry of New and Renewable Energy | ✓ Selection of area (For the first four pilot projects)<br>✓ Selection of ESCOs (for the first four pilot projects)<br>✓ Preparation of framework of sample standard contracts<br>✓ Subsidy funding |

| S.No. | Agencies | Roles and responsibilities |
|---|---|---|
| | | ✓ Assistance in carbon finance<br>✓ Awareness creation of end-users<br>✓ Capacity building of ESCOs |
| 2 | Indian Renewable Energy Development Agency | ✓ Providing refinance<br>✓ Disbursing capital subsidy in case the ESCO ties up with a lending institution and approaches MNRE directly for the capital subsidy<br>✓ Providing the verified M&E reports provided by the certified energy auditor to the MNRE for release of subsidy funds |
| 3 | Lending Institutions | ✓ Providing concessional finance for equipment and working capital<br>✓ Acting as aggregators and assisting ESCOs in accessing the capital subsidy from MNRE<br>✓ Awareness creation of end-users |
| 4 | Program Administrators (PAs) to include: Central and State Government Ministries and Departments and their organizations, State Nodal Agencies, Utilities, local bodies, PSUs and reputed Non-Governmental Organizations | ✓ Selection of area<br>✓ Selection of ESCOs<br>✓ Channelling the capital subsidy to the ESCO<br>✓ Review of consumer complaints |
| 5 | Certified Energy Auditors | ✓ Verification of M&E reports of the ESCO<br>✓ Verification of Baseline calculations<br>✓ Providing M&E reports of the ESCO to the PA on request by the latter |
| 6 | ESCO | ✓ Selection of area<br>✓ SWH service<br>✓ Operation and maintenance of system<br>✓ Ensuring system availability to guaranteed levels<br>✓ Preparing and submitting M&E reports |

# IX. ANNEXES

## ANNEX 1 – APPROACH OF AREA SPECIFIC MARKET ASSESSMENT

This annex summarizes the detailed sampling approach for each of the four identified areas and provides the questionnaires that have been used for the area-specific surveys.

**SAMPLING DESIGN**

Taking into account the heterogeneity among each demand segment, separate samples were structured for and within each demand segments.

**Gurgaon**

An adequate sample was structured for different respondents within each demand segment to map the demand trends and existing service mechanisms in place. The sample from residential demand segment was drawn following a stratified sampling approach. Various factors were taken into account in stratifying the population. These include:

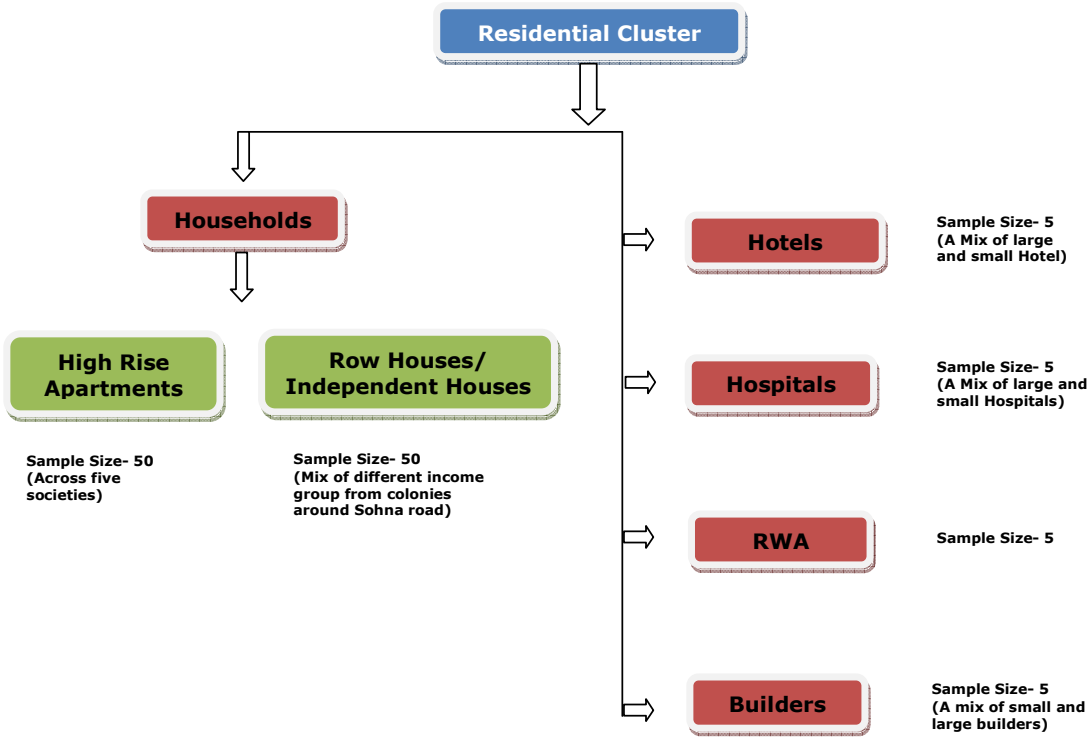
- Geographical spread
- Sectors/User group (Residential Household, Institutional)
- Type of settlement (Row houses/ independent houses, high rise apartments)
- Income group mix

For the purpose of this assessment the sample was restricted to 120 sample units (stratified as per above mentioned criteria). This is done to ensure that the survey can be administered with care and accuracy for the chosen sample. At the same time, the practice of stratification and the uniformity within each stratum ensures that the sample of 120 would be close representation of the population.

Out of the total, 120 sample units, 20 sample units were targeted from Hotels, Hospitals, Resident Welfare Associations (RWA) and Builders (5 sample units from each sector/ user group). While 100 sample units were targeted from residential household sector. Hospitals and hotels were chosen taking into consideration their high consumption of hot water and steam. In order to make the sample more representative to the population, the 100 residential household sample units was further divided equally into row houses/ independent houses and high rise apartments. Thus, 50 sample units from each stratum were selected through Simple Random Sampling without Replacement (SRSWR) methodology. The survey was administered with great care to ensure coverage from different income group.

The sample structure for residential cluster is summarized below:

**Figure 1: Sample structure for the Residential Cluster**




**Haridwar and Rishikesh**

The sample from Religious Township/ Tourist Center was drawn following a stratified sampling approach to map the demand trends and existing service mechanisms in place. Various factors were taken into account for stratification, these include:

- Type of Institution (Ashrams, Dharamshalas, Hotels/ Guest Houses, Residences, Industrial units)
- Size of Institution (Number of Rooms/Beds)
- Geographical Spread

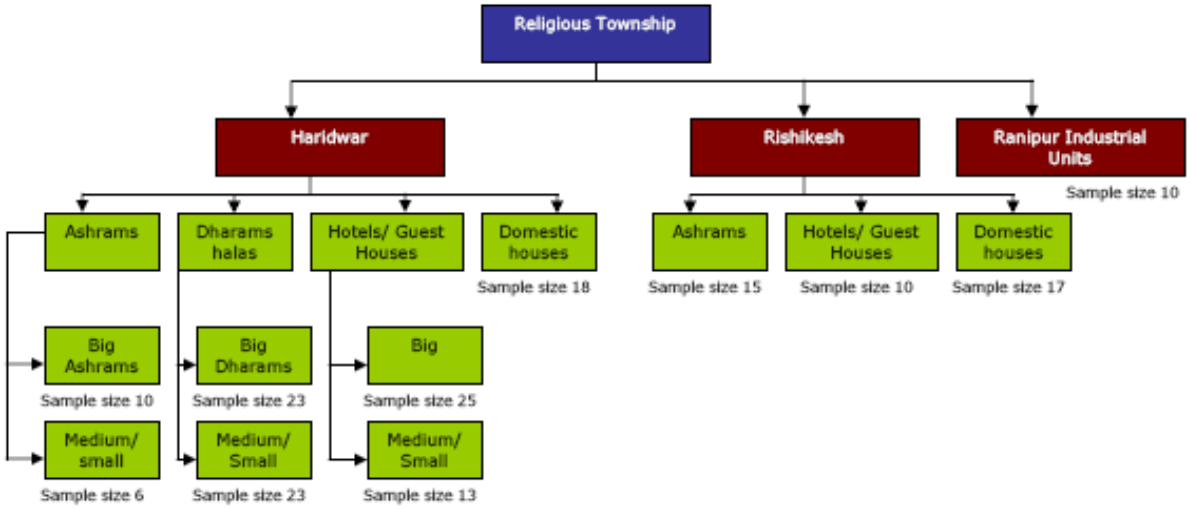
For the purpose of this assessment the sample was restricted to 170 sample units (stratified as per above mentioned criteria). This is done to ensure that the survey can be administered with care and accuracy for the chosen sample. At the same time, the practice of stratification and the uniformity within each stratum ensures that the sample of 170 would be close representation of the cluster.

Out of the total, 170 sample units, 16 sample units were targeted from a mix of large, medium and small ashrams in Haridwar. While 46 sample units were targeted from a mix of large, medium and small dharamshalas in Haridwar and 38 sample units were targeted from a mix of large, medium and small hotels and guest houses in Haridwar. In Rishikesh, 10 hotels and 15 ashrams were

surveyed. Ashrams, dharamshalas, hotels and guest houses were chosen taking into consideration their high consumption of hot water. Apart from this, in order to ensure completeness of the cluster, 16 residences in Haridwar, and 17 households in Rishikesh were surveyed along with 10 industrial units in Ranipur district were surveyed for hot water demand and willingness to convert to an ESCO based SWH model. Sample units from each stratum were selected through Simple Random Sampling without Replacement (SRSWR) methodology.

The sample structure for Religious Township/ Tourist Center is summarized below:

**Figure 2: Sample structure for religious township**



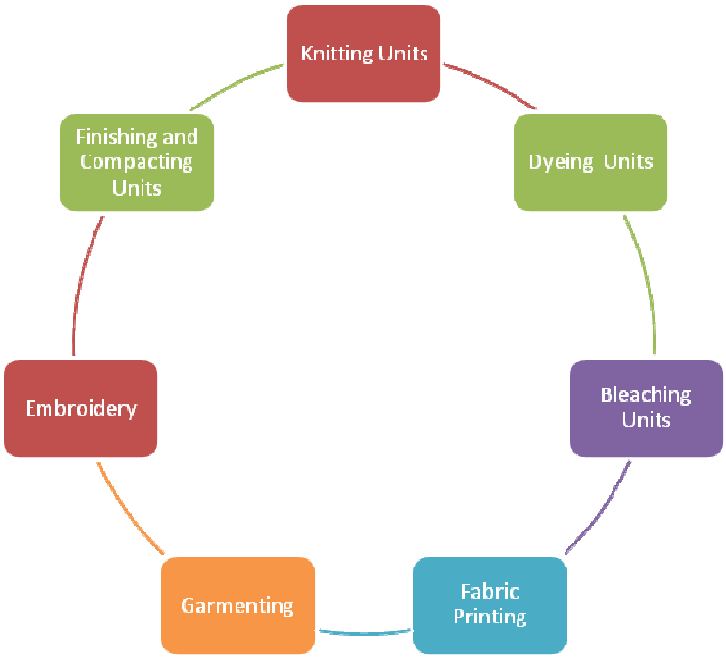

**Coimbatore/Tirupur**

The approach and methodology adopted to conduct the market assessment in the industry cluster was largely consultative. The framework of our approach, methodology and sample for industry cluster was tweaked. The two stage approach and methodology used for industry cluster include:

- Identification of Key Parameters
- Focus Group Discussion and Data Collection

More than 6,500 units are operational in and around Tirupur. The town is known for its cluster approach and each activity of garment making is being carried out by a different unit. Major units around Tirupur are Knitting Units, Dyeing Units, Bleaching Units, Fabric Printing, Garmenting, Embroidery, Finishing & Compacting Units and Calendaring and other ancillary units.

**Figure 3: Major units operating in Tirupur**




Based on the preliminary research prior to the field visit and discussion with the industrial associations of Tirupur it was learnt that the 730 dyeing and bleaching units are the major users of water, including hot water. According to the data of dyers association, all other units put together use an insignificant amount of hot water as compared to the dyeing and bleaching units.

It was also learnt that, 20 Centralized Effluent Treatment Plants (CETP) have been set up in Tirupur, serving 529 dyeing and bleaching units; the remaining 200 units have their own Effluent Treatment Plants. These CETP's are treating the effluent water of all the networked units at a centralised location and sending it back to the units. Thus, CETP's are an important source of information on water usage in the networked plants.

Considering the above facts, the study team's strategy focused on meeting the representatives of industry associations, CETP's, dyeing and bleaching units to understand the trend of hot water usage in different process and collect relevant quantitative and qualitative data for demand assessment.

**Leh**

The sample from Remote Hilly Region was drawn following a stratified sampling approach to map the demand trends and existing service mechanisms in place. Various factors were taken into account for stratification, these include:

- Geographical spread
- Sectors/User group (Residential Household, Institutional including hotels guest houses and Army Establishments)
- Income group mix
- Size of Institution ( Number of Rooms/Beds)

For the purpose of this assessment the sample was restricted to 95 sample units (stratified as per above mentioned criteria). This is done to ensure that the survey can be administered with care and accuracy for the chosen sample. At the same time, the practice of stratification and the uniformity within each stratum ensures that the sample of 95 would be close representation of the population.

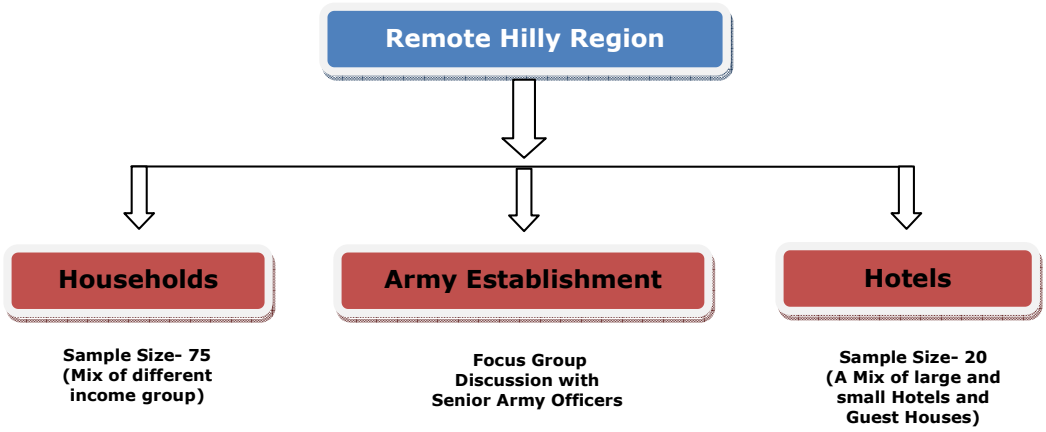
Out of the total, 95 sample units, 20 sample units were targeted from the institutional sector i.e. Hotels/Guest houses. While 75 sample units were targeted from residential household sector. Hotels and guest houses were chosen taking into consideration their high consumption of hot water. In order to make the sample more representative of the population, sample units from each stratum were selected through Simple Random Sampling without Replacement (SRSWR) methodology from different locations within the town. The survey was administered with great care to ensure coverage from all sections of the society.

A focus group discussion with senior army officials was conducted for understand the trend of hot water usage in army camps across Leh region. The discussion also focus on understanding the following

- Current mechanism in place for supplying hot water
- Fuel/used
- Related cost implication
- Challenges in the area
- Proper channel to service army establishments, etc

The sample structure for Remote Hilly Region is summarized below:

**Figure 4: Sample structure of remote/hilly region**




**QUESTIONNAIRE DESIGN**

Based on the identified focus area and sampling design, separate questionnaires for primary data collection from residential household, hotels, hospitals, RWAs and builders were developed. Special care was taken to make the questionnaires simple and to the point.

A training program was conducted to train the field executives prior to the survey. The training program focused on educating the field executives about the background of study as well as familiarizing them with the focus area and questionnaire.

**FIELD SURVEY**

The field survey largely involved identification of respondents in conformity with sampling design and then administering the questionnaire to identified respondents through personal interviews. Teams with appropriate skill sets were constituted to undertake the survey at different identified location. Apart from the field executives, one supervisor was also appointed to supervise the data collection activity and quality control.

Senior team members were involved in focus group discussions and primary data collection from the identified institutional sample units as the army, industry, hotels, hospitals, real estate developers and RWAs.

# ANNEX 2 – MARKET ASSESSMENT QUESTIONNAIRES

**Questionnaire – Domestic**

1. Respondents Details

| | | |
|---|---|---|
| a. | Name | |
| b. | Address | |
| c. | Communication Details | Tel No.<br><br>Mobile No. |

2. Respondents Profile –

| | | |
|---|---|---|
| a. | No. of Family Members | Adult<br><br><br>Children |
| b. | Occupation (of respondent) | |
| c. | Monthly Household Income (INR) | |

3. What is the source of water for your house:

| Sr. No. | Source | Percentage |
|---|---|---|
| a. | Piped Supply | |
| b. | Bore Well | |
| e. | Any Other, pls Specify | |

4. What do you use hot water for? (Tick Multiple Options)

| | | |
|---|---|---|
| a. | Bathing | |
| b. | Cooking | |

| | | |
|---|---|---|
| c. | Washing Clothes | |
| d. | Washing Utensils | |
| e. | Any Other, pls Specify | |

5. Quantity of hot water consumed –

| Sr. No. | Season | In buckets per day |
|---|---|---|
| a. | Summer | |
| b. | Monsoon | |
| c. | Winters | |

6. Fuel used for heating water –

| Sr. No. | Fuel | Percentage |
|---|---|---|
| a. | Electricity | |
| b. | LPG | |
| c. | Kerosene | |
| d. | Natural Gas | |
| e. | Other | |

*If Electricity is not used for heating water, skip Q No. 7*

7. What is your average electricity bill per month -

| Sr. No. | Season | Avg. Monthly Bill in INR |
|---|---|---|
| a. | Summer | |
| b. | Monsoon | |
| c. | Winters | |

*If LPG is not used for heating water, skip Q No. 8 and Q No.9*

8. In case of LPG how many gas cylinders are required per month –

| Sr. No. | Number of Cylinders | Tick One |
|---|---|---|
| a. | Less than 1 | |
| b. | More than 1 but less than 2 | |
| c. | 2 or More | |

9. What is the cost of a LPG cylinder (14.2 Kg) – in INR _____

*If Natural Gas or Piped Gas is not used for heating water, skip Q No. 10*

10. In case of Natural Gas or Piped LPG what is your monthly bill -

| Sr. No. | Season | Avg. Monthly Bill in INR |
|---|---|---|
| a. | Summer | |
| b. | Monsoon | |
| c. | Winters | |

*If kerosene is not used for heating water, skip Q No. 11 and Q No. 12*

11. In case of kerosene what is the monthly requirement of kerosene in liters

| Sr. No. | Season | Avg. Monthly Requirement of Kerosene (Liters) |
|---|---|---|
| a. | Summer | |
| b. | Monsoon | |
| c. | Winters | |

12. What is the rate of Kerosene Rs/ Litre : INR _____

13. How satisfied are you with your current water heating system? (tick one)

| | | |
|---|---|---|
| a. | Highly Satisfied | |
| b. | Adequately Satisfied | |
| c. | Partially Satisfied | |
| d. | Dissatisfied | |

14. Would you be willing to switchover to solar hot water service in case it is made available: **Yes/ No**

    If yes,

| Sr. No. | Price per Litre | Capture Willingness to Pay (Only Highest Value) |
|---|---|---|
| a. | @ 50 p per litre | |
| b. | @ 75 p per litre | |
| c. | @ 100 p per litre | |
| d. | Any other, pls specify | |

15. If yes, what would be the influencing factors for your switchover to solar water heating

| Sr. No. | Factors | Capture Multiple/Single Responses |
|---|---|---|
| a. | Economical | |
| b. | Safer | |
| c. | Convenient | |
| d. | Environment Friendly | |
| e. | Government Order | |
| f. | Other (specify) | |

16. If No, what are the reasons? Please specify

| Sr. No. | Reason | Justification |
|---|---|---|
| a. | | |
| b. | | |
| c. | | |
| d. | | |

17. Which of these is these most suitable billing mode for the hot water supply

| Sr. No. | Mode | Tick One | | |
|---|---|---|---|---|
| a. | Prepaid | Monthly | Quarterly | Half Yearly |
| b. | Post Paid | Monthly | Quarterly | Half Yearly |
| c. | Any other, pls specify | | | |

18. How critical is the hot water usage in the household? (tick one)

| | | |
|---|---|---|
| a. | Very Critical | |
| b. | Moderate | |
| c. | Not Critical | |

19. Would you use any alternate source along with the solar water heating – Yes/ No

If yes, pls specify

**Questionnaire – Builder (High Rise)**

1. Respondents Details

| | | |
|---|---|---|
| a. | Name | |
| b. | Designation | |
| c. | Address | |
| d. | Communication Details | Tel No.<br>Mobile No. |

2. Proposed number of flats in the building/township? **No.** _____

3. What is the proposed source of water:

| Sr. No. | Source | Percentage |
|---|---|---|
| a. | Piped Supply | |
| b. | Bore Well | |
| e. | Any Other, pls Specify | |

4. Is there a provision for centralized hot water system in the building/ township? **Yes/ No**

If No, skip to Q 6

What is the proposed fuel used for heating water -

| Sr. No. | Fuel | Percentage |
|---|---|---|
| a. | Electricity | |
| b. | LPG | |
| c. | Kerosene | |
| d. | Natural Gas | |
| e. | Solar Water Heater | |
| f. | Other | |

5. If you don't have provision for solar water heater, would you be willing to switchover to solar hot water service in case it is made available? **Yes/ No**

   If Yes,

| Sr. No. | Price per Litre | Capture Willingness to Pay (Only Highest Value) |
|---|---|---|
| a. | @ 50 p per litre | |
| b. | @ 75 p per litre | |
| c. | @ 100 p per litre | |
| d. | Any other, pls specify | |

6. **If yes**, what would be the influencing factors for your switchover to solar water heating

| Sr. No. | Factors | Capture Multiple/Single Responses |
|---|---|---|
| a. | Economical | |
| b. | Safer | |
| c. | Convenient | |
| d. | Environment Friendly | |
| e. | Government Order | |
| f. | Other (specify) | |

7. **If No,** what are the reasons? Please specify

| Sr. No. | Reason | Justification |
|---|---|---|
| a. | | |
| b. | | |
| c. | | |
| d. | | |

8. Which of these is these suitable billing mode for the hot water supply

| Sr. No. | Mode | Tick One | | |
|---|---|---|---|---|
| a. | Prepaid | Monthly | Quarterly | Half Yearly |
| b. | Post Paid | Monthly | Quarterly | Half Yearly |
| c. | Any other, pls specify | | | |

9. Would you be comfortable if the solar water heating system covers 80% of your terrace area? **Yes/ No**

   Note: 5 sq mts space is required to provide 100 lpd

10. Is there any space other than the terrace for installing the solar water heating system?

    **Yes/ No**

    ***If yes,*** *pls collect the details of the space*

    _____
    _____
    _____
    _____
    _____

11. What is the monthly maintenance charge proposed to be collected per family? **Rs.** _____

12. Do any of your previous projects have solar water heating system installed? **Yes /No**

**If yes,** what are your and residents experiences? (Pls get contact details of concerned person)

_____
_____
_____
_____

**Questionnaire – Institutional (Hotels/Ashram/Guest House)**

1. Respondents Details

| | | |
|---|---|---|
| a. | Name | |
| b. | Designation | |
| c. | Address | |
| d. | Communication Details | Tel No.<br>Mobile No. |

2. Size of the Institution – No. of Rooms _____

No. of Bed _____

3. What is the source of water:

| Sr. No. | Source | Percentage |
|---|---|---|
| a. | Piped Supply | |
| b. | Bore Well | |
| e. | Any Other, pls Specify | |

4. What do you use hot water for? (Tick Multiple Options)

| | | |
|---|---|---|
| a. | Bathing | |
| b. | Cooking | |
| c. | Washing Clothes | |
| d. | Washing Utensils | |
| e. | Any Other, pls Specify | |

5. What is the average quantity of hot water used per day (in Litre) _____

6. Is there any centralized hot water system in the building? **Yes / No**

7. What is the fuel used for heating water -

| Sr. No. | Fuel | Percentage |
|---|---|---|
| a. | Electricity | |
| b. | LPG | |
| c. | Kerosene | |
| d. | Natural Gas | |
| e. | Other | |

*If Electricity is not used for heating water, skip Q No. 8*

8. What is your average electricity bill per month -

| Sr. No. | Season | Avg. Monthly Bill in INR |
|---|---|---|
| a. | Summer | |
| b. | Monsoon | |
| c. | Winters | |

*If LPG is not used for heating water, skip Q No. 9 and Q No.10*

9. In case of LPG how many gas cylinders are required per month –

| Sr. No. | Number of Cylinders | Tick One |
|---|---|---|
| a. | Less than 1 | |
| b. | More than 1 but less than 2 | |
| c. | 2 or More | |

10. What is the cost of a LPG cylinder (19 Kg) – in INR _____

*If Natural Gas or Piped Gas is not used for heating water, skip Q No. 11*

11. In case of Natural Gas or Piped LPG what is your monthly bill -

| Sr. No. | Season | Avg. Monthly Bill in INR |
|---|---|---|
| a. | Summer | |
| b. | Monsoon | |
| c. | Winters | |

*If kerosene is not used for heating water, skip Q No. 12 and Q No. 13*

12. In case of kerosene what is the monthly requirement of kerosene in liters

| Sr. No. | Season | Avg. Monthly Requirement of Kerosene (Liters) |
|---|---|---|
| a. | Summer | |
| b. | Monsoon | |
| c. | Winters | |

13. What is the rate of Kerosene Rs/ Litre : INR _____

14. How satisfied are you with your current water heating system? (tick one)

| | | |
|---|---|---|
| a. | Highly Satisfied | |
| b. | Adequately Satisfied | |
| c. | Partially Satisfied | |
| d. | Dissatisfied | |

15. Would you be willing to switchover to solar hot water service in case it is made available: **Yes / No**

If Yes,

| Sr. No. | Price per Litre | Capture Willingness to Pay (Only Highest Value) |
|---|---|---|
| a. | @ 50 p per litre | |
| b. | @ 75 p per litre | |

| | | |
|---|---|---|
| c. | @ 100 p per litre | |
| d. | Any other, pls specify | |

16. If yes, what would be the influencing factors for your switchover to solar water heating

| Sr. No. | Factors | Capture Multiple/Single Responses |
|---|---|---|
| a. | Economical | |
| b. | Safer | |
| c. | Convenient | |
| d. | Environment Friendly | |
| e. | Government Order | |
| f. | Other (specify) | |

17. If No, what are the reasons? Please specify

| Sr. No. | Reason | Justification |
|---|---|---|
| a. | | |
| b. | | |
| c. | | |
| d. | | |

18. Which of these is these suitable billing mode for the hot water supply

| Sr. No. | Mode | Tick One | | |
|---|---|---|---|---|
| a. | Prepaid | Monthly | Quarterly | Half Yearly |
| b. | Post Paid | Monthly | Quarterly | Half Yearly |
| c. | Any other, pls specify | | | |

19. Would you be comfortable if the solar water heating system covers 80% of your terrace area? **Yes/ No**

Note: 5 sq mts space is required to provide 100 lpd

20. Is there any space other than the terrace for installing the solar water heating system?

**Yes/ No**

*If yes, pls collect the details of the space*

_____
_____
_____
_____
_____

**Questionnaire – Institutional (Hospitals)**

1. Respondents Details

| | | |
|---|---|---|
| a. | Name | |
| b. | Designation | |
| c. | Address | |
| d. | Communication Details | Tel No.<br>Mobile No. |

2. Size of the hospital – No. of Beds _____

3. What is the source of water:

| Sr. No. | Source | Percentage |
|---|---|---|
| a. | Piped Supply | |
| b. | Bore Well | |
| e. | Any Other, pls Specify | |

4. What do you use hot water for? (Tick Multiple Options)

| | | |
|---|---|---|
| a. | Bathing | |
| b. | Cooking | |
| c. | Washing Clothes | |
| d. | Washing Utensils | |
| e. | Cleaning Floor | |
| f. | Washing Equipments | |
| e. | Any Other, pls specify | |

5. What is the quality of hot water required:

| Quality of Hot water | Application/ Purpose | Quantity in Percentage/lpd |
|---|---|---|
| Lukewarm | | |
| Warm | | |
| Hot | | |
| Boiling | | |
| Steam | | |

6. Is there any centralized hot water system in the building? **Yes / No**

7. What is the fuel used for heating water -

| Sr. No. | Fuel | Percentage |
|---|---|---|
| a. | Electricity | |
| b. | LPG | |
| c. | Kerosene | |
| d. | Natural Gas | |
| e. | Other | |

*If Electricity is not used for heating water, skip Q No. 8*

8. What is your average electricity bill per month -

| Sr. No. | Season | Avg. Monthly Bill in INR |
|---|---|---|
| a. | Summer | |
| b. | Monsoon | |
| c. | Winters | |

*If LPG is not used for heating water, skip Q No. 9 and Q No.10*

9. In case of LPG how many gas cylinders are required per month –

| Sr. No. | Number of Cylinders | Tick One |
|---|---|---|
| a. | Less than 1 | |
| b. | More than 1 but less than 2 | |
| c. | 2 or More | |

10. What is the cost of a LPG cylinder (19 Kg) – in INR _____

*If Natural Gas or Piped Gas is not used for heating water, skip Q No.11*

11. In case of Natural Gas or Piped LPG what is your monthly bill -

| Sr. No. | Season | Avg. Monthly Bill in INR |
|---|---|---|
| a. | Summer | |
| b. | Monsoon | |
| c. | Winters | |

12. How satisfied are you with your current water heating system? (tick one)

| | | |
|---|---|---|
| a. | Highly Satisfied | |
| b. | Adequately Satisfied | |
| c. | Partially Satisfied | |
| d. | Dissatisfied | |

13. Would you be willing to switchover to solar hot water service in case it is made available: **Yes /No**

If Yes,

| Sr. No. | Price per Litre | Capture Willingness to Pay (Only Highest Value) |
|---|---|---|
| a. | @ 50 p per litre | |
| b. | @ 75 p per litre | |
| c. | @ 100 p per litre | |

| | | |
|---|---|---|
| d. | Any other, pls specify | |

14. If yes, what would be the influencing factors for your switchover to solar water heating

| Sr. No. | Factors | Capture Multiple/Single Responses |
|---|---|---|
| a. | Economical | |
| b. | Safer | |
| c. | Convenient | |
| d. | Environment Friendly | |
| e. | Government Order | |
| f. | Other (specify) | |

15. If No, what are the reasons? Please specify

| Sr. No. | Reason | Justification |
|---|---|---|
| a. | | |
| b. | | |
| c. | | |
| d. | | |

16. Which of these is these suitable billing mode for the hot water supply

| Sr. No. | Mode | Tick One | | |
|---|---|---|---|---|
| a. | Prepaid | Monthly | Quarterly | Half Yearly |
| b. | Post Paid | Monthly | Quarterly | Half Yearly |
| c. | Any other, pls specify | | | |

17. Would you be comfortable if the solar water heating system covers 80% of your terrace area? **Yes/ No**

    Note: 5 sq mts space is required to provide 100 lpd

18. Is there any space other than the terrace for installing the solar water heating system?

**Yes/ No**

*If yes, pls collect the details of the space*

_____
_____
_____
_____
_____

19. Are you aware of any similar initiatives of provision of solar water heating system for any of your other hospital? **Yes/ No**

    If yes, where (get the contact details), and what were the experiences?

_____
_____
_____
_____
_____

**Questionnaire – RWA (High Rise)**

1. Respondents Details : (Note details of other members on a separate sheet)

| | | |
|---|---|---|
| a. | Name | |
| b. | Designation | |
| c. | Address | |
| d. | Communication Details | Tel No.<br>Mobile No. |

2. How many residential flats are there in the building? **No.** _____

3. What is the source of water:

| Sr. No. | Source | Percentage |
|---|---|---|
| a. | Piped Supply | |
| b. | Bore Well | |
| e. | Any Other, pls Specify | |

4. Is there any centralized hot water system in the building? **Yes/ No**

*If the answer is No, skip to Q 11*

5. What is the fuel used for heating water -

| Sr. No. | Fuel | Percentage |
|---|---|---|
| a. | Electricity | |
| b. | LPG | |
| c. | Kerosene | |
| d. | Natural Gas | |
| e. | Other | |

*If Electricity is not used for heating water, skip Q No. 6*

6. What is your average electricity bill per month -

| Sr. No. | Season | Avg. Monthly Bill in INR |
|---|---|---|
| a. | Summer | |
| b. | Monsoon | |
| c. | Winters | |

*If LPG is not used for heating water, skip Q No. 7 and Q No.8*

7. In case of LPG how many gas cylinders are required per month –

| Sr. No. | Number of Cylinders | Tick One |
|---|---|---|
| a. | Less than 1 | |
| b. | More than 1 but less than 2 | |
| c. | 2 or More | |

8. What is the cost of a LPG cylinder (19 Kg) – in INR _____

*If Natural Gas or Piped Gas is not used for heating water, skip Q No. 9*

9. In case of Natural Gas or Piped LPG what is your monthly bill -

| Sr. No. | Season | Avg. Monthly Bill in INR |
|---|---|---|
| a. | Summer | |
| b. | Monsoon | |
| c. | Winters | |

10. How satisfied are you with your current water heating system? (tick one)

| | | |
|---|---|---|
| a. | Highly Satisfied | |
| b. | Adequately Satisfied | |
| c. | Partially Satisfied | |
| d. | Dissatisfied | |

11. Would you be willing to adopt /switchover to solar hot water service in case it is made available: **Yes /No**

    If Yes,

| Sr. No. | Price per Litre | Capture Willingness to Pay (Only Highest Value) |
|---|---|---|
| a. | @ 50 p per litre | |
| b. | @ 75 p per litre | |
| c. | @ 100 p per litre | |
| d. | Any other, pls specify | |

12. If yes, what would be the influencing factors for your switchover to solar water heating

| Sr. No. | Factors | Capture Multiple/Single Responses |
|---|---|---|
| a. | Economical | |
| b. | Safer | |
| c. | Convenient | |
| d. | Environment Friendly | |
| e. | Government Order | |
| f. | Other (specify) | |

13. If No, what are the reasons? Please specify

| Sr. No. | Reason | Justification |
|---|---|---|
| a. | | |
| b. | | |

| | | |
|---|---|---|
| c. | | |
| d. | | |

14. Which of these is these suitable billing mode for the hot water supply

| Sr. No. | Mode | Tick One | | |
|---|---|---|---|---|
| a. | Prepaid | Monthly | Quarterly | Half Yearly |
| b. | Post Paid | Monthly | Quarterly | Half Yearly |
| c. | Any other, pls specify | | | |

15. Would you be comfortable if the solar water heating system covers 80% of your terrace area? **Yes/ No**

    Note: 5 sq mts space is required to provide 100 lpd

16. Is there any space other than the terrace for installing the solar water heating system?

    **Yes/ No**

    *If yes, pls collect the details of the space*

    _____
    _____
    _____
    _____
    _____

17. What is the monthly maintenance charge collected per family? **INR** _____

18. What is the organisation structure of RWA and who are the key decision makers? (draw the structure and collect contact details)

| Sr. No. | Name | Designation | Contact Details |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |

| | | | |
|---|---|---|---|
| 5. | | | |
| 6. | | | |

19. Does the real estate company have any role in the decision making process? **Yes /No**

If yes, what is the specific role?

# ANNEX 3 – CASE STUDIES OF SOLAR WATER HEATING ENERGY SERVICE COMPANIES IN INDIA

As a part of the stakeholder consultation process, detailed discussions were carried out with existing ESCO players in the country. This annex provides brief case-studies of the business models followed by some of the existing ESCOs in SWH.

## 1. Elpro Dimensions Pvt. Ltd – ESCO Operation in a Housing Complex

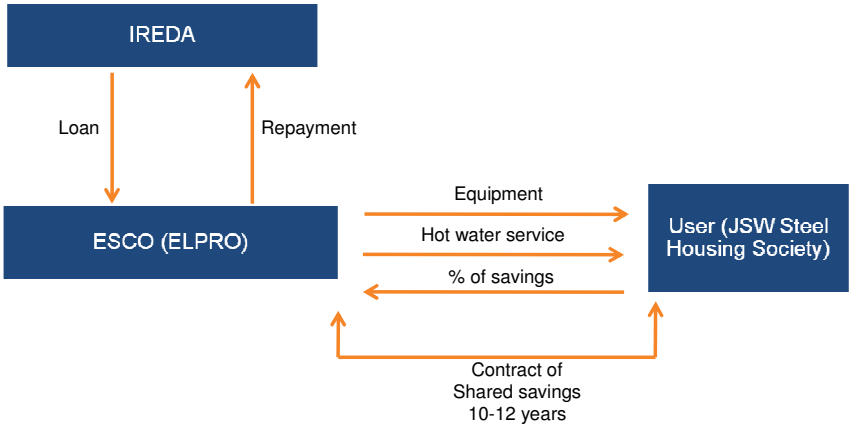
**About the Company**

- ✓ Elpro Energy Dimensions Pvt Ltd (Elpro Energy) was founded in 2000.
- ✓ It is an Energy Centre opened with funding from IREDA & is also Business Development Associate of IREDA.
- ✓ Elpro Energy is part of the KANSHAL group of companies which comprises of 5 companies which are engaged in Energy, Electronics, IT and Building construction.
- ✓ Elpro undertakes Energy Audits, Feasibility report Preparation, Detailed Project Reports, Project Integration, Energy Financing, Turnkey Project Implementation, Procurement & Tendering, Conferencing & Expositions, Research & Development, ESCO Services, Consultancy in the areas of energy efficiency and renewable energy.
- ✓ Elpro Energy has implemented more then 15 big projects in the areas of energy conservation for industrial and commercial consumers.
- ✓ **Elpro Energy has successfully implemented a Solar Water Heating project on an ESCO mode for the Jindal Housing Society in Bellary, Karnataka**

**Elpro Energy Business Model for SWH ESCO**

The figure below illustrates the current business model of Elpro in servicing the Jindal Housing Society's hot water needs.

**Figure 5: Elpro ESCO Business Model**




Some highlights of this model have been summarized below:

- ✓ Solar water heating system size: 23,000LPD
- ✓ Total Project Cost: Rs.23.4 lakhs
- ✓ IREDA has provided a loan of Rs.19.86 lakhs to ELPRO Energy Dimensions Pvt. Ltd.
- ✓ Security has been provided in the form of Bank Guarantee from Vijaya Bank
- ✓ It is a Shared Savings Model
    - A baseline estimation is made of the value of energy consumption in water heating
    - Savings in the value of energy consumption is computed by using an SWH system
    - The savings in the value of energy consumption is shared between the ESCO and the User. In this case, 7.5% of the savings were shared with the user.
- ✓ ELPRO would install the solar water heaters and would monitor the energy saved by them
    - No upfront payment by the client (JSW)
    - Sharing of energy saved (5-7.5%) to the client
    - No O&M charges to the client
    - Contract period = 10-12 years

## 2. Synergy Solar Pvt. Ltd – ESCO operation in an educational institution

**About the Company**

Synergy Solar has experience of more than two decades in the field of Renewable Energy and have successfully commissioned India's biggest Solar Water Heating Systems of capacity 2,40,000 LPD and have also electrified various Villages of India with Solar Energy.

The company is involved exclusively in the development of Solar Energy and other Energy Saving Devices.

These products have been installed at Homes, Hostels, Dairies, Swimming Pools, Army Establishments, Religious Places, Co-Operative Societies, Nursing Homes, Hospitals, Industries etc.

The engineering experience of the company comprises of the following:

- ✓ Solar Water Heating Systems
- ✓ Solar Power Packs – Rooftop SPV Generators
- ✓ Solar Lighting – LED and CFL
- ✓ Solar Steam Generation – Cooking etc.
- ✓ Solar Cooling Systems – Solar AC & Refrigerator
- ✓ Solar Farming – Solar Power Stations
- ✓ Energy Efficient Lighting – LED based indoor & Outdoor
- ✓ DC Power Systems – Telecom Cell Sites
- ✓ Outdoor Cabinets – Telecom Cell Sites
- ✓ Control Systems – Telecom Sites

**Business Model for SWH ESCO**

The figure below illustrates Synergy Solar’s business model for an SWH ESCO at an educational institution at Chandigarh.

**Figure 6: Synergy Solar Business Model for SWH ESCO**

Some of the highlights of the ESCO model of

Synergy Solar at the MCM DAV College for Women at Chandigarh have been summarized below:


- ✓ Nature of Institution: Educational Institution
- ✓ Name and Location : MCM DAV College for Women, Chandigarh
- ✓ Capacity of System: 4500 LPD
- ✓ Type: Evacuated Tube Collector
- ✓ Usage: For hot water usage in the hostel
- ✓ Total Project Cost: approx. Rs.7 Lakhs
- ✓ Financing: entirely equity financed
- ✓ Contract with the institution for 10 years
- ✓ Payment: 6 months summer charges – minimum charge and 6 months winter charges – maximum charge. On an average, Rs.0.45/litre is charged for the hot water supply
- ✓ Project operational since 2009

## 3. Transsolar Technologies – ESCO Operation in a Hospital

**About the Company**

Transsolar Technologies is a Tamil Nadu based Company offering a wide range of products and services in power, heating and chilling. The company is committed to promoting Clean Energy Solutions through Wind, Solar Thermal & Solar PV. Some of the current ESCO Projects of transsolar technologies are:

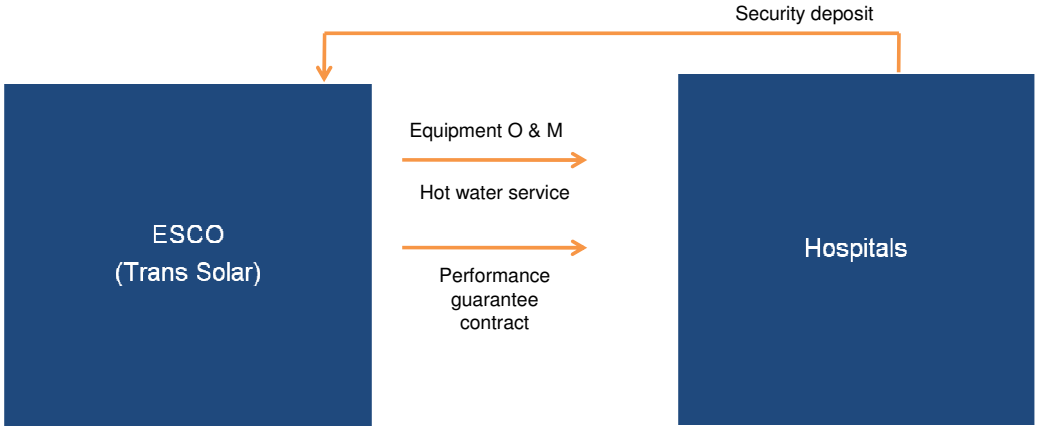
- ✓ Hospital – Holy Family Hospital, New Delhi – 15,000LPD - SWHS
- ✓ School - Rohtak 5 KW Power Plant
- ✓ College -Meerut -10000 LPD –SWHS
- ✓ Hospital – Delhi – 500 TR Chilling

✓ Resort- Khajuraho 30 KW Power plant

**Business Model for SWH ESCO**

The figure below illustrates Trans Solar's business model for an SWH ESCO at Holy Family Hospital at New Delhi

**Figure 7: Trans Solar Business Model for SWH ESCO**




Some of the highlights of the ESCO model of Trans Solar at Holy Family Hospital have been summarized below:

✓ Solar water heating system size: 15,000LPD

✓ Usage: 18,000 Ltrs hot water/day

✓ Operational status before ESCO

- Average Gas Bill (PNG) / Month- Rs.65,000/-
- Maintenance Of Gas Boiler – Additional Cost
- Staff for Maintenance –Additional Cost
- Capital Cost on Boiler – Additional

- ✓ Current status after ESCO
    - 15,000 LPD FPC –SWHS installed
    - No Capital Cost to HFH
    - 100% Guaranteed Hot Water
    - Monthly Outflow to HFH Rs.51,000/-
    - Free Equipment after 7 years
    - No additional cost to HFH- (Maintenance)
    - No HFH staff required for maintenance

# ANNEX 4 – INTERNATIONAL EXPERIENCE

This annex summarizes the international development models of promoting SWH in four countries – South Africa, Brazil, Italy and Australia.

## South Africa

In this section, the key features of the SWH program in South Africa have been summarized.

**Present Environment**

- ✓ Electricity consumption for water heating needs by residential, commercial and industrial sector constitutes 18% of coal based electricity generation.
- ✓ Goal: 10,000 GWh – Renewable Energy Consumption Target by 2013 – 23% contribution expected from SWH and by 2020 – 50% Residential water heating needs to be met by SWH.
- ✓ Under National SWH Strategy and Implementation Launch - Start of tendering by April 2010 and classified into Manufacturing and ESCO tendering
- 2010 – Installation Commences,
- 2011 – 13 -> Installation and Local Manufacturing,
- 2014 – Minister's 1 Million Systems Target & 2020 – 4 Million Systems Target
- ✓ ESCO to provide
- Low cost SWH with a 5 year guarantee
- Funding enabled services for domestic SWH and others like CDM, DSM (Demand Side Management)
- Customer interests and rights protection along with accountability to National Energy Regulator South Africa (NERSA), Government
- ✓ Testing Standards as per South African Electricity Public Utility - Eskom and not legalized
- System must have passed the South African Bureau of Standards (SABS) tests, and comply with the South African National Standards (SANS) for thermal and mechanical performance and safety.
- Supplier of the system must be registered with SESSA (Sustainable Energy Society of South Africa) solar water heating division.

- Stringent quality procedures along with import of equipments introduce delay in approvals.

✓ Funds paid to consumer on Rands/MWh or claimed under tax rebate both year on year basis.

✓ Energy Efficiency (EE) projects – financial assistance up to 50% of the capital and implementation expenditure cost in addition to incentives for SWH projects

✓ Trading mechanism for white certificates (WhC) is being drafted

✓ The first gold certified project in the world, the kuyasa expected to get completed by Aug 2010 will generate 2073 CER's (Certified Emission Reductions).

✓ Several CDM SWH projects are in pipeline from PDD (Project Design Document) stage to releasing CER stage which take an average time of 1 – 1.5 years. Hence financial assistance for these projects are generally from the Government or World Bank and other Multilateral organizations

✓ South African Association of Energy Efficiency (SAEE) is involved with the local/state/centre and various other stakeholders for development of EE sector on a long term perspective

**Key Learning**

✓ Programme Implementation plan (Expected Market Penetration)

- Upper income group – Subsidy based / Insurance for geyser replacement (damaged ones)

  (47% - 5,60,000 – By 2020)

- Low/Middle income group – Retrofit / New Build Programme

  (58% - 17,50,000 – By 2020)

- Non – Geyser group - Non – Geyser Delivery Programme / New Build Programme

  (41% - 26,90,000 – By 2020)

- Total Penetration inclusive of above groups – 46%

✓ Targeting the non geyser users and low income categories is a priority for domestic SWH sector along with stringent quality procedures

✓ Private participation hindered by short term targets of 10,000 GWh and market conditions and laws not supporting quality in-house suppliers and implementation agents

- ✓ Supply, demand situation to be monitored and be synchronized with Manufacturing, Approvals, Implementation procedures

- ✓ ESCOs evaluated on the basis of

- ▪ Technically competency, Financial stability, Legal requirements & Procurement / Contract parameters

- ▪ For projects especially :Track record of the company, staff qualifications and consultancy agreement with ESCO and customer through an LOI (Letter of Intent), savings target, baseline data, linkage with time of demand

- ✓ Capacity development for all stakeholders from public, private and end consumers and auditors to ensure right use of technology and equipments and adhere to quality and legal procedures

- ✓ SWH market requisites

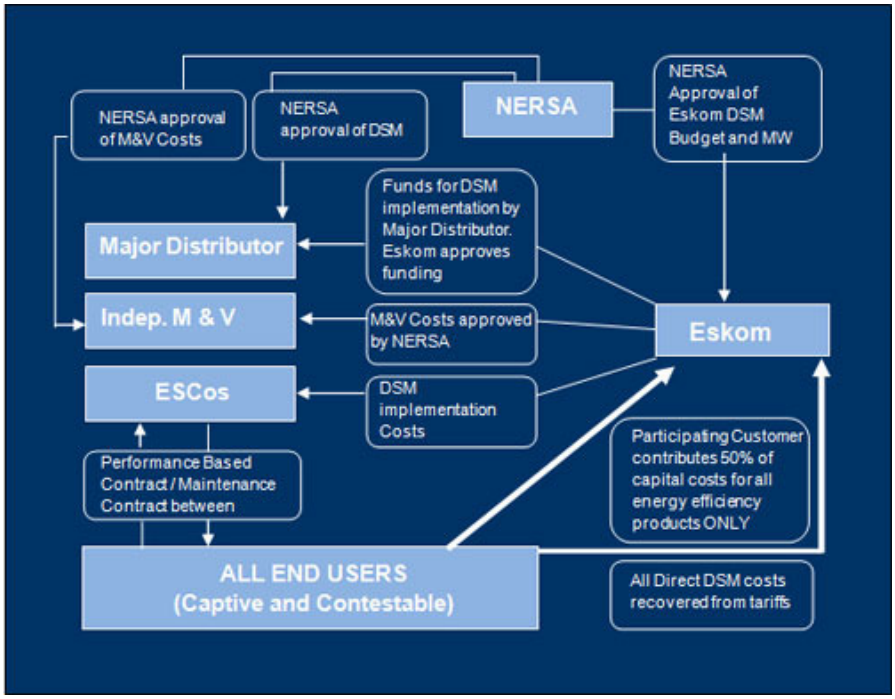
- ▪ Policy framework/intervention for SWH from the centre and from states / municipalities

- ▪ Linking of National Building Codes with SWH policy

- ▪ Regulatory and legal matters concerned with the sector

- ▪ Amendments in policy, laws in line with the national, market and customer interests

**Figure 8: Illustration of the ESCO Model in South Africa**

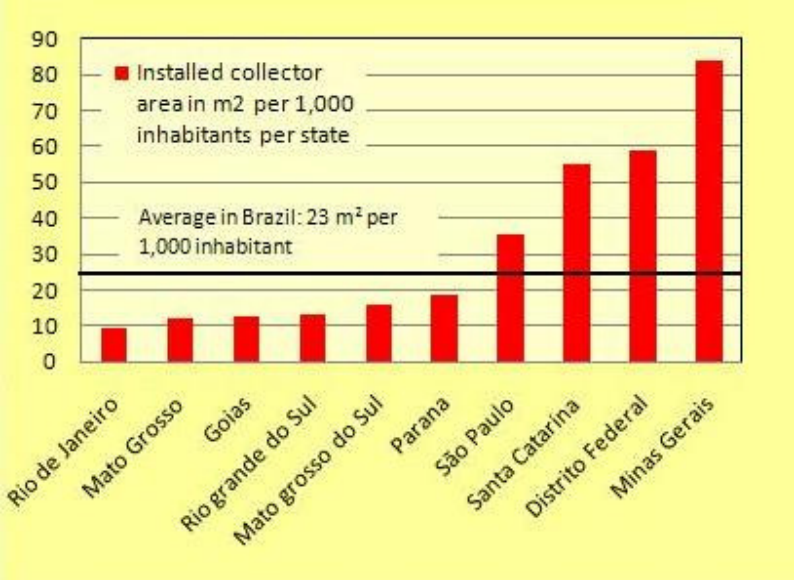


## Brazil

Minas Gerais is the leading state for solar thermal technology in Brazil: The state housing company COHAB plays a major role and started solar housing projects already in the late nineties. The month of March will mark the beginning of the implementation of the far-reaching agreement between the Housing Company of the Brazilian state of Minas Gerais (COHAB-MG) and the state-wide energy utility CEMIG. Together, they agreed on installing solar water heaters in more than 15,000 housing units being built in various regions of the state during 2010.

Minas Gerais is the Brazilian state with the highest amount of installed collector area per one thousand inhabitants. According to a 2007 survey among manufacturers of solar water heaters in the country, Minas Gerais had 84 $m^2$/1,000 inhabitants, while the national average was only at 23 $m^2$/1,000 inhabitants (see figure below).

**Figure 9: Ten leading states in Brazil based on the total installed collector area per 1,000 inhabitants**




Source: SE-Studio Equinócio – Marca Solar Group

The Brazilian collector manufacturer Aquecemax won CEMIG's invitation to tender and is now responsible for the installation of 14,600 systems. More than 3,700 additional units are under consideration and could be purchased and installed by placing change orders for the current contract. It was decided that COHAB and CEMIG will monitor the installation of the equipment together.

The energy utility is obliged to spend at least 0.5 % of its net operation income on activities aimed at reducing the electricity consumption throughout the country, a requirement the national Electricity Regulatory Agency (ANEEL) brought forth a while ago. ANEEL specifies obligations and charges for energy utilities in Brazil.

The program for SWH is to install these systems in COHAB-built houses, which have an average electric energy consumption of 150kWh/month and therewith replace the former electric showers. The solar systems' storage capacity of 200 litres provides for sufficient hot water equalling five daily baths. On cold days, those systems can operate with assistance by electric showers at low power. According to statements during former solar projects of COHAB, a solar water heater can reduce the power consumption of a house by 30 % to 40 %. The monthly savings can reach up to Brazilian Real (BRL) 80 for a nuclear family of four.

The use of solar thermal technologies is, however, not widespread in the Brazilian market, despite certain current tax exemptions. Brazil's existing solar thermal collectors total approximately 1,800,000m2, which is small compared to countries like the United States and Canada. It is also far less than Barbados, where nearly 40 per cent of homes use solar water heating systems, and Israel, where the use of solar energy is obligatory for newly constructed homes.

## Italy

Italy, known for its imports of fossil fuels for their energy needs has been building up a low carbon economy with a national renewable energy plan from the past 17 years with an annual growth of 14%.The growth was fast in the start and slowed down in the later half. In spite of this slowdown 167 municipalities have complied with solar building codes as per Italian Environmental Organisation. European Directives like those of RES 2020 has pressurised the local authorities towards use of renewable energy including solar thermal energy. Out of 2996 municipalities 253 municipalities have obligations to install solar thermal panels. **Lazio region leads the track in the implementation of solar thermal at local levels through a stipulated legislative frame work in addition to financial and communication incentives. Orienting the building efficiency law with Solar thermal by laws has been the limelight of this region (Lazio).** People of Italy pay a nominal cost to transaction charges involved in facilitating the white certificate market in their energy charges. Initial problems do occur during implementation which occurred when building efficiency law 2005 did not work at all and poor response continued till its amendment 2007 and effective action fostered. As Italy is expected to reduce its emissions as per Kyoto targets it has allocated funds under Italian Carbon Fund with World Bank. White certificates under a framework are traded in Italy and more than 200 ESCOs are operating which is just a turnaround of UK. Compulsory installation of solar panels (thermal) in new and renovated constructions is promoted their usage.

The beginning of white certificates (WhC) trading scheme was with a delay due to targets acceptance, stakeholder issues and monitoring and verification methodologies and political preferences which was necessary for effective implementation of the plan. Adding to these issues are, only few municipalities embraced renewable building standards necessitating a revised approach at various levels. National and European targets are way ahead of Italy's present situation of reaching their targets due to political uncertainties and ambiguities in the policy design. Complex authorisation procedures at local levels and financial barriers with regard to end use cost associated are one among the major issues generally faced. Bureaucratic obstacles are the biggest when implementing action plans which require coordination at all levels and with various departments at public and private. With EU directive 2006 it is expected that Italy will face a tough chance in competing with their counterparts when WhCs are traded between nations. When an industry/ locality is unable to meet its targets due to natural calamities and other acts of god the stipulations are not clear enough in following a certain ideology to oblige to this regulation.

Sustained growth is a factor which is influencing the WhC, SWH and CDM market which may get disturbed due to risks involved in this sector and example is the recent financial meltdown which is from an external environment.

In Italy the Solar thermal market has been growing in the past few years with many cities and local municipalities driving this market within their jurisdiction. A thorough study reveals that the market of Renewable Energy Technologies (RETs) is based on exploiting cheap energy resources and opportunity to trade as green certificates. **Italy takes any kind of thermal energy under WhC** and hence a tough competition is expected in the open market within the country between various source players. If Italy exposes itself to entire Europe, it needs to modify its policy and create a sound strategy for the country to achieve its targets and be an international player in the WhC market. Solar thermal market is a dual option market as it generates carbon credits as well as green certificates. With target of renewable energy mix in the total consumption to be 17% by 2020, Italy will require a strong push from the federal and state side by removing subsidies to polluting energies and mainstreaming renewables. Establishing a favourable market for solar energies and thermal especially necessitates a clear understanding of costs, reliability and sustenance both for buyer and seller in terms of generation and end use. Out of its 2000 plus municipalities only a small percentage has been progressive and others are lagging in solar thermal and CDM activities.

**Key learnings**

- ✓ Tendering of ESCO activities is not energy performance based but price based
- ✓ ESCO needs to be technically sound, able to guarantee system performance and build suitable energy savings scheme to exhibit its advantage in terms of economics and reliability on a long term basis
- ✓ Linkage with local FIs (Financial Institutions) for financing is preferable due to easy availability of funds based on bank's experience with the local customers
- ✓ Combination of Solar thermal with EE (Energy Efficiency) projects proves to be an economically viable proposal especially for smaller projects
- ✓ Effective awareness programmes essential for large scale Solar Thermal (ST) projects which brings involvement from the local populace
- ✓ Public Sector focus - "Public ESCOs", which means that the energy agency acts as an ESCO and implements EPC (Energy Performance Contracting) in certain fields with social importance and large demonstration effects
- ✓ 30% cost covered for solar thermal (ST) projects (domestic SWH) from government and includes a 5 year guarantee
- ✓ The technical solutions applied should be as simple as possible, the contract between the ESCO and the end-user doesn't cover all aspects concerning billing, end-user consumption along the future, insurance and risks management.

- ✓ The heat supply contract contains all technical prerequisites and conditions that are requested in order to assure a sound operation and the expected energy supply of the solar system.

- ✓ The contract must fix the minimum amount of energy that the customer is going to use. In case of lower consumption, either a basic price or a penalty fee may be charged to the customer. In some cases it might be sensible to fix a profile for the range of the consumed energy over the year.

## Australia

Australian Government's push towards developing renewable energy markets has been phenomenal in the past ten years. The SWH sector is leading and has been a part of research study for other countries for their implementation and introduction of trading mechanisms. This is through the Renewable Energy Act 2000 and Renewable Energy Regulations 2001 which sets the target generation of 45000 GWh by 2030. Solar credits have been prevalent from June 2009 which encourages small system installations. Australian government urges electricity generation with renewable energy mix up to 20%. The department of Climate Change updates the regulation with policy changes as required by Renewable Energy Electricity Amendment Act 2006 and 2009. The Act allows for RECs to be electronically transferred between REC Registry account holders (typically between eligible and liable parties) listed in the REC Registry. REC transfer transactions are reported automatically to the Regulator in the REC Registry under section 28 of the Act. This process is market driven with the price of RECs determined by supply and demand. The sale of RECs by eligible parties to liable parties is not a rebate but a financial transaction. The REC price is not regulated by ORER (Office of Renewable Energy Regulator).

Australia is racing to meet its Kyoto targets with just 1% below the set margin on national emissions trajectory in comparison to its performance. The emission reduction schemes that work under the CPRS (Carbon Pollution Reduction Scheme) has set legally binding targets to achieve 25% below 2000 levels by 2020. The RET (Renewable Energy Technologies) provides renewable energy power stations and owners of solar water heater and small generation unit installations (small-scale solar PV, wind and hydro electricity systems) with a financial incentive through the creation and trade of RECs via the REC Registry. Each REC created from an eligible energy source can be sold for a negotiated price and transferred to liable parties in a market based online system called the REC Registry.

The suspension of REC trading by the Australian Securities and Investment Commission from 13 April 2010 has been a surprise and the reason not been divulged so far. Solar Rebate programs have been replaced by Renewable Energy Bonus Scheme which has reduced the rebates for SWH and along with it are the delayed payments. Any transitional arrangements at the implementation level due to new technologies and procedures have created complexities. Transitional price cap for Emission Reductions (ER) at 46 AUD/tonne if legalized for a period of four years from 2012-13 will seriously affect the emission intensive industries if prices for ER increase yearly at a constant rate. Increase of shortfall charges from 40AUD/MWh to 65AUD/MWh for those defaulting on REC obligations would ensure that non performance becomes costly for the non renewables group. A surge in SWH usage in the year 2009 forced the government to rethink their strategy in their rebate programs. Now with Queensland announcing 500 AUD for a SWH the Ministry of Mines and Natural Resources needs to be careful in releasing RECs to Queenslanders which can influence the

market. As the REC prices are decided by the market it is important that the system is made stable which has seen turbulences

The government's plan towards emission caps has been supported by several communities who are proposing a 2 year carbon tax for reopening the emissions trading scheme. Western Australia's interest in low carbon technologies (bio and geo energy, clean coal and renewable energy technologies) is being promoted through its Low Emissions Energy Development (LEED) Fund offering, a total of 30 million AUD expected to drive the carbon markets and new R&D. Only 7% of the Australian homes are fitted by SWH and expected to touch 12% by 2020, a very small percentage achieved. Phasing out of electric hot water systems by 2011 has been initiated through government's National Strategy on Energy Efficiency. Upcoming problems are the SWH at commercial and industrial establishments whose growth in SWH requires further focus from the government and the regulator.

# ANNEX 5 – CDM EXPERIENCE IN SWH PROJECTS

## General Overview of Solar Water heating Systems in CDM

It is a well known fact that SWH systems replace fossil fuels and they do no represent business as usual scenario. Therefore, use of this appliance, in principle, qualifies as a CDM project. However a single solar water heater system is a very small unit to generate sufficient Certified Emission Reductions (CERs) to be pursued as a CDM project. This is the reasons that single Solar water heating projects have not been registered till date. Therefore several units need to be bundled and / or implemented as a programme, using an appropriate methodology and monitoring and verification protocol, in order to have a financially viable CDM project. The Methodology used for all solar water heating systems in order to get the CDM credits is AMS. I C - Thermal energy production with or without electricity.

## CDM- Solar Water heating Experience

### International

***(I) Individual Projects***

**Korea Land Corporation Pyeongtaek Sosabul-district new and renewable model city (solar water heating system)- Gyeonggi-Do, Korea**

The main purpose of the project activity is to supply Pyeongtaek Sosabul-district with thermal energy from solar water heating system and in Pyeong-taek city. The participant, Korea Land Corporation (KLC) will develop Pyeongtaek Sosabul-district to ecofriendly, renewable energy residence district including detached houses, apartments, schools, and public buildings. This area will be approximately 3,021,281$m^2$ and move in 12,542 households. KLC is going to be developed that will be supplied up to 5.23% of Total consumption energy by renewable sources in 2014. Participant makes the plan that detached houses, schools, and public buildings will be installed solar water heating system on the roof.

The annual generation thermal energy will be 17.19 TJ/year from solar water heating system. And approximately 3 kt $CO_2$ /year emission will be reduced. This project falls into those categories as it uses renewable energy by introduction of solar water heating system. The project displaces the uses of fossil fuels. All detached houses, schools, and public facilities will be equipped solar water heating system Korea Land Corporation Pyeongtaek Sosabul-district new and renewable model city (solar water heating system) aims to install solar water heating system on detached houses, schools and public buildings.

**Installation plan of detached houses: 6m$^2$ per a family for all detached houses**

System Installation scale for detached house was calculated by considered the building-to-land ratio and floor space index with Land scale and development-density.

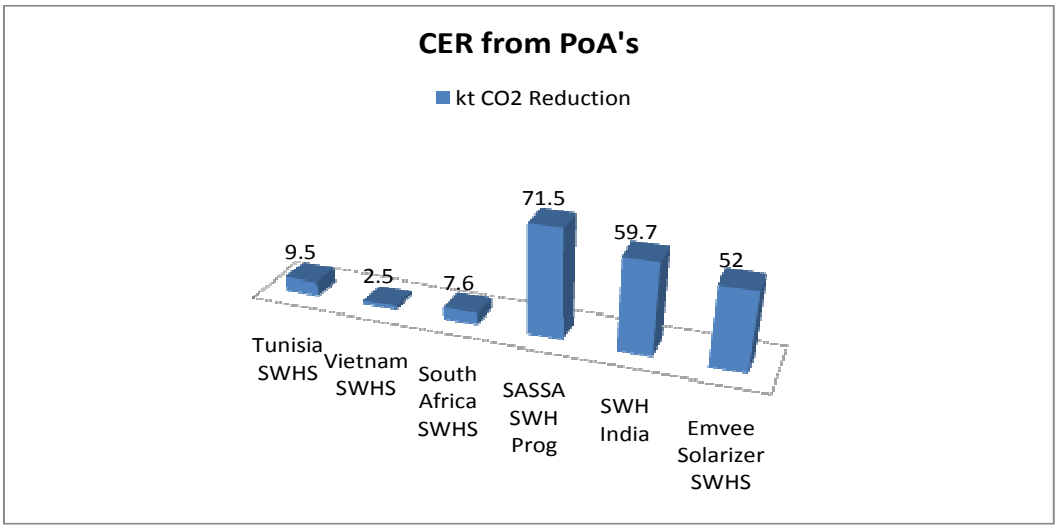
**Installation plan of Schools and Public buildings: Up to 50% of water heat**

System Installation scale for detached house was calculated by considered the building-to- land ratio and floor space index with Land scale and development-density. Assuming schools operation time is 12 hours (8 o'clock to 20 o'clock).

***(II) Program of Activities (PoA)***

PoA is a Voluntary coordinated action by a private or public entity implementing any policy/measure or stated goal. PoA constitutes of individual CDM project activities (CPAs), with no limits on CPAs under a PoA. Action of PoA leads to GHG emission reductions or increase net GHG removals by sinks that are additional to any that would occur in the absence of the PoA.

**Figure 10: CERs expected from SWH PoAs**




1. **Solar Water Heater Programme in Tunisia**

The proposed small-scale CDM Programme Activity (SSC CPA) consists of a group of 19,976 solar water heaters (SWH) installed under the Solar Water Heater Programme in Tunisia across the 21 Tunisian provinces. The proposed CPA is a voluntary initiative taken by the coordinating and managing entity of the PoA, the Tunisian National Agency for Energy Conservation (Agence Nationale pour la Maîtrise de l'Energie – ANME). The PoA is a programme for the installation of

domestic SWH in households throughout Tunisia set up by the coordinating and managing entity. The objective of the PoA is to support the development of solar energy for water heating in Tunisia, including for water heating, in line with the 11th Plan set by the Tunisian government. The stated goal of the PoA is to install around 30,000 SWH per year in households in Tunisia, thereby displacing carbon intensive electricity from the grid and fossil fuels currently used to provide hot water in the households and reducing greenhouse gas emissions. The proposed SSC CPA is expected to reduce 9.5 kilo tonnes $CO_2$/year for 10 years. In addition, the PoA will provide households with a flexible and in-house supply of hot water. It will also support the unstable Tunisian SWH sector and promote new investment in renewable energy projects.

### 2. Installing Solar Water Heating Systems in the South of Viet Nam

The purpose of this PoA is to install SWH systems in households, kindergartens, small hotels and buildings in the south of Viet Nam. The SWH systems will be systematically installed through a subsidy programme coordinated by the Energy Conservation Center of Ho Chi Minh City. The cost of the SWH systems will be subsidised as an incentive to encourage people to install SWH systems. The goal of this PoA is to promote energy saving in the southern region of Viet Nam. Each CPA included in the PoA will install a group of SWH systems in a certain year with the available budget for the subsidy in the year. Using solar energy for water heating reduces demand for electricity and reduces the greenhouse gases (GHGs) associated with producing electricity from the national grid. This project is a voluntary initiative coordinated by the Energy Conservation Center (ECC) of Ho Chi Minh City. The ECC was established in 2002 through a decision by the People's Committee of HCMC, aiming to improve energy efficiency, promote renewable energy, fund research and development and develop human resources. The ECC aims to reduce electricity consumption in the south of Viet Nam through the use of SWH systems supplying heated water. The ECC will coordinate this PoA and all CPAs under this PoA. The ECC will promote the use of SWH systems by providing information regarding the economic and environmental benefits of SWH systems and explain the support structure of the subsidy programme and SWH system distributors. Under the programme, the ECC will receive applications from prospective users and select applicants who are eligible for the subsidy. Consumers will receive the subsidy from the ECC only after the power companies or the ECC have confirmed installation of the SWH system. Estimated $CO_2$ emission reduction is 2.5 kilo tonnes/year for 7 years.

### 3. South African Solar Water Heater (SWH) Programme

This small scale program of activities (PoA) is a program for the installation of SWH throughout the Republic of South Africa (SA). The PoA is an initiative undertaken by Unlimited Energy Resources Ltd (UE). The PoA and each individual small scale CDM programme activity (CPA) will be coordinated and managed by UE. A typical CPA will consist of a group of SWH installed, to provide hot water for domestic use, within the borders of the SA. In order to qualify for the carbon revenue, consumers will be required to install South African Bureau of Standards (SABS) approved SWH from SWH installers who have met the participation criteria of the programme. The total number of installed square meters of collectors of each individual CPA will remain below the small-scale threshold of 64,000 m². Estimated $CO_2$ emission reduction is 7.6 kilo tonnes/year for 10 years.

### 4. SASSA Low Pressure Solar Water Heater Programme

Africa has one of the highest levels of solar radiation in the world. Due to high solar radiation in South Africa the concept of heating water with the sun is logical. The small-scale programme of

activities (PoA) of the Solar Academy of Sub Saharan Africa Ltd (SASSA) is a programme for the installation of low pressure solar water heaters (SWHs) in low income households throughout South Africa. Traditionally electric geysers have been used in South-Africa to heat water for domestic hot water purposes. Due to the historically low cost of electricity, alternatives have not been considered. Additional reasons for low market penetration are relatively high upfront costs and a lack of consumer awareness. SWHs will help to reduce the electric water heating load. SWH offers also a great opportunity for households outside the national grid system. Suppressed demand for energy services refers to a state where current levels of access to energy services are inadequate because of income or infrastructure constraints.

This state does not accurately reflect the real demand for energy services by energy poor households. The SWH rollout will eliminate part of the suppressed demand by decreasing the cost of energy services, thus increasing access to energy services whilst allowing energy poverty to decline. The objective of the PoA is to install South African Bureau of Standards (SABS) approved non-pressure (also called low-pressure) storage tank and vacuum tube solar collectors of SASSA to low income households free of charge. The municipalities and households will not have to pay anything towards this project. This opportunity is only available while Eskom and carbon finance, subsidies can be sourced and by the supplier sourcing high volumes of equipment at reduced prices. This project is a voluntary initiative coordinated by SASSA. SASSA will market, supply and install the SWHs. The project fulfils the national sustainable development criteria determined by the Department of Minerals and Energy of South Africa and contributes to sustainable development. Estimated $CO_2$ emission reduction is 7.6 kilo tonnes/year for 10 years.

## National

### *(I) Individual Projects*

#### 1. Bagepalli CDM Solar Hot Water Heating Programme-Karnataka

Through this CDM Project Activity, 25790 solar hot water heaters will be installed in Kolar District, and Bangalore Rural District, Karnataka, for community and private hot water supply. The community heaters will be installed wherever families do not have the kind of house on which a solar hot water can be easily installed. Private hot water heaters will be installed for individual families wherever people have houses with suitable roofs. By installing the 25790 solar hot water heaters, emission reductions to the extent of 108873 tonnes of $CO_2$ per annum will be achieved, as 98'529'537.64 kWh every year which would have been generated by the electric generating stations connected in the Southern Regional grid and consumed by the project participants in geysers with an efficiency of 80%, will now not be consumed. The Government of India through Indian Renewable Development Agency provides some soft loans of between 2% and 5% interest rate (after subsidy from MNRE) for users to install solar hot water heating systems. Estimated $CO_2$ emission reduction is 109 kilo tonnes/year for 7 years.

#### 2. Bundled Solar Water Heater Project- Maharashtra, Gujarat, Karnataka

The project activity is a voluntary and proactive initiative undertaken by participating entities towards using renewable energy systems. It involves using of solar water heater to suffice the low temperature hot water requirement and thereby refraining from the use and replacing the electric

geysers used previously. The proposed CDM project activity is to cover installation undertaken in the following locations in India:

1. Maharashtra – Western Region

2. Gujarat – Western Region

3. Karnataka – Southern Region

The proposed project activity is an aggregation of solar water heater installation at household, commercial, institutional and industrial facility to cater the low temperature hot water requirement. The project is based on utilization of renewable energy (solar radiation received on the earth surface) to heat up ambient water. Installation of SWH will substitute usage of electrical heaters used in the baseline scenario. Estimated $CO_2$ emission reduction is 38 kilo tonnes/year.

The project is envisaged to result into:

- ✓ Promotion of renewable energy technology.
- ✓ Reducing Green house gas emission and abate environmental pollution by refraining from the use of grid power which is predominantly of fossil fuel origin.
- ✓ Reducing pressure over the grid that is currently operating with a huge demand supply gap.
- ✓ Addressing the overgrowing national threat towards ensuring availability of adequate and equitable supply of energy.
- ✓ Enhance the investment environment and economy in the renewable energy domain.

### 3. Solar Thermal Water Heating System of the Township Project- Magarpatta City, Maharashtra

The Project Activity consists of an Organised System of the Solar Thermal Water Heating Devices and its Infrastructure installed on the residential and social buildings in Magarpatta City Township. Magarpatta City Project is a single township development project, which Magarpatta Township Development and Construction Company Limited is developing, exclusively. The purpose of this Project Activity is to heat the water required for the household activities like bathing, washing, flushing using Solar Thermal Energy. In Magarpatta City Township, every residential and social building is equipped with Solar Thermal Water Heating System. The entire hot water requirement of the respective buildings is fulfilled by the Solar Thermal Water Heating System. This system is saving electricity which would have been used by the electrical water heating devices, in individual households, to heat the water. In case of the absence of the solar thermal water heating system, to generate the electricity required for heating the water, the thermal power generation stations would be burning fossil fuel which would result into emission of greenhouse gases in the environment. Thus, implementation and usage of solar thermal water heating system is reducing the emission of greenhouse gases at the electricity generation point in the respective electrical grid.

Magarpatta City's solar thermal hot water system installation is the largest in India which is also recognised by 'Limca Book of Records'. Estimated $CO_2$ emission reduction is 15 kilo tonnes/year for 7 years.

***(II) Program of Activities (PoA)***

**3. Solar Water Heater Program in India**

The objective of the proposed PoA is to reduce emissions by distributing and installing SWH in buildings (residential and commercial) in India. The program will be designed as a Program of Activities (PoA) following the guidelines of the CDM Executive Board. J.P. Morgan Energy Ventures Corporation (JPMVEC) is the coordinating/managing entity (CME) for this PoA. Its responsibility is to communicate with CDM Executive Board and coordinate the work relating to validation, verification, registration and issuance of carbon credits generated by the PoA. The PoA will be divided into individual CDM Program Activities (CPAs), each consisting of a maximum number of installations adding to 64,000 $m^2$ collector area. A UNEP-sponsored study in selected cities of Western India found that 90% of urban respondents relied solely on electricity to heat water, and that between 20% and 30% of their electricity consumption goes to heat water. On an average 0.79 kg of $CO_2$ is produced when one unit of electricity is generated by grid based power plants, which are primarily fossil fuel based. Heating water requires a significant amount of electric power. The energy consumption for hot water preparation accounts for 23% of the total electricity consumption. The purpose of PoA is to install SWH in residential as well as commercial buildings in Bangalore. The program aims to save electricity generated from fossil fuel by using renewable energy to meet hot water requirement and will result in reduction of $CO_2$ emissions. Estimated $CO_2$ emission reduction is 59.7 kilo tonnes/year for 10 years.

**4. CDM Solar Hot Water Project of M/s Emmvee Solar Systems Private Limited-Karnataka**

The purpose of this CDM program of activities is to install flat plate solar collectors for the supply of hot water. The SHW systems are for community, public, domestic and private commercial use. The SHW systems will be installed on blocks of flats, private homes, hotels, office blocks, corporate buildings, government buildings, and other places wherever hot water is required. The project will add 64,000 $m^2$ additional capacity of solar hot water installation, in different sizes of systems, ranging form 100 litre systems to around 5000 litre systems, but predominantly in the 100 and 200 litre category. 1 $m^2$ of solar collector can heat 50 litres of water. The average temperature rise of the water is 45$^oC$, as measured on a sample of systems. The baseline electric geysers are 90.00%, as per typical manufacturer data and Environment Protection Agency US data. The solar hot water systems operate for 300 days a year. The systems are state of the art solar hot water systems of varying capacity. The purpose of the project is to reduce the peak time electric load on the very unstable regional grid, which would otherwise be very much overloaded if electric geysers were installed for hot water generation; The project reduces the emissions of greenhouse gases compared to the emissions associated with the generation of electricity which would be used to heat the hot water with electric geysers in the absence of the project activity. The project is located in Southern India. The additional annual emission reductions in project activity from adding 64,000 $m^2$ of solar hot water collector area every year, is thus 52 kilo tonnes/year for 7 years.

**CDM- SWH ESCO Model- i HOT Anu Solar Project**

The city of Bangalore is divided into 147 wards under the Bruhat Bengaluru Mahanagara Pallike (BBMP) which is the civic development authority for the Bangalore Metropolitan Area. For the purpose of the project activity, these wards are grouped into 8 zones comprising of specific wards. These are the service zones and cover the entire city of Bangalore. These zones and the wards will form the basis for the implementation of the project activity.

**Objective**

The generation of renewable energy which will reduce $CO_2$ emissions Anu Solar Thermal Private Limited's programme iHOT aims to reduce electricity generated from fossil fuel, hence $CO_2$ emissions, by installing solar water heaters mainly in households.

**Project description**

- ✓ Through the iHOT programme solar water heaters will be installed in households as well as hotels, hospitals and other small businesses to provide thermal energy to the end user in the form of hot water.

- ✓ In urban and semi-urban areas of India – the regions targeted by the project – the most common method for heating water is the use of electric geysers. In most regions, the solar water heaters will be able to provide hot water 300 days per year, reducing greenhouse gas emissions through the displacement of coal fired electricity generation.

- ✓ The solar water heaters are made up of evacuated tubes which absorb thermal energy from the sun and convert it into usable heat.

The programme envisages the installation of 400,000 $m^2$ of solar water heaters per year. The programme has already started with eight separate projects in and around Bangalore with 64,000 $m^2$ of solar collector area per project. The investment analysis for 200LPD system has been summarized below.

**200 LPD systems:** As per the assumptions, a 200 lpd system is capable of providing 60,000 litres of hot water. This is in line with the assumption that the solar water heaters are able to provide sufficiently hot water for 300 days in a year. The cost of a 200 lpd system is Rs 26,250 which is borne by the coordinating entity. For a 200 lpd system, the users are not charged on a per litre basis for the first 2,000 litres of water that they use. The users are entitled to pay Rs 160 every month as a base rent irrespective of their usage. The water used over and above 2,000 litres is charged at Rs 0.05 per litre. The other sources of revenue are from the interest on the security deposit which is Rs 3,800 for a 200 lpd system (Rs 1,900 per 100 litres of installed capacity) and the installation charges as outlined above which is Rs 2,000 per system for a 200 lpd capacity system. The costs involved are the operation and maintenance costs, estimated to be 10% of the total revenue from the sale of thermal energy, administration costs which is 5% of the revenue from sale of thermal energy. The actual installation costs for a 200 lpd system is expected to be Rs 4,000 per system and the marketing cost which is apportioned from the total marketing cost involved over the first 4 years when the project activity is being planned to be implemented. Based on the above figures, the return on a 200 lpd system without CER revenues is 9.6%. The return on a system including the CER revenues for a 200 lpd system at a rate of € 13 per CER is 21.9%.

The benchmark assumed for the project activity is the cost of financing which has been taken from the commercial lending rates and the guarantees for India. The commercial lending rates are published by the Reserve Bank of India website, the rate reported at the end of January 2009 was 12.00% to 12.50%. The guarantee for India has been obtained from the OECD country risk classifications and for India in January 2009 is reported at 3%. Combining these two rates we arrive at a benchmark of 15% for the proposed project. Whilst undertaking the financial analysis, it has been assumed that the end user consumes 100% of the water which may not be the case; this would translate into lower revenues. There are also the risks associated with managing 16,000 installed units, which are high, as there are likely to be instances wherein end-users do not make timely payments thus negatively impacting the cash flows predicted in the financial analysis.

# ANNEX 6 – IMPLIMENTATION GUIDELINES FOR AREA BASED ESCO MODEL FOR SOLAR WATER HEATING

## 1. About the Program

In the recent years, India has witnessed considerable progress on the Solar Water Heating (SWH) front. A total of 3.53 million sq. m. of SWH collector area has so far been installed in the country. Several initiatives taken in the last few years have resulted in acceleration in the pace of development. The Ministry for New and Renewable Energy (MNRE) has been at the forefront of devising promotional measures for greater offtake of SWH. A target of 7 million sq. m. has been set for the first phase of the Jawaharlal Nehru National Solar Mission (2010-13) and a goal of 20 million sq. m for 2022. In order to give a further thrust to SWH development, MNRE proposes to launch a program based on innovative service delivery mechanism for solar water heating. Hereinafter, the program shall be referred to as 'Area based Energy Service Company Program for Solar Water Heating' (A-ESCOP-SWH). The key features of the program are as under:

- The ESCOs will be accredited
- These ESCOs will be selected based on eligibility criteria outlined in these guidelines
- The ESCO will enter into a contract with the end-user
- The ESCO will submit periodic monitoring and evaluation reports to the Program Administrator
- Capital subsidy will be disbursed by MNRE,
    - Directly to Program Administrators – these would include Central and State Government Ministries and Departments and their organizations, State Nodal Agencies, Utilities, local bodies, PSUs and reputed Non-Governmental Organizations, and
    - To ESCOs provided they are able to tie-up with a lending institution

## 2. Applicability of these Guidelines

These guidelines will be applicable for those ESCOs that will be accredited by certified accreditation agencies (CRISIL, ICRA, CARE, etc).

## 3. Selection of Area

**3.1** MNRE will carry out a preliminary assessment of the area and the selection of the area would be done by:

a) MNRE (or)

b) PA (or)

c) Suo-moto basis by the ESCO

The selected area will be known as *'Designated Area'*.

**Explanation:** for the first four (4) pilot area based ESCO projects for SWH, MNRE will select the area. In subsequent cases, the selection of area could be undertaken by the PA or on a suo-moto basis by the ESCO. However, in either case, the selected area will be approved by MNRE.

**3.2** Within the designated area, the minimum capacity to be served by an ESCO (in Litres Per Day) on a non-exclusive basis will be specified by MNRE as a threshold volume.

**Explanation:** In a particular designated area, one or more ESCOs will be allowed to operate.

## 4. Selection and Accreditation of ESCOs

### 4.1 Accreditation of ESCOs

The ESCOs may directly approach certified accreditation agencies (CRISIL, ICRA, CARE, etc) for getting accredited. These accreditation guidelines are to be outlined by September 2010

Those ESCOs that have been accredited will be eligible for applying to new area based ESCO projects for SWH.

### 4.2 Selection of ESCOs

A two stage selection process will be followed for selection of accredited ESCOs – Request for Proposal (RfP) and Evaluation of RfPs.

**Stage 1 – Request for Selection**

For the first four (4) pilot area based ESCO projects for SWH, MNRE will float RfP.

For new area based ESCO projects for SWH, RfP will be floated by the PA where the project is,

i) identified by PA and/or

ii) identified by an accredited ESCO on a suo-moto basis.

The accredited ESCO shall submit the RfP within 30 days of the invitation by MNRE or PA, as applicable.

**Stage 2 – Evaluation of RfP**

The RfP will be evaluated based on certain technical and financial criteria.

**Technical criteria**

The accredited ESCO proposing to deploy the SWH system and service the hot water requirements of the end-user shall be considered to be technically qualified and eligible for participation in the A-ESCOP-SWH only if they comply with the BIS standards.

It will be mandatory for the ESCO to have demonstrated experience of ESCO based operation of SWH systems and such projects should have been in operation for at least 1 year.

The accredited ESCO should submit the documentary evidence and evidence in this regard along with the application to the MNRE or PA, as applicable.

**Financial criteria**

Accredited ESCOs will be required to submit annual audited accounts for the last three financial years, 2007-08, 2008-09 and 2009-10 (if available).

## 5. Roles and Responsibilities of various entities

The solar water heating programme has been designed taking into account active participation from various governmental agencies and other institutions. The key roles and responsibilities of the entities involved are provided below.

### 5.1 MNRE

MNRE will be responsible for implementation of the first four pilot projects. Thereafter the role of MNRE would primarily be to facilitate implementation of this programme.

MNRE will be responsible for the following activities:

1. Selection of designated area for the first four (4) pilot ESCO projects
2. Selection of accredited ESCOs for the first four (4) pilot ESCO projects
3. Floating of RFP for the first four (4) pilot ESCO projects

4. Evaluation of RFP for the first four (4) pilot ESCO projects
5. Preparation of sample standard contract
6. Funding of capital subsidy
7. Assistance in carbon finance
8. Awareness creation of end-users
9. Capacity building of ESCOs

### 5.2 IREDA

The subsidy provided by MNRE will be routed through IREDA.

IREDA will provide loans to the ESCOs on a case to case basis.

### 5.3 Program Administrator

Program Administrators would include Central and State Government Ministries and Departments and their organizations, State Nodal Agencies, Utilities, local bodies, PSUs and reputed Non-Governmental Organizations. The PA will access the capital subsidy directly from MNRE.

The PA will be responsible for the following activities:

1. Selection of designated area for the ESCO projects
2. Selection of the ESCO projects
3. Floating of RFP for the ESCOs
4. Evaluation of RFP for the ESCO projects
5. PA will evaluate the customer contract submitted by the ESCO
6. Act as a nodal agency for consumer grievance redressal
7. Disbursement of capital subsidy to the ESCOs

### 5.4 Lending Institutions

Lending institutions will provide loans to ESCOs for equipment and working capital.

They will act as aggregators and assist ESCOs in accessing the capital subsidy from MNRE.

### 5.5 ESCOs

These are companies which would install, own and operate the SWH system and provide hot water services to the end-users. These guidelines will be applicable for those ESCOs that are accredited by certified accreditation agencies.

1. If an ESCO is interested in servicing a new area that has not been identified by MNRE or the PA, then it will submit this interest to the PA, subsequent to which a RfP will be floated by the PA on a suo-moto basis.

2. The ESCO will submit the customer contracts to the PA for its approval

3. The ESCO will enter into a contract with the end-user for providing the hot water service

4. The ESCO will provide hot water service to the end user as per the terms and conditions of the contract

5. The ESCO will maintain the system

6. The ESCO will endeavour for providing system availability to guaranteed levels as specified in the contract

7. The ESCO will submit monthly Monitoring & Evaluation reports to the PA or IREDA, as applicable

## 6. Funding Pattern

Funding under the scheme would be in project mode i.e. there must be a project report which would include client details, technical and financial details, O&M and monitoring arrangements. The total project cost will be funded through a mix of debt and incentives where the promoters' equity contribution would be at least 20% (unless otherwise specified).

MNRE will provide capital subsidy directly to the ESCO provided they can tie up with a lending institution. These lending institutions could then enter into an agreement for refinance/interest subvention with IREDA. MNRE will provide IREDA fund handling charges at the rate of 2% for the capital subsidy/interest subvention portion.

MNRE will provide capital subsidy to the PA and PA shall enter into Memorandum of Understanding (MoU) with the ESCO for disbursement of capital subsidy

The benchmark project cost for SWH systems based on flat plate collector or evacuated tube collector for 2010-11 has been worked out by MNRE and a CFA of 30% has been defined in the boundary conditions detailed in *Annexure 1B of the Guidelines for Off-grid and Decentralized Solar Applications*.

Capital subsidy of 60% of the benchmark cost would be available for special category states viz. NE, Sikkim, J&K, Himachal Pradesh and Uttarakhand as per the *Guidelines for Off-grid and Decentralized Solar Applications.*

## 7. Monitoring and Evaluation

The ESCO will submit Monitoring and Evaluation (M&E) reports as per approved performance formats. These formats will include:

- Basic data on number of installations and system capacities
- Account of consumer complaints and redressal of the same
- Utilization of MNRE approved subsidy

It is envisaged that certified energy auditors would be empanelled for certifying whether the outputs of the system correspond to the parameters laid down in the in-principle approval for non credit linked projects

This verified M&E report of the ESCO will be submitted by the certified energy auditors to the MNRE either through IREDA or the PA, as the case may be

## 8. Consumer Protection

Area coverage – the accredited ESCO that gets selected for servicing a particular area shall endeavour to cater to all demand segments in an identified cluster which will enable in scaling of SWH usage.

Redressal mechanism – the PA will receive complaints against the ESCO from the end-user. On evaluation of the complaint and in case of a genuine default by the ESCO, the ESCO's accreditation may be withdrawn.

## 9. Timelines for Program Management

Under this program, for every area-based ESCO project, the following timelines will be applicable.

| | |
|---|---|
| Floating of Request for Proposal (RfP) | Zero date |
| Submission of RfP | 30 days from zero date |
| Evaluation of RfP | 30 days from submission of RfP |
| Selection of ESCOs | 30 days from submission of RfP |
| Letter of Award | 7 days from selection of ESCO |

## 10. Review

The scheme would be reviewed by an Internal Review Committee at 6 monthly/yearly interval and modifications therein would be incorporated by the Ministry.

## 11. Power to Remove Difficulties

If any difficulty arises in giving effect to any provision of these guidelines or interpretation of the guidelines, the Internal Review Committee to be constituted by MNRE shall meet and take decision, which will be binding on all parties.

# ANNEX 7 - FRAMEWORK FOR SWH ESCO-END USER HOT WATER SERVICE CONTRACT (SWHSC)

This annex highlights some of the key elements of a ESCO-end user contract for provision of hot water services through a solar water heating system.

1. **Parties**
   a. Service Provider
   b. End-user

2. **Agreement Period**
   a. Start date is the date on which the supply of hot water is to commence. The start date shall be specified in the contract.
   b. SWHSC shall remain valid for a period of _____ years from the start date.
   c. The terms of SWHSC shall be extendable on mutually agreed terms and conditions.
   d. The effectiveness of the rights and obligations under the SWHSC shall be subject to the satisfaction by the end-user and the service provider of the condition precedents detailed in the SWHSC. The SWHSC shall prescribe a date by which the Parties are required to satisfy the condition precedents, which shall be the effective date of the SWHSC.

3. **Commitment**
   a. Service Provider's Commitment:
      i. to service and offer hot water at the end-user's premises the agreed quantity and quality of hot water from the installed SWH system in the end-user's premises
      ii. in case the service provider owns the SWH equipment, it shall always remain the absolute property of the service provider
   b. End-user's Commitment:
      i. to pay for the hot water service at the price and other terms agreed between the two Parties
      ii. in case the end-user owns the SWH equipment, it shall always remain the absolute property of the end-user

4. **Quantities**
   a. The service provider shall offer for delivery to the end-user _____Litres Per Day (LPD) of hot water
   b. In case of reasons attributable to Force Majeure conditions, the service provider shall not be obligated to supply hot water to the end-user

5. **Sale Price**
   a. The price of hot water service at the end-user premises shall be _____Rs./Litre.
   b. The sale price shall be exclusive of all applicable taxes and duties which shall be borne solely by the end-user. All new taxes and changes in rates of existing taxes including those arising from any statutory or regulatory changes shall be passed through to the end-user.

c. The service provider shall have the option to revise the sale price applicable for hot water service after the termination of contract period, at a mutually agreeable time-frame.

**6. Payment terms**

a. All payments shall be made against the invoices within _____calendar days of receipt of invoice by the end-user. Late payment interest rate in respect of any party shall be _____% computed for each day payments overdue until paid.

**7. Measurement**

a. Quality of hot water delivered by the service provider to the end-user shall be measured through appropriate instruments installed by the service provider.

**8. Quality of hot water**

a. The specifications for and determination of hot water to be sold under the SWHSC shall be agreed between the Parties in the SWHSC.
b. The service provider will use reasonable endeavors to deliver hot water in accordance with the specifications mentioned in the SWHSC.

**9. Security deposit**

a. The end-user shall provide a refundable security deposit
b. A monthly fixed charge to be paid by the end-user may be applicable as per the agreed terms and conditions mentioned in the SWHSC

**10. Defaults**

a. In case of default by either Party the terms and conditions of the SWHSC would prevail.

# ANNEX 8 - FORMAT FOR REQUEST FOR PROPOSAL

This annex provides a format of the Request for Proposal (RfP) document that will be floated by MNRE.

## 1. Procedure for Submission of Proposals

The ESCO should submit two hard copies and one soft copy of their proposal in a sealed cover. The proposals will be in two envelopes marked A and B. Envelope A should contain only technical qualifications as specified and Envelope B should have the financial information of the project in the prescribed format.

The document should be page numbered and appropriately flagged and contain a list of contents with page numbers. Different copies must be bound separately. The lack of documentation may result in the rejection of the proposal. Soft copy of the RFP should be submitted in the form of a non-re-writeable CD (Compact Disc). The CD media must be duly signed by the ESCO using a "Permanent Pen/Marker" and should bear the name of the ESCO. The sealed cover should be superscripted with the wordings "Area based SWH ESCO Program".

The ESCO must ensure that the information provided by him/her in respective CDs is identical to that submitted by him/her in the original paper document. In case of any discrepancy observed in the contents of the CDs and original paper documents, the information submitted on original paper document will prevail over the soft copy.

## 2. Technical Information

The technical proposal will contain References of previous projects where the proposed technology had been successfully applied along with the name of demand segments and regions where the project had been carried out, contact names and telephone numbers.

The proposal will also contain the engineering estimates (calculations) of the expected annual energy and demand savings. Overall technical and engineering approaches proposed for the implementation of the SWH project in each demand segment will have to be described in the proposal.

All installations must abide by all the technical norms as per BIS.

## 3. Financial Information

The financial information will contain the total project cost with a detailed breakdown of costs. The financial information submitted by the ESCO will be valid for a period of 180 days following RfP closure.

ESCOs are requested to include an estimate of the annual energy savings for electricity expressed in energy (kWh), percentage of current energy usage and monetary (INR) terms. Projected energy

savings must be based on existing fuel rates/utility rates valid on the date of submission of the proposal.

**4. Cost of RFP Preparation**

The ESCO shall bear all costs associated with the preparation and submission of its RFP, including cost of presentation for the purposes of clarification of the RfP, if so desired by MNRE. MNRE will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the tendering process.

**5. Contents of the RFP**

The ESCO is expected to examine all instructions, forms, terms and conditions and statement of work in the RFP documents. Failure to provide all information required or submission of an RFP document not substantially responsive to the RFP in every respect will be at the ESCO's risk and may result in the rejection of the RFP.

**6. Conflict of Interest**

The ESCO who is selected for preparing the present RfP will be barred from participating in the bidding process for the program management. The ESCO and each of its subcontractors shall be disqualified from subsequently providing goods, works or services for such preparation or implementation.

**7. Language of Bids**

The bids prepared by the ESCO and all correspondence and documents relating to the RfP exchanged by the ESCO and MNRE, shall be written in English, provided that any printed literature submitted by the ESCO may be written in another language as long as it is accompanied by an English translation in which case, for purposes of interpretation of the RfP, the English translation shall govern.

**8. Confidentiality**

MNRE requires recipients of this document to maintain its contents in the same confidence as their own confidential information and refrain from any public disclosure whatsoever.

**9. Disclaimer**

MNRE and/or its officers, employees disclaim all liability from any loss or damage, whether foreseeable or not, suffered by any person acting on or refraining from acting because of any information including statements, information, forecasts, estimates or projections contained in this document or conduct ancillary to it whether or not the loss or damage arises in connection with any omission, negligence, default, lack of care or misrepresentation on the part of State Designed Agency (SDA) and/or any of its officers, employees.

### 10. Authorized Signatory (ESCO)

The "ESCO" as used in the RFP shall mean the one who has signed the RFP document forms.

The person should be the duly authorized representative of the ESCO, for which a certificate of authority will be submitted. All certificates and documents (including any clarifications sought and any subsequent correspondences) received hereby, shall, as far as possible, be provided and signed by the authorized representative.

The power or authorization, or any other document consisting of adequate proof of the ability of the signatory to bind the ESCO shall be annexed to the bid. MNRE may reject any outright proposal not supported by adequate proof of the signatory's authority.

### 11. Subcontractor Related Conditions

The ESCO shall have the option to submit the proposal either alone or along with other subcontractors including the parent company/firm. The project may require specific expertise and companies can collaborate to submit a joint proposal. The following type of companies/experts can jointly submit a proposal:

- ESCOs
- Energy auditors
- Consultants
- Maintenance companies
- Financial partners

The ESCO shall be the sole point of contact for all contract purposes. The ESCO will have the prime and sole responsibility for the execution of the Project.

In case of a proposal with subcontractors, the ESCO would need to submit a Memorandum of Understanding (MoU) / Agreement with the subcontractor clearly defining their relationship. Such MoU should be prepared on a stamp paper of requisite value. Proposals fulfilling partial requirements would be summarily rejected.

The subcontractors should not be involved in any major litigation that may have an impact of affecting or compromising the delivery of services as required under this contract. The ESCO or any of the subcontractors must not have been black-listed by any Central / State Government or public sector undertakings. If at any stage of tendering process or during the contract, any suppression / falsification of such information is known, MNRE shall have the right to reject the proposal or terminate the contract, as the case may be, without any compensation to the ESCO.

### 12. Queries on the RFP Document

Any ESCO requiring clarification on this document may send a query in writing at the MNRE contact address. MNRE may also hold a conference to give clarifications and invitation of the same will be sent to the ESCOs who have given their contact details.

### 13. RFP Amendments

Whether at its own initiative or in response to a clarification requested by a prospective ESCO, MNRE may at any time or for any reason and prior to the last date for receipt of bids, amend the RFP document. In order to provide prospective ESCOs with reasonable time to take the amendment into account to prepare their proposals, MNRE may, at its discretion, extend the last date for the receipt of bids and/or make other changes in the requirements set out in the invitation for RFP.

### 14. Documents to Enclose in the RFP

The proposal prepared by the ESCO shall contain the following components:

RFP Form 1: RFP Letter Proforma

RFP Form 2: Minimum Eligibility

RFP Form 3: Prior Experience

RFP Form 4: Approach and Methodology/Description of Commercial and Business Model

RFP Form 5: Declaration Letter

RFP Form 6: Financial Model and Energy Saving Calculations

Certificate of Accreditation received from the rating agency

Memorandum of Understanding (MOU)/ Agreement prepared on a stamp paper of requisite value with the subcontractor, if it is the case, clearly defining their relationship

Relevant MOU/Contract with the appropriate channel partner (PA/IREDA/Scheduled Commercial Bank)

MNRE shall not be responsible for non-receipt / non-delivery of the RFP due to any reason whatsoever. ESCOs are advised to carefully study the RFP document. Submission of RFP shall be deemed to have been done after thorough study and examination of the RFP document with full understanding of its implications.