Melbourne City Council Offices (CH2)

# Renewable Energy Report - Solar

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Melbourne City Council

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design advice

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# EXECUTIVE SUMMARY

This report investigates the potential for the incorporation of renewable solar energy into the design of the Melbourne City Council Offices on Little Collins Street.

The feasibility of renewable solar energy discussed in the report is based on the investigation of the following:

- The intensity of solar radiation for Melbourne;
- The degree of overshadowing at the proposed location of the panels;
- The potential energy generated from solar photovoltaic cells and from solar hot water panels;
- The cost of installing solar photovoltaic cells and/or solar hot water panels; and,
- The potential for the energy savings to recoup the cost of installing the cells/panels over 20 years.

At the publication of this report, the data available clearly shows that neither solar hot water nor photovoltaic panels come close to repaying the significant capital outlays required for their installation. Solar hot water panels are estimated to make a loss of over $26,000 (for a $40,000 system) over 20 years, and photovoltaic panels are estimated to make a loss of more than $300,000 (for a $435,000 system) over the same period.

Although subsidies are not considered in these costs, it is not expected that the photovoltaic system could ever come close to a payback period of 20 years, even in the event of significant subsidies. This report therefore recommends against the adoption of photovoltaic cells for financial reasons and it can be argued that such an outlay could provide more meaningful environmental outcomes elsewhere on the building.

Solar hot water systems have often been shown to pay back over 20 years, and this report recommends that all capital costs and possible subsidies be confirmed before the initiative is abandoned. If the costs presently associated with the system are confirmed, however, it is not recommended that solar hot water be adopted.

Both of the proposed systems provide environmental benefits through the reduction of greenhouse gas emissions over the life of the building. However the outcome of this report is that, barring a significant error in the estimated upfront cost of solar hot water, the capital cost of the initiatives significantly outweighs the potential environmental benefits of these systems.

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| | | |
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# 1 INTRODUCTION

This report summarises a series of studies aimed at identifying the potential for the use of solar-based renewable energy for the Melbourne City Council (MCC) development on Little Collins St, Melbourne.

The report investigates the potential and feasibility of using Photo-Voltaic Cells and Solar Hot Water collectors on the roof of the MCC development.

Specifically the report investigates the following issues:

- The solar access of the roof top
- The annual level of solar radiation for Melbourne
- The potential energy savings
- The anticipated pay-back period

Following on from these outcomes, some recommendations will be made about which strategy (if any) should be adopted.

## 1.1 Assumptions

The modelling carried out was based on drawings provided by Design Inc, dated 10 March, 2003.

We have also assumed for the purposes of comparison, that the annual energy consumption of the building is 100 kWh/m². This is a conservative estimate, approximated from figures to date and experience in other commercial buildings. This should not be taken as an energy rating forecast for the building.

The hot water demand for the building is assumed to be 2000L per day. This will need to be confirmed with the hydraulics consultant.

# 2 APPROACH

This report investigates two renewable solar possibilities – photo voltaic cells and solar hot water generation.

The approach taken was as follows:

1. Determine the average solar radiation available for the area of panels to be provided
2. Determine the degree of overshadowing and adjust solar potential accordingly
3. Estimate the energy output from the PV cells and hot water systems
4. Estimate the overall benefit of the system

This approach is described in greater detail below.

## 2.1 Daily Solar Radiation

RETScreen® refers to itself as renewable energy project analysis software. It is useful for determining the "Solar Resource Load" of a surface.

Based on the drawings provided, the solar panels were assumed to be angled at 26.4° to the horizontal and at N21°W.

| Month | Fraction of month used (0 - 1) | Monthly average daily radiation on horizontal surface (kWh/m²/d) | Monthly average temperature (°C) | Monthly average daily radiation in plane of PV array (kWh/m²/d) |
|---|---|---|---|---|
| January | 1.00 | 6.69 | 20.5 | 6.42 |
| February | 1.00 | 5.97 | 20.8 | 6.08 |
| March | 1.00 | 4.53 | 19.1 | 4.96 |
| April | 1.00 | 3.17 | 16.2 | 3.85 |
| May | 1.00 | 2.19 | 13.3 | 2.97 |
| June | 1.00 | 1.69 | 10.8 | 2.41 |
| July | 1.00 | 1.89 | 10.1 | 2.63 |
| August | 1.00 | 2.56 | 11.3 | 3.22 |
| September | 1.00 | 3.56 | 13.0 | 3.99 |
| October | 1.00 | 5.00 | 15.0 | 5.19 |
| November | 1.00 | 5.81 | 16.9 | 5.66 |
| December | 1.00 | 6.39 | 18.9 | 6.05 |

Figure 1: Average daily solar radiation for PV cells

These results then needed to be considered against possible overshadowing of the photovoltaic cells.

## 2.2 Overshadowing

Ecotect was used to calculate the overshadowing of the photo-voltaic panels. The Ecotect model included all of the surrounding buildings in order to take into account the possibility of those buildings overshadowing the solar panels.

Based on the drawings provided, no shading from surrounding buildings is anticipated as a result of overshadowing, but the angle and orientation of the panels cause some shading during the summer months.

| Month | Percent Shading | Resultant daily radiation (kWh/m²/day) | Total daily radiation (kWh/day) |
|---|---|---|---|
| January | 7.1% | 5.97 | 2207.73 |
| February | 7.1% | 5.64 | 2088.55 |
| March | 8.3% | 4.55 | 1684.47 |
| April | 9.1% | 3.50 | 1294.63 |
| May | 0.0% | 2.97 | 1099.91 |
| June | 0.0% | 2.41 | 891.05 |
| July | 0.0% | 2.63 | 973.84 |
| August | 0.0% | 3.22 | 1189.88 |
| September | 0.0% | 3.99 | 1478.13 |
| October | 7.7% | 4.79 | 1772.58 |
| November | 7.1% | 5.25 | 1943.89 |
| December | 13.3% | 5.25 | 1942.09 |

Figure 2: Resultant Daily Solar Radiation

The above table shows the degree of overshadowing and estimated daily solar radiation for various months, based on a solar panel area of 370m².

## 2.3 Photovoltaic Solar Panels

The photovoltaic panels modelled were BS Solar Panels, model BP 585F. The data sheet for these panels is included in Appendix A – Data sheet for BP585. This information was obtained from the BP Solar website, www.bpsolar.com. The nominal PV module efficiency for these modules is 13.5% according to the RETScreen database, and these modules were selected on the premise that they were amongst the most efficient available. BP Solar Australia later advised us that a comparable local product, BP480 would be the most appropriate local alternative. The data sheet is included in Appendix B – Data sheet for BP480.

An image of the solar photovoltaic panels is shown in Figure 3.

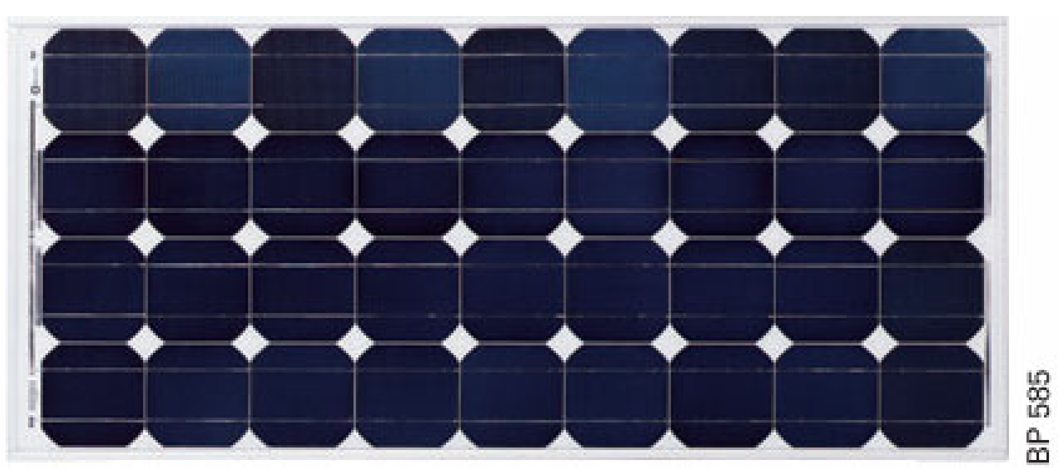



Figure 3: Image of Solar PV Panels for BP585 (from BP Solar website)

## 2.4 Solar Hot Water Panels

The Solar Hot Water Panels used for the RETScreen simulation were Viessmann 200 series solar hot water panels. This is a German product and was selected because performance information was available in the RETScreen program used.

A comparable Australian product would be the Solahart S Panels, although we would anticipate a slightly higher performance from the Solahart product than from the Viessmann panel.

A photo of the Viessmann panel is shown below.

Figure 4: Image of Veissmann Solar Hot Water Collector (200 series)

The hot water design assumed that the hot water requirements would be 2000 L/day. As the main requirement for hot water are the showers, we anticipate that this would be quite a variable requirement, and, given that there are over 80 bicycle spaces available, the hot water requirements could feasibly be much higher (80 x 5-minute showers @ 7.5L per minute = 3000L).

The results of the solar hot water collectors need to take into account not only daily demand, but annual variations in weather and solar radiation. It is for these reasons that the model aimed to identify not only the amount of solar hot water panels required to supply 100% of hot water requirements, but also the optimum amount of panels according to requirements and weather variations.

# 3 RESULTS

RETScreen was used to assist in determining the efficiencies and output from both systems.

## 3.1 Photovoltaic Cells

Based on 370m² of solar PV panels on the roof of the office building (the total roof coverage of the area allotted to solar PV panels), the cells would be expected to provide 76,535 kWh of electricity annually. The overall efficiency of the PV cells is estimated at 12.9%.

| Site Conditions | | | Estimate |
|---|---|---|---|
| | **Project name** | | **Melbourne City Council** |
| | **Project location** | | **Melbourne, Australia** |
| | Nearest location for weather data | - | Melbourne |
| | Latitude of project location | °N | -37.8 |
| | Annual solar radiation (tilted surface) | MWh/m² | 1.62 |
| | Annual average temperature | °C | 15.5 |
| | DC energy demand for months analysed | MWh | 876.209 |
| | AC energy demand for months analysed | MWh | 292.000 |
| **System Characteristics** | | | **Estimate** |
| | Application type | - | Off-grid |
| | Grid type | - | Central-grid |
| **Base Case Power System** | | | |
| | Source | - | Genset |
| | Fuel type | - | Propane |
| | Specific fuel consumption | L/kWh | 0.5500000 |
| **Power Conditioning** | | | |
| | Suggested inverter (DC to AC) capacity | kW (AC) | 50.00 |
| | Inverter capacity | kW (AC) | 0.5 |
| | Average inverter efficiency | % | 90% |
| | Miscellaneous power conditioning losses | % | 0% |
| **Battery** | | | |
| | Days of autonomy required | d | 2.0 |
| | Nominal battery voltage | V | 24.0 |
| | Battery efficiency | % | 85% |
| | Maximum depth of discharge | % | 70% |
| | Charge controller (DC to DC) efficiency | % | 95% |
| | Battery temperature control | - | Minimum |
| | Constant battery temperature | °C | 25.0 |
| | Minimum battery temperature | °C | 15.0 |
| | Average battery temperature derating | % | 4% |
| | Suggested nominal battery capacity | Ah | 410,207 |
| | Nominal battery capacity | Ah | 1,770 |
| **PV Array** | | | |
| | PV module type | - | mono-Si |
| | **PV module manufacturer / model #** | | **BP Solar/Solarex/ BP585F** |
| | **Nominal PV module efficiency** | **%** | **13.5%** |
| | NOCT | °C | 45 |
| | PV temperature coefficient | % / °C | 0.40% |
| | PV array controller | - | MPPT |
| | Miscellaneous PV array losses | % | 0.0% |
| | Suggested nominal PV array power | kWp | 1,647.63 |
| | Nominal PV array power | kWp | 49.30 |
| | **PV array area** | **m²** | **365.2** |
| **Annual Energy Production (12.00 months analysed)** | | | **Estimate** |
| | Equivalent DC energy demand | MWh | 1,200.653 |
| | Equivalent DC demand not met | MWh | 1,124.118 |
| | Specific yield | kWh/m² | 209.6 |
| | **Overall PV system efficiency** | **%** | **12.9%** |
| | **Renewable energy delivered** | **MWh** | **76.535** |
| | | **kWh** | **76535** |

Figure 5: Summary of Solar PV Calculations for RETScreen

Therefore, for every m² of solar panel installed, 209.5 kWh of electricity per annum can be contributed to the building.

Assuming the total annual energy consumption of the offices is 100 kWh/m², the average annual energy demand of the offices would be 748,800 kWh per year. Therefore, with 365 m² of solar panels, approximately 10% of the total energy demand for the building would be met by solar PV collectors. These results are summarised in the table below.

| | |
|---|---|
| *Approximate energy demand of building (kWh per m² per year)* | *100 kWh/m²/year* |
| Net Lettable Area of building (m²) | 7488 m² |
| *Approximate energy demand of building (kWh per year)* | *748,800 kWh/year* |
| Estimated energy production of PV panels (kWh/year/m²) | 209.5 kWh/year |
| Area of solar PV collectors (m²) | 365 m² |
| Total energy production of PV panels (kWh per year) | 76,535 kWh/year |
| ***Approx percent of energy demand delivered by PV panels (%)*** | ***10%*** |
| ***Approx percent of energy demand delivered per m² of PV panel (%)*** | ***0.03%*** |

Figure 6: Summary of Solar PV energy production

It should be noted that the proportion of the building's energy consumption that could be offset by the use of PV cells would increase if the actual demand of the building was lower, and these figures are published as an indicative guide only.

### 3.2 Solar Hot Water

The hot water design assumed that the hot water requirements would be 2000 L/day.

The results of the solar hot water collectors need to take into account not only daily demand, but annual variations in weather and solar radiation. It is for these reasons that the model aimed to identify not only the amount of solar hot water panels required to supply 100% of hot water requirements, but also the optimum amount of panels according to requirements and weather variations.

RETScreen was used to calculate the % annual hot water requirements met for various Hot Water solar collector areas. A typical RETScreen output is shown on the following page in Figure 7.

Based on the Viessmann solar panels used, each panel was 2m² in area. The RETScreen analysis was carried out to determine the overall efficiency and proportion of hot water requirement provided for 1 to 25, 30, 35, 40, 50 and 60 solar hot water panels. These results are shown in Figure 8 to Figure 10.

| RETScreen® Energy Model - Solar Water Heating Project | | | |
|---|---|---|---|
| | | | |
| **Site Conditions** | | | **Estimate** |
| | **Project name** | | **Melbourne City Council** |
| | **Project location** | | **Melbourne, Australia** |
| | **Nearest location for weather data** | | **Melbourne** |
| | Annual solar radiation (tilted surface) | MWh/m² | 1.62 |
| | Annual average temperature | °C | 15.5 |
| | Annual average wind speed | m/s | 6.6 |
| | Desired load temperature | °C | 60 |
| | **Hot water use** | **L/d** | **2,000** |
| | Number of months analysed | month | 12.0 |
| | **Energy demand for months analysed** | **MWh** | **27.08** |
| | | | |
| **System Characteristics** | | | **Estimate** |
| | Application type | | **Service hot water (with storage)** |
| **Base Case Water Heating System** | | | |
| | Heating fuel type | - | **Natural gas** |
| | Heating system seasonal efficiency | % | 70% |
| **Solar Collector** | | | |
| | Collector type | - | Glazed |
| | **Solar water heating collector manufacturer** | | **Veissmann Canada** |
| | **Solar water heating collector model** | | **200 series** |
| | Area per collector | m² | 2.00 |
| | Fr (tau alpha) coefficient | - | 0.82 |
| | Fr UL coefficient | (W/m²)/°C | 2.19 |
| | Suggested number of collectors | | 8 |
| | **Number of collectors** | | **13** |
| | **Total collector area** | **m²** | **26.0** |
| **Storage** | | | |
| | Ratio of storage capacity to coll. area | L/m² | 45.9 |
| | Storage capacity | L | 1,193 |
| **Balance of System** | | | |
| | Suggested pipe diameter | mm | 19 |
| | Pipe diameter | mm | 8 |
| | Pumping power per collector area | W/m² | 0 |
| | Piping and solar tank losses | % | 1% |
| | Losses due to snow and/or dirt | % | 3% |
| | Horz. dist. from mech. room to collector | m | 5 |
| | # of floors from mech. room to collector | - | 2 |
| | | | |
| **Annual Energy Production (12.00 months analysed)** | | | **Estimate** |
| | Pumping energy (electricity) | MWh | 0.00 |
| | Specific yield | kWh/m² | 769 |
| | **System efficiency** | **%** | **48%** |
| | **Solar fraction for months analysed** | **%** | **74%** |
| | **Renewable energy delivered** | **MWh** | **20.00** |
| | | GJ | 72 |

Figure 7: Example of RETScreen Hot Water output

Figure 7 shows many of the assumptions which were made about the solar panels to be used. It shows what could be considered as the optimum number of collectors – an area of about 26m² including 13 collectors. This configuration would save 20,000 kWh (72GJ) of water heating per year, and would offset the electricity demand of the hot water system by 74%.

The graphs below show how this has been determined as the optimum configuration of solar panels. Figure 8 plots the efficiency of the hot solar hot water panels vs. the % of demand they are able to offset. The efficiency of the system dips significantly once it is sized to provide more than 75% of the input for the system. This is because to provide 100% solar hot water in winter, a much larger area of panels is required.

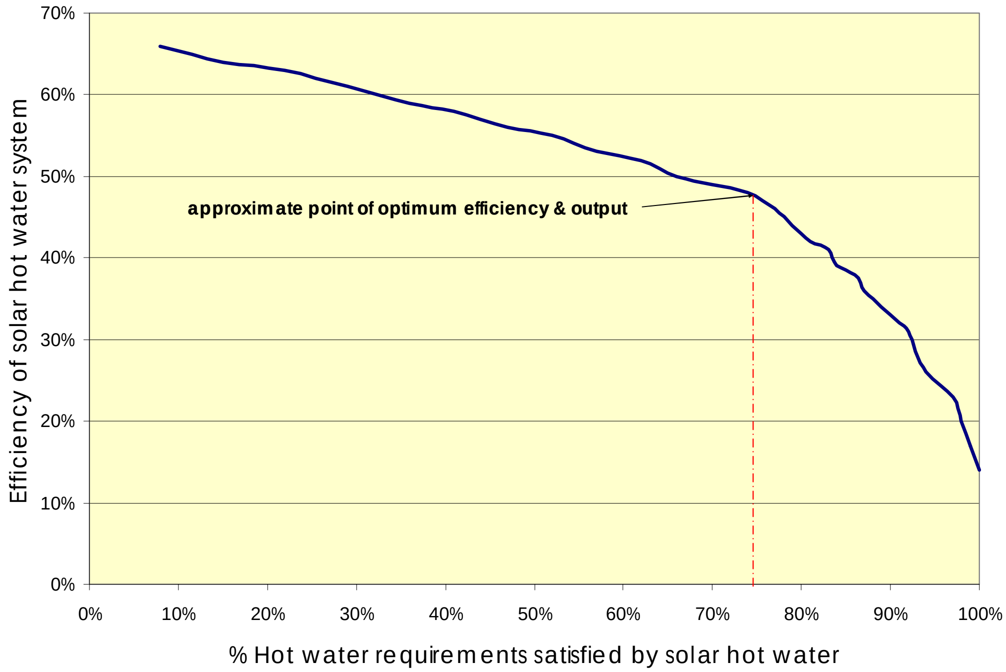



Figure 8: Efficiency vs. % Output for Hot Water panels

The results from Figure 8 are reflected in Figure 9, which shows the efficiency and the output plotted against the area of hot water solar panels. Note that the area of each panel is 2m². This graph indicates that for an output of about 75%, an area of approximately 26m² is required.

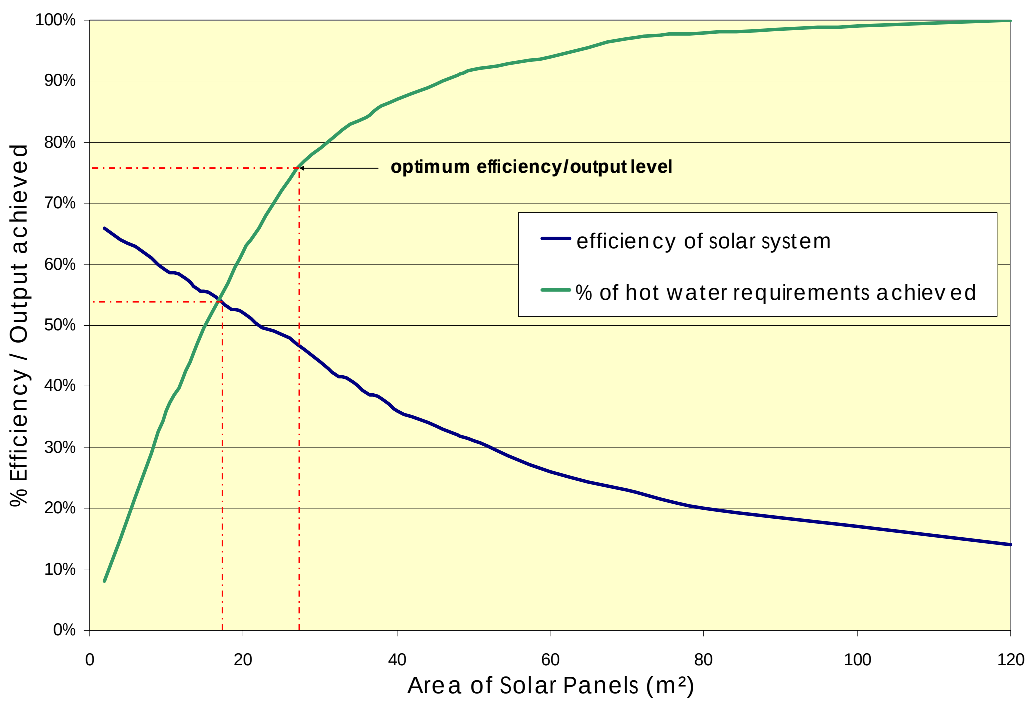



Figure 9: Efficiency and % output vs. solar hot water panel area required

### 3.3 Solar Hot Water vs. Photovoltaic Panels

Figure 10 shows the efficiency of each additional solar hot water panel being added to the roof, compared with the efficiency of each additional PV cell. The first hot water panel on the roof is approximately 66% efficient. Two panels produce slightly less heating than one in terms of overall efficiency, and therefore, the second panel has a lower efficiency than the first.

The aim of this graph is to assist in determining when it would be more efficient to use PV panels rather than solar hot water panels on the roof. The graph suggests that no more than 20 hot water panels (40m²) should be installed on the roof if efficiency is the overriding criteria, as that roof space would be best employed for solar PV panels by that stage.

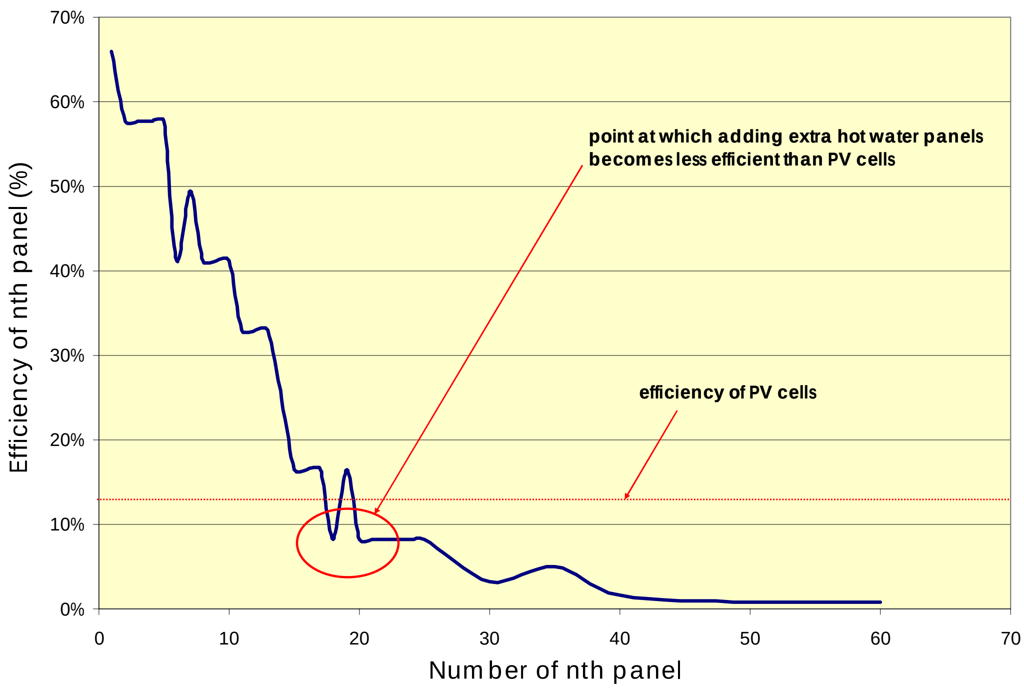



Figure 10: Efficiency of adding an additional solar panel

Based on these results, it will be assumed for the cost benefit analysis that a collector area of approximately 35m² for hot water panels will be incorporated, and that the area of PV cells will be approximately 330m²

### 3.4 Economic Analysis

The economic analysis for both systems assumed the following:

- A 20-year analysis period
- A discount rate of 7%
- An inflation rate on the cost of electricity and gas of 3%
- Negligible maintenance costs

According to an initial assessment from the hydraulics consultant, the total capital cost for 36m² of solar hot water collectors is estimated at $40,000. We have assumed that this does not include any available rebates.

Information from BP Solar costed the installation of Solar PV cells similar to those modelled at $1,100 to $1,300 per m² ex GST. We assumed that the cost inclusive of GST would be $1,320 per m².

Figure 11 below summarises the cost outcomes of the analysis.

| | | | | | | |
|---|---|---|---|---|---|---|
| **LIFE CYCLE COST ANALYSIS - PRESENT WORTH METHOD** | | | | | | |
| Project Name : | **Melbourne City Council** | | Prep. by : | ADC | Date : | 26/03/2003 |
| Project No : | AESY8200.00 | | Chkd by : | ...................... | Date : | ............... |
| Building name: | **Stage 2** | | | | | |
| **Discount Rate (%)** | | **7.00 %** | **Analysis No. 1** | | **Analysis No.2** | |
| **Economic Life (Yrs)** | | **20 Years** | **Description** | | **Description** | |
| | | | **Solar Hot Water** | | **Solar PV Panels (330m²)** | |
| | | | Estimated Costs | Present Worth | Estimated Costs | Present Worth |
| **CAPITAL COSTS** | | | | | | |
| **SOLAR HOT WATER SYSTEM PER M² INCLUDING** | | | | | | |
| A. Entire system (inc. gas) | | | | $40,000 | | |
| **SOLAR PHOTOVOLTAIC CELLS** | | | | | | |
| B. Entire system | | | | | | $435,600 |
| C.Sub Total | | | | $40,000 | | $435,600 |
| D.Contingencies (%) | | 0.00 % | | $0 | | $0 |
| E.Escalation (%) | | 0.00 % | | $0 | | $0 |
| **TOTAL INITIAL COST** | | | | **$40,000** | | **$435,600** |
| **ANNUAL ENERGY SAVINGS** | | | | | | |
| Diffl.Escal.Rate (%) | | 3.00 % | | | | |
| PWA with Escal Factor | | 13.73 | | | | |
| F. Hot Water Savings (MJ) | | | -82,160 | | | |
| G. Hot Water Savings (MJ=$0.0141*) | | | -$980 | -$13,454 | | |
| H. Electricity Savings (kWh) | | | | | -68,742 | |
| I. Electricity Savings (kWh=$0.1396*) | | | | | -$9,596 | -$131,774 |
| **TOTAL ANNUAL OPERATING COSTS** | | | | **-$13,454** | | **-$131,774** |
| **ANNUAL MAINTENANCE COSTS** | | | | | | |
| Diffl.Escal.Rate (%) | | 3.00 % | | | | |
| PWA with Escal Factor | | 13.73 | | | | |
| J. Maintenance assumed negligible | | | $0 | $0 | $0 | $0 |
| | | | | | | |
| **TOTAL ANNUAL MAINTENANCE COSTS** | | | | **$0** | | **$0** |
| **TOTAL PRESENT COST** | | | | | | |
| **(EQUAL TO SUBSIDY REQUIRED TO BREAK EVEN)** | | | | **$26,546** | | **$303,826** |
| **APPROXIMATE PAYBACK PERIOD** | | | | **never** | | **never** |
| **COST OF GAS (PER MJ)/ELECTRICITY (PER kWh)** | | | | | | |
| **REQUIRED TO BREAK EVEN** | | | | **$0.036** | | **$0.460** |
| *Energy costs obtained from Energex website - www.energex.com.au | | | | | | |

Figure 11: Net Present Cost of Solar Hot Water and PV cells

# 4 DISCUSSION

Based on these results, neither the solar hot water, nor the solar photovoltaic cells will ever break even. Both systems are extremely expensive for the output, even when the benefits of 20 years of operation are taken into account. There are, however, some things to consider in the cost approximations.

It should be noted that the costs do not include any available subsidies. Assuming no subsidies are available, the cost of gas would have to increase by over 140% to make the solar hot water system financially viable and the cost of electricity would need to increase by over 220% to make the PV panels break even.

Substantial subsidies may help the equation look less lop-sided, but it should be remembered that subsidies of over 50% of the entire system would be necessary to come close to providing a 20 year pay-back scenario.

The costs quoted are for the entire systems, and these upfront costs may be high. For example, the hot water cost includes the gas boiler, which will probably be excluded from the building, with the waste heat from a micro-turbine system contributing the balance of the hot water generation. There may also be structural costs included in the hot water price which could be economised in the case of both systems being adopted.

The following table summarises the margin for error in the results provided.

| Element | Source | Chance of error in calculations |
|---|---|---|
| PV energy generation | RETScreen analysis | Saving slightly higher than BP Solar estimates – low error |
| Hot water generation | RETScreen analysis | Assumption regarding hot water requirements need to be confirmed |
| Energy tariffs | Energex.com.au | Negligible |
| Capital cost photovoltaic cells | BP Solar | Low (say 10% margin), but does not include subsidy |
| Capital cost solar hot water | CJ Arms & Associates | Medium – likely to have overestimated capital cost, also may not include subsidies |
| Discount Rate (7%) | State Government | Low chance of error |
| Inflation of energy costs (3%) | General Inflation rate | Low chance of error |
| Maintenance costs | Nil | Not included in calculations but may be considerable |

Figure 12: Potential errors in cost evaluation

The figures in this report suggest that neither system will ever totally pay itself off without a substantial subsidy and significant change in the figures obtained. However based on the errors above, solar hot water has the potential to pay itself back if refinement of the capital costs show a significant overestimation in its upfront cost, and if the demand is expected to be higher than anticipated in this report.

We do not recommend the further pursuit of solar photovoltaic panels for this development unless Melbourne City Council is committed to the use of photovoltaic panels as a principle. As an environmental initiative, we believe the money would have a more significant impact furthering other environmental features of the development.

# APPENDIX A – DATA FOR BP585 SERIES

# APPENDIX B – DATA FOR BP480 SERIES

# APPENDIX C – DATA FOR VIESSMANN 200 SERIES

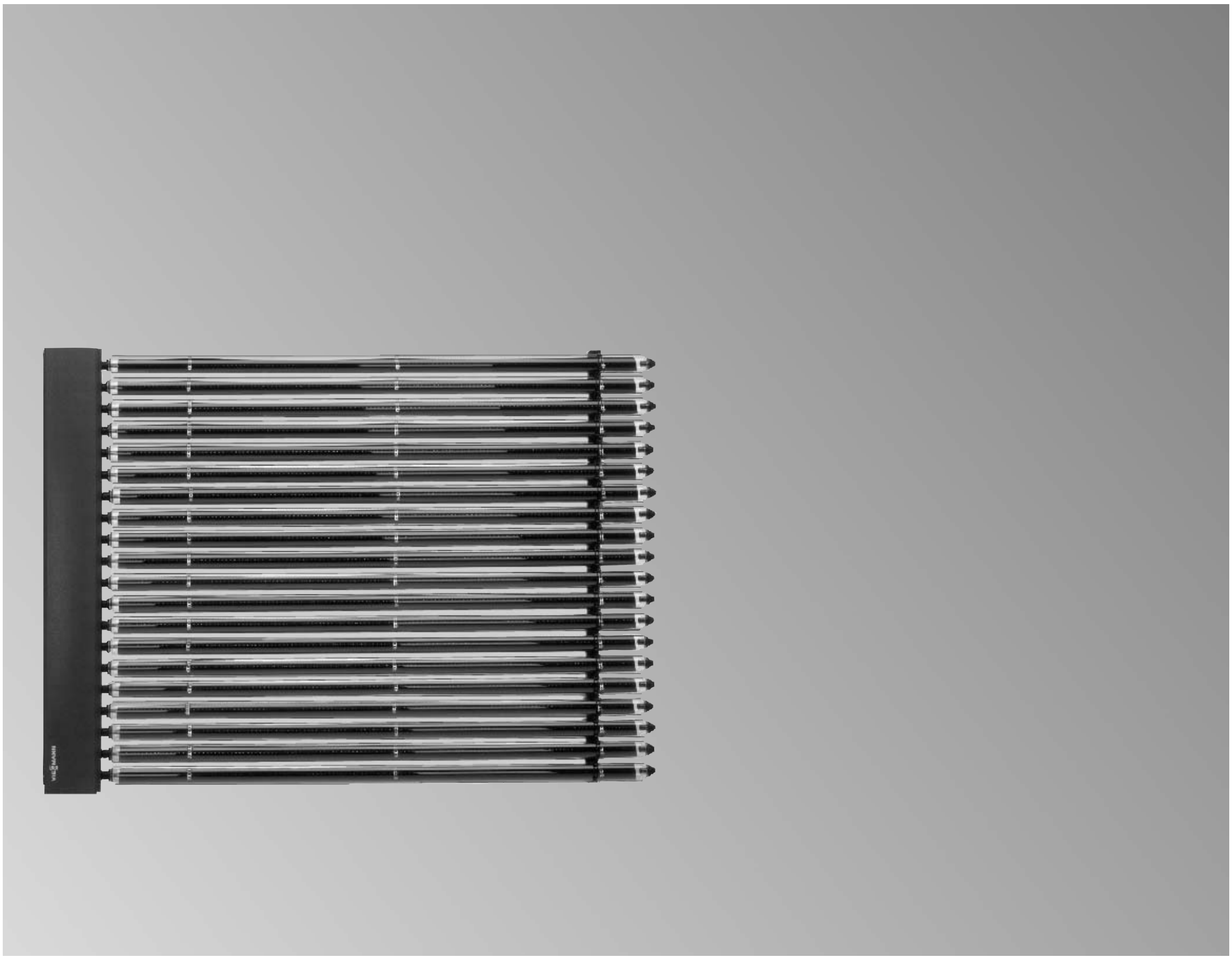
VIESSMANN

**VITOSOL 200**

Direct-flow vacuum tube collector
for utilizing solar energy

# Technical Data

**Part No. and prices: see Price List**



**File in:**
Vitotec 1 Manual, Index 16

## Vitosol 200

**Type D10, D20 and D30**

**Vacuum tube collector**

For installation on pitched and flat roofs, walls/fascias and balustrades.

For heating domestic hot water, low-temperature heating systems and swimming pool water via a heat exchanger

**Pressure loading capacity up to 6 bar**

”Blue Angel” environmental certificate awarded to the Vitosol 200 vacuum tube collector in accordance with RAL-UZ 73

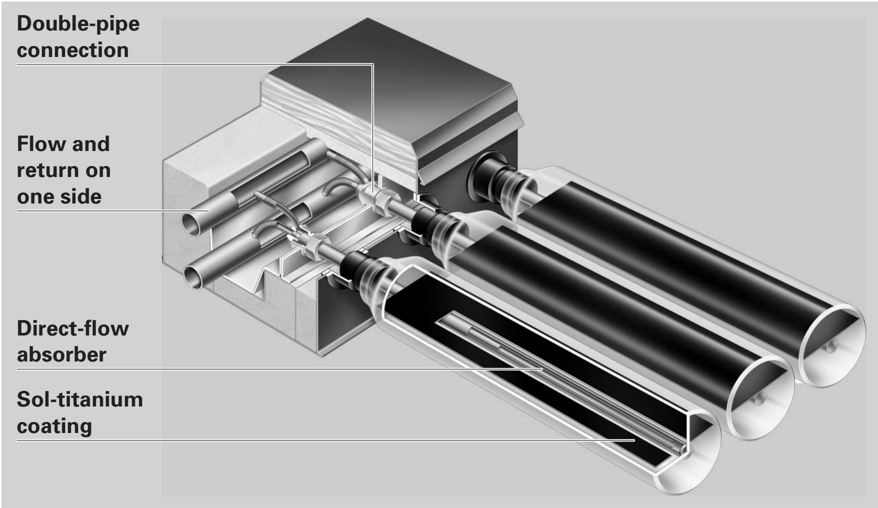
Certificated in accordance with DIN ISO 9001
Certificate Reg. No. 12 100 5581

5822 127-2 GB 6/2001

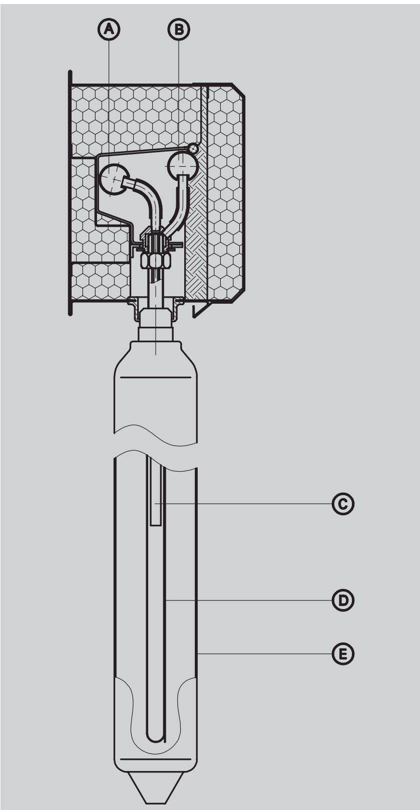
## VITOSOL 200

**The benefits at a glance**

- Collector surface area: 1, 2 and 3 $m^2$.
- High efficiency through vacuum collector tubes and Sol-titanium coated absorber.
- The direct-flow collector tubes permit vertical and horizontal installation without support frames.
- Wide application range for pitched and flat roofs as well as walls/fascias.
- High level of operational reliability and a long service life thanks to the use of high-grade, corrosion-resistant materials, such as borosilicate glass, copper and stainless steel.
- Awarded the "Blue Angel" environmental certificate, quality-tested by the SPF Institute Rapperswil.




**Vitosol 200 – vacuum tube collector with Sol-titanium coating**




**Functional description**

Vitosol 200 vacuum tube collectors are available in three versions:
The D10 version consists of 10 (≙ 1 $m^2$),
the D20 version of 20 (≙ 2 $m^2$),
the D30 version of 30 (≙ 3 $m^2$)
high-vacuum glass tubes.

Vitosol 200 collectors are suitable for installation on pitched and flat roofs, walls/fascias and balustrades.

On pitched roofs, the collectors can be mounted both longitudinally (with the vacuum tubes at right angles to the roof ridge) and transversely (with the vacuum tubes parallel with the roof ridge).

The vacuum in the glass tubes ensures optimum heat insulation; convection losses between the glass tube and the absorber are almost eliminated. This enables the vacuum tube collector to make use of low radiation (diffused radiation), too.

Built into each vacuum tube is a Sol-titanium coated copper absorber. This ensures high absorption of the solar radiation and low emission of the thermal radiation.

A coaxial heat exchange pipe, through which the heat transfer medium passes, is embedded in the absorber.
The heat transfer medium picks up the heat from the absorber via the heat exchange pipe.
The heat exchange pipe feeds into a header.

In order to be able to make optimum use of solar energy, each vacuum tube is pivot-mounted; this enables the absorber to be optimally oriented towards the sun.

Collector surface areas of up to 6 $m^2$ can be joined in parallel and a further 6 $m^2$ in series to form a collector panel with the aid of flexible and insulated connecting pipes sealed with O-rings. (Collector panels which are connected in series must be of the same dimensions).

A connection kit with clamping ring connections facilitates the connection of the collector panel to the piping of the solar circuit.
The collector temperature sensor is installed in a sensor mounting on the flow pipe in the connection housing of the collector.

Ⓐ Return pipe (inlet)
Ⓑ Flow pipe (outlet)
Ⓒ Coaxial heat exchange pipe
Ⓓ Absorber
Ⓔ Evacuated special glass tube

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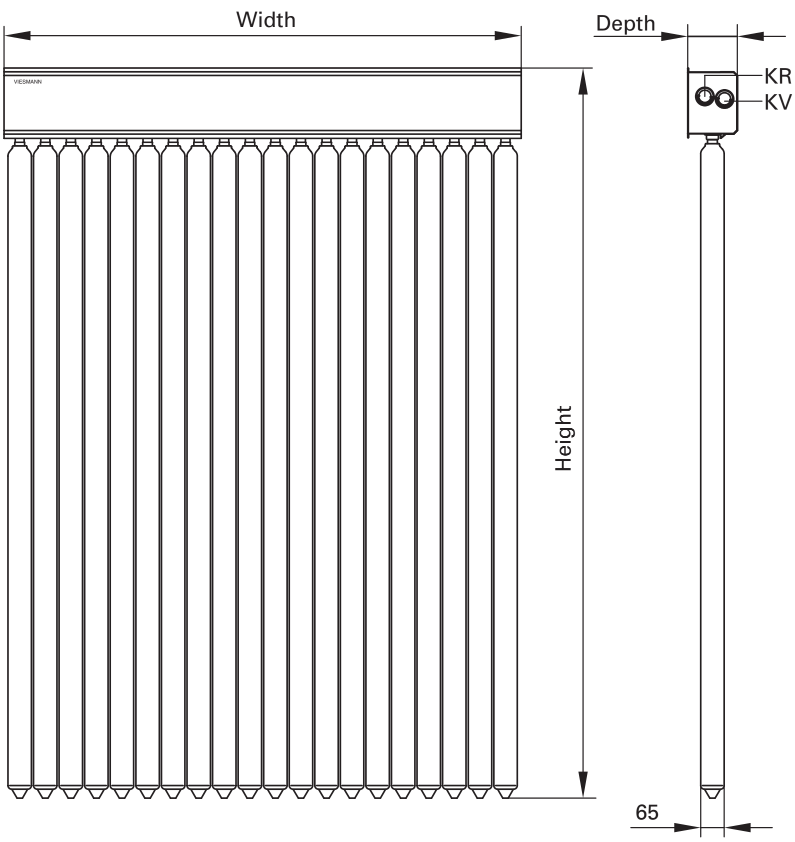
## Technical data for the Vitosol 200 solar collector

| | | | | |
|---|---|---|---|---|
| **Type**<br>**Number of tubes** | | D10<br>10 | D20<br>20 | D30<br>30 |
| **Type approval code** | | | 06-328-118 | |
| **Gross surface area** | $m^2$ | 1.50 | 2.94 | 4.38 |
| **Absorber surface area** | $m^2$ | 1 | 2 | 3 |
| **Aperture** | $m^2$ | 1.07 | 2.14 | 3.21 |
| **Dimensions**<br>Width<br>Height<br>Depth | <br>mm<br>mm<br>mm | <br>741<br>2028<br>138 | <br>1450<br>2028<br>138 | <br>2159<br>2028<br>138 |
| **Optical efficiency***1 | % | 84 | 84 | 84 |
| **Heat loss coefficient $U_1$***1<br>**$U_2$***1 | $W/(m^2 \cdot K)$<br>$W/(m^2 \cdot K^2)$ | 1.75<br>0.008 | 1.75<br>0.008 | 1.75<br>0.008 |
| **Weight** | kg | 23 | 45 | 68 |
| **Fluid capacity**<br>**(heat transfer medium)** | litres | 2 | 4 | 6 |
| **Max. operating pressure***2 | bar | 6 | 6 | 6 |
| **Max. stagnation temperature***3 | °C | 300 | 300 | 300 |
| **Connection** | ∅ mm | 22 | 22 | 22 |
| **Installation area on flat roofs** | $m^2$ | approx. 1.5 | approx. 2.94 | approx. 4.38 |
| **Requirements to be satisfied by installation surface and anchorage** | | Roof construction with adequate load capacity for prevailing wind forces | | |

*[*1]Based on the absorber surface area.*
*[*2]With sealed systems, an overpressure of at least 1.5 bar must be present in the collectors in the cold condition.*
*[*3]The stagnation temperature is the temperature which applies at the hottest point of the collector at a global radiation intensity of 1000 W when no heat is conducted away by the heat transfer medium.*




KR Collector return (inlet)
KV Collector flow (outlet)

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### Technical data for the heat transfer medium

Non-toxic fluid for solar heating systems containing effective corrosion and ageing inhibitors.

| | |
|---|---|
| Antifreeze protection: | down to –28°C to ASTM D 1177 |
| Density at +20°C: | 1.032 to 1.035 g/cm$^3$ to ASTM D 1122 |
| Viscosity at 20°C: | 4.5 to 5.5 mm$^2$/s to DIN 51562 |
| pH value: | 9.0 to 10.5 to ASTM D 1287 |
| Colour: | Clear, fluorescent red |
| Container: | 20-litre drum, non-returnable |

## Standard delivery

The following are packed in separate cartons:
- Connection box with installation rails and product literature
- Vacuum tubes (10 per packaging unit)

Accessories, separately packed, depending on order:
Fastening accessories
Connecting pipes with insulation
Connection kit
Solar Divicon (pumping station for collector circuit)
Solar pump line (for a second pump circuit)
Air separator
Quick-acting air vent valve with tee and clamping ring connection
Connecting cables
Installation kit for connecting cable
Solar flow and return pipe
Clamping ring connection (with or without air vent)
Covering for the hydraulic connections
Filling valve
Solar manual filling pump
Solar expansion vessel with shut-off valve
Heat transfer medium
Antifreeze tester
Set of spare parts (assortment of small parts which may be mislaid during installation of the collectors)

**Fastening kits**

The fastening kits contain the parts required for the installation work concerned, such as:
Mounting plates, roof battens, roof hooks, nuts and bolts.

Printed on environmentally friendly, chlorine-free bleached paper

### Please note:

Viessmann offers complete solar heating systems with Vitosol 200 (Type D30) for domestic hot water heating and/or as space heating backup (see Price List, Index 16).

Subject to technical modifications.

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