This chapter examines the technologies developed by HVAC International (Pty) Ltd to realise sustainable DSM saving in the mining sector. The platforms of these technologies are extended to measure emissions for CDM applications.
4.1 Introduction

The purpose of the Clean Development Mechanism under the Kyoto Protocol is twofold with the primary focus on GHG reductions and promoting sustainability through technology transfer to Annex 2 countries. Technology transfer is only possible within a bilateral agreement where a technology gap exists between the development of a project activity abatement intervention and the host country’s capability. The greater the amount of technology transfer, the greater the leverage will be for an Annex I country to reduce the CER price in the ERPA.

The DSM initiative in South Africa has stimulated the development of in-house technologies by ESCos. Technologies such as REMS (Real-time Energy Management System) and OSIMS (On-site Information Management System), developed by HVAC International, have found a niche within industrial energy efficiency projects. HVAC International is the holder of 4 patents and 3 trade marks related to industrial control systems. The company has already created a 72.18MW savings for Eskom DSM. On average, an over-performance of 12% on contract specification has been achieved [1].

This chapter will concentrate on how HVAC International’s technologies can be applied to CDM energy efficiency projects. These technologies and experience of the ESCos, in the field of industrial energy efficiency, could enable the ESCos to act unilaterally as CDM developers and obtain a maximum CER price. REMS-CARBON, as an extension of these technologies, is developed to support the CDM developer. In addition, this chapter will identify the key performance indicators in order to establish a risk profile for an ESCo from an investor’s perspective.
4.2 Real-time Energy Management System (REMS)

4.2.1 Background
This section is an overview of the development philosophy of a computer control system that would enable automatic control of industrial equipment to optimize the use of energy. This computer program, or control system, is dubbed REMS. The input and output of the system are discussed. The development specification is obtained from the defined set of requirements and integrated into a practical system that can be used by this industry.

4.2.2 Control system requirements

Dr. J.W. Rautenbach, the developer of REMS, explains that certain requirements are essential to electricity cost saving, but that no one system in South Africa combines them all [2]. These requirements were originally stipulated for load-shedding and adjusted slightly to suit energy efficiency in this paper:

- **Simulation.** This program must have the capability to simulate electric systems. The simulation or simulated model is used for optimisation, testing and potential investigations.

- **Optimisation.** This program must have the ability to optimise the build-up of an integrated system. The optimisation is done to improve the overall performance or efficiency of the system, or to lower electricity consumption and/or cost.

- **Energy efficiency.** This program must have the capability to compile an optimised operation schedule for a system that will result in energy efficiency.

- **Reduces running cost.** This program takes real-time electricity cost and pricing structures into account to schedule workload to low cost periods.
• **Control.** These computer controlled systems have the ability to control the components of a system within pre-described constraints.

• **Automated operation.** These systems have the ability to complete designated tasks without the need for 24-hour human intervention. Packages and systems like these must have the ability to deal with emergency situations without affecting normal operations.

• **Monitor.** These systems are designed as data and information tools and automatically log and manage data.

The above attributes conclude that a new novel solution is needed that adheres to and combines the following specifications:

• The solution must be able to realise electrical running cost savings in the operation of industrial electric systems, by calculating optimised operating schedules for both the equipment (pumps, compressors, etc.) and controls (valves, guide vanes and field instrumentation) of the system.

• It must be able to reduce the electricity baseline in the automated control of industrial equipment.

• The program is designed to predict and calculate the potential savings and energy efficiency potential of any proposed system or project before any implementation has commenced.

• The production and throughput of the system or plant must not be compromised.

• These energy efficiency and running cost reductions must be realised through the scheduling of electrical systems to utilise profiles of electricity pricing. This schedule must be continuously recalculated, based on real-time simulation results.
• Any system has to take into account the cost of controlling equipment. The overall running costs, including maintenance, operator and electrical cost must be lowered.

• A system that can keep track of its own performance in terms of energy efficiency and realised savings.

• A system that incorporates an alert/alarm system to notify control room or mining personnel in case of emergencies or malfunctions.

### 4.2.3 Control system application

An important step before developing a system or solution such as this is to first understand the operation environment [3]. This section will examine the operational aspects of a water pumping system on a typical South African mine.

Up to 40% of the electricity consumed on a typical South African gold mine is used for cooling and water pumping [4]. Figure 44 shows a layout of a typical water pumping cycle of a South African gold mine. In the refrigeration plants, water is cooled down to an average of 3°C. This cold water then flows down the mine to a series of bulk air coolers used to cool the air in the mine tunnels [5].

Underground, the mine working water combined with fissure water, flows into the settlers. The settlers remove a certain amount of mud and sediment from the water. This relatively clean water is then fed into underground dams from where it is returned to the surface by pump stations, each consisting of between 3 to 8 pumps running in parallel. These pumps can range from between 1 MW to 4 MW depending on shaft depth and/or mass flow required to prevent flooding.
Each pump station has a maximum head capacity. The energy usage per volume of water pumped, increases as the delivery head is increased. Therefore, the deeper the mine, the more electricity is needed to pump the used water to surface.

The water pump system is usually subjected to various control limitations and restrictions such as minimum and maximum dam levels, the maximum number of running pumps per pump station etc. These parameters must be incorporated into the control philosophy.

### 4.2.4 The control system philosophy

The solution philosophy of REMS is shown in Figure 45 [2]. Level 1 must be capable of basic pump control (on and off). Only then will the Level 2 control philosophy optimise the...
operational cost and simulate on Level 3. This philosophy is for load-shift (REMS) and will be adapted later for energy efficiency (REMS-CARBON).

**Figure 45: REMS-CARBON control philosophy**

**Pump control concept**
REMS is designed to control water pump systems. The first and most important factor to be considered in the design of this control system is the given control constraints. Some of these constraints, shown in Figure 62, include the minimum and maximum dam levels as well as the maximum number of pumps allowed to run simultaneously at any given pump station.

If these constraints are violated, dams could overflow, water columns could burst etc., resulting in system downtime, production loss and ultimately financial loss. This explains why the control constraints are the first priority in the control algorithm.

The algorithm is also responsible for maintaining control within the specified constraints and boundaries as set by the user. The final solution algorithm will consist of the components illustrated in Figure 46.
**Energy efficiency philosophy**

One of the primary factors that motivated the development of this control system is electrical energy efficiency. Second in priority to the control constraints, REMS was developed to achieve energy efficiency by calculating the pump control and control valves schedules in such a way that as little water as possible is allowed into the system. This reduces the amount of water that has to return to the surface and electricity cost of pumping, accordingly.

Figure 47 illustrates the active mining level and the strategic positioning of the control valves to isolate these levels from water during blasting hours. REMS will control these valves with OPC via a SCADA system. The SCADA in return will signal the PLC via optical fibre to open or close the control valves. The scheduling of these control valves will be integrated with the production schedule of the mine.
REMS-CARBON’s pump-control philosophy is applied to each pump station. The pump group controller consists of two sections: the upstream controller and the downstream controller. The upstream controller is responsible for the water level in the upstream dam. The downstream controller is responsible for controlling the water level in the downstream dam as shown in Figure 64.
The downstream controller monitors the downstream dam boundaries. The controller will shut down the first of any running pumps in the downstream pump group, as soon as the water level in the downstream dam reaches the specified downstream maximum dam level. If the downstream dam level still keeps rising, pumps in this group that are still running will be turned off one by one as the level rises in increments of the specified downstream offset.

The upstream controller works by using an upper bound control parameter. This will be referred to as the upper bound. The upper bound is a profile consisting of 24 values. Each of the 24 values corresponds to a certain hour of the day. When the upstream dam level exceeds the upper bound for a specific hour, the upstream controller will start an additional pump in the pump station. If the upstream dam level exceeds the upper bound plus the upstream offset, the upstream controller will start another pump in the pump station.

When the upstream dam water level drops below the upper bound, minus the upstream control range, the controller will stop a running pump at the pump station. When the upstream dam level drops below the upper bound minus the upstream control range, minus
the upstream offset, the upstream controller will stop another pump at the pump station. Figure 49 explains the control philosophy for the down and upstream dams.

![Figure 49: Schematic control philosophy](image)

The upper-bound profile is calculated using the electricity price profile. This profile, like the upper-bound profile, consists of 24 values. REMS creates an upper-bound profile for each of the pump groups. The electricity price profile can be either a fixed profile set by the user, or a variable profile given by ESKOM. Currently REMS uses the Megaflex pricing as its electricity price profile.

**Cost-saving philosophy**

REMS was also developed to achieve electrical running cost reductions. This philosophy does not attempt to lower running cost by reducing workload or running time but rather to re-schedule workload to inexpensive costing periods. This is in line with Eskom DSM load-shifting philosophy. The addition of the control valves will add the energy-efficiency component as will be explained later on with the development of REMS-CARBON.
Simulation element
A further requirement for REMS-CARBON is the ability to calculate the potential of any project before implementation. This information will enable engineers to calculate the feasibility of the project. Because this feature is not used or activated during operation of the water pumping system, it is at the bottom priority level of the system philosophy.

4.2.4 REMS development specification

Delphi 6 was chosen as the coding language for REMS-CARBON. One reason is that Delphi is a language focused on rapid application development for a broad spectrum of Microsoft Windows-based application. A second reason is the availability of a broad spectrum of APIs (Application Program Interface) developed for Delphi and available on the Internet that assist in the incorporation of functionalities such as OPC and e-mail capabilities. The integration of the different hardware components can be seen in Figure 50.

![Figure 50: Hardware system integration](image-url)
**SCADA communication**

REMS must be able to control, monitor and communicate with the water pump system elements. This is accomplished by direct communication with the SCADA systems. A SCADA system is software that is used to monitor and control all electrical and industrial components and processes from one control room.

SCADAs usually consist of more than one computer interface allowing multiple users simultaneous access to the controlled systems. Since mine operations are dependent on the SCADA, it cannot be removed or replaced. REMS was designed to be able to manage data via the OPC (Object Linking and Embedding for Process Control) protocol. OPC is a standard protocol in the SCADA industry and most SCADA systems are OPC compatible. The OPC connection enables REMS to work in conjunction with the SCADA and to gain control of all the system elements.

**Data loggings**

REMS is able to log and store data in a convenient format. This data will be used for various purposes including measurement, verification and reporting. The data is logged with reference to time and component name, making this data valuable not only to REMS-CARBON, but also to the mine operators and system technicians.

**Alarm system and alarm formats**

REMS controls components and systems of the mine which are directly linked to mine production. A broad spectrum of alarm systems, using audio and visual prompts are built into REMS. These alarms also trigger e-mail and SMS messages via the national cell phone network and GPRS.

**Automated control**

In most mines, system control is managed by control room operators through SCADA. This allows for manual control of all the pump stations from one central point. REMS automates this control by eliminating the need for full-time human assistance. This improves control
sustainability. REMS incorporates sophisticated alarm systems which will alert operators when and if human intervention is required.

**Data communication**
REMS’ data communication network is illustrated in Figure 51. The data communication network of a system describes the data input and output of the system under normal operational conditions between the pumps, valves, dam levels, SCADA and REMS.

![Figure 51: REMS-CARBON data communication network](image)

To allow REMS to fully interact with the required information and electrical components, the following channels, as illustrated above, have been engineered into the system:

- Connection to the Internet: REMS-CARBON uses this connection to access varying electricity prices, if applicable, and to send e-mails.

- SMS Gateway: This gateway is used to contact specific persons in prescribed events.

- SCADA-OPC Connection: This connection is needed to exchange data between REMS-CARBON and the SCADA.
4.2.5 REMS operation interface

The main operating interface displayed on the screen, Figure 52, shows the graphic system build up of the water pumping system controlled by REMS. All the displayed components on the platform are interactive, making access to the different tools and properties quick and easy. Clicking on any of the icons will access the tools associated with that component. The interface displays real-time data regarding the components for immediate on-glance comprehension.

Simulation tools
REMS can also be used as a simulation tool. Figure 53 shows the simulation of a mine. This is done to provide the user with information on how the actual system will react when controlled by REMS.
During the simulation REMS does not need to communicate with the SCADA. This means that the simulation can be done anywhere and is independent of the actual system being simulated. The user will set the control parameters, as if controlling the actual mine system and then start the simulation.

The simulation can be run at any speed. In Figure 53 the simulation is run at 120 times actual time. The speed can be altered during the simulation process. The simulation can also be paused and resumed at any time. The status of each system is logged in data files for further in-depth investigations after the simulation is concluded.

The status and system conditions are also displayed in real-time on the system build-up. This enables the user immediate understanding on how the system will react in an actual control situation. The simulation can be replayed at any time and speed.
4.2.6 Sustainable benefits of REMS

Automated control

The introduction of automated control in many industrial systems increases the reliability of that system [6]. Prior to the implementation of REMS, the water levels of the different dams above and below the ground were controlled manually. This process was only as reliable as the operators responsible for controlling the dam levels.

Another drawback of a manually operated system is that optimised control is not always possible and sustainable. One reason for this is that the operators do not always have the necessary information required for optimum control. Furthermore, some operators have neither the necessary training nor the understanding to control a complicated system efficiently enough to produce optimum output.

By implementing REMS, manual intervention is eliminated. This results in a more reliable system that constantly controls the dam levels for optimum output. Labour can amount to between 40% - 50% of the total costs of a typical deep level mine [7]. By incorporating automated control this expense can be lowered.

Better safety through alarm systems

In the event of system component failure, even in components of the water pumping system, better and more diverse alarm systems were introduced. A very good example of this was the introduction of the SMS alarming and reporting system.

Comprehensive data logging

REMS is capable of extensive data capture. This data can be used to construct actual performance graphs of the pumps or conduct research on the overall performance of the system to ensure optimal performance.
Maintenance
Proper maintenance is critical to ensure sustainable performance and operation of equipment [8]. Traditional maintenance consists of scheduling workload between components and servicing or replacing crucial parts and components at set work-hour intervals. Normal maintenance on these system components is improved with the aid of this new technology.

REMS can be commanded to automatically distribute workload as dictated by the component technicians. REMS also reports on the work-hours and schedule history of every component in the system. This is then used to schedule the servicing and replacement of components. Predictive maintenance such as this contributes huge benefits to a mine [9].

4.3 On-site Information Management System (OSIMS)

4.3.1 Background

For power stations an international norm of 15% is used for reserve capacity [10]. Therefore the utility assumes that only 85% of the maximum (rated) generation capacity will be required at any given time to satisfy consumer demand (see Figure 54). HVACI’s goal is to create a virtual power station with availability of more than 85%.

![Figure 54: International definitions for a power station](image)

Figure 54: International definitions for a power station
A virtual DSM “power station” can also be defined in terms of its maximum rated capacity and sustainable available capacity. Rated capacity is usually defined as the initial measured performance of a DSM project. Unfortunately, sustainable capacity is often overlooked in DSM projects. It is usually, rather optimistically, assumed that rated capacity will be maintained over time.

However, international trends show that the performance of DSM projects deteriorates rapidly with time. Eskom’s recent DSM initiative in the Western Cape showed that the performance was reduced by 69% after the first year [11] (see Figure 55). The sustainable capacity of this virtual power station dropped to 31% of the initial rated DSM capacity. Clearly a need exists for technologies to address sustainability of DSM projects.

Inter alia, one would need real-time information on all the elements in a plant to ensure high availability. This information must be acquired, analysed, reported and communicated to the correct people to help solve problems in real-time. It is also necessary for decision-making where new opportunities are discovered as a result of new insight brought on by good acquisition, management and feedback of information.

Traditionally engineers prefer to focus on the “hard” technologies, those needed for successfully achieving the initial rated capacity. Unfortunately they are less interested in the “softer” technologies of information management, which ensures the sustainable capacity
later on in the project’s life. HVAC International developed OSIMS with the aim to improve this situation with the development of technologies focused on sustainability.

4.3.2 OSIMS development

For HVACI, the DSM virtual rated capacity is achieved using the “hard technologies” of simulation, optimisation and control. This is done by a Real-time Energy Management System (REMS). The sustainable capacity is achieved via the “soft” technologies of information management using an On-Site Information Management System (OSIMS).

OSIMS was specifically developed to sustain DSM projects. It has successfully sustained 20 DSM projects. OSIMS has actually helped to gradually increase performance in many projects, as acquired data are retrieved and analysed to show new opportunities.

Figure 56 shows the layout of the core OSIMS technologies and how they connect to REMS and the system being controlled. The top row represents OSIMS with REMS directly below. The interconnection with the controlled system elements is shown in the lower rows.

![Figure 56: Interconnection of OSIMS and REMS](image-url)
SENTINEL
This system monitors REMS, the SCADA system and the communication network. If a problem with REMS is detected, Sentinel will take over full control from REMS while at the same time trying to restore REMS. All detected problems are communicated to HVACI’s office. Sentinel backs-up and securely transmits project data to head office.

MARVIN
This system, located at HVACI’s head office, monitors all the REMS projects. If problems occur they are immediately reported via SMS and e-mail to the responsible engineers. Furthermore Marvin retrieves, verifies, calculates, interprets and saves project data. Marvin performs in-house M&V (Measurement & Verification) functions and generates reports and presentations for Eskom, HVACI and their clients.

Project performance and other information are available online and via mobile phone to project engineers. The immediate availability of information helps issues to be addressed instantly.

Figure 57: MARVIN daily energy profile display
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HERMES
Hermes is a redundant communication system developed to ensure seamless communication between HVACI’s head office (Marvin) and DSM site (Sentinel). Many projects are located at remote sites with limited communication networks. Fixed line, GPRS and GSM technology are utilised to ensure two-way communication.

MICS/CALDS
CALDS (Compressed Air Leakage Detection System) is a bouquet of mobile communication devices used to promote regular equipment checking and maintenance. Poorly maintained equipment is a major cause of equipment failure. This results in DSM potential being lost and takes days, after the problem has been solved, to re-establish control. These devices are customised for the specific installation. Sentinel uploads this information for monitoring. The overall maintenance quality is improved by this system.

EMS
This enterprise management system logs data from all project installations and investigations. The shared information helps HVACI’s engineers to effectively address issues at one site that may previously have been encountered at other sites. Furthermore, EMS helps to keep track of project progress to ensure problems are attended to within acceptable timeframes and on budget.

4.3.3 Results

OSIMS was implemented in 20 DSM projects over a 3-year period. Measurements by Eskom DSM’s independent M&V teams, Figure 58, show that OSIMS helped to achieve a sustainable capacity of 109%.
4.3.4 Conclusion

A successful DSM programme not only needs initial virtual (rated) capacity, but even more importantly, sustainable capacity. As most DSM projects lack the sustainability component, it makes OSIMS unique. This technology holds tremendous potential for South Africa’s DSM programme, as it can be used to bring under-performing DSM projects of other ESCos back on track.

The same reason for DSM deterioration, holds for CDM energy-efficiency projects. If a project activity fails to deliver the specified CERs as stipulated in the ERPA (Emission Reduction Purchase Agreement), the developer could face serious financial penalties. OSIMS guarantees the purchaser of CERs minimum supply risk. The proven OSIMS track record would give HVAC International bargaining power for higher CERs prices in a CDM developer’s position.
4.4 **Development of REMS-CARBON**

4.4.1 REMS-CARBON development specification

This section will expand REMS and OSIMS to accommodate the necessary measurement, verification and projection of accumulated CERs.

REMS-CARBON must include the following functions:

- Subtract the energy-efficiency intervention baseline from the business as usual baseline, to give a MWh saving;
- Calculate the cumulative CERs for any given period;
- Forecast the expected amount of CERs at the end of the chosen crediting period, based on historic system performance;
- Information must be attained from a user-friendly GUI (Graphical User Interface); and
- REMS-CARBON must have report-writing capabilities.

4.4.2 Certified Emission Reduction calculations

The following formula is used to determine the anthropogenic emission by source of GHGs of the baseline (before intervention or project activity):

\[
EB = \frac{\sum_{i} (ni \cdot pi \cdot oi)}{1 - l}
\]

Where:

- \(EB\) = annual energy baseline in kWh per year
- \(\sum_{i}\) = the sum over the group of “\(i\)” devices (number of pump stations)
- \(ni\) = the number of devices of the group of “\(i\)” devices (number of pumps in station)
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pi = the rated power of the devices of the group of “i” devices (kW install capacity of each pump)

oi = the average daily operating hours of the devices of the group of “i” devices (hours)

l = average technical distribution losses for the grid serving the locations where the devices are installed, expressed as a fraction.

The energy baseline (EB) is multiplied by a Baseline Carbon Emissions Factor (EF, measured in kg CO₂ e/kWh) for the electricity displaced. Therefore the baseline emissions (BE) are calculated as follows:

\[
BE = EB * EF
\]

Project activity (after intervention) total emissions are calculated daily as follows:

\[
PE = \sum_i (OH_i) \times (RP_i) \times (EF)
\]

Where:

PE = Daily Project Emissions in tons CO₂ e

\(\sum_i\) = the sum over the group of “i” devices

OH\(i\) = Daily Operating Hours for device CO\(i\)

RP\(i\) = Rated Power of device \(i\)

EF = Emissions Factor (measured in kg CO2equ/kWh)

\(\sum_i (OH_i) \times (RP_i)\) = Daily total electricity power used on all the clear water pumping systems.

The total GHG emissions reduction, due to the project activity, is the difference between BE and PE:

\[
CER = BE – PE
\]
The emission factor is the mass of carbon dioxide emitted per kWh generated and is unique for various distributions networks or electricity grids. Eskom’s annual report for 2007 as shown in Table 8 reports an emission factor of 0.958kg/kWh, but with a foot-note stating that it should be 1.2kg/kWh according to the CDM approved consolidated methodology 0002. An emission factor of 1.2kg/kWh will therefore be used throughout this document for CER calculations.

### Table 8: Grid emission factor for Eskom 2007

<table>
<thead>
<tr>
<th>Factor</th>
<th>kWh</th>
<th>MWh</th>
<th>GWh</th>
<th>TWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal use</td>
<td>0.55</td>
<td>kilogram</td>
<td>ton</td>
<td>thousand tons (kt)</td>
</tr>
<tr>
<td>Water use</td>
<td>1.35</td>
<td>litre</td>
<td>kilolitre</td>
<td>megalitre</td>
</tr>
<tr>
<td>Ash produced</td>
<td>157</td>
<td>gram</td>
<td>kilogram</td>
<td>ton</td>
</tr>
<tr>
<td>Particulate emissions</td>
<td>0.20</td>
<td>gram</td>
<td>kilogram</td>
<td>ton</td>
</tr>
<tr>
<td>CO₂ emissions</td>
<td>0.958</td>
<td>kilogram</td>
<td>ton</td>
<td>thousand tons (kt)</td>
</tr>
<tr>
<td>NOₓ emissions</td>
<td>8.601</td>
<td>gram</td>
<td>kilogram</td>
<td>ton</td>
</tr>
</tbody>
</table>

Use of table: Multiply electricity consumption or saving by the relevant factor to determine the environmental implication.

Example 1:
- Used 90 kWh of electricity
- Water consumption: 90 x 1.35 = 121.50
- Therefore, 121.50 litres of water used

Example 2:
- Used 90 GWh of electricity
- CO₂ emissions: 90 x 0.958 = 86.22
- Therefore, 86.22 thousand tons of CO₂ emitted

1. Figures are calculated based on total energy sold by Eskom. Further information can be obtained through the Eskom environmental hotline. Contact details appear on page 116.
2. Figures represent the 12-month period from 1 April 2006 to 31 March 2007.
3. Volume of water consumed per unit of generated power sent out, excluding rain and mine water used.
4. Calculated annual figures based on coal characteristics and power station design parameters.
5. Represents the Eskom average CO₂ figure. We have calculated the carbon emission factor to be 1.2 kg/kWh in accordance with the clean development mechanism (CDM) approved consolidated methodology 0002. The methodology can be found on the official CDM website (http://cdm.unfccc.int).

### 4.4.3 REMS-CARBON interface

REMS-CARBON allows the user to view the real-time cumulative savings of carbon over the life time of the project. The business as usual baseline remains fixed over the crediting period in the case of CDM, or over the contractual DSM period. For a CDM project the crediting period could be 10 years, or 3 times 7 years when the baseline is updated after 7 years [12]. A DSM client will have a 5 year obligation towards Eskom after which the client becomes the owner of the DSM equipment.
The intervention baseline (runtime in MW hours), is subtracted from the business as usual baseline, in MWh, and multiplied by the grid emission factor. This is then displayed on the REMS-CARBON interface as a continuous graph over time. This accumulation of $CO_2$ savings is simply the accumulation of sellable CERs up until that specific time of the project. See Figure 59.

![Figure 59: REMS-CARBON interface](image)

### 4.5 Conclusion

From this Chapter it is clear that HVAC International and very possibly other ESCos, have certain technologies borrowed from their DSM experience that could be adapted to satisfy the need of CDM projects. These technologies create the opportunity to explore more than one energy-efficiency market.
REMS and OSIMS are two proven technologies that can reduce the technical risks of a project activity. However, in the context of energy-efficiency funding mechanisms such as DSM and CDM, the technical feasibility is only one link within the total decision-making chain. Chapter 6 will conduct an in-depth investigation into other risks involved in the two projects under discussion.

For the purpose of this study the project activity is first developed to make sure energy-efficiency savings are at hand for investment analysis. A retrospective approach is followed to both the DSM and CDM mechanism. In the next Chapter we implement the project activity and in further Chapters we analyse which approach would have the least risks.

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