



Solar Water Heater

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Introduction

Amana Contracting & Steel Buildings was contracted in 2008 to construct staff accommodations for a global oilfield services company at Al Shamkha in Abu Dhabi.

With a built-up area of 30,000 square meters, the concrete-based complex consists of six identical blocks (G+2) and houses 492 trainees. A central amenities block is also included to provide entertainment and dining facilities as well as a 2,000 square meter indoor multipurpose court located adjacent to the accommodation buildings.



Image 1 – Elevated view of accommodation building



Image 2 – Solar water heaters & systems in place on roof

Work on the project began on October 25, 2008 and was completed in February 2010.

Problem Statement

In total, the entire facility consisted of over 500 bathrooms and common areas that require access to hot water. Under conventional heating methods, each bathroom would have its own independent electric water heater to provide hot water for that bathroom. This easily translates to the need to install approximately 500 electric water heater units across all six buildings. Amana recommended to the client a solution that would provide the bathrooms with hot running water while minimizing installation, running, maintenance and environmental costs. The change was still possible even though, at that point, the design with conventional electric water heater was already completed and construction had already started at site.

Conventional Electric Water Heater

Under the common practice of using conventional electric water heaters, 492 heaters required installation with each heater consuming 1.2kW of electricity per hour. Based on this, the annual electricity consumption cost of using electric water heaters can be determined as follows:

Number of Electric Water Heaters	492 units
Electricity Consumption	1.2kW/unit
Operational Hours per Day	4 hours
Days Operational	365 days
Average Cost for 1kW	AED 0.15/kW
Annual Electrical Cost	AED 129,298

Furthermore, the cost of purchasing electric heaters is around AED 1,200 per unit. The combination of initial required capital expenditure plus the

annual running cost for this solution is summarized below:

Average Cost of Conventional Electric Water Heaters	
Purchase Cost	AED 1,200/unit
Total Quantity	492 units
Initial Cost	AED 590,400
Annual Cost	AED 129,298

In terms of environmental impact, conventional electric water heaters contribute to CO₂ emissions. Based on approved calculations by Abu Dhabi Future Energy Company (Masdar), where 1kWh of electricity in the UAE amounts to 0.844kg of carbon dioxide emissions, the CO₂ emissions from conventional water heaters is calculated as follows:

Carbon Emissions from Conventional Electric Water Heaters	
Number of Electric Water Heaters	492 units
Electricity Consumption	1.2kW/unit
Operational Hours per Day	4 hours
Days Operational	365 days
Average Emissions per 1kWh	0.844kg
Total Annual Carbon Emissions	727.51 mt

Solar Water Heater Solution

The solar water heating system proposed by Amana and Millennium Energy Industry consisted of 95 solar water heaters of integrated 150 liters pressurized tanks with 220 liters total capacity using state-of-the-art 24 evacuated tubes solar collectors. Each solar water heater caters hot water for six bathrooms.

The integrated system has another important benefit, which is the availability of pressurized water. This eliminates the need to use any circulation pumps thus providing further cost reductions and higher reliability. In order to ensure regular availability of hot water during the evenings or overcast days, a back-up electric heater is added to each unit with a unit consumption of 1.5kW per hour. The resulting annual electricity consumption of the solar water heaters would be as follows:

Number of Electric Water Heaters	95 units
Electricity Consumption	1.5kW/unit
Operational Hours per Day	4 hours
Days Operational	365 days
Average Cost for 1kW	AED 0.15/kW
Annual Electrical Cost	AED 31,208

In comparison to a conventional electric water heater, this produces annual operating savings of over 75%.

Annual Electricity Cost of 4-Hour Operational Water Heaters	
Electric Water Heater	AED 129,298
Solar Water Heater	AED 31,208
Saving	76%

As for the initial cost of purchase, one solar water heater costs on average AED 6,000. The combination of initial required capital expenditure plus the annual running cost for this solution is summarized below:

Average Cost of Solar Water Heaters	
Purchase Cost	AED 6,000/unit

Total Quantity	95 units
Initial Cost	AED 570,000
Annual Electricity Cost	AED 31,208

In addition to power consumption, solar water heaters reduce CO₂ emissions in comparison to electric heaters. Based on approved calculations by Abu Dhabi Future Energy Company (Masdar), carbon emissions from solar water heaters are calculated as follows:

Carbon Emissions from Solar Water Heaters	
Number of Electric Water Heaters	95 units
Electricity Consumption	1.5kW/unit
Operational Hours per Day	4 hours
Days Operational	365 days
Average Emissions per 1kWh	0.844kg
Total Annual Carbon Emissions	175.59 mt

In comparison, this results in a carbon reduction of approximately 76%:

Annual Carbon Emission of 4-Hour Operational Water Heaters	
Electric Water Heater	727.51 mt
Solar Water Heater	175.59 mt
Saving	551.92 mt

Implementation

Because of Amana's design-build capabilities, it was possible to incorporate the change in water heater solutions even though the design was already completed and the building was in an advanced stage of construction. For example, wind-load studies had to be undertaken to ensure that structural robustness of the solar

panel installation on the building roof. In addition, the construction schedule of the building had to be modified to allow for the installation and commissioning of the solar panels without delaying the overall building schedule.

Such capabilities coupled with the economic and environmental benefits of a solar water heater solution made the decision naturally acceptable to the client.

Summary

The use of solar water heaters has proven to have at least three advantages over the conventional electric water heaters. First, the solution is economic in both its initial capital requirements and its annual running costs resulting in savings of AED 20,400 in capital expenditures and AED 98,090 in annual running costs to the client.

Second, solar water heating solution is a fully integrated, low-maintenance heating system, resulting in lower maintenance requirements and expenses during the life-cycle of the building.

Thirdly, solar hot water systems are much less carbon intensive, being responsible for approximately 550 meter tons fewer CO₂ emissions annually, which is equivalent to taking 45 Hummer vehicles off the road per year (based on calculations by the US Department of Energy).

Result

	Electric Heaters	Solar Water Heaters
Initial Capital Cost	AED 590,400	AED 570,000
Annual Running Cost	AED 129,298	AED 31,208
CO ₂ Emissions	727.51 mt	175.59 mt

About Amana Contracting & Steel Buildings

Amana Contracting and Steel Buildings is a leading regional turnkey contractor. With eleven operational offices in Middle East, Amana provides to its clients that unique combination of local knowledge coupled with regional reach. Amana is the regional leader in its ability to deliver turnkey solutions for extremely time sensitive industrial and commercial projects on time, within budget and with the quality requirements. To learn more about Amana, visit www.amanabuildings.com.



About Millennium Energy Industry

Millennium Energy Industries (MEI) is an international solar energy solutions company operating in the Middle East North Africa region. Since 2002, MEI has been providing small and large-scale solar energy solutions for industrial, commercial, and residential clients in a wide range of applications including space heating and cooling, and industrial and domestic hot water systems.

