somfy
FOR BIOCLIMATIC FAÇADES

# Simulation report

## Simulation made for project:

| | |
|---|---|
| Name: | 4 family home |
| Address: | |
| City: | Johannesburg |
| Country: | |
| Type of building: | Residential |
| Project company: | |
| Consultant company: | |
| Simulation consultant: | |
| Installer company: | |
| Installer consultant | |



Somfy DISC
Dynamic Insulation Strategies & Comparisons

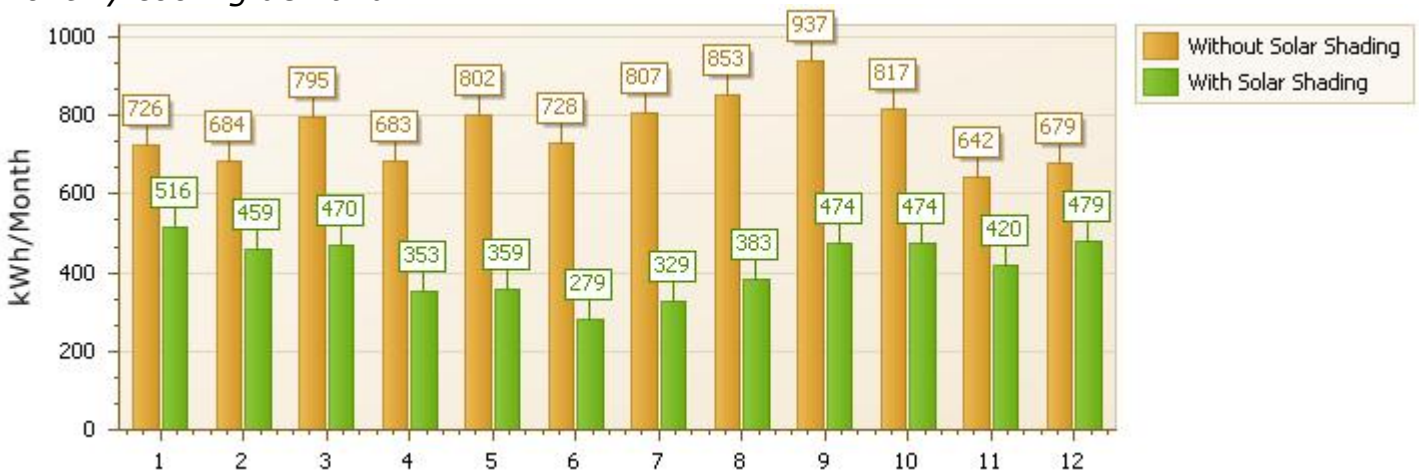
# Cooling results

*Annual cooling demands and loads*

| | Without solar shading | With solar shading | Saving in % | Saving |
|---|---|---|---|---|
| Cooling demand: | **9153 kWh** | **4996 kWh** | **45.4%** | **4157 kWh** |
| Cooling demand per m2: | **305 kWh** | **166 kWh** | **45.4%** | **139 kWh** |
| Cooling load: | **7808 W** | **4196 W** | **46.3%** | **3612 W** |
| Cooling load per m2: | **260 W** | **139 W** | **46.3%** | **120 W** |

*For more information see appendix 1.*

*Monthly cooling demand*



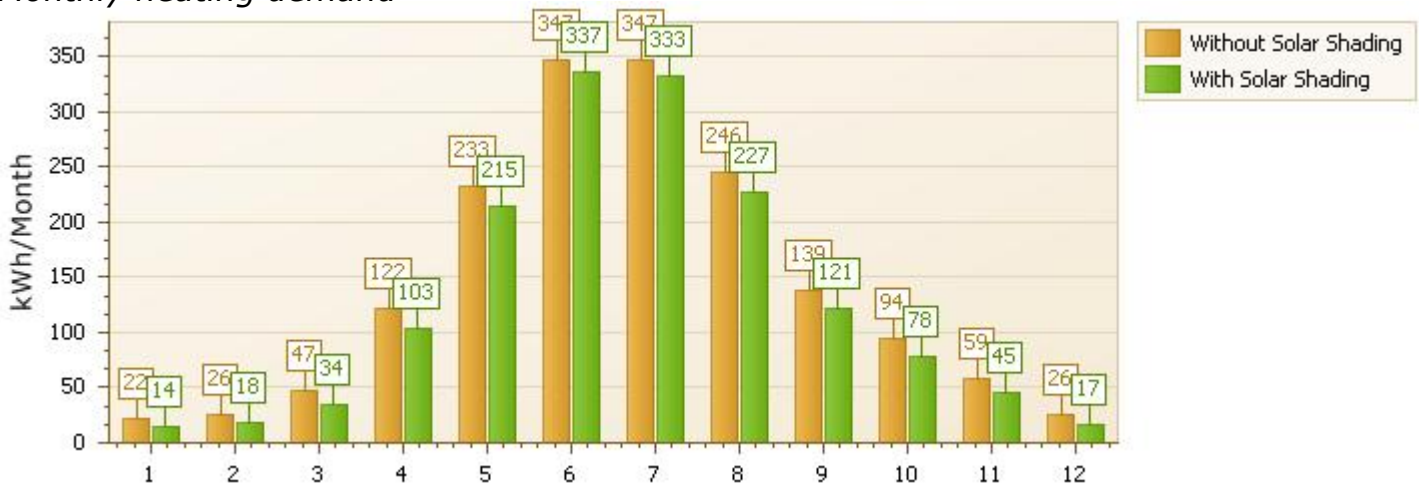

# Heating results

*Annual heating demands and loads*

| | Without solar shading | With solar shading | Saving in % | Saving |
|---|---|---|---|---|
| Heating demand: | **1707 kWh** | **1543 kWh** | **9.6%** | **164 kWh** |
| Heating demand per m2: | **56 kWh** | **51 kWh** | **9.6%** | **5 kWh** |
| Heating load: | **2067 W** | **1940 W** | **6.1%** | **127 W** |
| Heating load per m2: | **68 W** | **64 W** | **6.1%** | **4 W** |

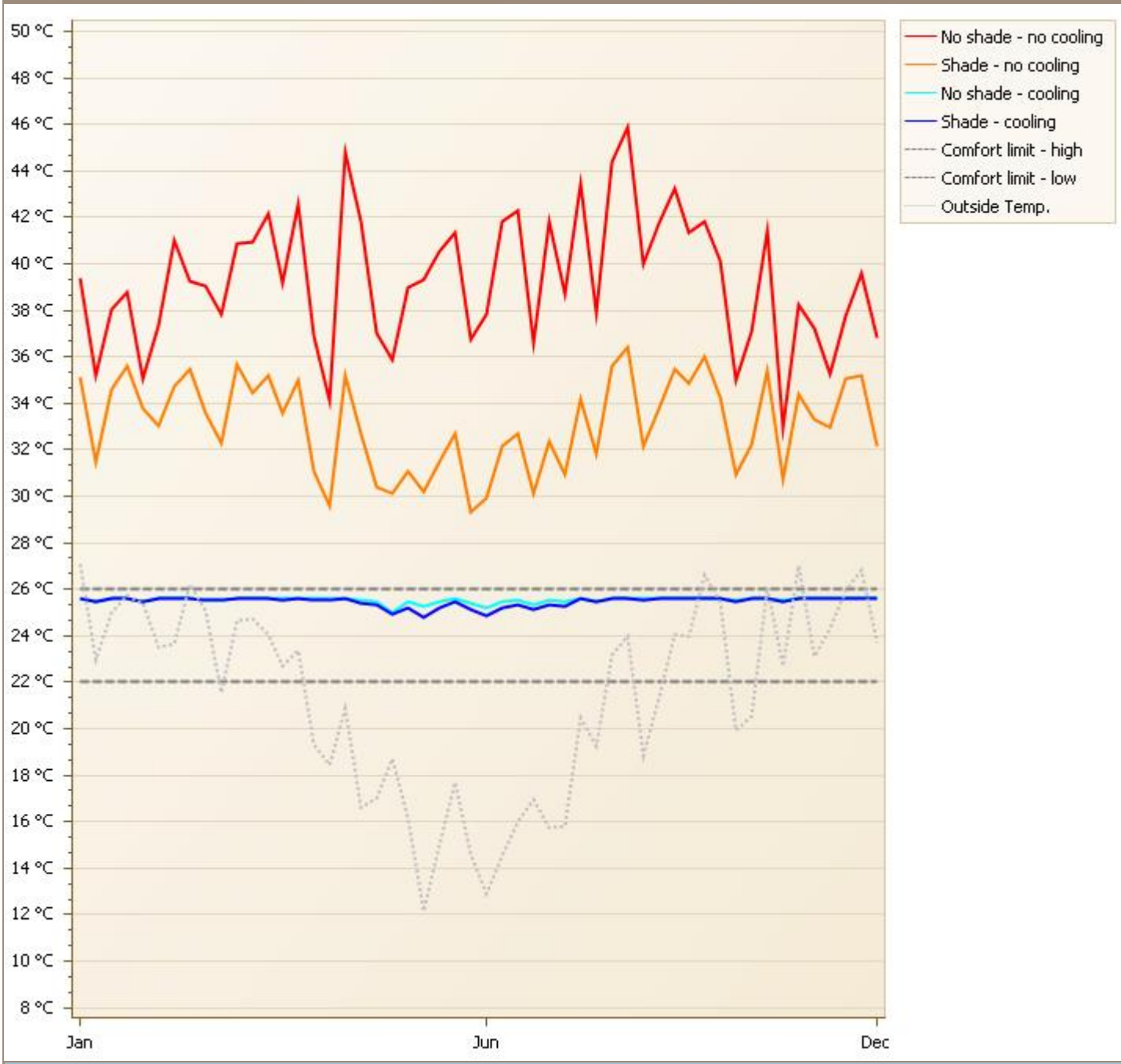
*For more information see appendix 1.*

*Monthly heating demand*



# Temperature Results

## Annual temperature graph, daytime 08:00-17:00 (weekly averages)



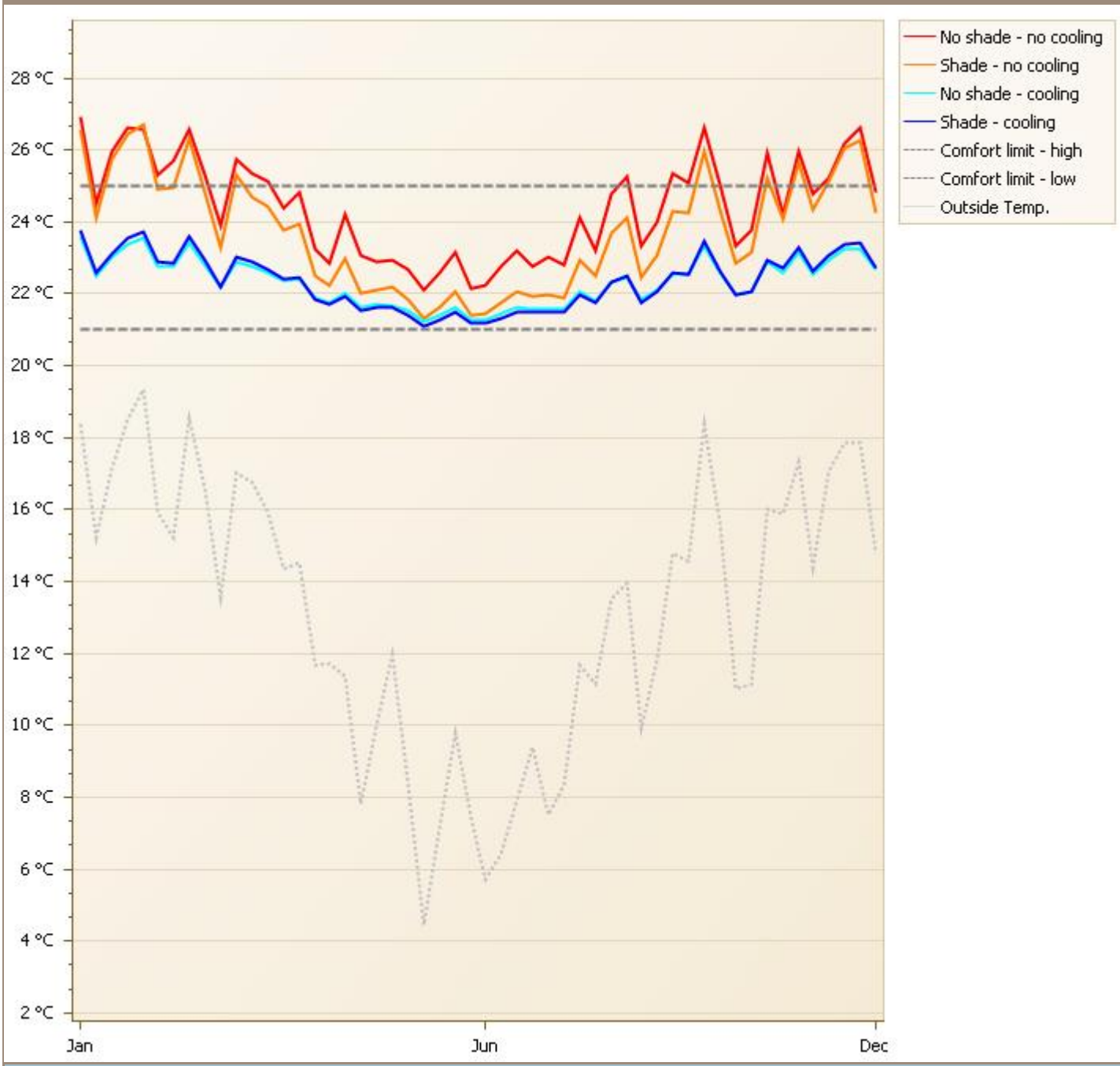

*For more information see appendix 1.*

## Annual temperature facts, daytime 08:00-17:00

| | Without Solar shading | With solar Shading |
|---|---|---|
| No. of hours over 25 degrees without cooling: | **2967 h** | **2930 h** |
| No. of hours over 30 degrees without cooling: | **2650 h** | **2291 h** |
| No. of hours outside comfort range without cooling: | **2988 h** | **2892 h** |

*For more information see appendix 1.*

## Annual temperature graph, nighttime 17:00-08:00 (weekly averages)



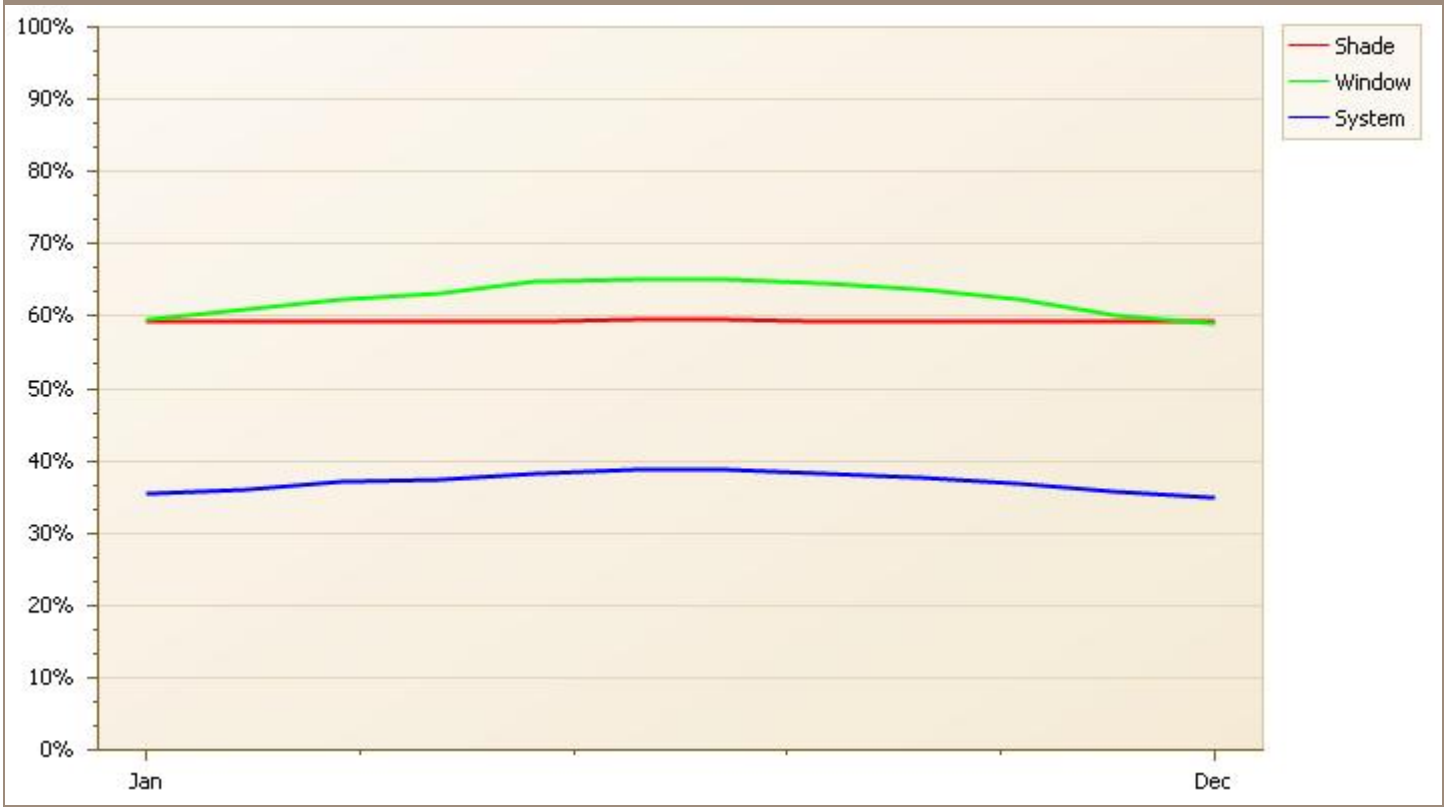

*For more information see appendix 1.*

## Annual temperature facts, nighttime 17:00-08:00

| | Without Solar shading | With solar Shading |
|---|---|---|
| No. of hours over 25 degrees without cooling: | **2050 h** | **1740 h** |
| No. of hours over 30 degrees without cooling: | **972 h** | **586 h** |
| No. of hours outside comfort range without cooling: | **4018 h** | **3755 h** |

*For more information see appendix 1.*

## Annual solar transmittance graph (g-value)




*For more information see appendix 1.*

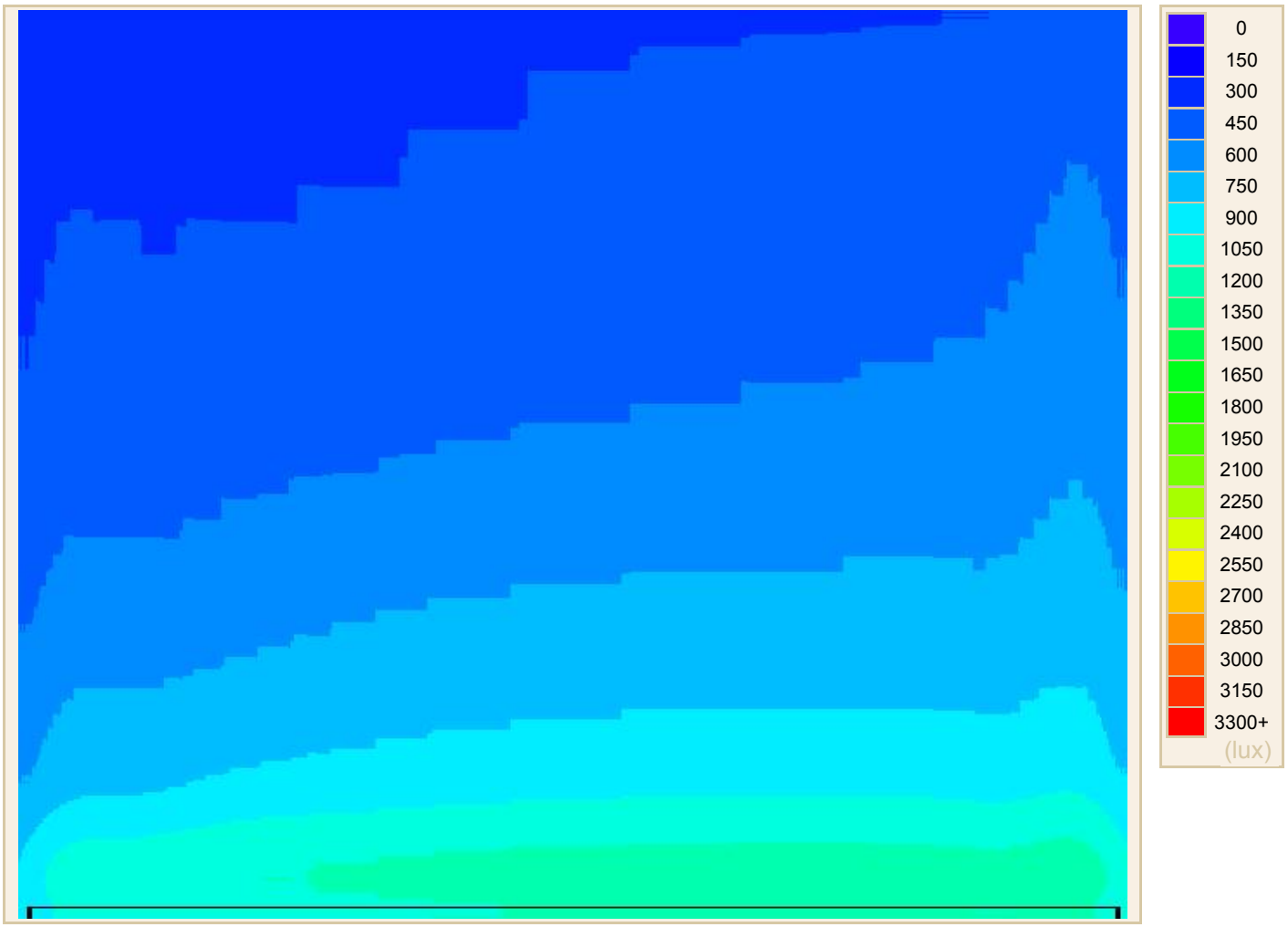
## Annual CO2 reduction potential in kg.

| | Heat- and Cooling demand without Solar shading | Heat- and Cooling demand with Solar shading | Savings |
|---|---|---|---|
| Coal: | **4,127 kg** | **2,485 kg** | **1,642 kg** |
| Wood: | **272 kg** | **163 kg** | **108 kg** |
| Oil: | **3,931 kg** | **2,367 kg** | **1,564 kg** |
| Gas: | **2,900 kg** | **1,746 kg** | **1,154 kg** |
| District heat: | **1,814 kg** | **1,746 kg** | **722 kg** |
| Electricity: | **6,559 kg** | **3,950 kg** | **2,610 kg** |

*Co2 conversion factors according to Gemis2002, eGRID2006. Electricity is based on EU avarage. For more information see appendix 1.*

# Daylight results

## Solar radiation from window (Room shown in birds view)




*For more information see appendix 1.*

## Solar radiation information

| Daylight simulation parameters | |
|---|---|
| • Time of simulation: | **December 1 9:00** |
| • Room size: | **600x500 cm** |
| • Window height: | **310 cm** |
| • Window width: | **590 cm** |
| • Window level above floor: | **3 cm** |
| • Direct radiation: | **1029 W/m² (102900 lux)** |
| • Diffuse radiation: | **114 W/m² (11400 lux)** |
| • Facade orientation: | **North-East** |
| • Fabric reference & supplier: | **1021 \| Light neutral - white (White) -** |

# Input data - Part 1

| **Location (Metrological)** | |
|---|---|
| • City: | Johannesburg |
| • Country: | South Africa |

| **Room data** | |
|---|---|
| • Facade orientation: | 45 ° |
| • Room height: | 320 cm |
| • Room width: | 600 cm |
| • Room depth: | 500 cm |
| • Room floor size: | 30.00 m2 |
| • Wall U-value: | 0.33 W/(m2K) |
| • Wall weight: | Medium |
| • Window height: | 310 cm |
| • Window width: | 590 cm |
| • Window height above floor level: | 3 cm |
| • Window size: | 18.29 m2 |
| • Window glazing type: | Single pane |
| • Window glazing U-value: | 6.34 W/(m2K) |
| • Window glazing g-value: | 0.87 |

| **Solar shading used** | |
|---|---|
| • Application: | Interior |
| • Type: | Roller Blind & Curtain |
| • Material: | 1021 \| Light neutral - white (White) |

| **Internal load (W)** | **Weekdays** | **Night and weekends** |
|---|---|---|
| • People: | 90 W | 360 W |
| • Computers | 90 W | 90 W |
| • Artificial light: | 200 W | 200 W |
| • Additional load: | 0 W | 0 W |
| • Summary: | 380 W | 650 W |

| **Comfort definition** | **Weekdays** | **Night and weekends** |
|---|---|---|
| • Comfort interval: | 22 - 26 °C | 21 - 25 °C |

| **Control Strategy** | Sun and Timer |
|---|---|

## Input data - Part 2

| Inlet air | Weekdays | Night and weekends |
|---|---|---|
| • Type: | Conditioned | Conditioned |
| • Flow: | 20.5 l/s | 50.5 l/s |

*For more information see appendix 1.*

## Project information

| Building information | |
|---|---|
| • Project name: | 4 family home |
| • Building type: | Residential |
| • Address: | |
| • Zip: | |
| • State: | |
| • City: | Johannesburg |
| • Country: | |
| • Company: | |
| • Contact Person: | |
| • Contact information: | |
| • Project notes: | |

| Consultant information | |
|---|---|
| • Company: | |
| • Consultant making simulation: | |
| • Contact information: | |
| • Project status: | |

| Solar Shading Installer information | |
|---|---|
| • Company: | |
| • Name of the installer: | |
| • Contact information: | |
| • Project status: | |

# 1 Appendix 1

## *1.1 Cooling and Heating results*

The demand is the annual energy required to keep the room within the user defined comfort span (i.e. 20ºC - 24ºC during days and 20ºC - 24ºC during nights). In simple words: The amount of energy (kWh) your supplier invoices you. The load is the required size / capacity of the HVAC machine needed to reach the comfort span. Keep in mind that a smaller capacity HVAC system is always a smaller hardware investment which may have a huge impact on the return on investment, CO2 footprint, maintenance and installation cost.

Note 1: The demand is presented in a 1:1 energy mapping. If e.g. the heat is provided by a heat pump the COP factor must be taken in to consideration.

Note 2: The result is highly impacted on the selected solar shading control strategy and type of solar shading and fabric / slat.

Demands are presented on a monthly and yearly basis, while load is only presented on yearly basis. The results are provided for the entire room, per square meter, related saving in percent and demand or load with and without solar shading devices.

Behind the calculations, the following data are used:

a) If type used of air inlet is set to <conditioned>, following input data is used:
Heat recovery efficiency is fixed to 50%. Heat recovery means that the HVAC system uses the warm outgoing air to heat the fresh incoming air. The fresh air that is pumped into the room is pre heated (if needed) and set to minimum 17ºC. The air flow is linked to the number of people in the room (1 person = 10l/s). Keep in mind that this can vary during the day and night according to the comfort span defined by the user. The minimum airflow is 3,5 l/s to ensure a fresh indoor climate. Conditioned air inlet is very common in non-residential buildings.

b) If type of air inlet used is set to <outdoor>, following input data is used:
The outdoor fresh air that is pumped into the room is NOT pre heated. The air flow is linked to the number of people in the room (1 person = 10l/s). Keep in mind that this can vary during the day, night and weekend according to the comfort span defined by the user. The minimum airflow is 3,5 l/s to ensure a fresh indoor climate. Outdoor air inlet is common in residential buildings.

c) The solar shading devices take, when down, a position to prevent direct glare. The solar shading devices can also be lowered to improve the window insulation or raised to gain heat from the sun during cold periods. When the solar shading device is actually down is related to a selected control strategy.

d) The climate of the location has a decisive role in calculating both solar transmittance and energy balance. Meteorological data is generated by MeteoNorm; a standardized software 8760 sample points per year (every hour) are used. Following data is calculated:

    1. Time (year, month, day, hour)
    2. Outside temperature (ºC)
    3. Intensity of diffuse solar radiation on a horizontal surface W/m$^2$
    4. Intensity of direct solar radiation on a surface normal to the rays from the sun (W/m$^2$)
    5. Sky temperature (ºC)

## *1.2 Temperature results*

The temperature results are divided in two annual graphs: Daytime (08:00-17:00) and night time (17:00-08:00). The graph resolution is 52 (meaning weekly average temperatures). This resolution does not display extreme peaks, but gives a very good overview. Remember that the result is highly influential on the selected solar shading control strategy and type of solar shading and fabric/slat type. Also note that the room is always heated. Following data are presented:

a) Room temperature without solar shading and without cooling
b) Room temperature with solar shading and without cooling
c) Room temperature without solar shading and with cooling
d) Room temperature with solar shading and with cooling
e) Outside temperature.
f) The user defined comfort span.

The graph shows some very interesting facts. For example, if you have a building without a cooling system you can directly see the temperature impact of installing solar shading devices. Maybe you do not need any cooling system at all to reach your requirements by using dynamic solar shading…

## *1.3 Annual temperature facts*

This table shows the number of hours per year that the room is above 25ºC, 30ºC and outside the user defined comfort span when no cooling machine is installed. The result is presented with and without solar shading devices. This data clearly indicates the real impact of using solar shading devices on temperature. Remember that the result is highly influenced by the selected solar shading control strategy and type of solar shading and fabric/slat type. The data is split in daytime (08:00-17:00) and night time (17:00-08:00).

## *1.4 Annual energy balance*

At a certain outside temperature the building requires neither heating nor cooling to reach the user defined comfort span. This is called balance temperature. In many buildings the balance temperature can be very low (e.g. -15ºC). The reason for this is that the insulation and windows are very efficient. This combined with a high internal heat load (people, computers etc generating heat) result in over heated rooms. It’s therefore not uncommon that even in northern countries such as Norway, cooling is required 24h/day on an yearly basis. The use of solar shading devices increases the number of hours the building is in balance and therefore decreases the energy usage. The table shows the annual number of hours in balance, when heating and when cooling when solar shading devices are used and not. Remember that the result is highly influenced by the selected solar shading control strategy and type of solar shading and fabric/slat type. The data is split in daytime (08:00-17:00) and night time (17:00-08:00).

## *1.5 Annual solar transmittance graph (g-value)*

This graph shows the g-Value (heat transfer) through the window, through solar shading device and through the solar shading device + the window. This information is useful if making a more detailed calculation in other simulation software’s.

## *1.6 Annual CO2 reduction potential in kg*

The energy saving potential of solar shading devices can be converted into CO2 reduction. Our conversion factors (according to Gemis2002, eGRID2006) are as below:

a) Coal 380 g CO2e/kWh
b) Wood 25 g CO2e/kWh
c) Oil 362 g CO2e/kWh
d) Gas 267 g CO2e/kWh
e) District heat 167 g CO2e/kWh (Note: There may be local variations.)
f) Electricity (local), see table below;

| Country | CO2 [g/kWh] | Country | CO2 [g/kWh] |
|---|---|---|---|
| Austria | 295 | Malta | 900 |
| Belgium | 349 | Netherlands | 734 |
| Bulgaria | 479 | Norway | 28 |
| Croatia | 446 | Poland | 1188 |
| Czech Republic | 1037 | Portugal | 655 |
| Cyprus | 1174 | Romania | 479 |
| Denmark | 565 | Slovakia | 479 |
| Estonia | 853 | Slovenia | 446 |
| Finland | 306 | Spain | 547 |
| France | 97 | Sweden | 43 |
| Germany | 670 | Switzerland | 110 |
| Greece | 1174 | Turkey | 1174 |
| Hungary | 706 | United Kingdom | 594 |
| Ireland | 875 | EU AVERAGE | 604 |
| Italy | 626 | | |
| Latvia | 853 | USA | 719 |
| Lithuania | 853 | Canada | 266 |
| Luxemburg | 637 | China | 1200 |

Note: Keep in mind that this result only includes one room. Likely the building has many rooms…

## *1.7 Daylight results*

This interpolated graph shows how the light is spread within the room for the used solar type of shading device. Normally you strive to have about 500lux at the working space. Too high level of natural sun light at the working space will not only create glare, it will also increase the energy used for the artificial lightning. The graph can be very useful when planning were to put the furniture in the room optimally. The lightest hour of the year when the sun hit the façade straight is used for the simulation. The sun light presented is seen "up" 20cm below the window frame. Keep in mind that if you print the report, the resolution in colours of the printer can be a limiting factor. The graph is best seen on a minimum 16bit resolution monitor.

## *1.8 Control strategies of the solar shading devices*

The used control strategy has huge impact on the result. The selectable control strategies vary if the building is a residential or a non residential building. The control strategies are built on a mixture of following criteria's:

a) Avoid glare
b) Gain heat from the sun when required
c) Preserve heat within the building when required
d) Timers

There is also a fully manual algorithm where there is no control system at all. This simulate a user, that

manually controlling the solar shading device. The algorithm behind is defined on user study *Solar Protection of Buildings (TABK-01/3060.).*

The control strategies are always acting different during working hours (Mon- Fri 08:00 - 17:00 and nights and weekends). This leads to, when the room is occupied, that a good ratio between energy saving and user comfort in terms of natural light, no glare and temperature are perceived. When the room is on the other hand not occupied, the system strives only for maximum energy savings. These types of algorithms reflect the reality much better rather then just optimize the results for showing maximum savings and actually not take the users in the building in to consideration.

By investing in solar shading devices and control systems optimized for the particular building will have huge impact on the pay back and user comfort. In buildings where the options are "either" to invest in solar shading or a cooling system you might see that by just investing in solar shading will solve the wanted comfort criteria's, and no cooling system are needed. Not only will this over time save huge amount of energy and CO2 footprint, it may also have an extremely short (sometimes zero) payback compared to the cooling system solution. In many cases the best solution is a reduced HVAC system in combination with dynamically controlled solar shading.

For detailed information about each control strategy please study the owner's manual.

## *1.9 General remark*

There are many others aspects to consider when investing in solar shading and control systems then e.g. energy savings. Maintenance, installation, dimensions, transparency, wind load resistance, design, colours, climate, interoperability, user interaction possibilities are a few examples. Therefore it's preferred that both a solar shading device and control system expert is consulted.

Appendix 2

### 1.1 Energy Performance Building Directive (EPBD) 2002/91/EC

The 28th of June 1999 all EC members agreed on the EPBD. The EPBD is the European answer to the international Kyoto protocol agreement. In short the EPBD framework is about energy saving, CO2 reduction and building certification. The EPBD was then locally adapted by the members to fit their local environment in terms of e.g. meteorological location. One important aspect of the EPBD is that it clearly states that passive solutions should be chosen before active solutions (or in combination when needed). One example of this is using solar shading devices (passive solution) to minimize or remove, if possible, the use of cooling machines (active solution).

### 1.2 Validation

This tool uses the DEROB/ParaSol calculation engine. The simulations were validated against measurements made in an experimental building, a solar laboratory and other calculation engines. Good agreement was achieved. For further information regarding these comparisons, see the report Solar Protection of Buildings (TABK-01/3060) which can be obtained from the Division of Energy and Building Design, Department of Construction and Architecture, Lund Institute of Technology, Lund University.

### 1.3 Usage agreement Somfy versus Lund University

Somfy has a written approval with Lund University (www.ebd.lth.se) and ParaSol (www.parasol.se) for using the DEROB/ParaSol calculation engine.

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