DETERMINING THE POTENTIAL IMPACT

OF A

MICRO HEAT PUMP

FOR DOMESTIC WATER HEATING

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Uittreksel

Warmwater vir huishoudelike gebruik in Suid-Afrika word oorwegend verhit met in-tenk elektriese verhitters. Hierdie sogenaamde "geysers" is die grootste bydraers tot die hoë oggend en namiddag pieke waaraan die kragnetwerk blootgestel word. Hierdie piekaanvraag is vir Eskom voordurend 'n probleem. Die "reduced capacity in-line water heating system design methodology" is ontwerp om hierdie probleem te oorkom. 'n Parallelle inlyn hittepomp waterverwarmer verminder die energiebehoefte selfs verder. Hierdie studie gebruik 'n detail statistiese termovloei simulasiemodel om die potensiële impak op die nasionale netwerk te bepaal indien hierdie metodiek wyd toegepas word in die huishoudelike mark.

Die resultate sal aantoon dat die gebruik van 'n mikro-hittepomp vir huishoudelike warm water in sekere gebiede in Suid-Afrika, ekonomies regverdigbaar is. Die kusgebiede met hul hoër natboltemperature en matige wintertemperature val in hierdie kategorie. Die binnelandse gebiede met temperature wat langdurig onder vriespunt is het egter 'n ander benadering nodig as die huidige standaard. Die gebruik van mikro-hittepompe sal die piekaanvraag op die nasionale kragnetwerk aansienlik verminder. Alhoewel die kragvoorsiener minder energie aan gebruikers sal verskaf, sal baie groot bedrae bespaar word deur verminderde kapitaaluitgawes aan kragsentrales.

Acknowledgements

I gratefully recognise the contributions of Prof. Pieter Rousseau, for his guidance and support in bringing this study to fulfilment.

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Glory to God.

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DETERMINING THE POTENTIAL IMPACT OF A MICRO HEAT PUMP FOR DOMESTIC WATER HEATING

ABSTRACT

Hot water used in the South African domestic sector is mostly heated by in-tank electrical resistance heaters. These so-called "geysers" are the major contributors to the undesirable high morning and afternoon peaks imposed on the national electricity supply grid. These peak demands continue to be of concern to Eskom. The "reduced capacity in-line water heating system design methodology" was developed to address this problem. A parallel in-line heat pump water heater further reduces the electrical energy required. This paper employs a detailed statistical thermo-fluid simulation model to investigate the potential impact on the national peak electrical demand if this methodology is extensively applied in the domestic sector.

The results will show that in certain areas of South Africa employing a micro heat pump for domestic hot water is a viable economic proposition. The coastal regions with the higher wet bulb temperatures and mild winter temperature fall in this category. The inland regions with their prolonged subzero temperatures requires a different approach to the standard way of using heat pumps. Implementing heat pumps for domestic use will also reduce the peak demand on the supply grid. Though the supplier of electricity will be selling less energy to customers, huge expenses in additional power stations to meet the peak demand, will be prevented.

1. INTRODUCTION

Most sanitary hot water used in the South African domestic sector is heated by direct electrical resistance heaters in the form of so-called geysers. These geysers are essentially conventional in-tank heaters and are according to Van Hamelen and Van Tonder (1998), major contributors to the undesirable high morning and afternoon peaks imposed on the national electricity supply grid and therefore continues to be of concern to Eskom. The Integrated Electricity Planning goals of Eskom of ensuring adequate supply capacity will have to be adapted to meet long term forcasts as set out by Surtees (1998). This paper will show that the in-line heater innovation applied to domestic water heating can make a positive impact on both supplier and domestic end-users of electricity. The innovative use of a small heat pump further enhances the possible electrical energy savings.

1.1 DOMESTIC WATER HEATER

A typical domestic water heater (geyser) consists of a vertical or horizontal tank with a cold water inlet at the bottom and a hot water outlet at the top. The heating element and the thermostat are located at the bottom. When hot water is drawn from the tank, cold water enters the tank at the bottom. The thermostat senses the cold water and switches on the heating element. The water circulates through the tank by natural convection forces caused by the hot element at the bottom until the thermostat senses the pre-set water temperature and switches the element off. This design philosophy therefore requires that the heater must be able to reheat the total content of the storage reservoir within a short period, typically three to four hours. Since the reservoir is usually sized to hold about half of the daily hot water consumption it means that the heater is sized to heat the total daily hot water consumption within six to eight hours.

In the domestic sector these specifications result in a reservoir size of 150 litre and a heating element capacity of 3 kW for a single-family residence according to Rousseau, Strauss, Greyvenstein (2000). This means that once hot water is drawn from a 'fully loaded' reservoir, the cold water entering the reservoir will lower the temperature and the thermostat will call for the full 3 kW of heating capacity to be activated. However, if the full storage capacity of the reservoir could be used efficiently so that the total daily consumption of hot water could be heated gradually in 24 hours, the heating capacity could theoretically asccording to Rousseau (1996) only be 0.75 kW. The full capacity will then be activated throughout the day with theoretically no peaks occurring in the morning and afternoon which will result in a perfect load factor of one. This can be done by means of using an inline water heating system that continuously adds hot water to the top of the tank.

1.2 IN-LINE WATER HEATER

An in-line heater as described by Greyvenstein and Rousseau, consists of a small circulating pump which draws the cold water from the bottom of the tank and circulates it through a reduced capacity resistance heating element (~1.2 kW) to the top of the tank. The thermostat in the tank will switch the pump and element on or off as required. A thermostatically controlled flow valve controls the outlet temperature of the in-line heater at 60°C. Because of stratification, the hotter water will remain at the top of the tank and the coldest water will flow to the in-line heater. Very little internal circulation takes place in the tank except for the slow movement from the top to bottom without disturbing the stratification, resulting in the highest temperature water being available to the user at any time. The smaller in-line heater is switched on for a longer period of time than the 3 kW in-tank heater, therefore reducing the peak demand.

In figure 1 the stratification of the water in an in-line heater system is not disturbed to the same extent as in an in tank heater (geyser) and the transition band from cold to hot is much smaller.

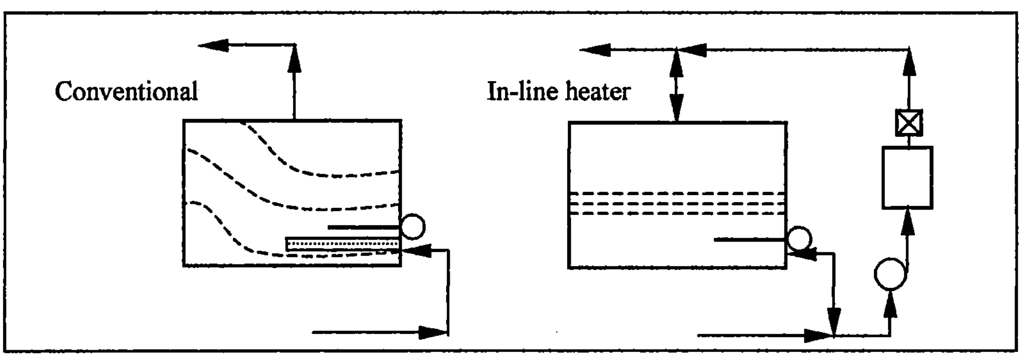

Figure 1: Stratification, Conventional versus In-line heater

Although the in-line water heating system saves on energy requirements and alleviate the electrical domestic peak demands, it can still be improved on by replacing it with an energy efficient hot water heat pump system.

1.3 HEAT PUMP

A heat pump is a closed loop vapour/liquid circuit which can transfer heat from a low temperature to a higher temperature. (Reay, 1992, Heap, 1979). A domestic refrigerator is an example of a heat pump extracting heat from the cabinet (low temperature) to the outside air (higher temperature). In a water heating heat pump heat is extracted from ambient air and transferred to cold inlet water (see figure 2). In the closed refrigerant loop the compressor compresses the working fluid vapour (refrigerant) to a higher pressure and temperature. In the condenser the refrigerant condenses to a liquid at a high pressure. Whilst changing phase from vapour to liquid, the heat (Q_{out}) is transferred to the water on the secondary side. The liquid then passes through a regulating orifice (expansion valve) which reduces the pressure. This valve is regulated by the conditions in the evaporator. The fluid moves to the evaporator where the liquid evaporates as it takes up heat (Q_{in}) from the air on the secondary side. The vapour moves to the compressor intake to complete the cycle. Most of the work (W_{comp}) required to operate the cycle (turning the compressor) is transferred to the refrigerant and can be rejected at the condenser. (Trott,1989)

The outlet water temperature is usually controlled by means of a 'water valve' which is activated by the condenser vapour pressure. The higher the condenser pressure, the more water flow through the secondary side. This higher flow rate increases heat transfer thus simultaneously controlling the condenser pressure to a safe level and the outlet water temperature to the set temperature. The water outlet is typically set to 60°C.

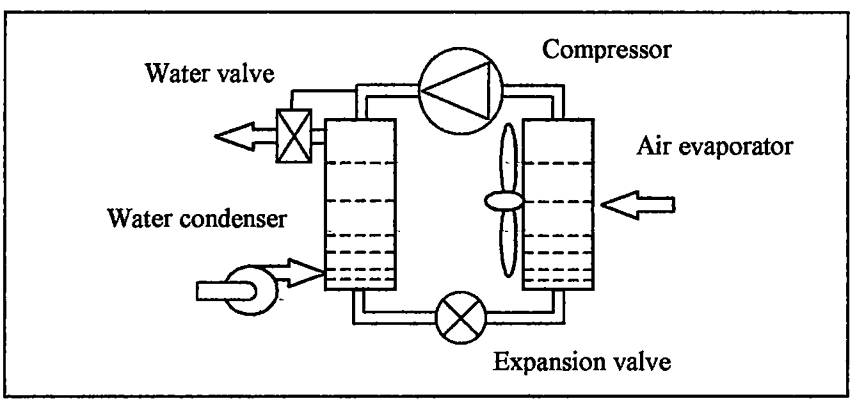

Figure 2: Hot water heat pump layout

The output energy is therefore approximately $Q_{out} = Q_{in} + W_{comp}$ (figure 3). In a typical heat pump operation the coefficient of performance (COP) = Q_{out} / W_{comp} is usually greater than two. More heat is thus generated at the output than was introduced as electrical work input, contrary to what happens with direct electrical heating elements.

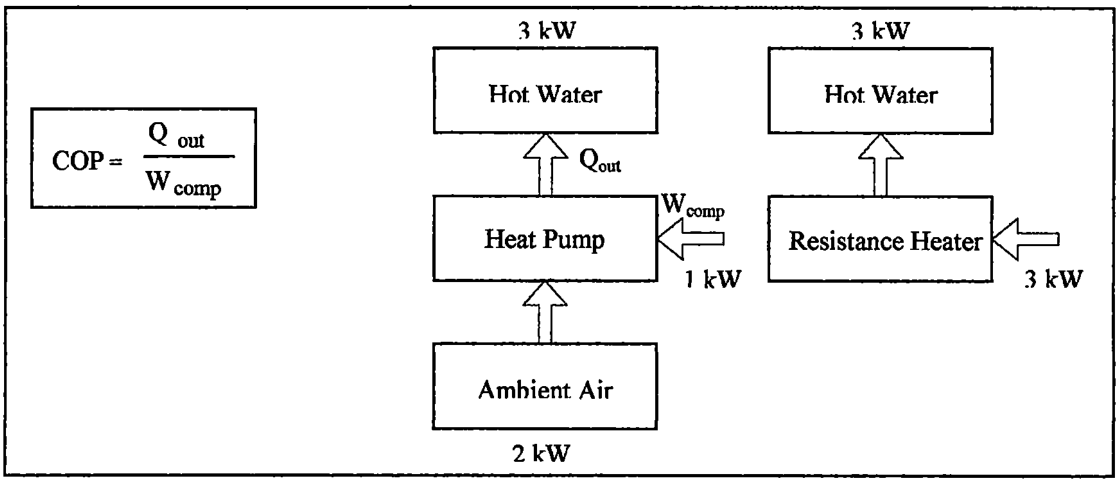

Figure 3: Energy flow, Heat pump versus Resistance heaters

The source of low temperature heat energy can be soil (ground water), other water sources or ambient air or home exhaust air (Afjei, 1997). When air is used as source, the heat absorbed by the evaporator Q_{in} is dependant on the wet bulb temperature (T_{wb}) of the ambient air on the secondary side. The 'wetter' the air, the more mass and thus capacity to carry energy at the same temperature. A higher T_{wb} will result in a higher Q_{in} and a better COP making coastal operations more efficient. Figure 4 indicates a typical performance curve of a nominal 1.2 kW heat pump showing the wet bulb versus kW to the left and

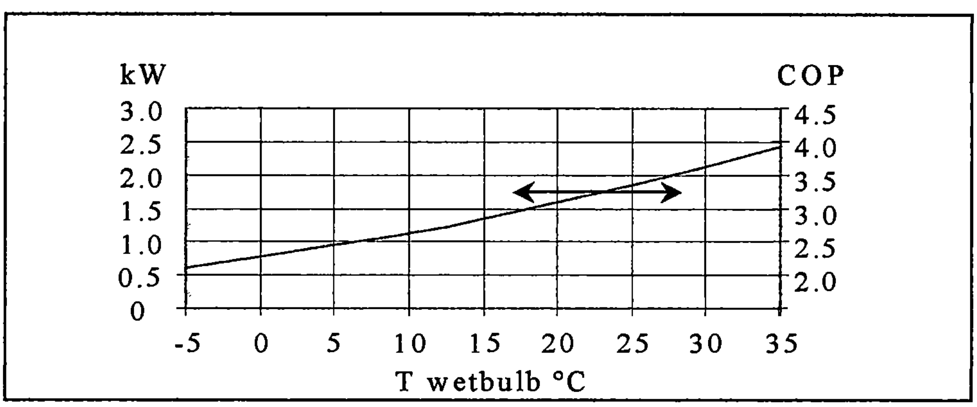

Figure 4: Typical performance curves of a heat pump

COP to the right.

Research in the design and simulation of micro heat pumps for domestic hot water has made it possible to design heat pump systems with a high COP and optimal performance at specified climatic conditions as indicated by Van Eldik (1998).

The greater the difference between water inlet and outlet temperatures, the lower the water flow rate which results in lower compressor work to be done. Lower compressor work also leads to a better COP and this fact emphasises the requirement to have good stratification in the storage tank.

Very low ambient air temperatures (<5°C) can cause freezing and blocking of the evaporator on the air side. As cold air moves through the evaporator, the air cools down to sub-zero temperatures which causes ice forming. This blockage will result in no or very low heat transfer, a low rate of vapour forming and thus low vapour flow. The low flow will starve the compressor of vapour and the much needed oil vapour for lubrication, which can eventually cause damage to the compressor. (In most hermetically sealed compressors the oil vapour travels with the refrigerant through the cycle.) The compressor is therefore fitted with an inlet air temperature safety cut-off switch. When the heat pump cannot operate, the heating function is taken over by the back-up electrical resistance in-line heater.

Very high air temperatures will cause the evaporator pressure to rise due to excessive heat transfer. This will cause the condenser temperature and pressure to rise too. The compressor now has to work much harder to maintain the mass flow and could cause damage to the motor if operated outside its design limitations. A break down in lubrication due to excessive high oil temperatures in the compressor could damage bearings and pitons. Some expansion valves (MOP type) are designed to prevent this situation to occur and will limit the liquid refrigerant to the evaporator.

Although the outlet water temperature is set to 60°C, the inlet water temperature will vary from its coldest (ground temperature) to the set point of approximately 55°C when the water tank is "charged" and the water valve fully open. This is at the maximum energy transfer rate of the condenser. Higher inlet temperatures will cause the compressor's head pressure to rise beyond the safe operating level.

In order to obtain true performance figures of a micro heat pump designed for hot water operation, a laboratory experiment was conducted to obtain performance characteristics. The heat pump had to perform at different ambient wet bulb temperatures and at various cold water inlet temperatures.

2. EXPERIMENTAL PROCEDURE

It was opted to use a micro heat pump set-up that was used in a previous experiment with the necessary changes to some components.

2.1 HEAT PUMP MODIFICATIONS

(a) Compressor Type

The compressor type used during previous experiments was changed from a Embraco PW5.5HK14 to a Danfoss SC10GHH. The Danfoss compressor was designed as a heat pump compressor with the following features:

(see detail specifications in Appendix A)

1. High back pressure.

This is a requirement for heat pump operation where the head pressure (outlet pressure) of the compressor is constantly working against a high condensor pressure to maintain a high condenser temperature.

2. Internal oil cooling.

A standard compressor without an internal oil cooling coil relies on sufficient ambient air flow around the compressor for cooling purposes which is typically 1.5 m/s at ambient temperature. The design rule for using an oil cooler is to use the refrigerant liquid in the condenser to perform cooling of the compressor oil. The flow of regrigerant through the condenser is interrupted approximately 30% from the inlet (thus in the two phase region) and diverted to the oil cooler to absorb the required heat to keep the compressor temperature within operating limits. The presence of an internal oil cooler in the compressor that was selected afforded the opportunity to investigate ways to save energy in the water heating operation. The advanced fluted tube condenser coil that was used during the experiment however, made it too complicated and expensive to interrupt the vapour flow to absorb the heat rejected in the compressor for further use. It was therefore decided to rather use the cold inlet water before it enters the condenser to cool the compressor which also suggests an increase in the COP of the system.

(b) Evaporator circuits

The previous evaporator consisted of a single refrigerant circuit. After operating with the new Danfoss compressor it became evident that the evaporator needed more circuits. The compressor was running at a very low evaporator pressure and freezing occurred on the evaporator fins. Too high vapour flow through the evaporator causes high pressure losses while too low vapour flow decreases heat transfer and could result in the accumulation of lubrication oil in the pipes. The system was then divided into two circuits with a suitable standard liquid distributor after the expansion valve.

2.2 EXPERIMENTAL LAYOUT

The refrigerant circuit was rebuilt with temperature sensors (indicated with arrows in figure 5) in the gas system at four points, i.e. in front of and after the condenser, and in front of and after the evaporator. These positions represented the four main points in the refrigerant cycle.

Temperature sensors were also built into the condenser water inlet and outlet and the oil cooler water inlet and outlet of the compressor. A control valve between the compressor oil cooler lines (see valve between the pump and condenser in figure 5) can control the by-pass to the condenser. By restricting the flow through the valve the flow rate through the oil cooler will increase. This was a precaution to be able to control the cooling rate of the oil cooler, should it be required. The evaporator air inlet wet bulb and dry bulb temperatures were also recorded (Photo 9). A surface temperature sensor was placed on the sump of the compressor to monitor compressor temperature. Calibrated four wire PT100 RTD temperature sensors were used throughout and readings were recorded by a Prema Precision Thermometer (Photo 8).

The energy input was recorded by means of a Microvip Energy Analyser (Photo 10) with a digital readout of 0.01 kWh. The water flow rate was calculated by positioning the condenser outlet over a bucket on an electronic mass scale with a digital readout of 0.01kg (Photo 6). The output water was directed into the bucket at the start of the experiment.

The evaporator with its own fan was mounted onto a 1200mm cube environmental chamber (Photo 1 & 5). The flow rate of the feed air to the chamber was controlled to match the evaporator's fan as to maintain a pressure in the chamber equal to atmospheric pressure. The feed air temperature and humidity to the chamber was controlled by means of electrical heating elements, a cooler unit and a steam generator (Photo 2). Al the electrical controls for the above can be seen in Photo 7.

The compressor inlet and discharge pressures (HP and LP) were recorded using a standard refrigerant gauge set (Photo 3). The gauge set was used to monitor the cycle pressures to ensure a safe operating environment for the compressor when operating at high wet bulb temperatures. No additional safety pressure switches were installed in the circuit, except for the standard compressor electrical current overload devices.

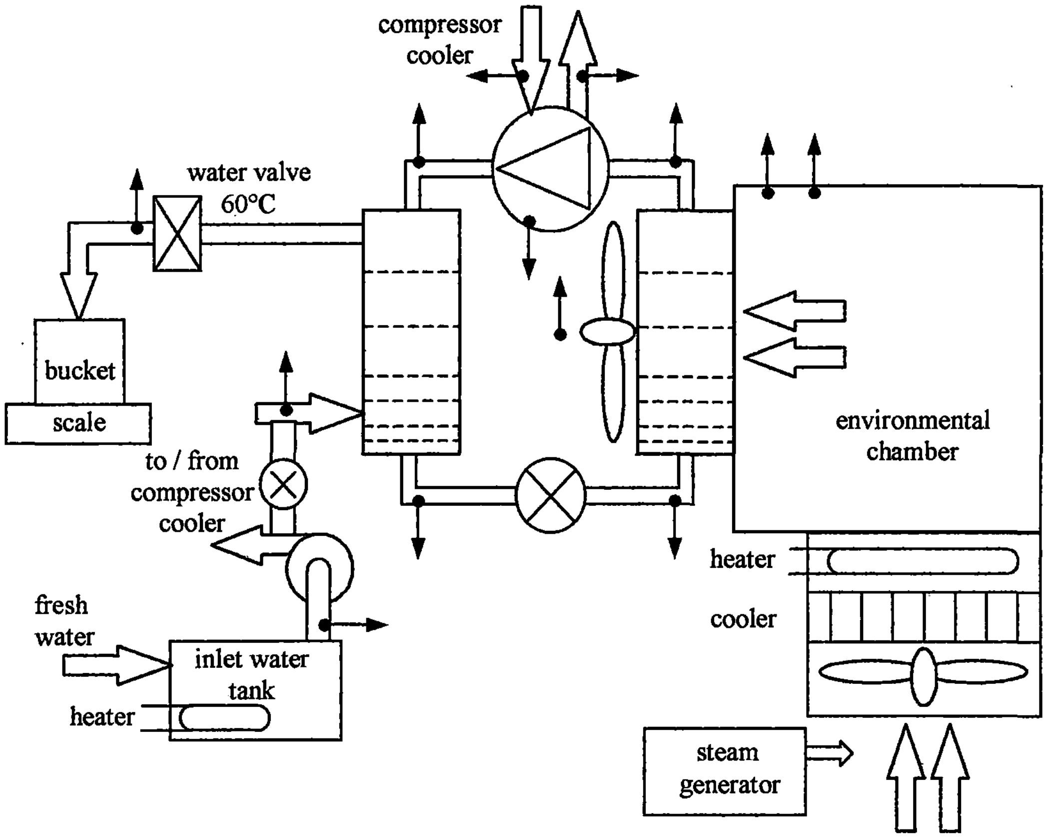

Figure 5: Experimental set up

2.3 TEST PROCEDURE

The environmental chamber was adjusted to the required 'ambient conditions' (temperature and humidity). The heat pump was running to stabilize it's cycle temperatures using a secondary water system. The controlled water tank (Photo 4) was then adjusted by mixing with cold water or using the electric heating element in the tank, to represent the correct inlet water temperature. The heat pump inlet was then switched to the controlled water tank and the system kept running to again stabilize the cycle temperatures.

A time interval method was used to measure the water mass flow rate and energy input and output. Readings were only taken after the heat pump cycle temperatures stabilized. Every time the kWh reading changed one digit (0.01 kWh), the time was recorded as well as the reading on the electronic scale, depicting the water accumulated during the time interval. The system temperature readings (gas, water, air) were then recorded as these were the most stable.

The ambient wet bulb temperatures were controlled on 5, 10, 15, 20, and 23 °C. A maximum allowable evaporator temperature of 15°C limited the operation to approximately 23°C wet bulb. This is considered ample as the highest wet bulb temperature. The inlet water temperatures were controlled at 15, 25, 35, 45 and 55 °C. For each combination of ambient air and inlet water a set of 7 readings were taken and an average value calculated.

2.4 TEST RESULTS

The test results were tabulated using an Excel spreadsheet (see appendix B for test results). The time, temperature, kilo Watt and scale readings were entered and the rest of the data calculated. The instantaneous COP was used to validate correctness of the readings. The data is represented in the graphical form: Energy output versus Wet bulb temperature (figure 6) and COP versus Wet bulb temperature (figure 7). The data conformed to typical heat pump performance characteristics.

These performance curves of a true hot water heat pump system has to be converted into a mathematical equation in order to be used in a simulation process at different locations and conditions.

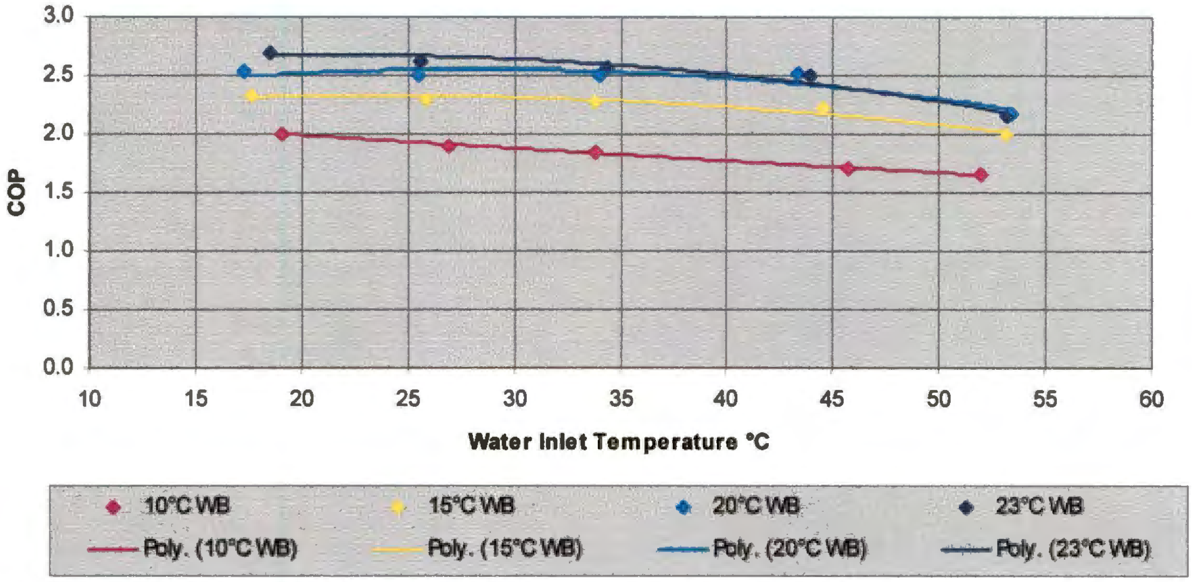

Figure 6: Output energy versus Water inlet temperature at different Wet bulb temperatures.

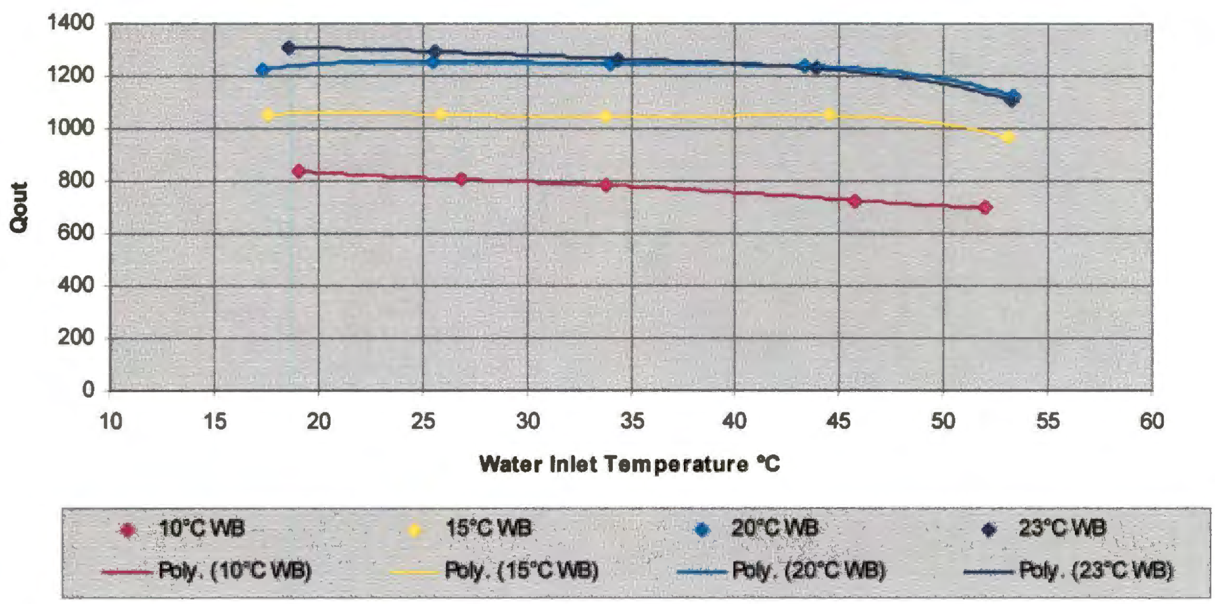

Figure 7: COP versus Water inlet temperature at different Wet bulb temperatures.

3. DATA PREPARATION FOR SIMULATION

A simulation program is a very repetitive procedure. Apart from the coding that needs to be optimised to take the least number of cycles to reach an answer, the data required by the simulation program needs to be easy and quickly accessible format.

3.1 HEAT PUMP PERFORMANCE CHARACTERISTICS

In order to use the micro heat pump's characteristics in the simulation program, the performance data were transformed to a formula for the output energy Q_{hp} and the COP as a function of the wet bulb temperature T_{wb} and the inlet water temperature T_{hi}.

The formulae used was of the form:

$$Q_{hp} = Q_{hpnom} (A_1 + B_1.T_{wb} + C_1.\ T_{wb}^{\ 2} + D_1.T_{hi} + E_1.\ T_{wb}.\ T_{hi} + F_1.\ T_{hi}^{\ 2})$$

$$COP = A_2 + B_2.\ T_{wb} + C_2.\ T_{wb}^{\ 2} + D_2.\ T_{hi} + E_2.\ T_{wb}.\ T_{hi} + F_2.\ T_{hi}^{\ 2}$$

where:

Q_{hp} = Energy output of heat pump

Q_{hpnom} = compressor nominal capacity

COP = Coefficient of performance

T_{wb} = Evaporator inlet wet bulb temperature

T_{hi} = Condenser water inlet temperature

A_1 to F_1 = coefficients for energy graph

A_2 to F_2 = coefficients for COP graph

The coefficients were obtained by using the Solver option in Excel. The data obtain from the experiment resulted in the following coefficients:

A_1	-0.215628253	A_2	+ 0.90574248
B_1	+ 0.080404026	B_2	+ 0.158018952

C_1	- 0.001235736	C_2	- 0.003417733
D_1	+ 0.016502204	D_2	- 0.015215286
E_1	- 0.0001041	E_2	+ 0.000392706
F_1	- 0.0002361	F_2	+ 0.000044559

These coefficients were used in the simulation program and validated against characteristics of heat pump of similar nominal capacity.

The main aim of any of the abovementioned heating methods (i.e. in-tank resistance heater, in-line resistance heater and in-line heat pump) is to heat the new intake of cold water to the required set temperature. It is therefore necessary to know the hot water take-off rate for a typical domestic customer through the cause of the day in order to determine the electrical energy consumption at a specific time of the day.

3.2 WATER CONSUMPTION PROFILE

Very little information was available on energy consumption and the use of hot water in the South African commercial sector (Cooper, 1998) until the report by Greyvenstein and Rousseau (1998). In the domestic sector however more work has been done. An experimental survey of sanitary hot water usage patterns conducted by Meyer and Tshmankinda (1997) in developed and developing communities of Johannesburg covered 300 households. These households included so-called low-density, medium-density and high-density houses. Less dense dwellings represents the higher income group and thus have fewer occupants but uses more water per occupant. These results show that the total daily hot water consumption per household is a function of both the density classification as well as the season i.e. summer or winter with an average value of around 300 litres per day at 65 °C water temperature However, irrespective of the type of dwelling or the season, the usage patterns always show a distinctive morning and afternoon peak. Figure 8 shows the winter season profiles for the different types of dwellings.

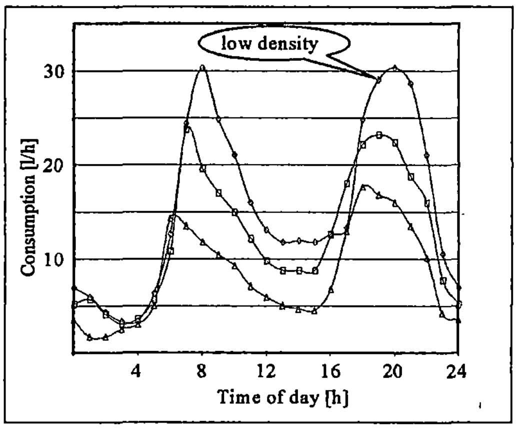

Figure 8: Winter hourly hot water take-off rates.

The results show that the morning peak occurs between 6:00 and 9:00 and the afternoon peak between 18:00 and 20:00 depending on the density classification. This corresponds well with the demand profile of domestic water heaters obtained by Lane (1995) and the National Energy Regulator (NER, 1999) statistics. This correlation between the hot water consumption and the water heater load profiles illustrates the fact that the storage capacity of hot water reservoirs is currently not fully exploited, mainly due to the conventional design philosophy employed.

The domestic sector can be divided into high, medium and low income households. Approximately 92% of the total electrical energy consumed in the domestic sector goes to high and medium income households according to the South Afican Energy Statistics No2 (1993). In these households approximately 40% of the electrical energy consumed is used for the heating of sanitary hot water and contributes 37% to the total electrical energy consumed in the domestic sector. In low income households only 12% of the electrical energy consumed is used for the heating of sanitary hot water and contributes only 1% of the total of electrical energy used and was therefore not considered for this study. About 88% of the above-mentioned high and medium income households make use of direct electrical heaters. The maximum standard deviation from the average consumption values varies between 11% during summer and 22% during winter as suggested by Meyer and Tshmankinda. A seasonal adjustment factor is required as the minimum average daily consumption is approximately 70% of the maximum and the winter and summer variation has a sinusoidal shape with the maximum occurring in mid-winter.

Prevailing ambient conditions thus play a significant role in the energy consumption for heating hot water. South Africa has many climatic types, each with it's own seasonal and daily dry bulb and wet bulb variations.

3.3 CLIMATIC REGIONS

(a) Regions around major centres

Figure 9 shows the monthly averaged wet bulb temperatures for nine of the most important cities in South Africa based on the 40 year climatic database compiled by Wentzel (1984) and graphically presented by Rousseau. The cities are Cape Town, Port Elizabeth, Durban, Bloemfontein, Johannesburg, Pretoria, East London, Kimberley and Pietersburg. From figure 9 it is clear that the profiles differs significantly in terms of annual average and swing (i.e. difference between maximum and minimum daily temperature). It is important to note that not only the annual average is important but also the swing since large seasonal variations are also encountered in hot water consumption profiles. It is therefore important that the various combinations between annual average and swing be covered in the study in order to obtain meaningful results.

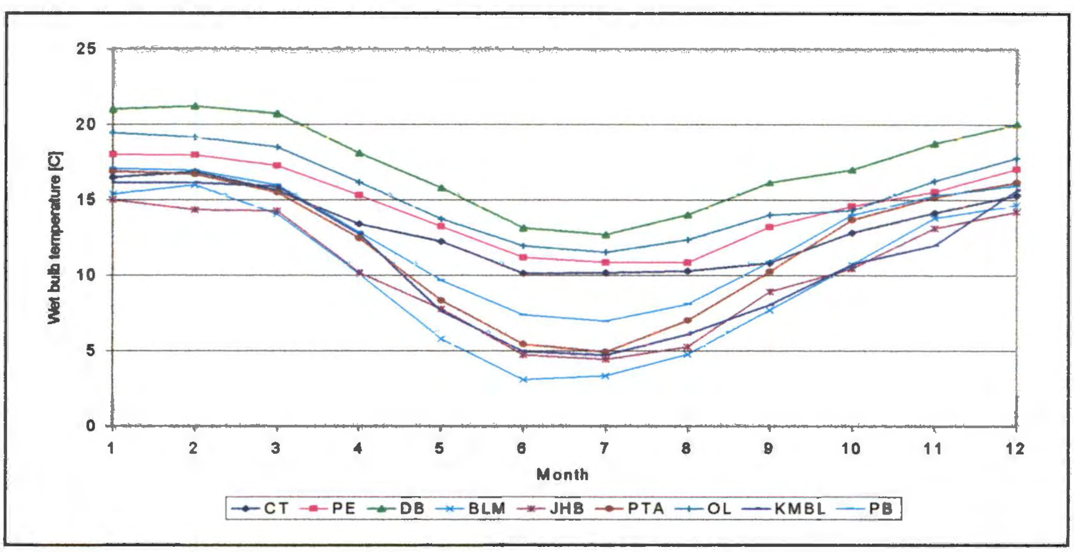

Figure 9: Averaged annual wet bulb temperature profiles [Rousseau].

A careful analysis of these wet bulb temperature profiles together with climatic data of other cities close to those indicated in the graph led to the identification of various climatic regions. This process eventually led to the identification of five distinct climatic regions by Rousseau that are important with regard to the operation of an in-line heat pump water heater.

The five climatic regions are:

1. Gauteng including Johannesburg and Pretoria.
2. East Coast including Durban, Port Elizabeth and East London.
3. Western Cape centred around Cape Town.
4. North West including the Free State and Northern Cape.
5. Northern Province centred around Pietersburg.

Figure 10 shows the qualitative population density in terms of the colour intensity of the shaded areas as well as the location of the five important climatic regions. Figure 11 shows the annual averages and swings in the wet bulb temperature profiles for the five regions. Figure 12 shows the analysis in terms of Low, Medium and High values of average and swing that led to the identification of the five regions. Note that each of the five regions have a unique combination of average and swing and there is therefore no duplication.

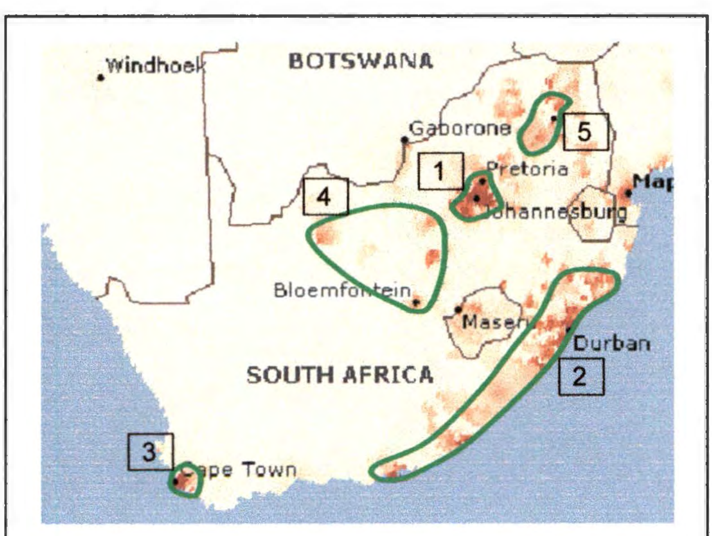

Figure 10: Population density and location of the five identified climatic regions. [Rousseau]

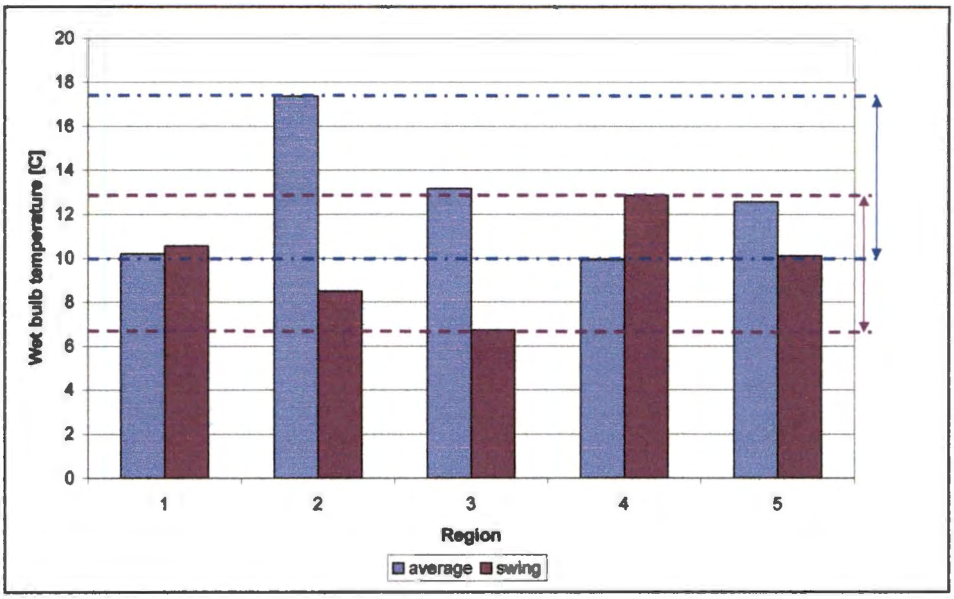

Figure 11: Annual average and swing in the wet bulb temperature profiles for the five identified climatic regions. [Rousseau]

Region	Average	Swing
1	Low	Medium
2	High	Medium
3	Medium	Low
4	Low	High
5	Medium	Medium

Figure 12: Analysis of the wet bulb temperature profiles for the five climatic regions. [Rousseau]

However, in order to make use of the available customer and energy sales data from the National Energy Regulator (NER, 1999) statistics, all other customers (cities and towns) must be included in the five identified regions.

(b) Extended climatic regions

The original climatic regions as indicated by figure 10 concentrated on the major cities and excluded numerous customer data points around the country. The NER statistics were used to evaluate the validity of excluding country side customers from the investigation. The data proved that country side consumption constitute on average 46% of the total consumption as summarized in figure 13.

	Customers			Consumption		
Region	**Centres**	**Country**	**Increase**	**Centres**	**Country**	**Increase**
1	526 474	515 675	98%	6 086 799	5 600 991	92%
2	655 007	190 580	29%	3 828 267	1 297 023	34%
3	371 998	209 936	56%	2 647 113	1 200 255	45%
4	120 147	296 806	247%	531 688	1 596 314	300%
5	19 590	203 761	1040%	157 899	1 766 347	1119%
Total	**1 693 216**	**1 416 758**	**46%**	**13 251 766**	**11 460 930**	**46%**

Figure 13: Major centres versus Country side contribution

Cities were grouped into the five climatic groups according to their relevant geographic location and prevailing weather patterns. Mountain ranges, altitude and distance from the coast were also used as indicators. Wet bulb temperature statistics from entzel (1984) from eleven additional weather stations around the country (large triangles in figure 14) were compared with the five weather stations which represents the five climatic regions (red circles in figure 14). The boundaries of the five original climatic regions were then expanded to include all the country side data as well. This more comprehensive grouped NER data (figure 14) was used to calculate the energy consumption per climatic region which will be used to compare the heat pump performances under varying wet bulb conditions.

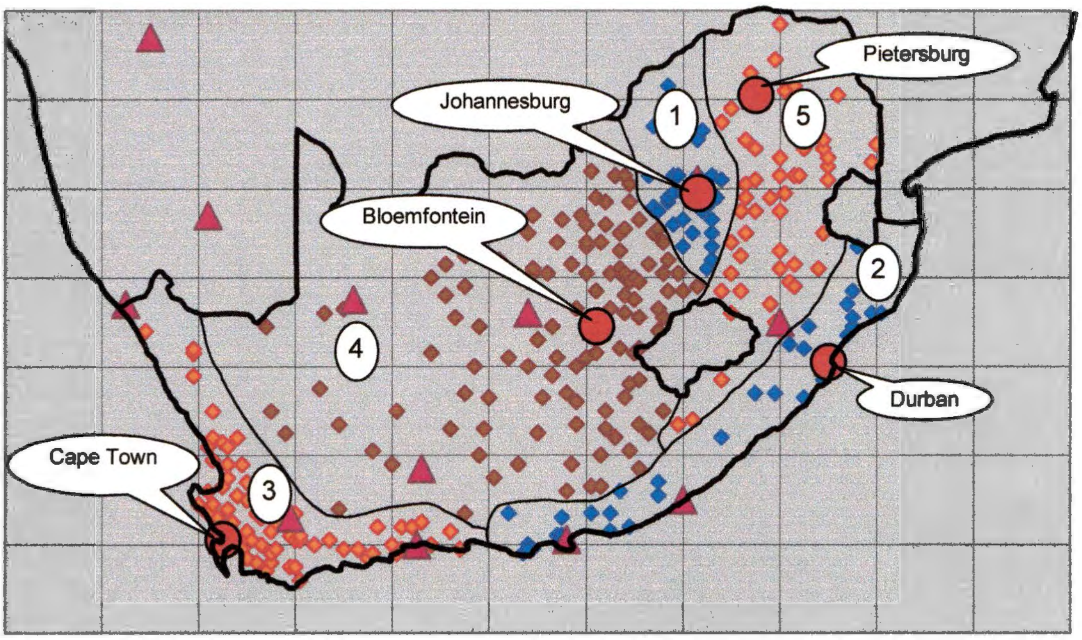

Figure 14: Comprehensive population density and location of the five identified climatic regions.

The NER statistics distinguish between Eskom direct sales to domestic customers and municipalities' sales to domestic customers as indicated in figure 15. The figure show that although Eskom supplies electricity to 50% of the customers it sells only 20% of the MWh. This can be contributed to the electrification process to many households of the lower income group (NER chapter 7) which is also evident if comparing the consumption per customer between Eskom and the municipalities.

	Eskom	Municipalities	Total
Customers	3 065 639	3 019 863	6 085 502
Consumption	6 195 747	24 853 005	31 048 752
Per customer	2.02	8.23	5.10

Figure 15: Contribution: Eskom versus Municipalities

As stated in paragraph 3.2 and referring to figure 8, very few of the lower income group use electric geysers. For this study it is considered feasible to only use the data from the municipalities as these figures more accurately describe the consumption of the customers which use hot water geysers.

For the simulation the climatic data of the following five centres will be taken as representative of the five major climatic regions:

1. Johannesburg
2. Durban
3. Cape Town
4. Bloemfontein
5. Pietersburg.

The NER statistics (chapter 8: town, customers, consumption in MWh) as published has some errors and omissions. The data for domestic customers was captured in Excel and a scatter graph of the consumption versus customer number was created. The original data (Appendix C figure C.1) indicated two values significantly out of bounds (using kWh in stead of MWh). Numerous towns did not distribute the total consumption amongst the various categories. Equivalent figures of other towns of similar size were used to generate artificial distributions. The average consumption/customer (originally 8.6) now dropped to 8.0 after this correction. Zero consumption/customer (3.1% of data) were also corrected to at least the average value (Appendix C figure C.2). Figures of more than two and a half times the average value (3.7% of data) were trimmed to a value of 20. The final average consumption/customer is 7.9 MWh/annum. (Appendix C figure C.3). This compares favourably with the average from the NER statistics (chapter 5) of 8.23 as shown in figure 15, not knowing whether the incorrect data was used or not.

As the seasonal changes and thus the ambient conditions influences the water take-off rates, so does it influence the water tank's losses and more so, the heat pump's operational performance. With all of the above factors known and available it is now possible to simulate how these three heating methods will respond to a typical water take-off profile in the five climatic regions.

4. SIMULATION PROCESS

The simulation process is to perform calculations and converge on solutions that represents the real world set-up. The process has to have the flexibility to change settings to simulate different conditions.

4.1 HEATING SYSTEM LAYOUT

The system layout that was investigated comprised of the three independent heating systems, all interacting on the water tank namely (figure 16):

1. in-tank resistance heating element,
2. in-line resistance heating element,
3. in-line water heat pump.

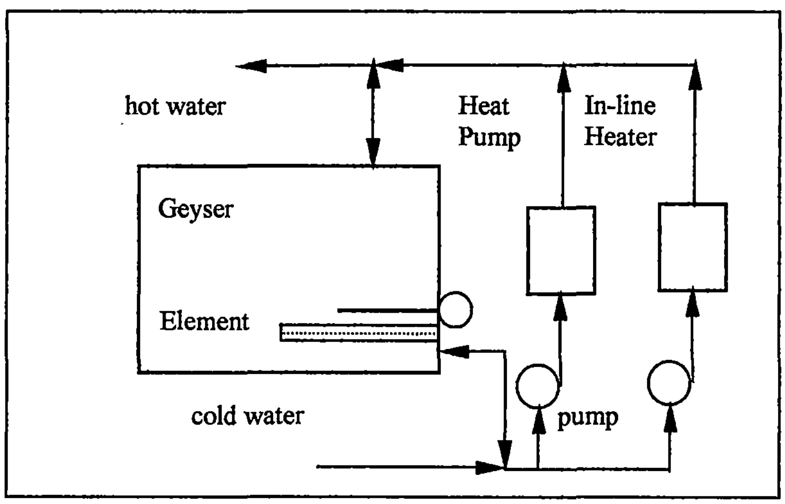

Figure 16: Water heating system layout

4.2 SIMULATION MODEL

The simulation model of the storage tank should take into account the water flow rate, conduction and convection. Different models (Kleinbach, *et al*, 1993) were developed with different approaches: multi-node model (Klein, 1976), plug flow model (Kuhn *et al*, 1980) and the plume entrainment model (Phillips & Pate, 1977). A computer simulation model was also developed by Rousseau, Strauss and Greyvenstein (2000) to fully simulate the conditions in a domestic hot water heater system using a horizontal or vertical storage tank with in-tank heating element and including an in-line heater and an in-line heat pump. The model includes a detailed deterministic simulation of the hot water storage tank, the electrical heater and the thermostatic control algorithm. The mathematical model for the storage tank is based on an electrical analogue approach that includes the effects of conduction as well as forced and natural convection. The tank is divided into a selected number of well-mixed control volumes from the top to the bottom each represented by a node. The heat transfer for each node is represented by the electrical analogue network shown schematically in Figure 17.

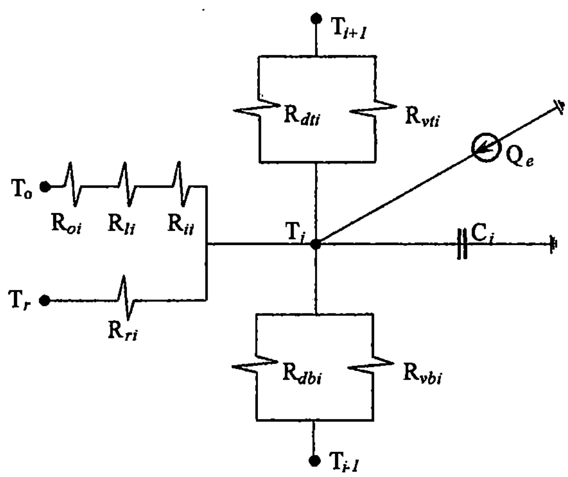

Figure 17: Analogue storage tank network schematic.

T_i represents the temperature at node i. The temperatures of the nodes above and below the node of interest are represented by T_{i+1} and T_{i-1} respectively. The conduction between the nodes is represented by the electrical current flowing through the resistances R_{dti} and R_{dbi} respectively. The forced convection is represented by the current flowing through R_{vti} and R_{vbi}. Forced convection takes place during water take-off or when the in-line heater or heat pump is operating. If the flow is upward from node i-1 towards node i, the value of R_{vbi} is derived from the magnitude of the mass flow rate. If the flow rate is downward from node i towards node i-1, T_i will not be influenced by T_{i-1} and therefore R_{vbi} will represent an open circuit with an infinite resistance. The same approach is valid for R_{vti} where T_i will not be influenced by T_{i+1} if the flow rate is upward from node i towards node i+1.

Heat losses or gains through the tank wall are represented by the current flowing through

R_{ii}, R_{li} and R_{oi}. These resistances represent the inside convective resistance, the material resistance (wall, lagging and cladding) and the outside convective resistances respectively. T_r is the liquid temperature of the return flow from the load and the resistance R_{ri} is added to allow for the return flow if present at that node. Return flow is used in ring mains systems where the hot water is continuously circulated to many take-off points and is therfor not used in this study. The thermal mass of the liquid in the control volume represented by node i is accounted for by the capacitor C_i. Q_e represents a heat input to the node if a heat source, such as a resistance heating element is present at the node.

The consumption from the top of the tank and thus the intake of cold water from the bottom is balanced with the circulation of the in-line heater or heat pump through the tank. Any combination of in-tank heater, in-line heater and heat pump capacities can be selected. Up to three thermostats can be positioned at any height and set to different temperatures, including the dead band of the switch. The hot water consumption is simulated by means of non-dimensional take-off rates, multiplied by the total daily consumption . The take-off profile is specified for 65^{0}C water supply temperature thus the flow rate must be adjusted whenever the supply temperature is different to this value by using a temperature compensating factor.

To generate the perturbations, a random generator was employed. The values supplied by the random generator were transformed to a normal distribution with the aid of the Box-Muller transformation. This transformation is imposed upon a set of rectangular random numbers between the value 0 and 1 after which 68% of the numbers will fall within -1 and +1 with an average value of 0 as shown in figure 18.

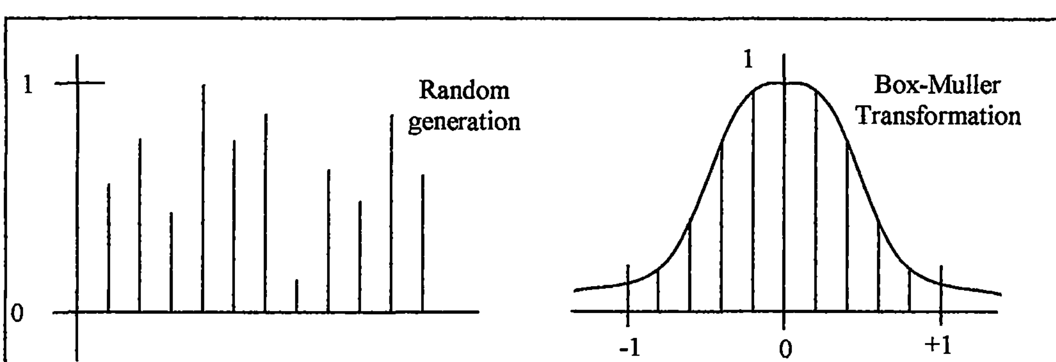

Figure 18: Random generation versus Box-Muller transformation

A typical yearly consumption distribution for a 10 year simulation is shown in figure 19.

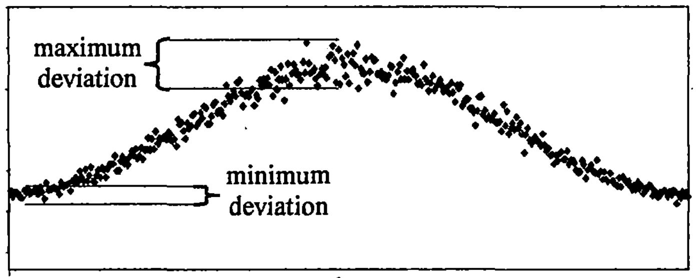

Figure 19: Annual water consumption distribution for a typical 10 year simulation.

It is important to correctly compensate for the ambient conditions, the seasonal changes and demographic location in order to evaluate the simulation results.

4.3 SIMULATION METHODOLOGY

The simulation was done as follows:

- The detailed deterministic model for the storage tank (150 litre horizontal) combined with either the in-tank heater (3.0 kW) or heat pump (1.1 kW nominal) with an in-line heater (0.5 kW) and its applicable control algorithm was employed together with a statistical approach.
- Detailed simulations (450 seconds time step) were carried out based on hourly climatic data for each day of the year statistically derived from measurements over an extended period compiled by Wentzel. This is done for the five centres representing the five climatic regions in the country.
- Two different systems were compared, i.e. a typical electrical geyser with a 3 kW in-tank heater and a 1.1 kW heat pump with a 0.5 kW back-up in-line heater. The in-line heater was only operated when the top thermostat switched (set to 50±5°C) or the ambient conditions dropped below 5°C when the evaporator is susceptible to freezing.
- For each system in each location a number of consecutive years were simulated based on a typical daily water consumption profile (3 persons, 100 litre/person) adjusted for seasonal changes throughout the year. The consumption profile was perturbed in a random fashion so that the resulting standard deviation is consistent with actual

measurements. In this case 25 years were simulated consecutively. This represents the number of years after which further simulations will not result in any significant deviation in the resultant probabilities.

- For each set of results obtained from the simulation the number of times was calculated for which the system was 'on' during a specific fifteen minute (450 seconds) period in the year. This was then divided by the total number of years for which the simulation was conducted. The result was then expressed as a percentage probability of the system being 'on' during a specific fifteen minute period in the course of a typical year.
- The inverse of the calculated probabilities was assumed to be the appropriate diversity factor for each system during each fifteen minute period during the year.
- The minimum output temperature of the water heating system for each day of the year was summarized at the end of the 25 year simulation cycle.
- The average kWh used for each day of the year was summarized at the end of 25 years and a average total kWh for a year calculated.
- The average kVA during peak and off-peak hours for each day of the year was summarized at the end of 25 years and the maximum peak demand calculated.

The energy used during each time step interval was divided by the number of time steps between the time interval. These values were summed to obtain the time interval average value .

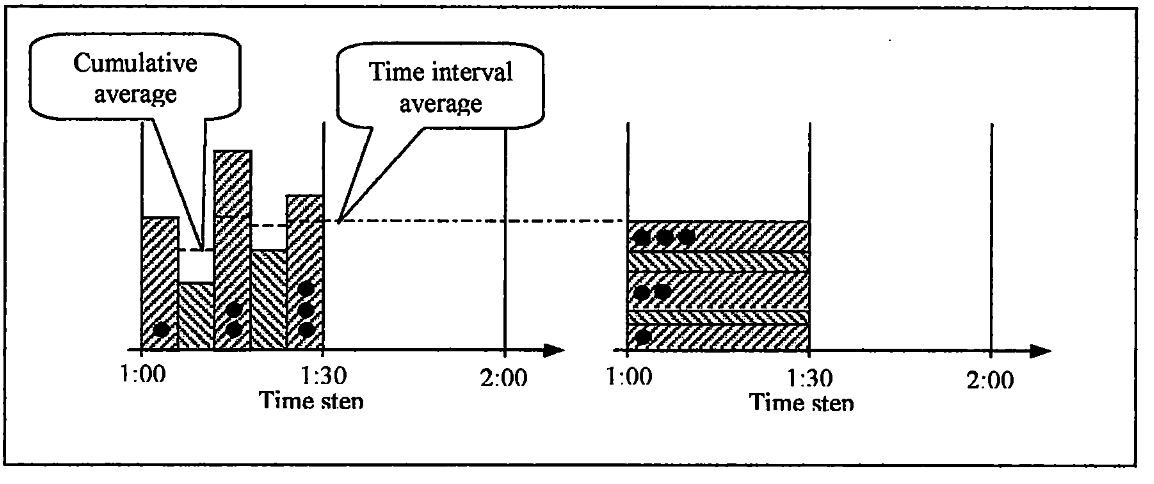

Figure 20: Time step interval energy consumption accumulated value between integration time steps.

Figure 21 (next page) depict a simplified flow diagram of the simulation process.

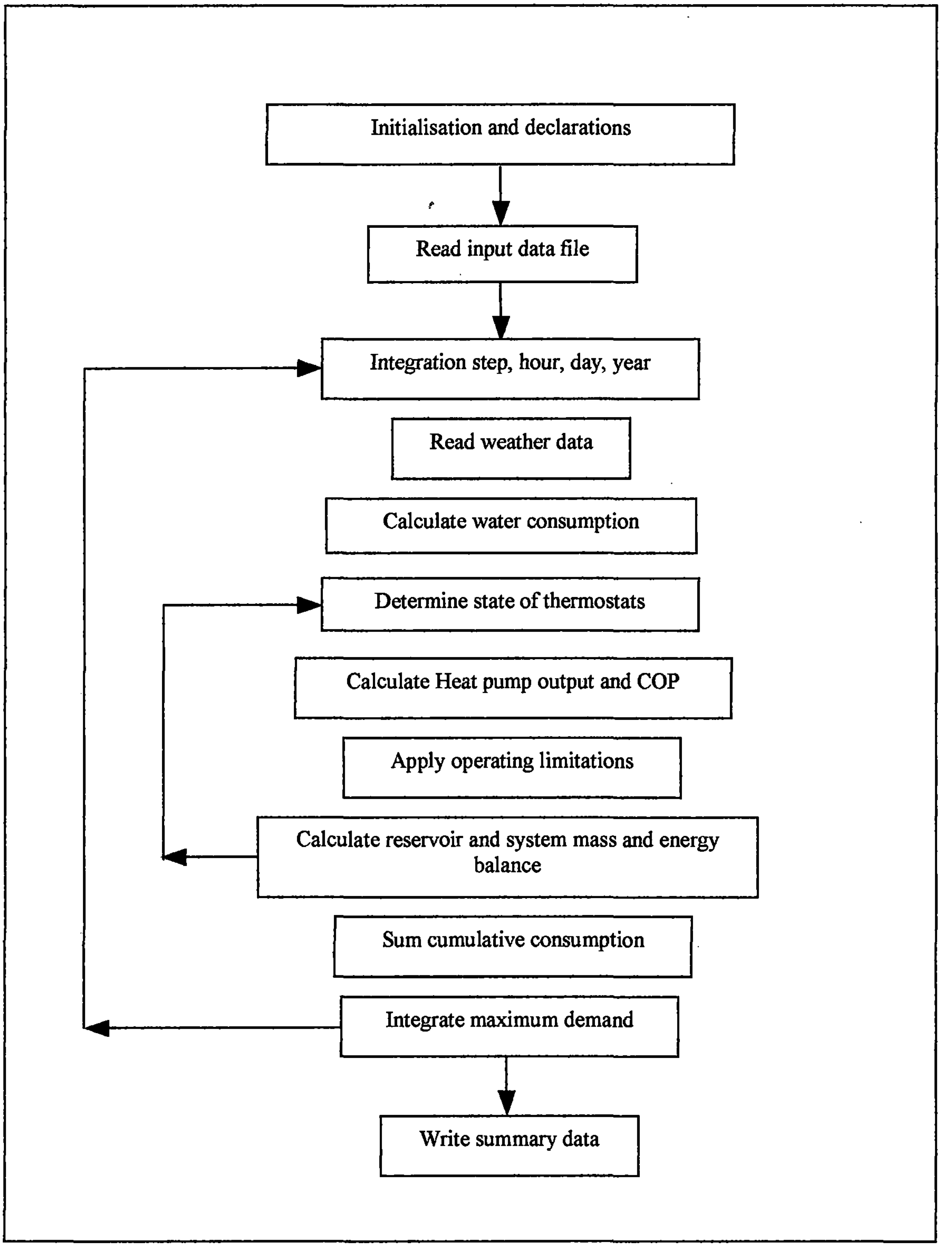

Figure 21: FLOW DIAGRAM

5. SIMULATION RESULTS

The simulated water heating data (complete set in Appendix E) obtained for the various regions were plotted on different charts to compare heating systems employing an in-tank heating element (indicated as ELE) to in-line heat pumps (indicated as HP). The heat pump operations at the various regions were compared and a 4^{th} order polynomial trend line fitted through the two extreme data points. A 4^{th} order polynomial would fit better if the data extended a few months before and beyond the twelve months in view but is considered sufficient for this study as it is the trend through the winter months where the focus lies. This type of trend line is used throughout this study. The extreme cases of the five regions will be used in comparing operational characteristics with in-tank heating. The electric in-line heater (backup heater) was only used when the top thermostat switched on due to the outlet temperature dropping to lower than 50°C or when the heat pump was not operational due to extremely low ambient temperature (<5°C dry bulb). The different ambient conditions at the five regions did not make any significant difference to the data of the in-tank element.

5.1 WATER CONSUMPTION PROFILE

The hot water consumption profiles during heat pump operation of the different regions for every day of the year (Figure 22) indicates a profile as suggested in paragraph 3.2 and figure 19. A sinusoidal shape profile with the maximum occurring in mid-winter with a smaller standard deviation in summer as suggested by Meyer and Tshmankinda. The extreme cases are region 1 (Johannesburg area – highest) and region 2 (Durban area - lowest) mainly due to the lower average winter temperatures at region 1.

There was no significant variation in the consumption for the in-tank heaters (elements) of all five regions. If the element operation is compared with the two extreme cases for heat pump operation however a difference is noticed (Figure 23). As the hot water take-off rates were measured at 65°C, the simulation program increased the consumption proportionately to the lower outlet temperatures, keeping the amount of energy in the outlet water the same. The elements used between 20% and 40% more water than the heat pump which points to a lower average outlet water temperature for the elements. This lower average temperature can be attributed to the different functioning of the storage tank. An in-tank heated tank has less defined stratification levels due to the internal circulation when the heater is switched on. With cold water entering close to the element, the temperature of the outlet water decreases due to this circulation.

5.2 MINIMUM OUTLET TEMPERATURE

The minimum outlet temperature is an indication of how well the water heating system meets the water take-off requirements. The minimum water temperature is calculated at the tank outlet. If the water temperature is maintained at the set temperature, it meets the requirements all the time. At a lower temperature more hot has to be used to meet the requirements. If the temperature drops below a "usable" temperature, the tank is too small or the heater capacity insufficient.

The minimum outlet temperature during heat pump operation of the different regions for every day of the year (Figure 24) suggests that the heat pump meets the demand for most part of the year in all regions. During the winter months however the temperature for some regions drops to 48°C. A hot shower is considered to be approximately 45°C. Below 5°C ambient the heat pump seizes to operate and the in-line (back-up) heater takes over the function. The 500 watt in-line heater is too small to keep the temperature at the set 60°C during prolonged cold winter days and sub zero nights, however this seldom happens two days in a row. The inland regions (1, 4 and 5 i.e. Johannesburg, Bloemfontein and Pietersburg) fall in this category. The coastal regions maintain a very smooth outlet temperature at the set point of 60°C within 0.8°C.

Due to the difference in operation of in-tank heaters and in-line heaters (electric or heat pump), the outlet water temperature will differ. In-tank heaters continuously mixes the water as soon as cold water enters the tank resulting in the supply temperature dropping to an average 49.5°C (Figure 25). In-line heaters on the other hand keeps topping up the tank with water at the set-point temperature of 60°C and causes no noticeable mixing of the stratification layers. A much higher average *minimum* supply temperature of 59°C is therefore maintained. In all three cases in figure 25 the drop in average temperature during winter can be attributed to the higher water take-off during winter. Should the outlet temperature drop below the top thermostat setting of 50°C ± 5°C, the in-line heater will assist the heat pump to maintain a "usable" temperature. The minimum outlet temperature dropped to lower than 50°C only twice and only in region 1 for heat pump operation while the in-tank heater never reached 50°C.

5.3 DAILY ENERGY CONSUMPTION

The increase in energy consumption (kWh) during winter is evident for heat pumps in all 5 regions (Figure 26), mainly due to the higher water consumption. The coastal regions (2 and 3) show a smooth consumption whilst the other regions become very erratic around winter. This phenomenon is largely due to the back-up heater being used during winter which uses approximately the same amount of energy (500 watt element) but has to operate for a longer time period to obtain the same results as a heat pump with a COP of at least 1.5. Although region 4 (Bloemfontein) experiences colder peak conditions than region 1 (Johannesburg), the moving average minimum temperature of region 1 is lower, resulting in longer back-up heater operation and more energy used.

Due to the COP of the heat pump the daily average energy consumed throughout the year is on average only 75% of that of the in-tank heater for region 1 and only 45% for region 2 (Figure 27). This is a direct cost saving for the consumer in kWh and thus in Rands. The worst heat pump operation (region 1) consumed more energy per day than the in-tank elements for only 7% of the year with a peak of 20% more energy used.

5.4 PEAK kVA DISTRIBUTION

As direct energy savings benefits the customer, so does peak demand savings benefits the supplier. (Current trends in electricity supply suggests a peak demand measurement for domestic users in future too). To prevent a lowering in supply frequency or "brown-outs" (drop in supply voltage), the supplier must at all times have the generating capacity of the maximum peak demand. Suppliers use a time interval of 1800 seconds to calculate the peak demand. The half hour which uses the most energy for a day constitutes the peak demand for the day. Likewise the day with the highest peak will be the maximum peak demand for the year.

In figure 28 the coastal regions demonstrate a smooth daily peak demand for heat pump operations while the other regions show an erratic peak demand. These erratic peaks occur when the in-line heater assists the heat pump when the outlet water temperature drops lower than 50±5°C. If comparing the heat pump operation with in-tank heater operation (figure 29), the higher capacity of the heating elements (3 kW) give rise to a higher maximum peak demand of 1.350 kVA to only 1.041 kVA of the heat pumps. This is 77% of the peak demand compared to in-tank elements.

The maximum of 1.350 kVA recorded during winter when using in-tank elements indicates that as much as 45% (1.350/3.000) of all electric geysers in a large sample will be operational during a single integration step on the peak winter day.

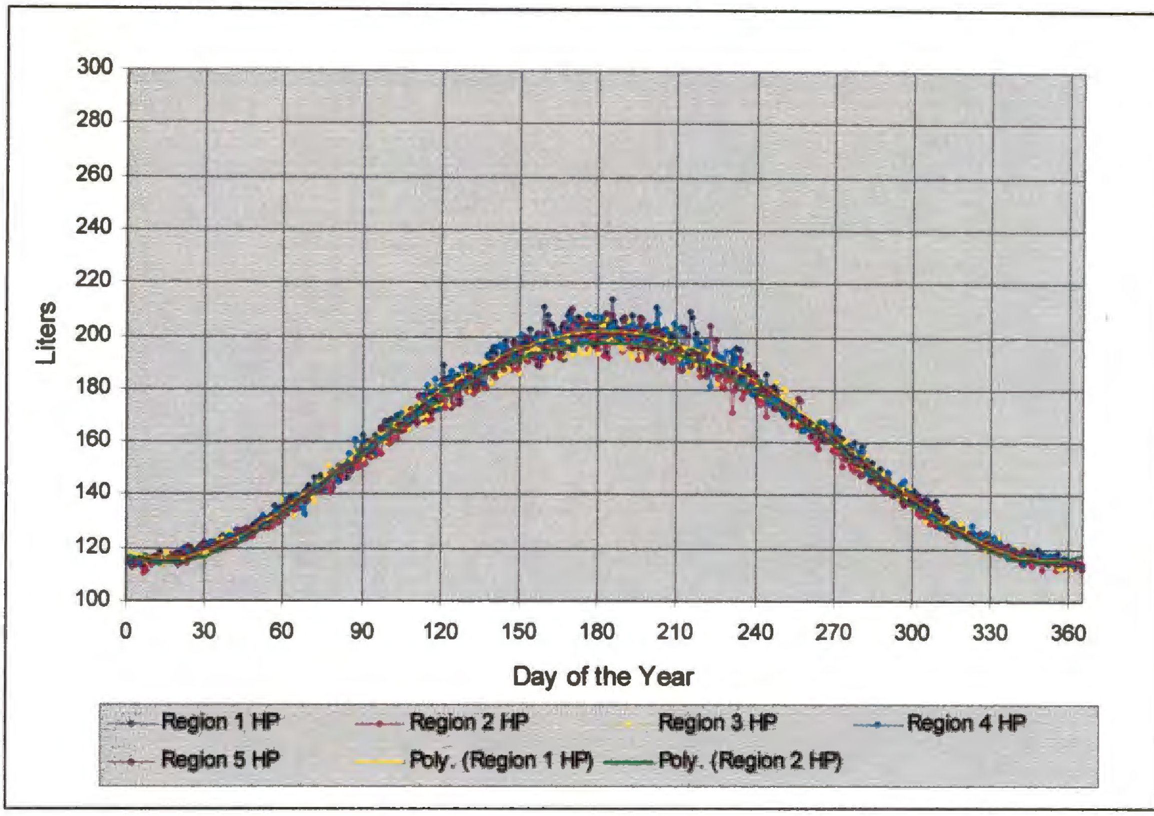

Figure 22: Daily hot water consumption for 5 Regions
Trend lines for extreme cases (Regions 1 & 2)

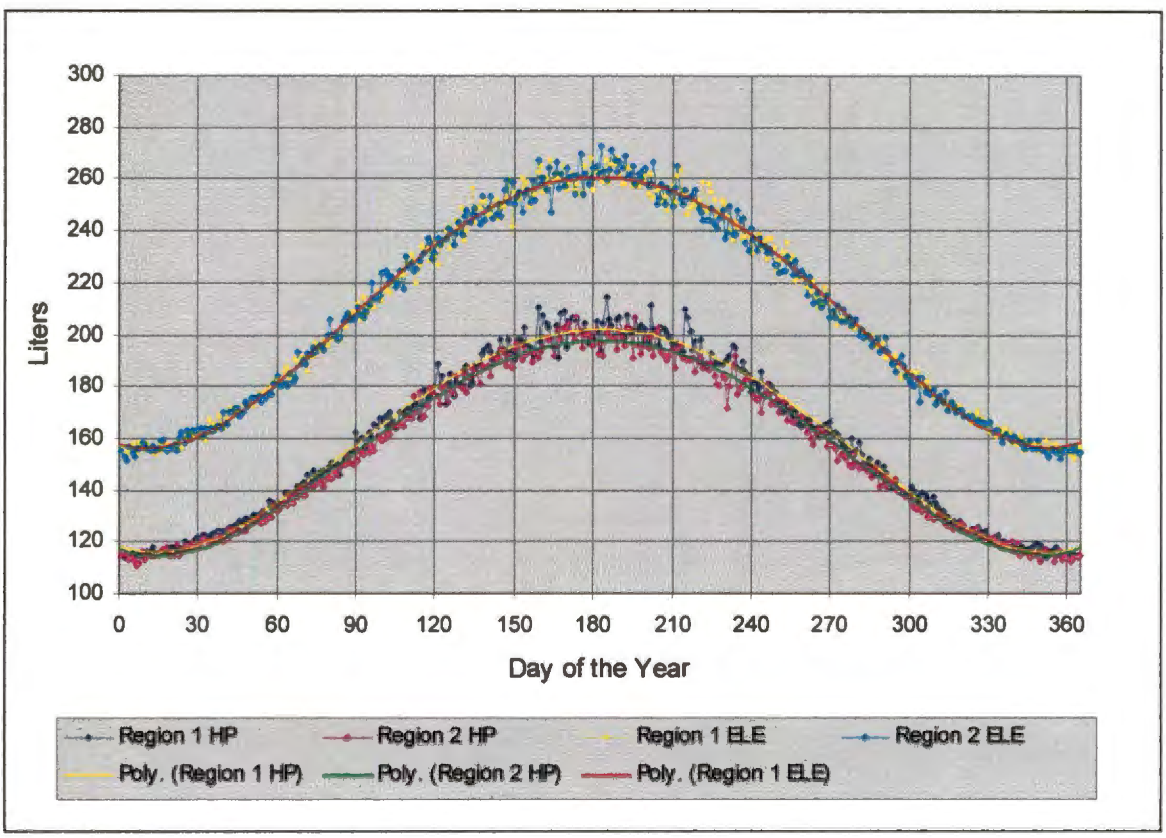

Figure 23: Daily hot water consumption HP (extreme cases) vs. Elements.

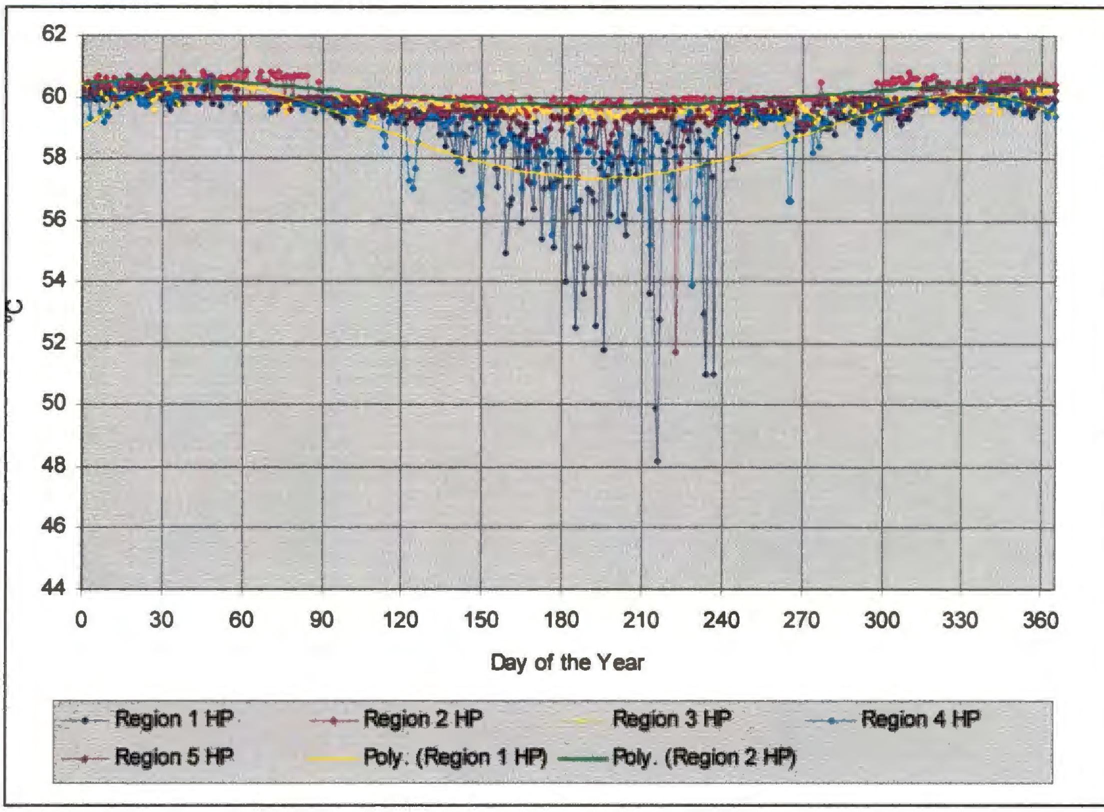

Figure 24: Minimum daily outlet temperature for 5 Regions Trend lines for extreme cases (Regions 1 & 2)

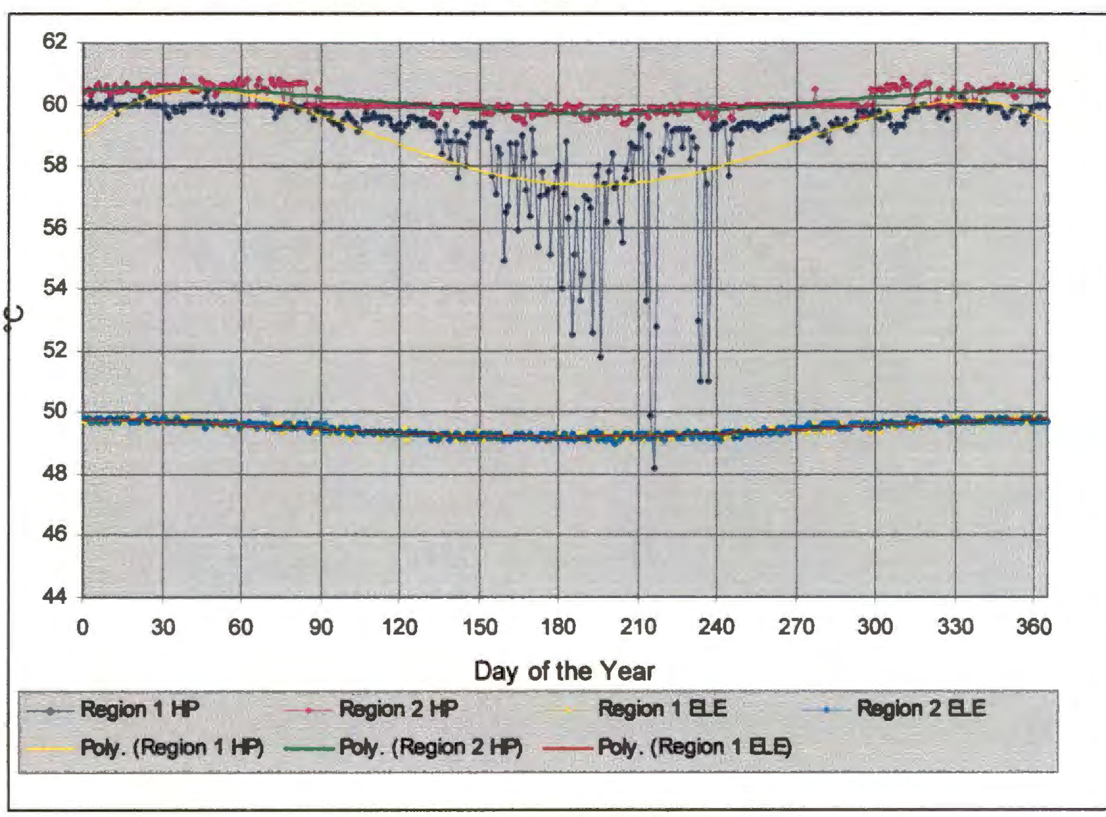

Figure 25: Minimum outlet temperature HP (extreme cases) vs. Elements

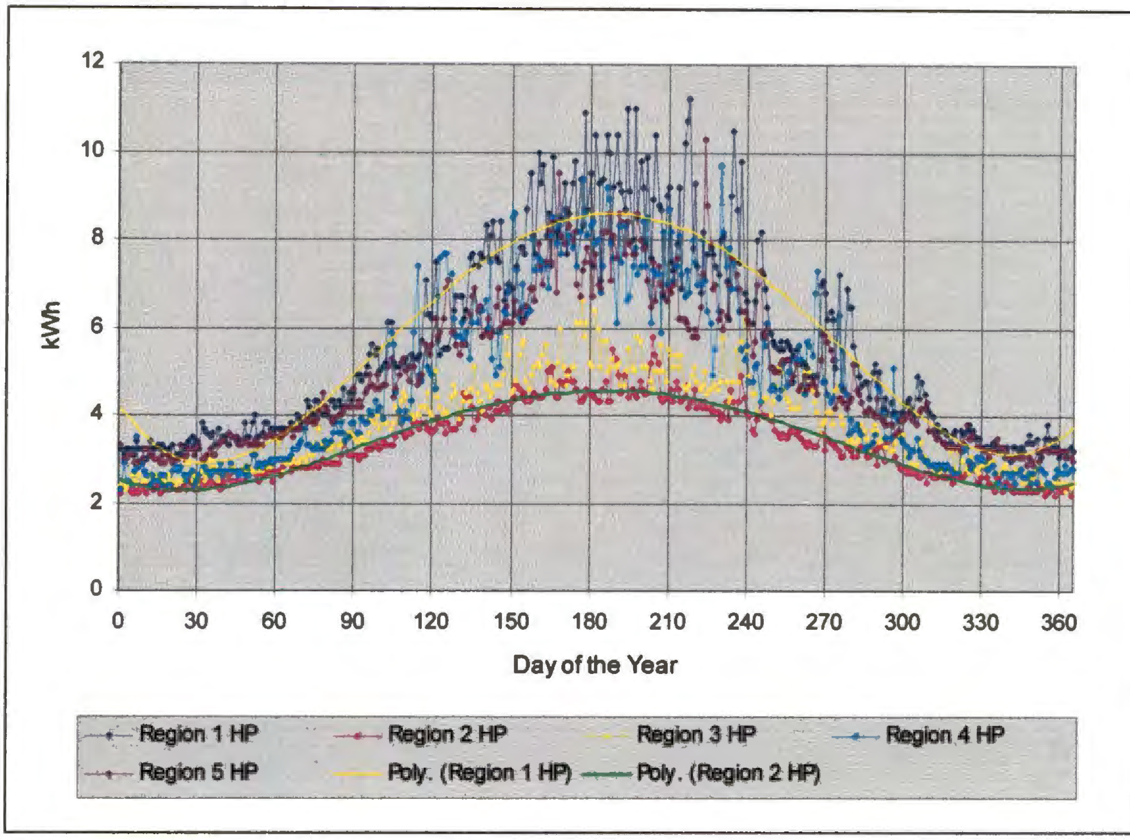

Figure 26: Daily Heat pump energy consumption for 5 Regions Trend lines for extreme cases (Regions 1 & 2)

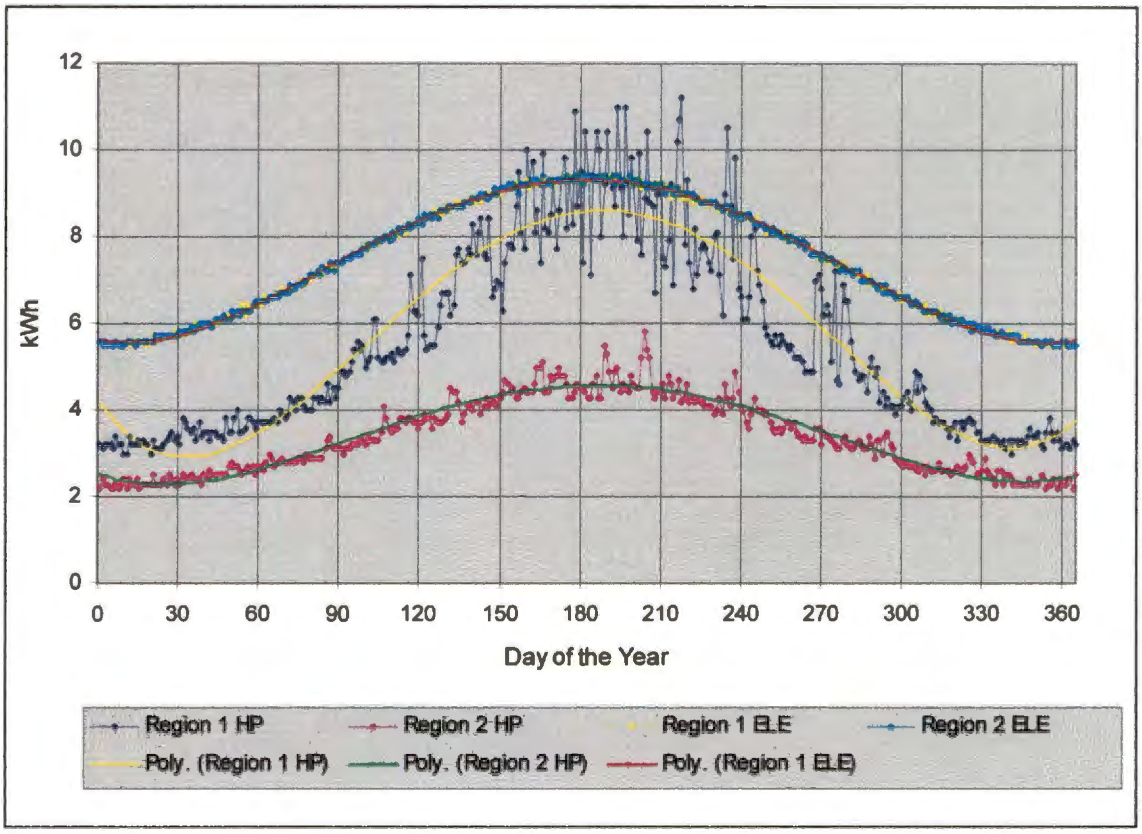

Figure 27: Daily energy consumption HP (extreme cases) vs. Elements

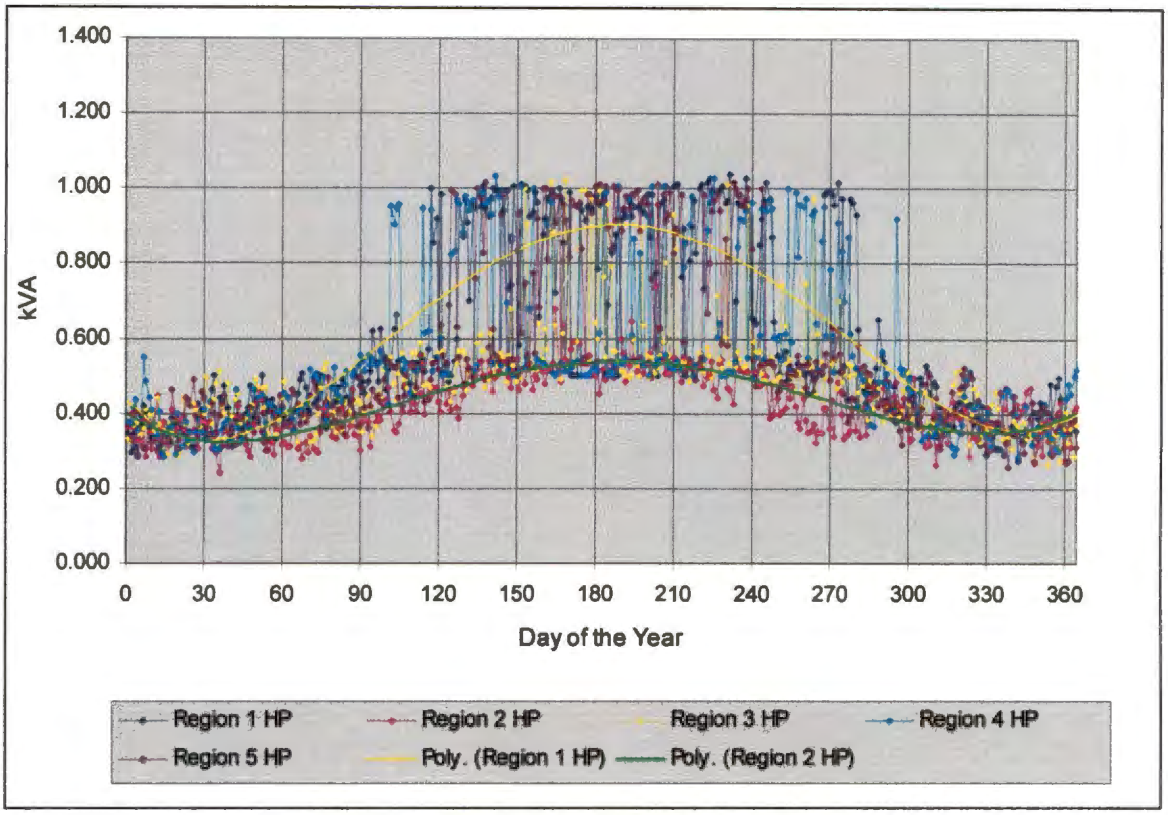

Figure 28: Daily Peak demand for 5 Regions Trend lines for extreme cases (Regions 1 & 2)

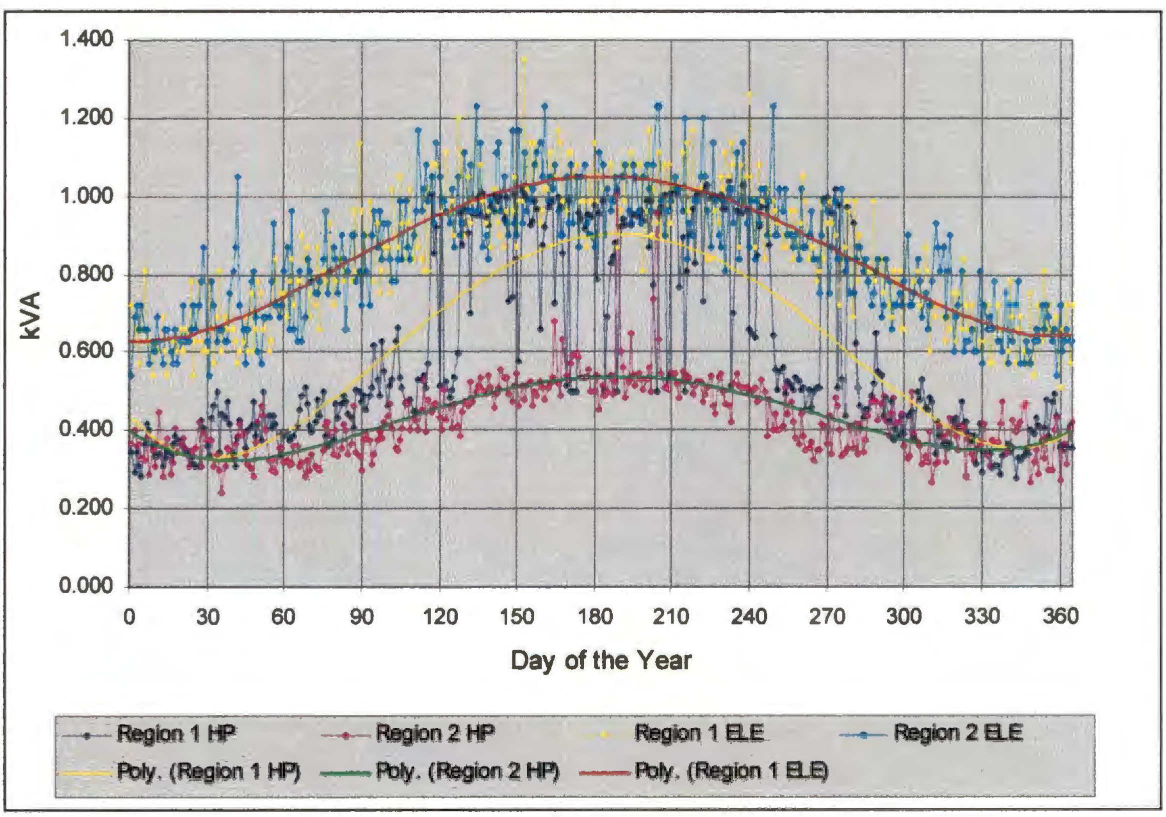

Figure 29: Daily Peak demand HP (extreme cases) vs. Elements

6. IMPACT ON CONSUMER

Although theoretically better, the higher average outlet water temperature obtained with the heat pump (Figure 25) does not really concern the average household. A lower peak demand also does not concern the user since peak demand charges are currently not directly applied in the domestic sector. However, the energy consumption is of great importance, since this is what the end user is billed for. Table 1 is a summary of the energy consumption for the five climatic regions. The first column denotes the number of customers. The annual energy requirement for a representative household (from Figure 27) amounts to 2712 kWh (2.712 MWh in column 2) when using an in-tank element (totals in column 3) compared to between 1233 kWh (region 2 column 4) and 2035 kWh (region 1 column 4) when using an in-line heat pump (totals in column 5). This represents a reduction of between 677 kWh and 1479 kWh per household or between 25% and 55% (column 6). Based on a electricity tariff of 32c/kWh and 36 c/kWh respectively (column 7), this translates to a saving of approximately R 217 per year in the interior and R 534 at the coastal locations (column 8). Therefore, at an initial cost of R 2000, the installation of an in-line heat pump with a nominal capacity of 1100 watt and a back-up heater of 500 watt will result in a pay-back period of less than 6 years at the coast (46% households). For inland operations the payback period exceeds 10 years. For 3.11 million households this means a total cost saving of R 1 167 million per year (column 9).

	1	2	3	4	5	6	7	8	9
	Total	Elements Consump		Heat Pump Consump		Energy	Tariff	Rand savings /annum	
Region	Customers	/Unit	Total	/Unit	Total	%Save	c/kWh	/customer	Total
1	1 042 149	2.712	2 826 100	2.035	2 120 461	25%	32.0	R 217	R 225 804 508
2	845 587	2.712	2 293 063	1.233	1 042 609	55%	36.1	R 534	R 451 413 914
3	581 934	2.712	1 578 089	1.393	810 518	49%	36.2	R 477	R 277 860 682
4	416 953	2.712	1 130 693	1.722	718 160	36%	35.0	R 346	R 144 386 654
5	223 351	2.712	605 683	1.801	402 143	34%	33.3	R 303	R 67 778 742
	3 109 974	2.712	8 433 627	1.637	5 093 890	40%	34.5	R 376	R 1 167 244 501

Table1: Energy consumption per climatic region

Refer to Appendix F for the consumption and savings graphs.

7. IMPACT ON ESKOM

The domestic sector is one of the major contributors to the present day peak demand. Heating of water is responsible for 32% of the domestic peak demand according to Lane which in 1999 was approximately 2 800 MW on a weekday as stated in the National Electricity Regulator report of 1999.

Table 2 (see next page) is a summary of the peak demand per climatic region. The first column indicates the current tariff in c/kWh as paid by the consumers of each region with an average tariff in the last row (34.5). With the total number of customers (column 2) a region weight (column 3) or percentage number of customers of the total number of house holds can be determined. With the calculated simulated heat pump peak demand (column 4) a weighted heat pump peak can be calculated (column 5) for each region. These peaks can be added up to the total weighted peak (1.027) using heat pumps. If multiplied by the total number of households (3 109 974) a total heat pump peak can be detemined (3 193 076 kW). Using the average electricity tariff (34.5) a peak cost when using heat pumps can be determined (R 110 224 967). Similarly the calulations can be performed for electrical element heaters as indicated (columns 6 & 7) with a peak (4 015 135 kW) and a peak cost of R 138 602 112. The difference in peak demand calculated and of that from the NER report can be attributed to fact that our representative geyser is 3 kW, while in practice this may be less on average.

The difference in using heat pumps rather than electric heaters amounts to a potential national peak demand reduction of 822 MW. The avoided cost to ESKOM associated with this potential demand reduction is approximately R4 billion if using R5million per MW as an estimated cost to provide electricity capacity.

	1	2	3	4	5	6	7	
Region	Tariff c/kWh	Total Customers	Region Weight	HP Peak kVA	Weighted Peak	ELE Peak kVA	Weighted Peak	
1	32.0	1 042 149	33.5%	1.041	0.349	1.350	0.452	
2	36.1	845 587	27.2%	1.008	0.274	1.230	0.334	
3	36.2	581 934	18.7%	1.025	0.192	1.250	0.234	
4	35.0	416 953	13.4%	1.035	0.139	1.320	0.177	
5	33.3	223 351	7.2%	1.020	0.073	1.300	0.093	
	34.5	3 109 974	100.0%	**1.026**	**1.027**	**1.290**	**1.291**	
					3 193 076	**kW**	**4 015 125**	**kW**
					R 110 224 967		**R 138 602 112**	
						Difference	**822 049**	**kW**
						Saving	**20%**	

Table 2: Peak demand per climatic region.

8. AREAS OF FURTHER STUDY

During the study it also became evident that certain areas need further investigation to further enhance the current level of investigation into the impact of micro heat pumps for domestic use on the customer and the supplier:

- The deterministic solution of the temperature in the storage tank should be expanded to a 3D model. Circulation due to the position of the in-tank heating element and the positions of the thermostats could further refine the calculation.

- The COP of the heat pump determines the pay back period and thus the economical viability of such a system. With a simulation model as used in this study, a more favourable heat pump solution especially during prolonged cold days, could prove it's viability for all regions in South Africa.

- Eliminate the need to switch the heat pump off during temperatures lower than 5°C by using air for the evaporator from inside the house instead of ambient air. The heat load on the rest of the house should be minimal, it will increase the complexity of the heat pump but will reduce the limitations on its operating environment. This would lead to more favourable energy consumption and maximum peak loads.

- Pre-heating of the inlet water through the oil cooler was beneficial at colder water temperatures. The influence of the pre-heating of the water using an air-to-water heat exchanger when ambient air is 5°C higher than the inlet water, should be investigated.

- Feeding pre-heated inlet water back to the tank's cold water inlet using an inner tube and without disturbing the stratification layers in the tank could improve the overall COP of the system to favourable economic levels.

- The weather data should be scrutinised for obvious typing errors and logical transitions from one month to another especially if peak demands are calculated when using heat pumps. These errors are more prevalent when performing detailed simulations using hourly data as was the case in this study.

9. CONCLUSION

Using the in-line heater concept and heat pumps instead of in-tank resistance heater elements to heat sanitary water for domestic use, can result in significant savings on peak demand (20%) and total energy required (40%). Introducing this heating philosophy could save billions of Rand for the supplier and the end user of electricity in South Africa.

As could be expected from the characteristic performance of heat pumps, coastal region operations reap far more benefits (30%) than inland regions due to more favourable climatic conditions. It is however also clear that the operating limitations imposed on the heat pump during this study should inspire further innovative developments to circumvent these limitations.

The technology to make this design concept work is available and need to be investigated further for a sound economical implementation. The true potential of this method of heating domestic hot water using a heat pump and saving vast amounts of money and energy resources, has been proven by this investigation.

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A. Compressor data

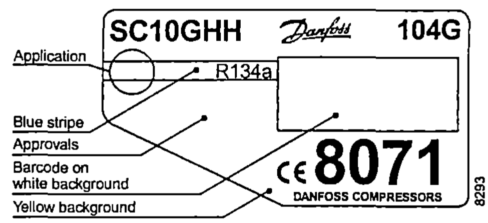
The Data Sheet of the Danfoss compressor used in the experimental set-up is on the next two pages.

SC10GHH
Heat Pump Compressor
R134a
220-240V 50Hz

Data Sheet (Replaces CD.44.E5.02)

General

Compressor		SC10GHH
Code number compressor with oil cooler		104G8071



Application

Application		HBP
Evaporating temperature range	°C	-15 to 15
Voltage range	V/Hz	198 - 254 /50
Motor type		CSR
Max. ambient temperature	°C	43
Comp. cooling at ambient temp.	32°C	O
	38°C	O
	43°C	O

S = Static cooling normally sufficient
O = Oil cooling
F_1 = Fan cooling 1.5 m/s (compressor compartment temperature equal to ambient temperature)
F_2 = Fan cooling 3.0 m/s necessary

Design

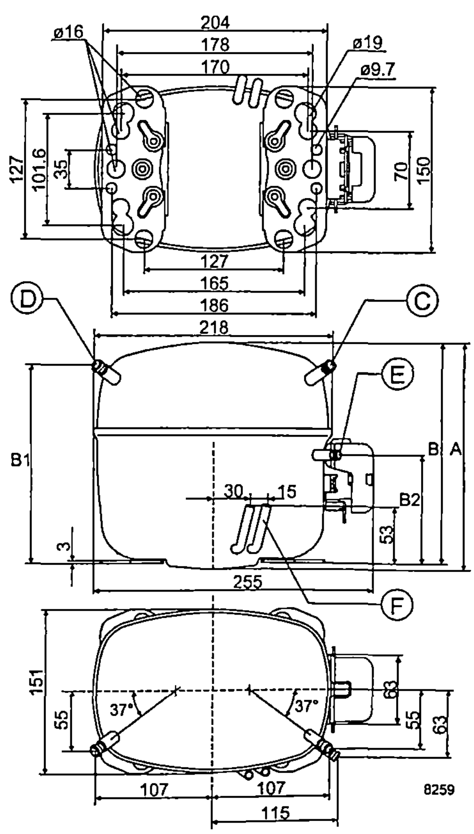
Displacement	cm³	10.29
Oil quantity	cm³	450
Maximum refrigerant charge	g	1300
Free gas vol. in compressor	cm³	1640
Weight without electrical equipment	kg	13.3

Motor

Motor size	watt	240
LRA (rated after 4 sec. UL984) HST	A	8.9
Cut-in current HST	A	8.9
Resistance, main and start winding (25°C)	Ω	10.9/37.3
Approvals		EN 60335-2-34

Dimensions

Height	mm	A	209
		B	203
		B1	183
		B2	100
Suction connector	location/I.D. mm	C	10.2 ±0.09
Process connector	location/I.D. mm	D	6.2 ±0.09
Discharge connector	location/I.D. mm	E	8.2 ±0.09
Oil cooler	location/I.D. mm	F	8.2 ±0.09
Compressors on a pallet	pcs.		80



Capacity (EN 12900/CECOMAF) watt

Comp.\°C	-15	-10	-5	0	5	10	15
SC10GHH	259	352	467	604	762	942	1144

Capacity (ASHRAE) watt

Comp.\°C	-15	-10	-5	0	5	10	15
SC10GHH	319	434	577	746	943	1168	1421

Power consumption watt

Comp.\°C	-15	-10	-5	0	5	10	15
SC10GHH	230	260	290	318	345	371	395

Current consumption A

Comp.\°C	-15	-10	-5	0	5	10	15
SC10GHH	1.03	1.15	1.28	1.40	1.53	1.66	1.77

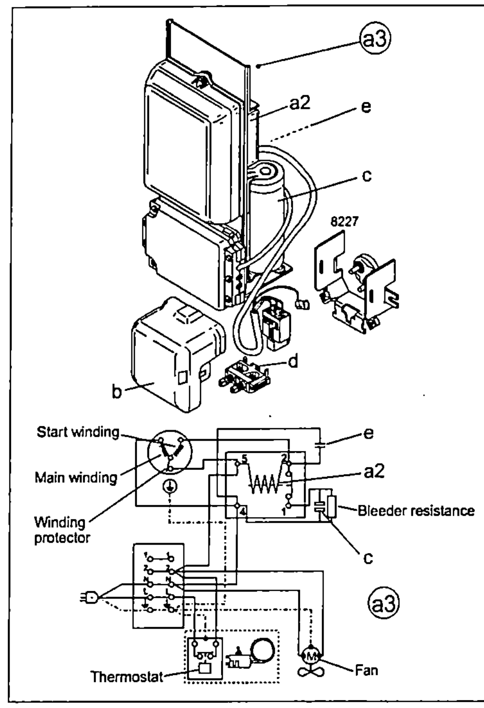
COP (EN 12900/CECOMAF) W/W

Comp.\°C	-15	-10	-5	0	5	10	15
SC10GHH	1.13	1.35	1.61	1.90	2.21	2.54	2.90

COP (ASHRAE) W/W

Comp.\°C	-15	-10	-5	0	5	10	15
SC10GHH	1.39	1.67	1.99	2.35	2.73	3.15	3.60

Test conditions	EN 12900/CECOMAF	ASHRAE
Condensing temperature	55°C	55°C
Ambient and suction gas temp.	32°C	32°C
Liquid temperature	55°C	32°C
Fan cooling, 220V 50Hz		



Accessories

Devices	Fig.	SC10GHH
Starting device	a3	117-7011 (470 mm cable length) 117-7014 (1000 mm cable length)
Cover	b	103N2009
Starting relay	a2	Components of starting device
Starting capacitor	c	
Run capacitor	e	
Cord relief	d	103N1004
Mounting accessories Bolt joint for one compressor Bolt joint in quantities Snap-on in quantities		 118-1917 118-1918 118-1919

B. Experimental data

Experimental data sheets on Excel as recorded during the experiment.

B1.1 : 10°C wet bulb at different inlet water temperatures.

B2.1 : 15°C wet bulb at different inlet water temperatures.

B3.1 : 20°C wet bulb at different inlet water temperatures.

B4.1 : 23°C wet bulb at different inlet water temperatures.

10°C Wet Bulb

TIME	hour	13	13	13	13	13	13	13	13	Averages
	minute	5	6	7	9	10	12	13	15	&
	second	0	33	55	18	48	10	33	3	Sums
TEMP 1	Water out	60.23	59.58	59.52	59.58	59.61	59.68	59.43	59.20	59.60
TEMP 2	Tank	14.08	15.23	14.05	15.36	16.25	14.49	15.35	16.85	15.21
TEMP 3	Oil cooler out	21.60	22.60	22.71	22.78	23.04	23.05	22.59	22.71	22.64
TEMP 4	Water in	21.34	22.42	22.66	22.85	23.05	22.97	22.74	22.86	22.61
TEMP 5	Condenser in	78.36	78.79	79.38	79.54	78.63	78.37	78.12	78.40	78.70
TEMP 6	Wet bulb	9.95	10.05	9.95	9.99	9.76	9.75	10.34	10.63	10.05
TEMP 7	Oil cooler in	18.20	18.84	19.17	19.24	19.29	19.35	19.25	19.22	19.07
TEMP 8	Dry bulb	13.87	13.95	13.89	13.97	13.73	13.72	14.17	14.23	13.94
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	460.00	860.00	1260.00	1690.00	2110.00	2530.00	2980.00	2980.00
Flow	kg/s		0.0049	0.0049	0.0048	0.0048	0.0051	0.0051	0.0050	0.0049
Delta s	second		93	82	83	90	82	83	90	603
Delta T	°C		40.74	40.35	40.34	40.32	40.33	40.18	39.98	40.53
Qin	kW		387.10	439.02	433.73	400.00	439.02	433.73	400.00	417.91
Qout	kW		843.12	823.53	813.41	806.01	864.28	850.69	836.38	838.12
COP Accum.		Oil cooler	2.18	2.02	1.97	1.98	1.98	1.97	1.99	2.01
COP Instant.		No cooler	2.18	1.88	1.88	2.02	1.97	1.96	2.09	1.83

TIME	hour	13	13	13	13	13	13	13	13	Averages
	minute	25	26	27	29	30	32	33	34	&
	second	0	31	53	16	38	1	31	54	Sums
TEMP 1	Water out	59.10	59.10	59.33	59.35	59.45	59.28	59.07	59.11	59.22
TEMP 2	Tank	25.54	25.61	25.67	25.77	25.69	25.82	25.90	26.03	25.75
TEMP 3	Oil cooler out	28.53	28.75	28.89	28.96	28.89	29.00	29.01	29.03	28.88
TEMP 4	Water in	28.37	28.65	28.86	28.91	28.90	29.04	29.00	29.05	28.85
TEMP 5	Condenser in	78.78	78.46	78.77	79.04	78.90	79.37	79.42	78.91	78.96
TEMP 6	Wet bulb	10.52	10.53	10.55	10.58	10.58	10.52	10.45	10.40	10.52
TEMP 7	Oil cooler in	26.58	26.76	26.87	26.87	26.95	26.95	26.97	27.03	26.87
TEMP 8	Dry bulb	14.43	14.42	14.44	14.46	14.45	14.41	14.35	14.27	14.40
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	540.00	1020.00	1520.00	2010.00	2490.00	3040.00	3540.00	3540.00
Flow	kg/s		0.0059	0.0059	0.0060	0.0060	0.0058	0.0061	0.0060	0.0060
Delta s	second		91	82	83	82	83	90	83	594
Delta T	°C		32.34	32.46	32.48	32.50	32.33	32.10	32.08	32.35
Qin	kW		395.60	439.02	433.73	439.02	433.73	400.00	433.73	424.24
Qout	kW		802.94	795.00	818.65	812.56	782.28	820.76	808.57	806.68
COP Accum.		Oil cooler	2.03	1.91	1.91	1.89	1.87	1.90	1.90	1.90
COP Instant.		No cooler	2.03	1.81	1.89	1.85	1.80	2.05	1.86	1.79

TIME	hour	13	13	13	13	13	13	13	13	Averages
	minute	42	43	44	46	47	49	50	51	&
	second	0	32	54	17	41	10	33	55	Sums
TEMP 1	Water out	58.85	58.90	58.59	58.84	58.84	58.72	58.72	58.76	58.78
TEMP 2	Tank	35.00	34.23	34.91	34.11	35.13	34.31	33.87	33.37	34.37
TEMP 3	Oil cooler out	34.21	34.57	34.74	34.81	34.88	34.90	34.98	35.08	34.77
TEMP 4	Water in	34.05	34.53	34.67	34.80	34.84	34.87	34.98	35.05	34.72
TEMP 5	Condenser in	80.14	80.27	80.66	80.40	80.96	80.94	80.96	81.60	80.74
TEMP 6	Wet bulb	10.47	10.49	10.51	10.50	10.47	10.52	10.66	10.69	10.54
TEMP 7	Oil cooler in	33.38	33.62	33.80	33.86	33.86	33.87	34.04	34.07	33.81
TEMP 8	Dry bulb	14.32	14.33	14.35	14.38	14.27	14.33	14.49	14.49	14.37
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	650.00	1290.00	1910.00	2520.00	3210.00	3840.00	4470.00	4470.00
Flow	kg/s		0.0071	0.0078	0.0075	0.0073	0.0078	0.0076	0.0077	0.0075
Delta s	second		92	82	83	84	89	83	82	595
Delta T	°C		25.28	24.79	24.98	24.98	24.85	24.68	24.69	24.97
Qin	kW		391.30	439.02	433.73	428.57	404.49	433.73	439.02	423.53
Qout	kW		747.30	809.53	780.72	758.99	806.08	783.79	793.67	784.72
COP Accum.		Oil cooler	1.91	1.87	1.85	1.83	1.86	1.85	1.85	1.85
COP Instant.		No cooler	1.91	1.84	1.80	1.77	1.99	1.81	1.81	1.79

10°C Wet Bulb

TIME	hour	14	14	14	14	14	14	14	14	Averages
	minute	33	35	36	38	39	41	42	43	&
	second	55	17	47	9	32	2	25	47	Sums
TEMP 1	Water out	58.04	58.14	57.66	58.02	57.79	57.98	57.88	58.28	57.97
TEMP 2	Tank	50.31	50.15	49.95	49.64	49.41	49.06	48.88	48.49	49.49
TEMP 3	Oil cooler out	44.23	45.66	45.97	45.88	45.75	45.54	45.43	45.14	45.45
TEMP 4	Water in	44.23	45.68	46.08	46.02	45.88	45.66	45.52	45.30	45.55
TEMP 5	Condenser in	84.34	84.79	84.95	85.14	85.51	85.24	85.62	85.79	85.17
TEMP 6	Wet bulb	10.18	10.10	10.11	10.04	10.41	10.17	10.25	10.07	10.17
TEMP 7	Oil cooler in	44.83	45.89	46.28	46.18	45.95	45.79	45.51	45.34	45.72
TEMP 8	Dry bulb	14.10	14.05	14.01	13.99	14.49	14.42	14.36	14.19	14.20
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	1060.00	2380.00	3580.00	4790.00	6070.00	7270.00	8390.00	8390.00
Flow	kg/s		0.0129	0.0147	0.0146	0.0146	0.0142	0.0145	0.0137	0.0142
Delta s	second		82	90	82	83	90	83	82	592
Delta T	°C		12.25	11.38	11.84	11.84	12.19	12.37	12.94	12.25
Qin	kW		439.02	400.00	439.02	433.73	400.00	433.73	439.02	425.68
Qout	kW		662.55	698.34	724.95	722.19	725.38	748.28	739.49	726.54
COP Accum.		Oil cooler	1.51	1.62	1.63	1.64	1.67	1.68	1.68	1.71
COP Instant.		No cooler	1.51	1.75	1.65	1.67	1.81	1.73	1.68	1.73

TIME	hour	14	14	14	14	15	15	15	Averages	Averages
	minute	55	56	57	59	0	2	3	&	&
	second	0	32	55	18	40	5	33	Sums	Sums
TEMP 1	Water out	57.78	57.72	57.66	57.28	57.35	57.09	57.42	57.47	57.47
TEMP 2	Tank	56.05	55.69	55.43	54.99	55.11	55.09	54.60	55.28	55.28
TEMP 3	Oil cooler out	51.84	51.77	51.59	51.28	51.02	51.03	51.03	51.37	51.37
TEMP 4	Water in	52.28	52.19	51.92	51.68	51.41	51.41	51.38	51.75	51.75
TEMP 5	Condenser in	86.94	87.76	87.38	87.67	87.49	87.85	87.43	87.50	87.50
TEMP 6	Wet bulb	10.02	10.12	10.08	10.27	10.20	10.29	10.25	10.18	10.18
TEMP 7	Oil cooler in	52.57	52.49	52.17	51.95	51.71	51.67	51.37	51.99	51.99
TEMP 8	Dry bulb	13.99	14.05	14.09	14.24	14.19	14.25	14.26	14.15	14.15
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.060	0.060
WATER	gm water	0.00	2870.00	5450.00	8030.00	10500.00	13000.00	15600.00	15600.00	15600.00
Flow	kg/s		0.0312	0.0311	0.0311	0.0301	0.0294	0.0295	0.0304	0.0304
Delta s	second		92	83	83	82	85	88	513	513
Delta T	°C		5.23	5.49	5.33	5.64	5.42	6.05	5.48	5.48
Qin	kW		391.30	433.73	433.73	439.02	423.53	409.09	421.05	421.05
Qout	kW		682.63	714.01	693.20	710.81	666.98	747.89	697.42	697.42
COP Accum.		Oil cooler	1.74	1.69	1.66	1.65	1.63	1.67	1.66	1.66
COP Instant.		No cooler	1.74	1.65	1.60	1.62	1.57	1.83	1.73	1.73

15°C Wet Bulb

TIME	hour	15	15	15	15	15	15	16	16	Averages
	minute	53	54	55	57	58	59	0	2	&
	second	0	23	41	3	18	41	56	18	Sums
TEMP 1	Water out	60.69	60.81	61.14	61.28	61.19	61.19	61.12	61.15	61.07
TEMP 2	Tank	13.18	13.53	14.00	14.31	14.18	15.20	15.79	16.14	14.54
TEMP 3	Oil cooler out	20.51	20.75	20.94	21.00	21.17	21.33	21.52	21.72	21.12
TEMP 4	Water in	20.47	20.83	21.03	21.12	21.27	21.44	21.59	21.78	21.19
TEMP 5	Condenser in	79.62	79.61	79.37	79.18	79.05	78.78	78.59	78.53	79.09
TEMP 6	Wet bulb	15.05	15.05	15.11	15.08	15.07	15.16	15.15	15.05	15.09
TEMP 7	Oil cooler in	16.85	17.16	17.33	17.53	17.68	17.99	18.16	18.52	17.65
TEMP 8	Dry bulb	23.82	23.88	23.90	23.97	24.00	24.06	24.09	24.11	23.98
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	470.00	930.00	1400.00	1840.00	2320.00	2760.00	3240.00	3240.00
Flow	kg/s		0.0057	0.0059	0.0057	0.0059	0.0058	0.0059	0.0059	0.0058
Delta s	second		83	78	82	75	83	75	82	558
Delta T	°C		43.65	43.81	43.75	43.51	43.20	42.96	42.63	43.42
Qin	kW		433.73	461.54	439.02	480.00	433.73	480.00	439.02	451.61
Qout	kW		1034.18	1081.01	1049.19	1068.00	1045.29	1054.50	1044.08	1054.82
COP Accum.		Oil cooler	2.38	2.36	2.37	2.33	2.35	2.32	2.33	2.34
COP Instant.		No cooler	2.38	2.34	2.39	2.23	2.41	2.20	2.38	2.15

TIME	hour	16	16	16	16	16	16	16	16	Averages
	minute	14	15	17	18	19	21	22	23	&
	second	30	54	9	32	47	2	17	39	Sums
TEMP 1	Water out	60.68	59.94	60.00	60.16	60.23	60.37	60.41	60.38	60.27
TEMP 2	Tank	25.07	25.15	25.20	25.29	25.35	25.45	25.51	25.63	25.33
TEMP 3	Oil cooler out	27.26	27.69	27.80	27.92	28.00	28.05	28.11	28.18	27.88
TEMP 4	Water in	27.03	27.58	27.75	27.85	27.95	28.00	28.09	28.14	27.80
TEMP 5	Condenser in	78.61	78.74	78.86	78.82	78.96	78.98	78.99	79.14	78.89
TEMP 6	Wet bulb	15.29	15.18	15.09	15.08	15.09	15.12	15.29	15.24	15.17
TEMP 7	Oil cooler in	25.41	25.67	25.87	25.93	26.04	26.08	26.16	26.22	25.92
TEMP 8	Dry bulb	24.24	24.28	24.27	24.29	24.29	24.30	24.32	24.32	24.29
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	630.00	1170.00	1780.00	2320.00	2860.00	3420.00	4030.00	4030.00
Flow	kg/s		0.0075	0.0072	0.0073	0.0072	0.0072	0.0075	0.0074	0.0073
Delta s	second		84	75	83	75	75	75	82	549
Delta T	°C		34.27	34.13	34.23	34.19	34.29	34.25	34.16	34.35
Qin	kW		428.57	480.00	433.73	480.00	480.00	480.00	439.02	459.02
Qout	kW		1075.39	1028.16	1052.57	1029.97	1032.98	1069.99	1063.23	1054.96
COP Accum.		Oil cooler	2.51	2.32	2.35	2.30	2.27	2.26	2.28	2.30
COP Instant.		No cooler	2.51	2.14	2.43	2.15	2.15	2.23	2.42	2.17

TIME	hour	16	16	16	16	16	16	16	16	Averages
	minute	31	32	33	34	36	37	38	40	&
	second	0	24	39	54	17	31	47	9	Sums
TEMP 1	Water out	58.88	58.80	58.91	59.23	59.30	59.45	59.53	59.69	59.22
TEMP 2	Tank	34.99	34.90	35.15	35.21	35.15	35.04	34.99	34.86	35.04
TEMP 3	Oil cooler out	34.52	34.59	34.64	34.69	34.85	34.91	34.93	34.91	34.76
TEMP 4	Water in	34.42	34.52	34.57	34.59	34.76	34.83	34.86	34.86	34.68
TEMP 5	Condenser in	79.39	79.57	79.73	79.95	80.21	80.40	80.57	80.70	80.07
TEMP 6	Wet bulb	15.10	15.13	15.20	15.13	15.00	14.95	14.96	14.99	15.06
TEMP 7	Oil cooler in	33.68	33.70	33.73	33.74	33.95	33.97	33.97	33.93	33.83
TEMP 8	Dry bulb	24.39	24.40	24.41	24.41	24.43	24.42	24.42	24.43	24.41
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	850.00	1590.00	2320.00	3130.00	3860.00	4590.00	5400.00	5400.00
Flow	kg/s		0.0101	0.0099	0.0097	0.0098	0.0099	0.0096	0.0099	0.0098
Delta s	second		84	75	75	83	74	76	82	549
Delta T	°C		25.10	25.18	25.49	25.35	25.48	25.56	25.76	25.39
Qin	kW		428.57	480.00	480.00	433.73	486.49	473.68	439.02	459.02
Qout	kW		1062.69	1039.48	1038.06	1035.09	1051.68	1027.22	1064.65	1044.90
COP Accum.		Oil cooler	2.48	2.31	2.26	2.29	2.26	2.25	2.27	2.28
COP Instant.		No cooler	2.48	2.17	2.16	2.39	2.16	2.17	2.43	2.20

15°C Wet Bulb

TIME	hour	16	16	16	16	16	16	17	17	Averages
	minute	52	53	55	56	57	58	0	1	&
	second	30	54	10	25	40	55	10	25	Sums
TEMP 1	Water out	57.25	57.42	57.75	57.98	58.04	57.81	57.41	57.34	57.63
TEMP 2	Tank	46.36	48.57	48.60	48.63	46.42	46.27	45.99	45.84	47.09
TEMP 3	Oil cooler out	43.51	44.03	45.10	45.99	45.83	44.67	44.06	43.87	44.63
TEMP 4	Water in	43.51	43.91	45.11	46.03	45.91	44.65	44.11	43.90	44.64
TEMP 5	Condenser in	81.75	81.79	82.10	83.29	83.51	83.34	83.02	83.19	82.75
TEMP 6	Wet bulb	15.03	15.03	15.05	15.05	15.00	14.98	14.99	15.03	15.02
TEMP 7	Oil cooler in	43.48	43.93	45.01	46.09	45.98	44.32	44.01	43.68	44.56
TEMP 8	Dry bulb	24.52	24.52	24.52	24.54	24.54	24.53	24.54	24.54	24.53
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	1560.00	3010.00	4430.00	5950.00	7450.00	8880.00	10280.00	10280.00
Flow	kg/s		0.0186	0.0191	0.0189	0.0203	0.0200	0.0191	0.0187	0.0192
Delta s	second		84	76	75	75	75	75	75	535
Delta T	°C		13.49	12.74	11.89	12.06	13.49	13.40	13.66	13.06
Qin	kW		428.57	473.68	480.00	480.00	480.00	480.00	480.00	471.03
Qout	kW		1048.21	1016.99	941.89	1022.64	1128.84	1068.98	1066.86	1050.16
COP Accum.		Oil cooler	2.45	2.29	2.18	2.16	2.20	2.21	2.21	2.23
COP Instant.		No cooler	2.45	2.15	1.96	2.13	2.35	2.23	2.22	2.22

TIME	hour	17	17	17	17	17	17	17	17	Averages
	minute	12	13	14	16	17	18	19	20	&
	second	15	32	47	2	10	25	40	55	Sums
TEMP 1	Water out	60.66	60.76	60.69	60.50	60.39	60.03	59.88	59.64	60.32
TEMP 2	Tank	57.08	56.70	56.45	55.96	55.72	55.10	55.05	54.20	55.78
TEMP 3	Oil cooler out	53.42	53.52	53.36	53.04	52.83	52.43	52.08	51.83	52.81
TEMP 4	Water in	53.59	53.66	53.43	53.17	52.90	52.53	52.16	52.02	52.93
TEMP 5	Condenser in	87.81	88.31	88.59	88.77	88.88	88.91	88.87	88.87	88.63
TEMP 6	Wet bulb	14.84	14.85	14.87	14.88	14.90	14.90	14.91	14.95	14.89
TEMP 7	Oil cooler in	53.97	53.95	53.61	53.45	53.05	52.77	52.34	52.21	53.17
TEMP 8	Dry bulb	24.41	24.41	24.41	24.44	24.46	24.47	24.48	24.49	24.45
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	2530.00	4970.00	7400.00	9590.00	12000.00	14450.00	16800.00	16800.00
Flow	kg/s		0.0329	0.0325	0.0324	0.0322	0.0321	0.0327	0.0313	0.0323
Delta s	second		77	75	75	68	75	75	75	520
Delta T	°C		6.81	7.08	7.05	7.34	7.26	7.54	7.43	7.15
Qin	kW		467.53	480.00	480.00	529.41	480.00	480.00	480.00	484.62
Qout	kW		936.20	963.73	955.71	989.06	976.08	1030.55	974.06	966.50
COP Accum.		Oil cooler	2.00	2.01	2.00	1.96	1.98	2.01	2.01	1.99
COP Instant.		No cooler	2.00	2.01	1.99	1.87	2.03	2.15	2.03	2.06

20°C Wet Bulb

TIME	hour	10	10	10	10	10	10	10	10	Averages & Sums
	minute	21	22	23	24	26	27	28	29	
	second	0	18	33	47	3	10	25	40	
TEMP 1	Water out	61.17	61.33	61.45	61.74	61.91	61.89	61.99	61.85	61.67
TEMP 2	Tank	14.14	15.05	15.12	15.54	15.62	16.09	16.24	16.65	15.56
TEMP 3	Oil cooler out	20.33	20.20	20.09	20.17	20.32	20.52	20.66	20.80	20.39
TEMP 4	Water in	20.43	20.30	20.14	20.16	20.33	20.51	20.68	20.83	20.42
TEMP 5	Condenser in	77.48	77.47	77.58	77.67	77.85	77.91	77.92	78.01	77.74
TEMP 6	Wet bulb	20.00	19.90	19.90	19.92	20.01	20.03	20.10	20.09	19.99
TEMP 7	Oil cooler in	17.26	17.11	16.91	16.99	17.24	17.41	17.69	17.80	17.30
TEMP 8	Dry bulb	31.87	31.85	31.82	31.85	31.93	31.99	32.11	32.16	31.95
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	520.00	1030.00	1520.00	2000.00	2470.00	2960.00	3430.00	3430.00
Flow	kg/s		0.0067	0.0068	0.0066	0.0063	0.0070	0.0065	0.0063	0.0066
Delta s	second		78	75	74	76	67	75	75	520
Delta T	°C		44.22	44.54	44.75	44.67	44.48	44.30	44.05	44.37
Qin	kW		461.54	480.00	486.49	473.68	537.31	480.00	480.00	484.62
Qout	kW		1233.44	1267.22	1239.79	1180.42	1305.51	1210.96	1154.98	1224.40
COP Accum.		Oil cooler	2.67	2.66	2.62	2.59	2.55	2.55	2.53	2.53
COP Instant.		No cooler	2.67	2.64	2.55	2.49	2.43	2.52	2.41	2.35

TIME	hour	10	10	10	10	10	10	10	11	Averages & Sums
	minute	52	53	54	56	57	58	59	0	
	second	33	47	55	10	17	33	47	55	
TEMP 1	Water out	61.70	61.74	61.90	61.80	61.89	61.83	61.72	61.69	61.78
TEMP 2	Tank	24.20	24.20	24.28	24.30	24.35	24.37	24.43	24.46	24.32
TEMP 3	Oil cooler out	27.46	27.50	27.50	27.53	27.53	27.51	27.50	27.52	27.51
TEMP 4	Water in	27.36	27.40	27.42	27.44	27.44	27.43	27.42	27.43	27.42
TEMP 5	Condenser in	79.54	79.58	79.93	79.97	80.06	80.08	79.97	79.88	79.88
TEMP 6	Wet bulb	19.90	19.89	19.86	19.89	19.92	20.00	20.03	20.03	19.94
TEMP 7	Oil cooler in	25.44	25.47	25.47	25.50	25.50	25.48	25.48	25.50	25.48
TEMP 8	Dry bulb	32.84	32.89	32.90	33.01	33.05	33.17	33.22	33.28	33.05
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	600.00	1170.00	1790.00	2340.00	2960.00	3590.00	4150.00	4150.00
Flow	kg/s		0.0081	0.0084	0.0083	0.0082	0.0082	0.0085	0.0082	0.0083
Delta s	second		74	68	75	67	76	74	68	502
Delta T	°C		36.27	36.43	36.30	36.39	36.35	36.24	36.19	36.30
Qin	kW		486.49	529.41	480.00	537.31	473.68	486.49	529.41	501.99
Qout	kW		1230.44	1277.66	1255.53	1249.86	1240.72	1290.89	1246.98	1255.70
COP Accum.		Oil cooler	2.53	2.47	2.52	2.47	2.49	2.52	2.50	2.50
COP Instant.		No cooler	2.53	2.41	2.62	2.33	2.62	2.65	2.36	2.37

TIME	hour	11	11	11	11	11	11	11	11	Averages & Sums
	minute	9	10	11	12	13	15	16	17	
	second	0	9	24	40	47	2	16	24	
TEMP 1	Water out	59.91	59.57	59.81	59.95	59.89	60.02	60.10	60.02	59.91
TEMP 2	Tank	35.58	35.51	35.45	35.35	35.31	35.21	35.17	35.08	35.33
TEMP 3	Oil cooler out	34.12	34.80	35.01	35.09	35.10	35.04	34.95	34.95	34.88
TEMP 4	Water in	33.90	34.52	34.82	34.95	34.95	34.90	34.81	34.85	34.71
TEMP 5	Condenser in	79.95	80.04	80.57	80.83	80.85	81.05	81.06	81.07	80.68
TEMP 6	Wet bulb	20.01	19.94	19.87	19.84	19.83	19.94	19.82	19.86	19.89
TEMP 7	Oil cooler in	33.53	33.87	34.19	34.23	34.21	34.16	34.03	34.02	34.03
TEMP 8	Dry bulb	33.65	33.67	33.73	33.74	33.78	33.81	34.02	34.10	33.81
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	790.00	1620.00	2500.00	3290.00	4150.00	5010.00	5800.00	5800.00
Flow	kg/s		0.0114	0.0111	0.0116	0.0118	0.0115	0.0116	0.0116	0.0115
Delta s	second		69	75	76	67	75	74	68	504
Delta T	°C		25.70	25.62	25.72	25.68	25.86	26.07	26.00	25.88
Qin	kW		521.74	480.00	473.68	537.31	480.00	486.49	529.41	500.00
Qout	kW		1231.13	1186.28	1246.04	1266.89	1240.67	1267.65	1263.81	1246.04
COP Accum.		Oil cooler	2.36	2.41	2.48	2.45	2.48	2.50	2.48	2.49
COP Instant.		No cooler	2.36	2.47	2.63	2.36	2.58	2.61	2.39	2.43

20°C Wet Bulb

TIME	hour	11	11	11	11	11	11	11	11	Averages
	minute	25	26	27	28	29	31	32	33	&
	second	0	20	34	41	56	11	19	34	Sums
TEMP 1	Water out	57.81	58.40	58.53	58.69	58.77	58.89	59.01	58.96	58.63
TEMP 2	Tank	45.30	45.52	45.38	45.16	45.05	44.98	44.85	44.65	45.11
TEMP 3	Oil cooler out	43.19	43.67	43.75	43.69	43.59	43.46	43.34	43.17	43.48
TEMP 4	Water in	43.15	43.57	43.65	43.59	43.49	43.39	43.27	43.09	43.40
TEMP 5	Condenser in	82.26	82.76	83.29	83.51	83.81	83.95	84.06	84.15	83.47
TEMP 6	Wet bulb	20.33	20.39	20.46	20.47	20.46	20.42	20.40	20.41	20.42
TEMP 7	Oil cooler in	43.36	43.59	43.63	43.57	43.40	43.23	43.07	42.87	43.34
TEMP 8	Dry bulb	35.18	35.20	35.23	35.23	35.26	35.22	35.15	35.05	35.19
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	1540.00	3020.00	4340.00	5810.00	7250.00	8530.00	9940.00	9940.00
Flow	kg/s		0.0193	0.0200	0.0197	0.0196	0.0192	0.0188	0.0188	0.0193
Delta s	second		80	74	67	75	75	68	75	514
Delta T	°C		14.81	14.90	15.12	15.37	15.66	15.94	16.09	15.29
Qin	kW		450.00	486.49	537.31	480.00	480.00	529.41	480.00	490.27
Qout	kW		1192.83	1246.83	1246.36	1260.44	1258.01	1255.40	1265.63	1237.35
COP Accum.	Oil cooler		2.65	2.61	2.50	2.53	2.55	2.52	2.53	2.52
COP Instant.	No cooler		2.65	2.56	2.32	2.63	2.62	2.37	2.64	2.51

TIME	hour	11	11	11	11	11	11	11	11	Averages
	minute	41	43	44	45	46	47	48	49	&
	second	50	6	14	21	29	36	45	59	Sums
TEMP 1	Water out	62.79	62.06	61.92	61.77	61.84	61.77	61.80	61.95	61.99
TEMP 2	Tank	55.14	54.18	54.43	54.68	54.30	54.13	54.13	53.50	54.31
TEMP 3	Oil cooler out	53.86	53.40	53.22	53.05	53.05	52.75	52.91	52.61	53.11
TEMP 4	Water in	53.82	53.45	53.24	53.04	53.03	52.82	52.94	52.61	53.12
TEMP 5	Condenser in	89.54	89.70	89.89	90.08	90.28	90.61	90.74	90.81	90.21
TEMP 6	Wet bulb	20.43	20.38	20.36	20.33	20.35	20.32	20.32	20.32	20.35
TEMP 7	Oil cooler in	53.98	53.79	53.60	53.40	53.32	53.09	53.06	52.73	53.37
TEMP 8	Dry bulb	34.53	34.45	34.30	34.16	34.08	34.02	33.97	33.92	34.18
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	2140.00	4400.00	6680.00	8800.00	10900.00	13000.00	15240.00	15240.00
Flow	kg/s		0.0282	0.0332	0.0340	0.0312	0.0313	0.0304	0.0303	0.0312
Delta s	second		76	68	67	68	67	69	74	489
Delta T	°C		8.27	8.32	8.37	8.52	8.68	8.74	9.22	8.62
Qin	kW		473.68	529.41	537.31	529.41	537.31	521.74	486.49	515.34
Qout	kW		974.31	1156.95	1191.73	1111.37	1138.30	1112.94	1167.72	1123.53
COP Accum.	Oil cooler		2.06	2.12	2.16	2.14	2.14	2.14	2.17	2.18
COP Instant.	No cooler		2.06	2.19	2.22	2.10	2.12	2.13	2.40	2.24

23°C Wet Bulb

TIME	hour	12	12	12	12	12	12	12	12	Averages
	minute	27	28	29	31	32	33	34	36	&
	second	20	37	52	7	19	30	45	0	Sums
TEMP 1	Water out	60.63	61.38	61.34	61.53	61.47	61.42	61.37	61.82	61.37
TEMP 2	Tank	15.55	15.76	16.04	16.31	17.30	21.00	21.00	21.00	18.00
TEMP 3	Oil cooler out	22.60	21.93	21.55	21.44	21.43	21.41	21.46	21.47	21.66
TEMP 4	Water in	22.51	22.03	21.62	21.48	21.43	21.39	21.43	21.46	21.67
TEMP 5	Condenser in	79.43	79.36	79.23	79.14	79.00	78.86	78.77	78.72	79.06
TEMP 6	Wet bulb	23.11	23.09	23.03	22.95	22.97	23.00	23.03	23.08	23.03
TEMP 7	Oil cooler in	19.35	18.69	18.40	18.35	18.38	18.40	18.42	18.43	18.55
TEMP 8	Dry bulb	32.85	32.86	32.85	32.80	32.80	32.80	32.83	32.84	32.83
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	570.00	1120.00	1660.00	2190.00	2700.00	3260.00	3790.00	3790.00
Flow	kg/s		0.0074	0.0073	0.0072	0.0074	0.0072	0.0075	0.0071	0.0073
Delta s	second		77	75	75	72	71	75	75	520
Delta T	°C		42.69	42.94	43.18	43.09	43.02	42.95	43.39	42.82
Qin	kW		467.53	480.00	480.00	500.00	507.04	480.00	480.00	484.62
Qout	kW		1322.21	1317.51	1300.79	1327.12	1292.93	1341.78	1282.91	1305.72
COP Accum.		Oil cooler	2.83	2.79	2.76	2.73	2.69	2.71	2.71	2.69
COP Instant.		No cooler	2.83	2.74	2.71	2.65	2.55	2.80	2.67	2.50

TIME	hour	12	12	12	12	12	12	12	12	Averages
	minute	51	52	53	54	55	57	58	59	&
	second	0	17	32	47	54	9	25	32	Sums
TEMP 1	Water out	60.67	60.59	60.71	61.08	61.16	61.10	61.14	61.24	60.96
TEMP 2	Tank	24.82	25.00	25.09	25.11	25.20	25.24	25.31	25.35	25.14
TEMP 3	Oil cooler out	27.46	27.46	27.49	27.52	27.55	27.58	27.62	27.65	27.54
TEMP 4	Water in	27.43	27.42	27.46	27.51	27.52	27.55	27.58	27.62	27.51
TEMP 5	Condenser in	79.49	79.32	79.33	79.54	79.60	79.63	79.68	79.74	79.54
TEMP 6	Wet bulb	23.39	22.98	22.93	22.93	22.92	22.87	22.85	22.92	22.97
TEMP 7	Oil cooler in	25.51	25.49	25.51	25.53	25.57	25.61	25.66	25.69	25.57
TEMP 8	Dry bulb	33.04	32.84	32.70	32.64	62.50	32.44	32.51	32.65	36.42
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	700.00	1360.00	2000.00	2580.00	3240.00	3880.00	4470.00	4470.00
Flow	kg/s		0.0091	0.0088	0.0085	0.0087	0.0088	0.0084	0.0088	0.0087
Delta s	second		77	75	75	67	75	76	67	512
Delta T	°C		35.10	35.20	35.55	35.59	35.49	35.48	35.55	35.39
Qin	kW		467.53	480.00	480.00	537.31	480.00	473.68	537.31	492.19
Qout	kW		1335.08	1296.04	1269.26	1289.06	1306.71	1250.09	1309.81	1292.74
COP Accum.		Oil cooler	2.86	2.78	2.73	2.64	2.66	2.65	2.62	2.63
COP Instant.		No cooler	2.86	2.70	2.64	2.40	2.72	2.64	2.44	2.48

TIME	hour	13	13	13	13	13	13	13	13	Averages
	minute	7	8	9	10	11	13	14	15	&
	second	0	17	32	47	55	10	17	32	Sums
TEMP 1	Water out	59.92	59.49	59.66	59.73	60.00	60.18	60.24	60.31	59.94
TEMP 2	Tank	35.74	35.58	35.53	35.48	35.27	35.32	35.12	35.16	35.40
TEMP 3	Oil cooler out	35.52	35.17	35.30	35.32	35.33	35.33	35.31	35.27	35.32
TEMP 4	Water in	34.71	35.09	35.21	35.23	35.23	35.26	35.22	35.19	35.14
TEMP 5	Condenser in	80.10	80.24	80.54	80.85	80.97	81.20	81.32	81.41	80.83
TEMP 6	Wet bulb	23.24	23.23	23.23	23.27	23.27	23.23	23.20	23.19	23.23
TEMP 7	Oil cooler in	34.15	34.45	34.48	34.47	34.44	34.41	34.40	34.32	34.39
TEMP 8	Dry bulb	33.53	33.57	33.60	33.62	33.63	33.58	33.53	33.38	33.56
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	900.00	1800.00	2700.00	3500.00	4390.00	5180.00	6060.00	6060.00
Flow	kg/s		0.0117	0.0120	0.0120	0.0118	0.0119	0.0118	0.0117	0.0118
Delta s	second		77	75	75	68	75	67	75	512
Delta T	°C		25.04	25.18	25.26	25.56	25.77	25.84	25.99	25.55
Qin	kW		467.53	480.00	480.00	529.41	480.00	537.31	480.00	492.19
Qout	kW		1224.55	1264.24	1268.25	1258.15	1279.48	1274.78	1275.91	1265.34
COP Accum.		Oil cooler	2.62	2.63	2.63	2.56	2.58	2.54	2.56	2.57
COP Instant.		No cooler	2.62	2.63	2.64	2.38	2.67	2.37	2.66	2.50

23°C Wet Bulb

TIME	hour	13	13	13	13	13	13	13	13	**Averages**
	minute	22	23	24	25	26	28	29	30	**&**
	second	0	17	32	40	54	10	18	32	**Sums**
TEMP 1	Water out	58.90	58.66	58.56	58.60	58.69	58.67	58.75	58.79	58.70
TEMP 2	Tank	46.40	46.20	46.09	45.64	45.77	45.57	45.36	45.20	45.78
TEMP 3	Oil cooler out	42.34	43.84	44.25	44.27	44.23	44.12	44.01	43.88	43.87
TEMP 4	Water in	42.25	43.82	44.23	44.27	44.20	44.09	44.00	43.83	43.84
TEMP 5	Condenser in	82.34	82.80	83.16	83.45	83.76	83.94	84.04	84.21	83.46
TEMP 6	Wet bulb	23.28	23.32	23.31	23.31	23.30	23.24	23.24	23.27	23.28
TEMP 7	Oil cooler in	42.89	44.12	44.29	44.27	44.12	44.02	43.89	43.70	43.91
TEMP 8	Dry bulb	33.22	33.25	33.29	33.29	33.24	33.18	33.14	33.12	33.22
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	1430.00	2940.00	4300.00	5830.00	7350.00	8700.00	10170.00	10170.00
Flow	kg/s		0.0186	0.0201	0.0200	0.0207	0.0200	0.0199	0.0199	0.0199
Delta s	second		77	75	68	74	76	68	74	512
Delta T	°C		14.54	14.27	14.33	14.57	14.65	14.86	15.09	14.79
Qin	kW		467.53	480.00	529.41	486.49	473.68	529.41	486.49	492.19
Qout	kW		1129.80	1202.07	1199.13	1260.41	1225.91	1234.34	1254.20	1229.17
COP Accum.		Oil cooler	2.42	2.46	2.39	2.44	2.47	2.44	2.46	2.50
COP Instant.		No cooler	2.42	2.50	2.27	2.59	2.59	2.33	2.58	2.51

TIME	hour	13	13	13	13	13	13	13	13	**Averages**
	minute	39	40	41	42	43	44	46	47	**&**
	second	0	17	25	32	40	48	2	10	**Sums**
TEMP 1	Water out	61.16	61.85	61.94	62.04	61.95	61.87	61.72	61.55	61.76
TEMP 2	Tank	56.21	55.35	55.42	55.48	54.73	54.77	54.40	53.98	55.04
TEMP 3	Oil cooler out	52.54	53.32	53.27	53.23	53.04	52.85	52.56	52.23	52.88
TEMP 4	Water in	52.67	53.35	53.30	53.26	53.06	52.85	52.53	52.26	52.91
TEMP 5	Condenser in	88.84	89.46	89.81	90.16	90.38	90.51	90.61	90.57	90.04
TEMP 6	Wet bulb	23.22	23.15	23.04	22.94	22.94	22.93	23.00	23.07	23.04
TEMP 7	Oil cooler in	53.42	53.75	53.64	53.53	53.38	53.07	52.72	52.36	53.23
TEMP 8	Dry bulb	33.16	33.14	33.10	33.07	33.06	33.13	33.27	33.41	33.17
kWh		0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.070
WATER	gm water	0.00	2440.00	4540.00	6660.00	8760.00	1092.00	13180.00	15260.00	15260.00
Flow	kg/s		0.0317	0.0309	0.0316	0.0309	-0.1128	0.1634	0.0306	0.0311
Delta s	second		77	68	67	68	68	74	68	490
Delta T	°C		8.10	8.30	8.51	8.57	8.80	9.00	9.19	8.53
Qin	kW		467.53	529.41	537.31	529.41	529.41	486.49	529.41	514.29
Qout	kW		1073.93	1072.46	1126.63	1107.34	-4151.91	6151.16	1176.15	1110.98
COP Accum.		Oil cooler	2.30	2.15	2.13	2.12	0.09	2.07	2.09	2.16
COP Instant.		No cooler	2.30	2.03	2.10	2.09	-7.84	12.64	2.22	2.24

C. NER data

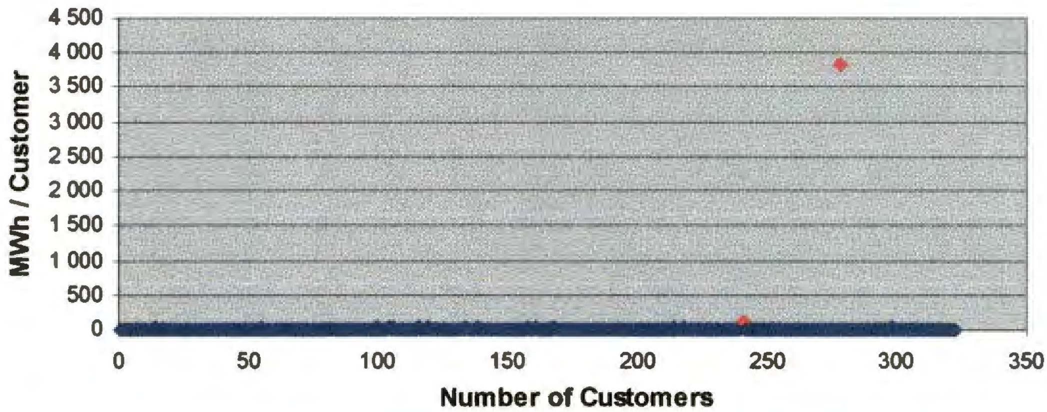


Figure C.1: Consumption Original Data

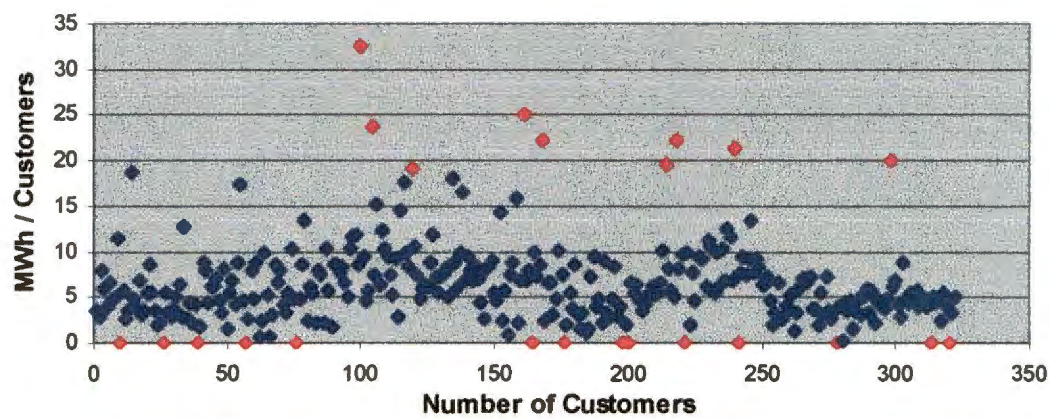


Figure C.2: Consumption First data change

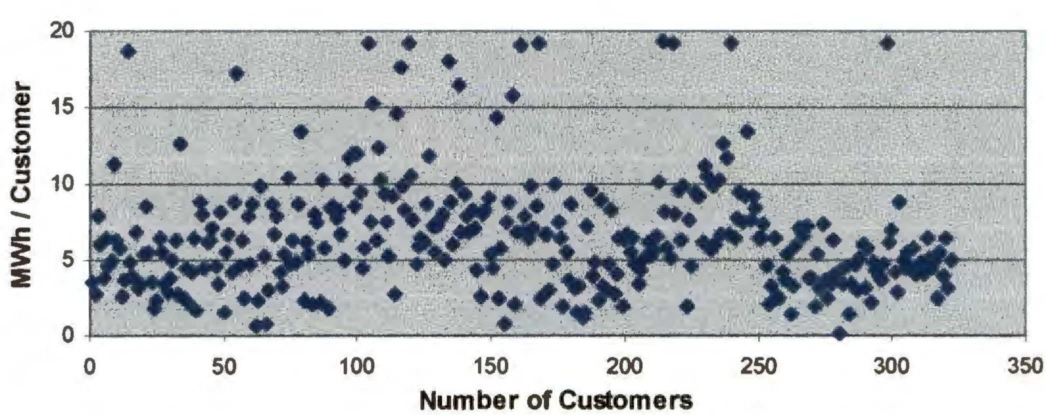


Figure C.3: Consumption Final data

D. Photos

Photo 1: Environmental Chamber (cube) with Air Controller (front).

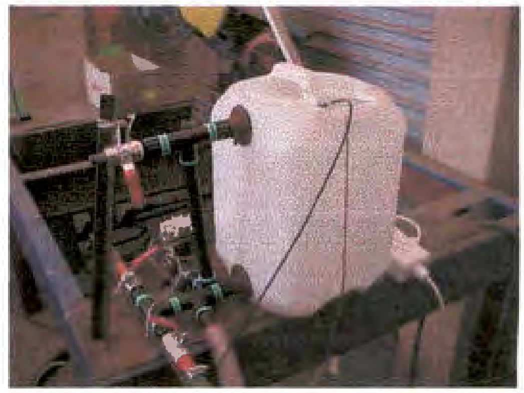


Photo 4: Inlet water pre-mixing tank.

Photo 2: Air Controller: heating elements (far), cooling coil (front) and humidifier.

Photo 5: Evaporator with fan mounted to the environmental chamber side.

Photo 3: Compressor and Condenser (top) mounted on top of environmental chamber.

Photo 6: Measuring bucket (blue) on electronic scale. Feed pump and water tank.

Photo 7: Environmental chamber controls: fan speed, heaters & humidifier.

Photo 9: Dry and Wet bulb (wet wick) sensors in environmental chamber.

Phote 8: Prema Precision Thermometer.

Photo 10: Microvip Energy Analyser.

E. Simulation Data

Region 1 HP, 2 HP, 3 HP and 4 HP on uneven numbered pages E.1 to E.9

Region 5 HP, 1 ELE and 2 ELE and comparison on even numbered pages E.2 to E.10.

HP = heat pump
ELE = electric elements

	Johannesburg		Region 1		Durban		Region 2		CapeTown		Region 3		Bloemfontein		Region 4	
Day	Consump	T Min	Energy	Peak	Consump	T Min	Energy	Peak	Consump	T Min	Energy	Peak	Consump	T Min	Energy	Peak
	57824.1	48.2	2034.7	1.041	56712.2	59.4	1233.0	1.008	57244.3	58.9	1392.8	1.025	57663.0	53.9	1722.4	1.035
1	114.9	60.0	3.2	0.344	114.5	60.4	2.2	0.363	114.6	60.4	2.4	0.332	114.2	59.9	2.3	0.379
2	113.9	59.9	3.1	0.294	115.1	60.5	2.4	0.400	114.7	60.3	2.4	0.325	115.2	59.9	2.9	0.370
3	115.0	60.1	3.2	0.346	114.4	60.3	2.3	0.359	114.5	60.2	2.3	0.367	113.4	59.3	2.5	0.417
4	113.7	60.0	3.2	0.308	113.4	60.4	2.3	0.363	115.3	60.3	2.4	0.369	114.4	60.3	2.5	0.438
5	115.7	59.9	3.2	0.284	113.9	60.6	2.2	0.329	114.1	60.2	2.6	0.377	113.5	60.3	2.4	0.357
6	114.4	60.0	3.1	0.365	112.6	60.7	2.2	0.324	115.1	60.1	2.5	0.346	115.1	60.0	2.7	0.392
7	114.7	60.0	3.4	0.418	111.0	60.5	2.3	0.383	113.6	60.1	2.4	0.359	116.7	59.5	3.5	0.551
8	114.9	59.9	3.2	0.403	111.7	60.5	2.2	0.287	113.7	60.5	2.6	0.407	117.1	59.2	2.8	0.483
9	114.5	60.1	3.2	0.359	116.0	60.6	2.3	0.349	116.2	60.0	2.5	0.398	115.6	59.5	2.9	0.440
10	114.6	60.1	3.0	0.332	113.4	60.4	2.4	0.309	115.2	60.3	2.5	0.398	115.6	59.4	2.7	0.409
11	116.0	60.2	3.0	0.336	114.9	60.3	2.2	0.371	117.0	60.1	2.5	0.353	115.0	60.1	2.6	0.369
12	116.6	60.0	3.4	0.340	115.0	60.6	2.4	0.449	115.9	60.2	2.6	0.442	114.4	60.0	2.4	0.339
13	118.1	59.7	3.2	0.310	114.5	60.4	2.3	0.283	117.1	60.0	2.6	0.372	114.5	60.4	2.6	0.405
14	115.7	60.0	3.2	0.329	114.7	60.4	2.3	0.362	113.6	59.8	2.6	0.299	115.0	60.0	2.5	0.295
15	115.1	60.0	3.3	0.343	115.3	60.4	2.4	0.379	118.4	60.0	2.6	0.330	115.2	60.0	2.5	0.285
16	115.6	60.0	3.2	0.335	115.6	60.5	2.2	0.290	117.5	60.0	2.5	0.291	116.3	60.0	2.6	0.354
17	116.2	60.0	3.3	0.367	117.2	60.7	2.3	0.319	116.3	60.2	2.5	0.371	116.3	60.1	2.4	0.324
18	115.3	60.0	3.2	0.386	117.6	60.5	2.3	0.408	116.1	60.3	2.5	0.326	115.7	60.1	2.6	0.368
19	116.8	60.0	3.2	0.369	114.8	60.5	2.3	0.345	114.3	60.0	2.6	0.382	114.3	60.2	2.4	0.292
20	118.2	60.1	3.0	0.375	114.8	60.5	2.3	0.363	116.9	60.2	2.5	0.284	116.1	60.2	2.4	0.398
21	117.8	60.0	3.3	0.359	114.8	60.4	2.5	0.380	117.1	60.2	2.5	0.295	116.6	60.0	2.7	0.307
22	116.7	60.2	3.1	0.351	118.8	60.5	2.3	0.355	115.8	60.3	2.4	0.440	119.9	59.8	2.8	0.311
23	116.8	60.2	3.1	0.345	114.5	60.6	2.3	0.310	117.0	60.3	2.5	0.373	117.2	59.9	2.7	0.375
24	116.9	60.0	3.1	0.330	116.2	60.7	2.3	0.351	119.2	60.2	2.5	0.317	118.5	59.7	2.8	0.331
25	120.0	60.1	3.2	0.313	117.1	60.6	2.4	0.335	118.2	60.3	2.5	0.334	119.2	59.8	2.6	0.351
26	117.0	60.0	3.3	0.307	118.6	60.4	2.3	0.354	119.9	59.9	2.9	0.423	117.4	60.1	2.5	0.294
27	119.1	60.0	3.4	0.307	117.5	60.5	2.5	0.420	119.3	59.6	2.9	0.408	119.2	60.3	2.6	0.348
28	119.4	60.0	3.5	0.426	119.1	60.4	2.4	0.309	119.2	60.0	2.5	0.394	119.4	60.2	2.7	0.390
29	120.9	60.0	3.3	0.407	118.2	60.6	2.3	0.391	120.2	60.1	2.6	0.361	119.5	60.2	2.4	0.349
30	122.0	59.9	3.4	0.358	117.9	60.4	2.4	0.376	117.4	60.3	2.4	0.401	120.4	60.3	2.5	0.410
31	120.3	60.0	3.2	0.333	119.4	60.5	2.3	0.374	118.6	60.5	2.5	0.494	120.3	60.0	2.6	0.329
32	122.2	59.7	3.8	0.432	121.0	60.6	2.5	0.377	121.1	60.3	2.7	0.420	121.8	59.9	3.0	0.430
33	122.3	59.6	3.7	0.463	120.8	60.4	2.4	0.309	119.9	60.4	2.5	0.372	121.4	59.8	2.8	0.347
34	122.0	59.9	3.6	0.499	119.2	60.6	2.4	0.338	122.1	60.0	2.6	0.437	122.3	60.0	2.7	0.307
35	122.5	59.8	3.5	0.347	119.6	60.5	2.5	0.296	122.5	59.9	3.0	0.480	120.0	60.1	2.6	0.300
36	123.3	59.8	3.6	0.443	120.1	60.5	2.4	0.241	122.1	59.8	2.8	0.509	121.9	60.0	2.7	0.308
37	124.0	60.0	3.3	0.432	121.3	60.6	2.4	0.311	123.6	60.0	2.8	0.420	121.6	60.0	2.7	0.355
38	123.8	59.8	3.7	0.474	120.8	60.8	2.4	0.354	122.0	60.0	2.5	0.397	122.7	60.0	2.7	0.373
39	123.0	60.0	3.4	0.417	121.7	60.6	2.3	0.348	125.5	60.2	2.6	0.479	124.0	60.0	2.9	0.382
40	124.0	60.0	3.5	0.342	120.4	60.6	2.5	0.329	124.0	60.3	2.6	0.357	124.5	60.0	2.6	0.331
41	122.6	60.0	3.5	0.310	121.4	60.5	2.4	0.364	125.4	60.0	2.6	0.392	124.1	60.2	2.7	0.363
42	125.9	60.0	3.3	0.382	125.0	60.4	2.6	0.388	124.5	60.4	2.7	0.437	126.3	60.0	2.7	0.462
43	125.9	60.0	3.5	0.429	124.2	60.4	2.5	0.418	124.0	60.0	2.7	0.451	125.1	60.0	2.9	0.359
44	126.5	60.0	3.5	0.389	123.8	60.5	2.5	0.393	124.6	60.0	2.8	0.370	123.4	59.8	2.7	0.323
45	125.2	60.0	3.4	0.355	123.5	60.8	2.5	0.340	124.8	60.0	2.7	0.337	125.0	60.3	2.7	0.336
46	127.7	60.2	3.4	0.399	123.8	60.7	2.5	0.316	126.7	60.0	2.7	0.387	126.6	60.3	2.6	0.367
47	127.6	60.4	3.3	0.412	124.0	60.6	2.5	0.302	127.4	60.0	2.7	0.362	125.5	60.5	2.7	0.401
48	128.5	60.0	3.8	0.472	124.5	60.7	2.5	0.283	127.0	60.0	2.8	0.405	125.8	60.6	2.6	0.362
49	129.0	59.8	3.5	0.388	125.7	60.6	2.7	0.372	128.3	60.0	2.7	0.426	127.8	60.3	2.8	0.462
50	128.3	60.0	3.5	0.419	128.4	60.3	2.8	0.423	126.5	60.3	2.8	0.489	129.3	60.0	2.6	0.435
51	130.5	60.0	3.8	0.376	127.3	60.4	2.7	0.462	127.9	60.0	2.7	0.467	128.4	60.0	3.1	0.441
52	130.4	59.7	4.0	0.501	127.8	60.6	2.7	0.436	130.6	60.4	2.7	0.466	131.7	60.0	3.1	0.446
53	130.1	60.0	3.5	0.400	129.4	60.6	2.6	0.403	128.4	60.3	2.7	0.413	128.7	60.0	2.8	0.345
54	131.2	60.0	3.5	0.436	127.0	60.6	2.5	0.323	130.4	60.5	2.8	0.470	129.2	60.0	2.9	0.372
55	131.8	60.0	3.6	0.409	131.5	60.6	2.6	0.300	129.9	60.3	2.7	0.344	129.5	60.0	2.8	0.425
56	130.3	60.0	3.8	0.437	127.8	60.5	2.7	0.325	130.5	60.0	2.8	0.407	131.6	60.0	2.9	0.420
57	135.7	60.0	3.8	0.415	129.9	60.7	2.6	0.293	130.9	60.0	2.8	0.394	133.5	60.0	2.9	0.393
58	133.1	59.9	3.7	0.336	129.9	60.6	2.7	0.357	131.3	60.0	2.8	0.345	133.2	60.0	3.0	0.406
59	134.8	60.0	3.6	0.392	133.1	60.8	2.5	0.353	131.5	60.0	2.9	0.380	134.4	60.0	2.9	0.402
60	134.3	60.0	3.7	0.384	131.8	60.6	2.7	0.320	137.9	60.0	3.0	0.441	134.1	60.0	3.0	0.415
61	135.4	60.0	3.7	0.394	132.5	60.7	2.7	0.322	135.2	59.8	3.4	0.486	138.0	60.0	3.0	0.452
62	134.1	60.0	3.7	0.375	134.6	60.8	2.6	0.315	134.2	60.0	3.0	0.406	135.4	60.0	3.0	0.439
63	138.7	60.0	3.7	0.380	135.2	60.0	2.8	0.313	136.7	60.3	2.7	0.375	135.1	60.0	3.0	0.406
64	139.1	60.0	3.7	0.384	133.9	60.0	3.0	0.361	131.6	60.0	2.9	0.383	135.8	60.0	3.0	0.381
65	137.3	60.0	3.7	0.410	137.2	60.0	2.9	0.359	139.1	60.3	2.9	0.348	139.5	60.0	3.0	0.358
66	138.9	60.0	3.8	0.454	134.7	60.6	2.7	0.307	137.0	60.0	2.9	0.324	137.1	60.0	3.1	0.402
67	139.5	60.0	3.7	0.489	138.5	60.8	2.8	0.319	139.5	60.0	3.0	0.396	135.3	60.0	3.2	0.398
68	140.9	60.0	4.0	0.508	137.3	60.5	2.8	0.281	138.2	60.0	2.9	0.419	133.0	60.0	3.2	0.411
69	141.7	60.0	3.9	0.469	140.2	60.5	2.9	0.322	140.4	60.0	2.9	0.386	136.9	59.9	3.3	0.423
70	143.1	60.0	3.8	0.410	138.1	60.4	2.8	0.296	138.8	60.0	3.0	0.427	140.6	59.8	3.4	0.439
71	142.4	60.0	3.9	0.396	138.5	60.8	2.8	0.340	138.7	60.0	3.0	0.325	142.2	59.5	3.7	0.515
72	146.1	59.9	4.3	0.424	141.2	60.7	2.8	0.309	137.6	60.0	2.9	0.328	143.5	59.9	3.3	0.498

Pietersburg		Region 5		ELEMENTS Jhb		Region 1		ELEMENTS Dbn		Region 2		Delta		
Consump	T Min	Energy	Peak	Consump	T Min	Energy	Peak	Consump	T Min	Energy	Peak	Consump		Day
57390.2	51.7	1800.5	1.020	76075.3	49.1	2711.8	1.350	76036.4	49.0	2713.4	1.230	HP/ELE		
115.2	60.2	3.3	0.365	155.9	49.7	5.6	0.720	155.4	49.8	5.6	0.540	41.0	36%	1
112.8	60.0	3.0	0.337	153.0	49.7	5.5	0.630	152.6	49.8	5.5	0.690	39.1	34%	2
115.1	60.2	3.0	0.324	154.2	49.8	5.5	0.660	151.6	49.7	5.6	0.720	39.2	34%	3
113.4	60.2	3.1	0.404	154.5	49.7	5.5	0.570	156.6	49.7	5.5	0.660	40.8	36%	4
115.8	60.1	3.1	0.290	157.3	49.7	5.5	0.660	154.4	49.8	5.5	0.720	41.6	36%	5
115.3	60.3	2.9	0.399	156.6	49.7	5.5	0.810	152.9	49.7	5.5	0.660	42.2	37%	6
113.3	60.4	2.9	0.306	153.7	49.7	5.6	0.630	155.8	49.8	5.6	0.660	39.0	34%	7
115.7	60.3	2.9	0.306	158.0	49.7	5.5	0.630	156.4	49.7	5.5	0.570	43.1	38%	8
114.3	60.4	3.0	0.379	156.5	49.7	5.5	0.540	158.5	49.7	5.5	0.630	42.0	37%	9
116.1	60.3	3.2	0.325	155.8	49.7	5.5	0.630	156.8	49.8	5.5	0.600	41.2	36%	10
116.7	60.0	3.2	0.326	157.8	49.8	5.6	0.600	155.8	49.8	5.6	0.690	41.8	36%	11
116.7	60.0	3.1	0.302	156.2	49.7	5.6	0.630	155.1	49.7	5.6	0.630	39.6	34%	12
115.2	60.0	3.1	0.328	155.3	49.8	5.5	0.690	157.0	49.8	5.6	0.570	37.2	31%	13
115.4	60.3	3.0	0.333	153.9	49.8	5.6	0.600	155.6	49.7	5.5	0.660	38.2	33%	14
115.4	60.3	3.0	0.321	155.6	49.7	5.6	0.540	156.3	49.8	5.6	0.660	40.5	35%	15
115.2	60.3	2.9	0.323	157.9	49.8	5.6	0.600	158.8	49.8	5.6	0.600	42.3	37%	16
116.2	60.2	3.1	0.330	156.5	49.8	5.6	0.630	159.3	49.8	5.6	0.570	40.3	35%	17
117.8	60.6	2.9	0.463	157.7	49.7	5.6	0.660	155.2	49.7	5.6	0.660	42.4	37%	18
116.2	60.3	3.1	0.388	157.0	49.8	5.5	0.600	156.1	49.7	5.6	0.570	40.2	34%	19
113.7	60.2	3.0	0.305	156.5	49.7	5.6	0.660	155.7	49.7	5.6	0.630	38.3	32%	20
117.0	60.5	2.9	0.328	156.6	49.7	5.7	0.600	157.6	49.7	5.6	0.720	38.8	33%	21
118.0	60.3	3.0	0.394	158.6	49.8	5.6	0.660	155.3	49.8	5.7	0.630	41.9	36%	22
116.5	60.3	3.0	0.442	160.2	49.7	5.7	0.630	160.1	49.9	5.7	0.630	43.4	37%	23
120.4	60.2	3.3	0.435	155.7	49.8	5.7	0.780	161.9	49.7	5.7	0.660	38.8	33%	24
119.2	60.1	3.0	0.418	158.5	49.7	5.7	0.540	158.7	49.7	5.7	0.720	38.5	32%	25
118.6	60.5	3.1	0.489	160.1	49.7	5.7	0.630	162.7	49.7	5.7	0.660	43.1	37%	26
117.3	60.3	3.2	0.391	161.2	49.8	5.7	0.780	160.6	49.8	5.7	0.720	42.1	35%	27
120.5	60.2	3.2	0.338	161.3	49.7	5.7	0.630	162.9	49.7	5.7	0.780	41.9	35%	28
119.0	60.4	3.1	0.459	160.9	49.7	5.8	0.600	162.4	49.7	5.7	0.870	40.0	33%	29
121.6	60.0	3.2	0.441	162.5	49.7	5.8	0.600	163.2	49.8	5.7	0.630	40.5	33%	30
119.8	60.1	3.3	0.361	160.7	49.7	5.8	0.780	163.8	49.8	5.8	0.540	40.4	34%	31
119.9	60.1	3.0	0.346	160.4	49.8	5.7	0.660	160.9	49.7	5.8	0.780	38.2	31%	32
119.3	60.4	3.0	0.425	159.2	49.7	5.8	0.570	163.8	49.7	5.8	0.720	36.9	30%	33
121.3	60.5	3.1	0.401	166.9	49.7	5.8	0.690	163.2	49.7	5.8	0.630	44.9	37%	34
120.2	60.3	3.2	0.352	163.4	49.8	5.8	0.810	164.0	49.7	5.9	0.660	40.9	33%	35
121.7	60.4	3.1	0.393	165.6	49.7	5.9	0.600	162.7	49.8	5.8	0.660	42.3	34%	36
121.5	60.3	3.1	0.423	163.9	49.7	6.0	0.690	164.9	49.7	5.9	0.630	39.9	32%	37
121.0	60.0	3.3	0.448	168.1	49.8	5.9	0.660	164.7	49.7	6.0	0.630	44.3	36%	38
122.9	60.0	3.4	0.311	165.0	49.8	5.9	0.750	163.9	49.6	5.9	0.750	42.0	34%	39
122.5	60.0	3.4	0.351	163.8	49.8	6.0	0.660	169.7	49.7	6.0	0.810	39.8	32%	40
122.9	60.0	3.4	0.358	167.5	49.7	6.0	0.630	165.2	49.7	6.0	0.870	44.9	37%	41
125.0	60.0	3.6	0.318	171.0	49.6	6.0	0.570	169.7	49.7	6.0	1.050	45.1	36%	42
126.7	59.9	3.5	0.337	171.5	49.7	6.0	0.600	170.3	49.7	5.9	0.720	45.6	36%	43
126.5	60.0	3.5	0.387	169.7	49.7	6.0	0.630	171.4	49.7	6.1	0.660	43.2	34%	44
125.8	60.0	3.5	0.386	169.4	49.7	6.0	0.690	171.7	49.7	6.1	0.570	44.2	35%	45
127.1	60.0	3.3	0.326	170.2	49.6	6.1	0.600	168.2	49.5	6.1	0.660	42.5	33%	46
125.6	60.3	3.3	0.369	170.2	49.7	6.1	0.750	170.2	49.7	6.2	0.780	42.6	33%	47
127.5	60.0	3.4	0.412	173.1	49.7	6.1	0.600	173.6	49.7	6.1	0.810	44.6	35%	48
126.2	60.6	3.4	0.352	172.4	49.7	6.2	0.660	172.1	49.6	6.1	0.690	43.4	34%	49
129.2	60.0	3.3	0.433	175.1	49.6	6.2	0.780	175.6	49.7	6.3	0.600	46.8	36%	50
129.1	60.0	3.3	0.386	172.7	49.6	6.2	0.750	175.5	49.7	6.2	0.570	42.2	32%	51
130.5	60.0	3.4	0.352	175.6	49.7	6.3	0.660	175.8	49.6	6.3	0.690	45.2	35%	52
127.7	60.3	3.3	0.324	176.8	49.6	6.2	0.690	176.6	49.6	6.2	0.690	46.7	36%	53
128.0	60.4	3.3	0.300	175.9	49.5	6.4	0.600	173.6	49.7	6.3	0.690	44.7	34%	54
129.5	60.3	3.3	0.328	175.6	49.7	6.2	0.630	175.4	49.6	6.3	0.780	43.8	33%	55
132.3	60.5	3.5	0.406	177.7	49.7	6.4	0.780	175.8	49.7	6.3	0.930	47.4	36%	56
131.7	60.0	3.5	0.370	179.5	49.6	6.3	0.840	176.8	49.6	6.3	0.720	43.8	32%	57
131.2	60.2	3.6	0.392	180.2	49.6	6.4	0.690	177.1	49.7	6.4	0.690	47.1	35%	58
131.1	60.0	3.5	0.445	181.6	49.7	6.4	0.750	180.8	49.5	6.5	0.720	46.8	35%	59
133.9	60.0	3.5	0.422	183.5	49.5	6.5	0.750	184.4	49.6	6.5	0.810	49.2	37%	60
135.3	60.0	3.5	0.365	183.2	49.6	6.4	0.690	180.5	49.6	6.5	0.870	47.8	35%	61
137.0	60.0	3.5	0.367	180.6	49.6	6.6	0.780	179.8	49.6	6.5	0.660	46.5	35%	62
137.2	60.0	3.6	0.375	185.6	49.6	6.5	0.840	180.9	49.7	6.5	0.960	46.9	34%	63
135.7	60.0	3.6	0.464	187.1	49.6	6.6	0.720	180.4	49.6	6.6	0.660	48.0	35%	64
135.0	60.0	3.7	0.451	183.6	49.5	6.6	0.780	184.5	49.6	6.6	0.630	46.3	34%	65
137.5	60.0	3.7	0.428	183.0	49.6	6.6	0.780	181.9	49.5	6.6	0.810	44.1	32%	66
138.5	60.0	3.5	0.372	189.9	49.6	6.7	0.900	183.0	49.6	6.6	0.630	50.4	36%	67
136.9	60.0	3.7	0.401	189.2	49.5	6.7	0.840	193.4	49.6	6.7	0.690	48.3	34%	68
139.0	60.0	3.7	0.375	191.0	49.5	6.8	0.870	188.7	49.6	6.7	0.840	49.3	35%	69
140.1	60.0	3.7	0.392	190.0	49.5	6.7	0.690	190.4	49.5	6.7	0.810	46.9	33%	70
141.4	60.0	3.9	0.447	191.8	49.5	6.8	0.750	188.5	49.6	6.7	0.780	49.4	35%	71
141.1	60.0	3.8	0.486	185.8	49.6	6.8	0.720	192.3	49.5	6.9	0.750	39.7	27%	72

73	143.5	59.6	4.2	0.478	142.4	60.6	2.8	0.304	144.0	60.0	3.1	0.344	143.3	59.9	3.3	0.507
74	147.1	59.8	4.0	0.436	141.3	60.8	2.8	0.298	142.6	60.0	3.1	0.400	142.7	60.0	3.2	0.490
75	145.5	59.9	4.3	0.501	142.3	60.6	2.9	0.351	145.0	59.9	3.3	0.468	144.2	60.0	3.2	0.454
76	146.5	59.9	4.3	0.385	143.7	60.0	2.9	0.411	147.1	59.7	3.9	0.517	141.8	60.0	3.3	0.493
77	145.1	59.9	4.1	0.359	142.6	60.7	2.8	0.423	151.3	59.5	3.7	0.535	145.8	60.0	3.2	0.380
78	147.2	60.0	4.0	0.367	141.4	60.6	3.0	0.392	147.1	59.8	3.3	0.434	146.5	60.0	3.2	0.421
79	147.2	60.0	4.0	0.374	144.6	60.0	2.9	0.339	146.6	60.0	3.3	0.367	148.5	60.0	3.4	0.467
80	149.2	60.0	4.0	0.467	145.3	60.7	2.9	0.402	148.1	60.0	3.2	0.403	146.4	59.8	3.3	0.521
81	150.8	59.8	4.3	0.433	144.6	60.7	2.9	0.334	146.8	60.0	3.2	0.349	144.8	60.0	3.4	0.462
82	149.4	59.9	4.3	0.467	146.7	60.7	2.9	0.356	149.2	60.0	3.3	0.441	151.0	59.8	3.6	0.448
83	150.0	59.9	4.2	0.490	146.2	60.7	2.9	0.415	149.0	60.0	3.1	0.358	148.7	59.6	3.8	0.433
84	146.1	60.0	4.3	0.476	149.0	60.7	2.9	0.400	148.8	60.0	3.3	0.430	152.5	59.8	3.6	0.478
85	150.8	60.0	4.2	0.443	150.1	60.0	3.1	0.339	151.4	60.0	3.3	0.432	155.6	59.8	3.8	0.510
86	152.2	59.8	4.6	0.430	149.9	60.0	3.3	0.364	153.3	60.0	3.4	0.405	149.3	59.8	3.6	0.429
87	151.6	59.5	4.2	0.406	152.9	60.0	3.4	0.464	156.2	60.0	3.4	0.385	160.9	59.7	3.4	0.499
88	154.7	59.9	4.5	0.503	150.5	60.0	3.1	0.346	154.6	60.0	3.6	0.429	155.1	60.0	3.5	0.510
89	155.2	59.8	4.3	0.497	150.0	60.5	3.1	0.337	154.7	60.0	3.6	0.435	156.4	59.9	3.8	0.528
90	162.1	59.9	4.5	0.475	156.4	60.0	3.1	0.301	153.2	60.0	3.5	0.425	159.3	59.6	3.8	0.556
91	158.4	59.7	4.9	0.487	151.7	60.0	3.1	0.375	155.0	60.0	3.4	0.350	157.1	60.0	3.6	0.538
92	159.7	59.7	4.9	0.452	154.6	60.0	3.0	0.392	157.9	60.0	3.4	0.406	155.5	59.8	3.6	0.510
93	160.2	59.5	4.8	0.487	153.9	60.0	3.1	0.377	155.8	60.0	3.5	0.445	157.5	59.8	3.9	0.555
94	155.7	59.7	4.9	0.509	156.7	60.0	3.1	0.312	154.5	60.0	3.4	0.412	158.8	59.6	3.8	0.529
95	162.6	59.4	5.1	0.617	154.6	60.0	3.2	0.338	158.4	60.0	3.4	0.339	155.2	59.9	3.8	0.544
96	159.6	59.4	5.4	0.532	156.8	60.0	3.2	0.376	159.8	60.0	3.6	0.367	161.8	59.8	4.1	0.530
97	165.6	59.3	5.6	0.487	155.2	60.0	3.2	0.395	163.1	59.9	3.9	0.451	161.2	59.6	4.0	0.533
98	164.4	59.2	5.4	0.627	161.0	60.0	3.3	0.382	162.2	59.8	3.8	0.444	164.6	59.5	4.3	0.566
99	167.5	59.5	5.5	0.551	160.1	60.0	3.3	0.421	159.8	59.8	4.0	0.515	161.9	59.5	4.1	0.538
100	166.6	59.7	5.0	0.465	159.2	60.0	3.2	0.435	160.0	59.8	3.7	0.530	165.2	59.5	4.2	0.523
101	168.5	59.6	5.1	0.517	160.1	60.0	3.4	0.466	167.0	60.0	3.8	0.538	166.3	59.6	3.9	0.428
102	164.9	59.5	5.2	0.530	161.5	60.0	3.3	0.406	165.1	60.0	3.8	0.550	164.2	59.5	5.1	0.954
103	169.9	59.4	6.1	0.627	161.7	60.0	3.3	0.357	165.5	59.9	3.8	0.479	168.5	59.1	5.6	0.903
104	166.6	59.1	6.1	0.664	164.6	60.0	3.3	0.352	165.4	59.8	3.7	0.436	166.0	59.1	5.9	0.950
105	164.2	59.2	5.2	0.536	164.7	60.0	3.3	0.374	164.3	60.0	3.8	0.506	170.5	59.1	5.6	0.961
106	165.7	59.5	5.1	0.512	164.3	60.0	3.5	0.406	169.1	59.8	4.2	0.560	168.4	59.3	4.5	0.543
107	170.1	59.7	5.1	0.470	166.5	59.9	4.1	0.475	172.2	59.8	3.8	0.488	167.5	59.5	4.1	0.515
108	169.8	59.5	5.2	0.466	164.3	59.9	3.8	0.466	164.4	59.7	4.3	0.469	166.9	59.9	3.8	0.533
109	168.8	59.6	5.2	0.477	167.8	60.0	3.6	0.403	171.8	59.4	4.5	0.527	168.6	59.9	3.9	0.455
110	171.3	59.7	5.3	0.449	168.0	60.0	3.5	0.433	173.3	59.3	4.4	0.558	167.5	59.9	4.1	0.525
111	170.7	59.6	5.1	0.448	168.0	60.0	3.6	0.427	173.8	59.8	3.9	0.458	172.7	59.9	3.9	0.519
112	172.0	59.6	5.4	0.531	176.6	60.0	3.6	0.404	174.4	59.9	4.0	0.559	170.6	59.9	4.3	0.513
113	173.4	59.4	5.3	0.530	170.0	60.0	3.8	0.452	169.5	60.0	3.9	0.585	177.9	58.8	5.9	0.515
114	167.7	59.6	5.3	0.542	177.5	60.0	3.8	0.532	166.8	59.7	4.0	0.557	175.2	58.4	7.4	0.949
115	172.6	59.6	5.4	0.510	167.6	60.0	3.7	0.398	170.1	59.7	4.0	0.474	181.6	59.2	4.9	0.615
116	178.4	59.5	5.7	0.573	168.5	60.0	3.8	0.477	180.3	59.6	4.2	0.481	175.3	59.4	4.8	0.619
117	174.9	59.3	7.1	1.003	172.4	60.0	3.8	0.449	173.4	59.7	4.2	0.470	179.3	59.3	5.6	0.945
118	176.0	59.2	6.3	0.854	179.2	60.0	3.7	0.466	173.7	59.5	4.5	0.540	183.9	59.3	5.1	0.513
119	177.1	59.3	6.3	0.921	176.7	60.0	3.7	0.466	172.9	59.8	4.1	0.552	172.5	59.3	5.0	0.547
120	176.8	59.4	6.2	0.517	177.3	60.0	3.6	0.432	174.5	59.9	4.0	0.562	181.1	59.4	4.9	0.517
121	189.1	59.1	7.5	0.987	176.3	60.0	3.7	0.402	178.7	59.6	5.0	0.611	178.9	59.5	4.6	0.605
122	179.8	59.3	5.7	0.505	173.2	60.0	3.9	0.503	181.8	59.4	4.4	0.566	183.3	58.0	6.7	0.500
123	184.3	59.4	5.4	0.525	179.1	60.0	3.8	0.428	174.1	59.7	4.2	0.469	183.8	57.3	7.6	0.507
124	173.2	59.6	5.5	0.482	180.5	60.0	3.8	0.464	181.6	59.9	4.0	0.493	186.8	57.0	7.7	0.502
125	180.8	59.6	5.5	0.502	174.1	60.0	3.6	0.408	179.3	59.9	4.1	0.432	185.4	57.7	7.7	0.823
126	185.0	59.5	5.5	0.536	178.9	60.0	3.8	0.466	183.5	60.0	4.0	0.457	179.7	58.5	7.1	0.835
127	176.4	59.5	5.9	0.597	177.1	60.0	3.7	0.412	180.9	59.8	4.4	0.535	180.8	59.1	7.2	0.970
128	182.1	59.3	6.4	0.958	184.4	60.0	3.7	0.387	184.3	59.6	4.7	0.565	188.1	59.3	6.2	0.958
129	181.1	59.5	6.7	0.875	181.0	60.0	3.7	0.449	188.4	59.6	4.5	0.567	182.9	59.3	5.8	0.883
130	179.8	59.3	6.7	0.967	179.1	60.0	3.8	0.471	182.5	60.0	3.9	0.558	184.1	59.3	5.8	0.981
131	186.7	59.4	6.7	0.908	184.7	60.0	3.9	0.465	179.4	59.9	4.1	0.462	189.0	59.4	6.1	0.966
132	188.0	59.3	6.2	0.702	178.2	59.7	4.5	0.524	186.7	59.8	4.3	0.512	186.8	59.4	5.7	0.943
133	180.4	59.3	6.4	0.956	183.2	59.7	4.4	0.475	187.2	59.8	4.5	0.495	181.5	59.4	5.9	0.968
134	181.5	58.8	7.6	0.950	186.9	59.6	4.4	0.500	180.8	59.8	4.3	0.505	185.0	59.3	5.3	0.514
135	188.1	59.1	7.7	0.999	185.1	59.7	4.2	0.515	179.5	59.8	4.6	0.585	186.6	59.1	6.1	0.530
136	187.9	58.4	7.4	0.952	185.7	60.0	3.7	0.537	187.6	59.6	5.1	0.611	182.1	59.0	6.9	0.981
137	189.1	59.3	7.4	1.007	180.8	60.0	3.9	0.502	190.2	59.7	4.5	0.565	187.7	59.2	6.1	0.989
138	192.3	58.8	7.7	0.949	187.8	60.0	4.1	0.492	186.7	59.6	4.3	0.470	192.9	59.2	6.5	0.959
139	194.5	58.2	7.6	0.926	187.0	60.0	4.1	0.539	182.0	60.0	4.1	0.492	190.0	59.3	6.4	0.968
140	195.9	58.8	8.3	0.974	187.7	60.0	4.0	0.508	190.1	59.7	4.7	0.614	186.2	58.8	6.6	0.932
141	193.2	59.1	7.6	1.003	184.4	59.8	4.2	0.460	186.3	59.6	4.6	0.549	195.7	57.9	6.0	0.534
142	190.1	57.6	8.1	0.994	190.9	59.9	4.2	0.494	185.1	59.8	4.4	0.507	196.9	58.8	7.5	1.035
143	191.6	58.8	8.4	0.987	189.9	60.0	3.9	0.512	188.5	59.7	4.5	0.525	195.6	59.4	5.3	0.978
144	192.8	58.7	7.6	0.997	191.4	60.0	4.1	0.556	185.6	59.6	4.7	0.559	193.9	59.5	4.9	0.525
145	197.8	58.0	7.5	0.941	194.3	60.0	4.3	0.536	188.0	59.7	4.7	0.548	195.7	59.4	5.9	0.989
146	194.3	59.0	8.4	0.997	193.0	60.0	4.1	0.535	187.4	59.6	4.7	0.485	189.4	59.4	5.1	0.697
147	193.0	59.4	6.6	0.730	187.7	60.0	4.2	0.495	192.1	59.5	4.9	0.553	194.4	58.5	6.4	0.516
148	197.8	59.3	6.8	0.741	191.9	59.9	4.2	0.471	190.6	59.5	5.8	0.681	191.8	59.1	6.3	0.874

140.8	60.0	3.9	0.465	191.7	49.6	6.8	0.870	192.3	49.5	6.8	0.750	48.2	34%	73
141.6	60.0	3.8	0.416	191.7	49.6	6.9	0.660	195.1	49.5	6.9	0.780	44.6	30%	74
143.5	60.0	3.8	0.362	196.2	49.6	6.9	0.810	193.3	49.5	6.9	0.840	50.7	35%	75
142.7	60.0	3.9	0.393	195.8	49.4	7.0	0.780	195.5	49.5	6.9	0.960	49.3	34%	76
146.2	59.9	4.1	0.433	194.1	49.6	6.9	0.750	195.7	49.6	7.0	0.750	49.0	34%	77
147.7	59.6	4.5	0.496	197.1	49.5	7.0	0.930	194.5	49.6	7.0	0.810	49.9	34%	78
142.9	59.9	4.2	0.422	195.6	49.6	7.0	0.720	199.8	49.5	7.1	0.870	48.4	33%	79
147.4	59.9	4.1	0.376	198.6	49.6	7.1	0.780	205.6	49.5	7.1	0.840	49.4	33%	80
149.8	60.0	3.9	0.377	198.0	49.5	7.1	0.840	199.8	49.5	7.1	0.750	47.2	31%	81
148.3	60.0	3.8	0.410	199.2	49.6	7.1	0.840	199.8	49.6	7.2	0.900	49.8	33%	82
149.9	60.0	3.9	0.368	199.8	49.6	7.2	0.780	198.2	49.6	7.1	0.840	49.8	33%	83
148.7	60.0	4.0	0.346	198.1	49.6	7.1	0.810	198.5	49.6	7.3	0.660	52.0	36%	84
151.0	60.0	4.0	0.396	204.9	49.5	7.3	0.810	204.8	49.5	7.2	0.810	54.1	36%	85
148.7	60.0	4.1	0.424	203.0	49.4	7.2	0.780	206.7	49.4	7.2	0.900	50.8	33%	86
151.6	60.0	4.2	0.437	206.9	49.6	7.3	0.960	208.3	49.5	7.4	0.900	55.3	36%	87
152.6	60.0	4.2	0.397	208.5	49.4	7.3	0.810	206.0	49.6	7.2	0.780	53.8	35%	88
152.9	60.0	4.2	0.364	209.0	49.5	7.4	1.140	206.0	49.6	7.4	0.810	53.8	35%	89
157.9	59.7	4.6	0.495	208.1	49.4	7.4	0.960	207.2	49.5	7.4	0.720	46.0	28%	90
155.4	59.9	4.2	0.470	211.9	49.5	7.4	0.810	210.5	49.4	7.4	0.900	53.5	34%	91
154.6	60.0	4.3	0.414	205.8	49.5	7.5	0.900	207.5	49.6	7.5	0.810	46.1	29%	92
156.3	60.0	4.2	0.359	214.2	49.4	7.5	0.990	206.5	49.4	7.5	0.720	54.0	34%	93
160.2	59.9	4.5	0.419	208.2	49.3	7.5	0.960	208.6	49.5	7.5	0.900	52.5	34%	94
157.6	59.7	4.6	0.462	210.5	49.5	7.6	0.780	211.6	49.5	7.6	0.960	47.9	29%	95
159.2	59.7	4.9	0.441	213.4	49.5	7.6	0.930	219.6	49.4	7.6	0.870	53.8	34%	96
164.9	59.7	4.7	0.446	210.5	49.4	7.6	0.750	213.6	49.4	7.6	0.960	44.9	27%	97
164.3	59.8	4.6	0.433	217.0	49.5	7.6	0.810	214.0	49.5	7.6	0.840	52.6	32%	98
164.5	59.8	4.9	0.491	214.1	49.3	7.7	0.870	215.0	49.5	7.7	0.930	46.6	28%	99
160.6	59.9	4.6	0.539	213.2	49.4	7.8	0.870	223.7	49.4	7.7	0.930	46.6	28%	100
162.9	59.8	4.7	0.538	218.6	49.3	7.7	0.750	224.8	49.5	7.8	0.840	50.1	30%	101
163.9	59.8	4.7	0.525	216.7	49.2	7.8	1.020	223.1	49.3	7.8	0.780	51.8	31%	102
166.8	59.7	5.1	0.521	216.3	49.4	7.8	0.900	221.0	49.5	7.8	0.780	46.4	27%	103
166.0	59.4	5.3	0.523	222.0	49.4	7.8	0.870	222.3	49.5	7.9	0.840	55.4	33%	104
163.5	59.8	4.4	0.444	217.9	49.4	7.9	1.050	218.0	49.4	7.9	0.990	53.7	33%	105
166.9	59.9	4.6	0.420	220.3	49.3	7.9	0.930	220.0	49.3	7.9	0.840	54.6	33%	106
166.7	59.8	4.9	0.446	222.8	49.4	8.0	0.840	224.5	49.4	8.0	0.990	52.7	31%	107
170.1	59.6	5.2	0.501	222.9	49.4	8.0	0.930	217.7	49.4	8.0	0.870	53.1	31%	108
172.2	59.5	5.3	0.528	230.0	49.4	8.0	1.020	229.6	49.4	7.9	0.840	61.2	36%	109
167.5	59.6	5.0	0.534	226.7	49.4	8.1	0.840	226.4	49.3	8.1	0.900	55.4	32%	110
166.9	59.8	4.8	0.522	230.9	49.4	8.1	0.900	227.7	49.4	8.0	0.960	60.2	35%	111
177.8	59.8	5.1	0.470	228.6	49.3	8.0	0.870	224.8	49.4	8.2	1.170	56.6	33%	112
172.6	59.6	5.1	0.555	220.0	49.2	8.1	0.840	225.3	49.3	8.1	0.960	46.6	27%	113
173.5	59.8	4.7	0.519	226.8	49.3	8.2	0.810	228.6	49.4	8.2	1.020	59.1	35%	114
172.7	60.0	4.8	0.432	233.9	49.4	8.1	1.020	230.4	49.3	8.2	1.080	61.3	36%	115
170.7	59.9	4.9	0.438	232.0	49.3	8.2	0.810	231.7	49.4	8.3	0.990	53.6	30%	116
171.8	59.5	5.6	0.488	233.2	49.4	8.3	1.080	236.6	49.4	8.2	1.050	58.3	33%	117
177.3	59.4	5.5	0.532	228.2	49.4	8.3	1.080	235.3	49.3	8.3	0.930	52.2	30%	118
175.4	59.6	5.4	0.539	235.4	49.3	8.3	1.080	229.3	49.4	8.3	1.140	58.3	33%	119
176.1	59.5	5.6	0.518	230.0	49.3	8.3	1.050	231.6	49.4	8.4	1.050	53.2	30%	120
183.5	59.6	6.2	0.637	226.5	49.3	8.3	0.960	236.8	49.3	8.3	0.990	37.4	20%	121
181.1	59.5	5.8	0.553	233.5	49.5	8.4	0.990	234.7	49.3	8.5	0.990	53.7	30%	122
178.8	59.3	5.9	0.533	235.2	49.1	8.4	1.110	236.4	49.3	8.4	0.960	50.9	28%	123
177.3	59.6	6.2	0.690	240.3	49.3	8.5	0.960	236.8	49.4	8.5	0.930	67.1	39%	124
182.9	59.3	6.9	0.994	241.4	49.3	8.4	0.990	241.1	49.3	8.4	1.020	60.6	34%	125
182.1	59.2	7.1	0.984	233.2	49.4	8.6	0.900	240.3	49.4	8.5	0.870	48.2	26%	126
174.9	59.3	5.9	0.630	234.9	49.4	8.5	1.200	234.6	49.3	8.4	1.050	58.5	33%	127
182.6	59.3	5.9	0.549	243.9	49.3	8.6	1.050	239.3	49.3	8.6	0.900	61.8	34%	128
189.2	59.4	5.6	0.475	241.0	49.3	8.5	1.110	243.4	49.3	8.6	0.930	59.9	33%	129
184.3	59.6	5.4	0.481	248.9	49.3	8.7	0.900	238.3	49.3	8.6	1.110	69.1	38%	130
183.5	59.7	5.6	0.546	236.2	49.3	8.6	1.050	245.8	49.3	8.7	0.960	49.5	27%	131
181.4	59.6	5.6	0.515	239.9	49.1	8.7	0.930	247.6	49.1	8.7	1.080	51.9	28%	132
183.4	59.5	5.6	0.497	243.3	49.2	8.7	0.990	243.3	49.3	8.7	0.960	62.9	35%	133
179.7	59.5	6.3	0.760	256.4	49.3	8.8	1.230	246.4	49.1	8.7	1.230	74.9	41%	134
182.5	59.4	6.7	1.000	243.1	49.2	8.7	0.960	248.3	49.2	8.7	0.960	55.0	29%	135
188.0	59.5	6.9	0.976	248.4	49.2	8.8	1.080	245.8	49.3	8.7	1.140	60.5	32%	136
186.7	59.4	6.4	0.828	248.8	49.3	8.8	0.990	242.7	49.3	8.8	0.870	59.7	32%	137
187.6	59.5	6.5	1.016	251.0	49.3	8.8	0.930	253.5	49.3	8.8	0.900	58.7	31%	138
191.1	59.7	5.8	0.574	251.5	49.3	8.9	0.960	244.0	49.1	8.8	0.840	57.0	29%	139
185.0	59.6	5.9	0.544	246.0	49.3	8.8	0.870	248.5	49.2	8.9	0.990	50.1	26%	140
189.0	59.6	6.2	0.623	246.2	49.2	8.8	1.020	253.6	49.3	8.9	0.960	53.0	27%	141
190.7	59.3	5.8	0.554	249.6	49.1	8.9	0.960	245.0	49.3	8.9	1.110	59.5	31%	142
190.1	59.6	5.9	0.537	251.6	49.3	8.8	0.930	246.3	49.2	9.0	1.140	60.0	31%	143
187.6	59.5	6.5	0.931	244.4	49.1	9.0	0.900	250.1	49.2	9.0	0.960	51.6	27%	144
191.1	59.6	6.9	0.983	249.8	49.3	9.0	0.870	245.2	49.2	8.9	1.050	52.0	26%	145
194.6	59.5	6.0	0.532	249.7	49.3	9.0	0.960	255.5	49.3	8.9	0.930	55.4	29%	146
190.0	59.3	6.1	0.546	252.4	49.2	9.0	0.900	259.4	49.2	9.0	0.900	59.4	31%	147
197.3	59.5	6.5	0.860	259.3	49.3	9.0	0.960	250.6	49.3	9.1	1.170	61.5	31%	148

149	193.6	59.3	7.0	1.006	187.4	60.0	4.1	0.513	197.7	59.3	5.4	0.529	192.1	57.1	6.8	0.500
150	190.2	59.4	6.9	0.837	193.8	60.0	4.3	0.545	186.0	59.5	4.5	0.487	197.0	56.4	8.5	0.500
151	191.9	59.3	6.3	0.579	196.8	59.9	4.4	0.465	191.1	59.7	4.6	0.501	200.3	58.2	8.6	0.514
152	198.1	59.4	7.4	1.015	196.1	59.7	4.7	0.515	192.2	59.6	4.8	0.497	195.8	59.2	7.3	1.007
153	197.2	58.9	7.8	1.006	190.5	59.7	4.6	0.480	194.0	59.5	5.4	0.999	199.0	58.8	6.2	0.523
154	202.4	59.1	7.8	0.994	194.6	59.7	4.4	0.515	195.0	59.5	5.6	0.905	192.4	58.4	7.0	0.549
155	195.4	57.7	7.7	0.926	192.3	59.7	4.5	0.525	194.9	59.5	5.7	0.545	198.0	58.8	6.5	0.676
156	195.3	57.1	8.7	0.937	193.5	59.9	4.3	0.462	196.4	59.4	4.8	0.529	199.9	59.2	6.3	1.002
157	189.3	58.6	9.5	0.989	189.6	60.0	4.3	0.499	195.0	59.8	4.6	0.519	197.2	58.5	6.4	0.521
158	191.5	58.4	8.1	0.966	192.6	59.9	4.4	0.488	194.2	59.7	4.9	0.515	191.9	58.6	8.0	0.544
159	210.7	54.9	7.7	0.658	191.1	59.8	4.5	0.523	198.9	59.6	5.1	0.641	199.9	58.6	7.3	0.541
160	197.2	56.5	10.0	0.877	193.4	59.9	4.4	0.512	196.0	59.4	5.2	0.544	194.3	58.8	7.6	0.533
161	207.7	56.7	9.3	0.920	194.7	60.0	4.4	0.480	190.2	59.5	5.1	0.623	198.9	58.8	7.3	0.530
162	204.2	58.7	9.7	0.975	199.1	59.9	4.4	0.512	198.8	59.6	5.4	0.573	198.2	58.6	7.5	0.903
163	202.6	57.7	8.1	0.984	197.8	59.6	4.6	0.518	195.3	59.7	5.6	1.017	197.5	58.5	7.4	0.962
164	199.2	58.7	8.6	0.986	198.2	59.5	5.0	0.534	200.9	59.6	5.2	0.885	201.0	58.4	6.9	0.508
165	195.3	55.9	7.4	0.724	192.0	59.6	5.0	0.681	195.0	59.5	4.8	0.637	201.0	57.0	8.1	0.500
166	203.8	59.0	9.9	1.001	195.6	59.5	5.1	0.522	198.0	59.8	4.8	0.526	197.1	58.4	8.5	0.513
167	191.1	58.3	8.2	0.973	202.2	59.4	4.4	0.487	192.0	59.7	4.7	0.489	204.9	57.9	7.9	0.532
168	208.1	57.2	8.1	0.855	198.1	60.0	4.4	0.634	198.4	59.6	5.2	0.616	202.8	58.5	8.3	0.528
169	209.3	56.4	8.5	0.513	202.9	59.8	4.8	0.543	200.6	59.3	6.0	1.025	206.8	57.2	7.7	0.514
170	195.2	59.2	9.3	0.989	201.7	59.6	4.7	0.528	193.0	59.7	5.1	0.523	200.0	58.4	8.7	0.512
171	204.9	58.4	7.7	0.500	203.9	59.7	4.8	0.572	193.8	59.7	4.7	0.528	194.7	57.7	7.9	0.523
172	207.0	55.4	8.6	0.500	200.2	59.7	5.0	0.594	195.4	59.6	4.9	0.525	203.9	58.3	8.1	0.533
173	205.5	57.0	9.3	0.500	198.4	59.7	4.8	0.595	203.9	59.5	5.1	0.592	198.6	58.1	7.8	0.539
174	205.9	57.8	9.8	0.956	206.8	59.7	4.8	0.585	193.7	59.6	5.1	0.838	197.1	58.9	8.2	0.959
175	201.0	57.1	8.2	0.943	200.8	59.7	4.6	0.535	206.7	59.5	6.1	0.994	197.9	58.2	7.4	0.500
176	200.9	57.2	9.4	0.917	195.1	59.9	4.3	0.535	193.2	59.4	6.1	0.997	208.0	55.5	8.2	0.500
177	204.0	55.1	8.3	0.953	199.4	60.0	4.3	0.533	195.4	59.4	6.6	0.987	203.4	57.1	9.4	0.500
178	196.6	57.3	10.9	0.951	200.5	59.8	4.4	0.557	202.9	59.3	5.8	0.538	206.9	58.3	8.6	0.500
179	197.0	57.8	8.7	0.947	199.2	59.8	4.6	0.501	198.1	59.3	6.1	0.975	206.9	58.1	8.1	0.514
180	197.8	58.0	9.5	0.979	195.4	59.7	4.5	0.500	193.2	59.7	5.2	0.642	202.2	58.2	8.3	0.520
181	205.1	54.0	7.4	0.785	201.6	59.8	4.5	0.540	204.1	59.6	5.1	0.598	206.9	58.0	8.4	0.512
182	200.8	57.1	10.4	0.959	192.5	59.8	4.4	0.451	204.2	59.2	6.4	0.998	200.3	57.6	7.9	0.612
183	193.7	58.8	9.3	0.988	196.6	60.0	4.3	0.515	206.8	59.3	6.0	0.766	200.3	58.8	8.0	0.977
184	204.0	56.3	7.1	0.500	191.8	60.0	4.3	0.489	198.3	59.2	5.1	0.548	203.0	59.3	6.8	0.993
185	214.2	52.5	9.4	0.688	200.3	59.9	4.6	0.500	199.6	59.5	5.7	0.957	204.4	56.4	7.4	0.500
186	205.7	55.1	10.4	0.830	202.3	59.7	4.8	0.539	202.5	59.5	5.7	0.794	203.7	58.4	9.2	0.513
187	203.7	56.6	10.0	0.843	199.1	59.9	4.3	0.496	198.4	59.7	5.0	0.565	199.6	58.3	8.9	0.500
188	197.9	53.6	8.0	0.878	198.1	60.0	4.3	0.523	196.8	59.7	5.1	0.568	199.9	58.6	7.9	0.530
189	206.2	54.5	9.2	0.500	194.1	59.6	5.5	1.008	195.4	59.6	5.3	0.539	199.0	59.0	7.6	1.006
190	206.6	57.0	10.4	0.921	201.1	59.5	5.3	0.600	199.6	59.5	5.1	0.511	202.5	58.2	6.1	0.531
191	199.3	56.9	9.3	0.944	198.9	59.5	4.9	0.561	205.6	59.5	5.2	0.514	203.1	58.6	8.3	0.531
192	199.2	56.6	9.1	0.928	195.6	59.8	4.5	0.482	193.8	59.4	4.7	0.499	200.9	57.9	7.5	0.545
193	207.7	52.6	8.7	0.965	202.4	59.7	4.9	0.527	191.9	59.8	4.7	0.494	204.1	58.4	8.3	0.976
194	200.6	57.7	11.0	0.926	201.9	59.6	5.0	0.648	201.5	59.5	5.0	0.499	198.0	59.2	6.6	0.611
195	201.4	58.0	9.1	0.953	191.4	59.8	4.4	0.542	194.8	59.4	5.5	0.599	203.4	58.2	6.7	0.866
196	206.9	51.8	8.0	0.952	206.6	59.8	4.6	0.513	202.6	59.2	5.1	0.529	198.9	57.5	7.4	0.538
197	201.8	57.4	11.0	0.949	195.7	59.9	4.5	0.548	191.9	59.5	5.0	0.503	200.0	57.9	7.8	0.831
198	203.2	56.2	8.5	0.965	192.3	59.7	4.4	0.530	197.7	59.5	5.8	0.894	200.4	58.1	7.2	0.538
199	196.8	57.8	9.8	0.939	195.4	59.8	4.8	0.505	201.5	59.4	5.7	0.633	203.9	57.1	7.4	0.529
200	201.7	58.4	9.2	0.986	197.9	59.8	4.6	0.532	201.6	59.4	5.1	0.552	198.6	58.5	8.4	0.924
201	196.4	57.3	7.9	0.871	194.7	59.7	4.5	0.561	196.1	59.4	5.1	0.495	201.2	56.0	7.4	0.500
202	211.2	57.4	9.9	0.986	199.1	59.9	4.5	0.498	203.4	59.4	5.1	0.547	204.6	58.8	8.5	1.005
203	202.3	56.2	7.6	0.773	191.9	59.7	5.2	0.737	195.2	59.5	4.8	0.504	208.4	58.0	6.1	0.530
204	201.9	55.5	8.9	0.500	201.1	59.4	5.8	0.957	199.9	59.8	4.6	0.522	191.6	57.8	7.3	0.531
205	195.9	57.6	10.4	0.957	203.0	59.4	5.4	0.632	195.0	59.7	5.0	0.556	202.6	57.5	7.2	0.542
206	202.4	57.9	8.8	0.971	193.0	59.4	5.2	0.545	199.0	59.6	5.0	0.592	202.1	59.2	7.2	1.006
207	202.1	58.7	8.7	1.006	191.8	59.5	4.4	0.507	202.4	59.6	5.6	0.803	198.6	58.0	5.9	0.555
208	200.2	57.5	6.7	0.514	190.2	59.8	4.3	0.515	195.8	59.5	5.0	0.540	194.0	58.5	8.2	0.535
209	199.2	58.6	9.0	0.534	191.5	59.8	4.4	0.505	198.1	59.5	4.8	0.554	205.0	56.4	7.0	0.520
210	196.7	58.6	9.2	1.008	194.2	59.8	4.4	0.548	196.7	59.6	5.5	0.930	197.0	57.9	8.7	0.517
211	194.1	59.2	7.5	1.015	187.1	59.7	4.6	0.546	192.0	59.4	5.4	0.839	203.3	58.3	8.2	0.516
212	196.3	59.3	7.3	1.011	194.1	59.8	4.3	0.520	193.2	59.3	5.1	0.517	189.4	57.0	7.1	0.537
213	192.4	53.6	7.9	0.766	195.5	59.7	4.8	0.486	196.0	59.4	5.4	0.541	202.0	55.2	7.4	0.518
214	193.6	59.0	9.2	0.896	190.7	59.6	4.6	0.549	186.7	59.6	5.1	0.526	190.2	58.1	8.1	0.793
215	209.5	49.9	6.9	0.500	190.9	59.9	4.3	0.526	194.1	59.5	5.4	0.537	190.6	58.8	7.2	0.855
216	206.9	48.2	10.2	0.806	189.9	59.9	4.4	0.539	191.7	59.6	4.7	0.486	195.4	58.6	6.7	0.904
217	201.5	52.8	10.7	0.900	190.3	59.7	4.7	0.533	189.7	59.6	4.6	0.530	198.9	58.6	7.3	0.980
218	193.8	58.3	11.2	0.968	191.3	59.8	4.2	0.494	195.9	59.6	4.7	0.493	196.8	57.6	6.8	0.501
219	197.6	57.8	7.8	0.830	185.5	59.9	4.3	0.517	186.7	59.5	4.9	0.524	190.5	57.9	8.0	0.525
220	189.4	58.5	9.3	1.003	189.5	59.7	4.6	0.526	190.0	59.4	5.1	0.559	195.0	57.0	7.5	0.531
221	198.4	59.3	7.4	1.015	191.2	59.7	4.2	0.524	195.6	59.5	4.8	0.531	197.8	57.5	7.0	0.549
222	188.4	58.4	6.8	0.732	187.5	60.0	4.3	0.475	192.1	59.4	4.6	0.513	190.3	56.7	7.0	0.543
223	187.8	59.1	8.2	1.018	188.6	59.9	4.2	0.494	193.2	59.6	4.7	0.577	181.6	58.1	8.0	0.890
224	187.7	59.2	7.1	1.028	186.4	59.8	4.3	0.507	192.1	59.6	5.0	0.553	187.1	59.2	7.1	0.965

191.3	59.5	6.1	0.543	242.0	49.3	9.0	1.050	258.8	49.2	9.0	0.930	48.4	25%	149
196.0	59.6	6.1	0.506	254.6	49.4	9.0	0.870	250.1	49.2	9.1	0.900	64.4	34%	150
194.8	59.5	6.6	0.935	254.3	49.3	9.1	0.990	253.0	49.3	9.1	1.170	62.4	33%	151
199.3	59.5	6.3	0.612	252.2	49.1	9.1	0.990	254.7	49.3	9.1	0.930	54.1	27%	152
196.0	59.6	6.4	0.747	260.5	49.3	9.1	1.350	247.0	49.2	9.2	1.110	63.3	32%	153
198.7	59.6	6.1	0.556	256.5	49.2	9.1	1.020	254.1	49.3	9.1	0.960	54.1	27%	154
197.0	59.4	6.2	0.532	259.1	49.3	9.1	1.140	255.6	49.2	9.2	0.990	63.7	33%	155
191.7	59.4	6.5	0.778	249.2	49.2	9.2	1.020	250.7	49.3	9.1	1.020	53.9	28%	156
201.3	59.5	6.9	0.560	259.2	49.3	9.2	1.140	259.2	49.2	9.0	1.080	69.9	37%	157
188.8	59.4	6.9	0.920	254.1	49.2	9.2	1.080	251.5	49.3	9.2	1.110	62.6	33%	158
195.8	59.4	6.6	0.685	262.3	49.3	9.2	0.930	267.4	49.1	9.2	1.140	51.6	24%	159
201.2	59.0	7.9	0.999	264.6	49.2	9.3	0.960	258.3	49.2	9.2	1.050	67.4	34%	160
204.7	59.3	7.4	1.004	255.2	49.2	9.1	1.020	260.5	49.2	9.2	1.230	47.5	23%	161
191.8	59.4	7.0	0.812	260.7	49.1	9.3	1.020	256.0	49.1	9.3	0.990	56.5	28%	162
203.0	59.2	7.5	0.995	258.3	49.2	9.2	1.110	264.0	49.2	9.3	1.050	55.7	27%	163
197.0	59.1	8.2	0.979	267.4	49.3	9.2	1.080	247.3	49.3	9.3	1.020	68.2	34%	164
194.5	58.8	7.5	0.910	259.9	49.3	9.2	1.050	262.1	49.2	9.2	1.080	64.6	33%	165
193.9	59.1	8.4	0.978	261.8	49.3	9.2	1.170	266.7	49.3	9.4	0.960	58.0	28%	166
204.8	57.3	6.8	0.528	260.5	49.2	9.3	1.140	256.1	49.2	9.2	0.900	69.4	36%	167
195.5	58.6	9.5	0.958	261.6	49.2	9.3	0.990	262.0	49.2	9.3	0.900	53.5	26%	168
202.9	58.6	8.1	0.914	264.8	49.2	9.3	0.960	257.0	49.3	9.2	1.050	55.5	27%	169
210.3	58.4	7.9	0.816	255.3	49.2	9.2	1.110	264.5	49.2	9.3	0.930	60.1	31%	170
200.7	58.7	8.7	0.971	257.8	49.2	9.3	1.110	260.1	49.2	9.3	1.080	52.9	26%	171
198.1	58.7	8.3	0.958	261.9	49.1	9.3	1.050	260.8	49.1	9.3	0.930	54.9	27%	172
206.0	58.5	8.0	0.953	256.0	49.2	9.3	1.080	254.1	49.2	9.3	1.050	50.5	25%	173
200.7	58.6	8.2	0.962	257.9	49.2	9.4	0.870	261.2	49.3	9.3	0.870	52.0	25%	174
202.0	59.0	7.0	0.838	254.1	49.2	9.3	0.990	269.9	49.1	9.4	1.050	53.1	26%	175
205.1	59.4	6.7	0.548	255.0	49.1	9.4	0.990	253.9	49.3	9.3	1.080	54.1	27%	176
204.1	59.3	7.3	0.985	264.7	49.2	9.3	0.870	261.6	49.2	9.3	0.930	60.7	30%	177
204.4	59.4	7.5	0.987	257.7	49.2	9.3	1.050	258.0	49.3	9.4	0.900	61.1	31%	178
202.9	59.3	7.8	0.936	267.9	49.2	9.4	0.990	260.3	49.2	9.3	0.900	70.9	36%	179
197.8	58.9	7.5	1.005	255.8	49.3	9.3	1.140	264.3	49.2	9.4	0.870	58.0	29%	180
200.9	59.3	6.7	0.966	262.7	49.2	9.4	0.990	264.8	49.2	9.2	0.900	57.6	28%	181
200.8	59.3	7.7	1.015	262.5	49.3	9.4	1.050	261.8	49.3	9.4	1.110	61.7	31%	182
209.0	59.4	7.0	0.970	260.4	49.3	9.3	1.080	272.7	49.2	9.4	1.080	66.7	34%	183
201.5	59.6	6.9	1.005	258.6	49.2	9.3	1.020	262.8	49.1	9.4	0.900	54.6	27%	184
208.0	58.3	8.2	0.900	267.1	49.3	9.3	1.020	259.5	49.3	9.3	1.020	52.9	25%	185
201.4	57.4	8.2	0.839	258.6	49.1	9.3	1.080	263.6	49.1	9.3	0.960	52.9	26%	186
201.5	59.2	8.6	1.009	266.1	49.2	9.3	1.050	271.3	49.2	9.4	0.990	62.4	31%	187
201.3	59.3	7.1	0.913	265.8	49.3	9.4	1.050	267.0	49.2	9.3	1.050	67.9	34%	188
202.8	59.2	8.1	0.995	268.4	49.2	9.3	0.870	262.6	49.2	9.4	1.020	62.2	30%	189
207.0	58.5	7.6	0.889	261.9	49.1	9.3	0.960	266.7	49.2	9.3	1.050	55.3	27%	190
202.2	58.5	8.6	0.946	257.8	49.3	9.4	1.080	264.2	49.1	9.3	1.050	58.5	29%	191
201.7	59.1	8.4	0.982	258.2	49.3	9.3	0.990	268.7	49.3	9.4	1.080	59.0	30%	192
195.6	58.4	7.7	0.947	264.2	49.3	9.4	1.080	260.2	49.3	9.2	0.960	56.5	27%	193
199.3	59.3	8.4	0.988	263.9	49.1	9.3	1.110	262.1	49.4	9.4	0.930	63.3	32%	194
196.1	59.1	7.9	0.988	257.5	49.2	9.3	1.080	264.8	49.1	9.3	1.080	56.1	28%	195
204.4	59.2	7.7	0.994	258.3	49.2	9.3	1.080	258.2	49.3	9.3	1.050	51.4	25%	196
206.2	58.2	7.7	0.890	256.9	49.3	9.3	1.080	261.8	49.1	9.2	0.960	55.1	27%	197
198.1	58.5	8.6	0.966	259.7	49.2	9.3	1.050	260.0	49.1	9.4	0.930	56.5	28%	198
194.5	58.8	8.0	0.974	258.5	49.2	9.2	0.810	263.3	49.2	9.3	1.050	61.7	31%	199
201.9	59.2	7.8	0.960	261.4	49.2	9.3	0.960	264.0	49.1	9.2	1.080	59.7	30%	200
201.0	59.0	7.8	0.934	254.4	49.3	9.2	1.170	257.0	49.0	9.3	1.020	58.0	30%	201
202.7	58.1	7.1	0.761	261.7	49.2	9.3	0.900	257.8	49.3	9.2	0.960	50.5	24%	202
198.7	59.3	6.5	0.574	252.6	49.3	9.1	1.020	266.4	49.1	9.2	1.080	50.3	25%	203
200.6	59.4	7.5	1.015	255.6	49.2	9.2	0.930	250.4	49.2	9.2	1.230	53.7	27%	204
190.5	59.3	6.6	0.622	256.3	49.2	9.1	1.110	252.3	49.3	9.1	1.230	60.4	31%	205
193.5	59.2	7.4	0.988	251.5	49.2	9.2	0.900	258.2	49.3	9.2	0.990	49.1	24%	206
198.3	59.3	7.0	0.917	253.6	49.2	9.2	1.080	249.9	49.3	9.1	0.900	51.5	25%	207
193.4	59.5	6.8	0.933	247.7	49.3	9.1	0.900	256.8	49.2	9.2	0.960	47.5	24%	208
194.3	59.4	6.6	0.989	255.0	49.2	9.2	1.080	254.6	49.2	9.1	0.960	55.8	28%	209
194.9	59.4	6.9	0.831	257.0	49.3	9.1	0.930	249.7	49.3	9.2	0.990	60.3	31%	210
195.3	59.3	6.8	0.894	251.1	49.2	9.2	1.020	256.6	49.2	9.1	1.050	57.0	29%	211
187.7	59.4	7.0	0.885	260.9	49.1	9.1	1.020	264.7	49.3	9.0	1.020	64.6	33%	212
203.7	59.2	7.6	0.986	263.4	49.3	9.1	1.020	252.7	49.3	9.1	1.020	71.0	37%	213
200.5	59.4	6.2	0.595	255.8	49.3	8.9	1.110	250.3	49.2	9.1	0.960	62.2	32%	214
189.2	59.4	6.2	0.509	254.0	49.2	9.1	0.960	255.7	49.2	9.0	1.200	44.5	21%	215
193.8	59.4	6.2	0.546	246.4	49.3	9.1	1.140	252.3	49.2	9.1	0.840	39.5	19%	216
194.1	59.5	6.1	0.524	248.7	49.2	9.1	0.960	252.7	49.3	9.0	0.930	47.2	23%	217
191.4	59.4	6.0	0.515	250.9	49.2	8.9	1.170	254.1	49.3	9.0	0.900	57.1	29%	218
187.4	59.4	5.8	0.492	249.3	49.1	8.9	1.020	255.8	49.2	9.0	0.990	51.7	26%	219
193.9	59.6	6.0	0.532	251.4	49.3	8.9	0.990	249.0	49.1	9.0	0.990	62.0	33%	220
185.4	59.4	5.8	0.549	248.8	49.3	9.0	1.020	247.4	49.3	9.0	1.050	50.4	25%	221
186.5	59.6	6.5	0.987	258.4	49.2	8.8	1.050	244.1	49.3	9.0	1.200	70.0	37%	222
204.5	51.7	7.2	0.670	248.2	49.3	8.8	0.960	243.7	49.3	8.9	1.050	60.4	32%	223
193.9	57.9	10.3	0.802	257.6	49.2	8.9	0.840	243.7	49.3	8.9	0.960	69.9	37%	224

225	192.3	59.2	7.7	0.994	188.8	59.7	4.2	0.539	191.7	59.5	4.5	0.496	187.1	59.1	6.4	0.985
226	189.0	59.2	7.8	0.991	184.3	60.0	4.2	0.463	182.0	59.7	4.6	0.510	192.4	59.0	6.1	1.031
227	189.2	58.6	7.7	0.988	181.1	60.0	4.1	0.444	187.4	59.5	4.9	0.718	192.3	59.4	4.9	0.604
228	188.7	59.2	7.4	0.998	180.5	60.0	4.1	0.534	188.1	59.5	4.7	0.546	187.6	59.5	5.5	0.639
229	188.5	59.2	7.2	1.006	183.7	60.0	4.1	0.546	188.7	59.7	4.6	0.524	194.1	53.9	6.4	0.500
230	189.3	58.2	8.0	0.966	183.5	60.0	3.9	0.499	184.6	59.6	4.8	0.601	189.3	56.6	9.7	0.500
231	189.9	58.9	8.1	0.967	171.7	60.0	4.0	0.469	185.1	59.3	5.8	1.013	194.2	58.5	8.2	0.511
232	192.2	58.6	7.1	1.041	180.0	59.9	4.3	0.463	188.0	59.5	4.8	0.532	189.6	57.5	7.4	0.509
233	196.0	53.0	6.2	0.513	188.1	60.0	3.9	0.424	187.9	59.7	4.3	0.512	191.7	57.8	7.8	0.510
234	195.2	51.0	9.0	0.701	192.0	59.7	4.6	0.522	185.9	59.7	4.4	0.523	183.7	56.1	6.9	0.536
235	187.2	57.9	10.5	0.963	176.8	59.6	4.3	0.545	186.3	59.5	4.8	0.564	183.5	58.6	7.5	0.847
236	186.0	57.4	8.7	0.958	179.4	60.0	4.1	0.516	188.7	59.2	5.5	0.543	185.4	58.4	6.9	0.920
237	189.2	51.0	7.5	0.958	180.5	59.7	4.3	0.509	179.5	59.1	4.8	0.522	180.3	58.8	6.4	0.914
238	185.6	59.2	9.8	1.031	182.3	59.5	4.9	0.511	181.4	59.1	5.7	0.527	181.1	59.0	5.5	0.945
239	183.8	59.3	6.8	0.961	183.3	59.6	4.4	0.511	178.9	58.9	6.2	0.958	178.5	59.2	5.3	0.548
240	177.8	59.2	6.6	0.659	182.2	59.8	4.1	0.494	181.2	59.2	5.5	0.496	179.7	59.1	5.6	0.962
241	182.0	59.3	6.1	0.650	176.0	59.9	4.0	0.501	181.5	59.3	4.9	0.592	179.9	59.3	4.8	0.497
242	181.3	59.4	6.1	0.639	174.7	60.0	3.7	0.510	177.2	59.5	4.5	0.567	182.7	59.4	4.8	0.549
243	179.5	59.4	6.6	0.851	175.5	60.0	3.6	0.474	177.4	59.5	4.5	0.563	180.2	59.3	5.1	0.610
244	185.8	57.7	8.0	0.921	170.2	60.0	3.9	0.481	176.5	59.7	4.1	0.508	181.6	59.4	5.2	0.947
245	176.2	58.7	8.2	0.971	176.7	59.6	4.3	0.532	176.5	59.8	4.3	0.490	176.1	59.5	4.3	0.543
246	176.8	59.2	7.2	1.018	180.9	59.5	4.0	0.500	175.9	59.6	4.3	0.489	174.3	59.6	5.8	0.942
247	181.2	59.2	6.9	0.975	176.9	60.0	4.0	0.387	176.2	59.6	4.4	0.536	177.1	59.3	5.6	0.971
248	179.8	59.3	6.5	0.875	173.0	59.9	4.0	0.479	183.0	59.6	4.4	0.549	176.1	59.2	6.1	0.950
249	177.7	59.2	5.9	0.645	173.4	59.9	3.9	0.400	174.9	59.6	4.0	0.486	176.1	59.4	4.6	0.603
250	174.9	59.4	5.7	0.557	174.6	59.9	3.9	0.441	177.6	59.6	4.3	0.491	172.5	59.6	4.7	0.597
251	173.2	59.4	5.6	0.505	170.4	60.0	3.7	0.400	180.5	59.4	4.7	0.503	171.0	59.3	4.6	0.611
252	169.9	59.3	5.5	0.551	174.1	60.0	3.6	0.404	180.2	59.3	5.1	0.745	174.5	59.7	4.4	0.546
253	173.0	59.4	5.7	0.563	174.1	60.0	3.5	0.412	169.6	59.1	5.0	0.636	173.2	59.5	4.6	0.614
254	170.9	59.3	5.5	0.492	166.9	60.0	3.6	0.507	172.7	59.4	4.6	0.533	173.1	59.4	5.2	1.000
255	170.7	59.3	5.7	0.524	171.6	60.0	3.5	0.442	176.1	59.3	4.4	0.542	171.9	59.4	4.7	0.521
256	168.1	59.2	5.6	0.515	166.5	60.0	3.6	0.474	168.1	59.5	4.3	0.501	170.2	59.3	5.0	0.594
257	170.0	59.3	5.5	0.505	165.9	60.0	3.7	0.420	164.6	59.6	4.2	0.460	169.6	59.3	5.3	0.992
258	165.6	59.3	5.4	0.534	167.7	59.9	3.7	0.379	166.8	59.6	4.2	0.512	164.7	59.4	4.8	0.818
259	164.3	59.4	5.5	0.525	168.3	60.0	3.6	0.363	164.9	59.7	4.2	0.504	164.4	59.3	5.3	0.961
260	167.6	59.4	5.2	0.506	167.8	60.0	3.7	0.442	167.9	59.5	4.2	0.464	165.5	59.4	5.6	0.953
261	167.3	59.5	5.2	0.508	162.6	60.0	3.5	0.384	167.6	59.5	4.6	0.749	168.0	59.3	5.3	0.973
262	166.9	59.6	5.2	0.454	165.1	60.0	3.4	0.352	166.4	59.2	5.0	0.545	164.7	59.4	4.5	0.550
263	164.5	59.5	5.1	0.506	160.3	60.0	3.3	0.354	166.8	59.2	4.6	0.521	164.9	59.3	5.7	0.934
264	163.8	59.6	4.9	0.456	157.8	60.0	3.4	0.370	164.4	59.3	5.0	0.973	167.3	58.8	5.6	0.944
265	163.9	59.5	4.9	0.498	161.5	60.0	3.3	0.324	168.3	59.3	4.6	0.454	167.5	56.6	5.4	0.642
266	160.7	59.6	4.9	0.512	163.6	60.0	3.3	0.351	166.9	59.3	4.3	0.615	167.6	56.6	6.8	0.519
267	164.3	59.9	4.9	0.508	161.5	60.0	3.3	0.352	162.4	59.5	4.1	0.538	166.7	58.6	7.3	0.862
268	165.0	58.9	7.0	0.988	162.1	60.0	3.6	0.417	161.6	59.8	3.6	0.437	165.0	59.1	5.9	0.955
269	162.4	59.1	7.1	0.991	157.1	60.0	3.6	0.412	159.2	59.9	3.8	0.495	162.3	59.1	4.8	0.608
270	165.9	58.9	6.8	0.997	157.9	60.0	3.2	0.363	159.5	59.7	3.9	0.490	161.2	59.1	4.8	0.786
271	161.4	59.2	6.2	0.988	157.7	60.0	3.5	0.438	159.5	59.6	4.1	0.532	162.8	59.3	4.5	0.606
272	162.0	59.1	6.4	0.958	156.3	60.0	3.4	0.338	161.2	59.6	4.1	0.545	164.8	59.4	4.3	0.512
273	161.6	59.1	6.2	1.019	151.1	60.0	3.4	0.484	157.3	59.5	3.8	0.466	159.5	59.3	4.4	0.912
274	159.3	59.2	5.1	0.510	153.7	60.0	3.3	0.465	160.0	59.4	4.6	0.699	156.5	58.2	5.3	0.622
275	157.5	59.2	7.2	0.977	153.7	60.0	3.2	0.400	160.6	59.2	4.7	0.482	158.3	59.0	6.3	0.837
276	156.3	59.5	4.7	0.530	151.8	60.0	3.1	0.332	157.4	59.3	4.0	0.507	158.3	58.4	4.7	0.699
277	153.5	59.3	4.6	0.438	149.9	60.5	3.1	0.344	153.3	59.5	3.8	0.532	158.8	59.0	5.5	0.875
278	159.9	59.3	6.9	0.975	149.3	60.0	3.3	0.356	152.9	59.9	3.4	0.501	153.7	59.2	4.5	0.613
279	154.2	59.0	6.5	0.964	153.9	60.0	3.4	0.414	150.9	60.0	3.4	0.530	155.9	59.2	3.6	0.556
280	155.0	59.0	6.5	0.934	150.5	60.0	3.2	0.356	153.7	60.0	3.5	0.505	154.0	59.7	3.9	0.520
281	158.3	59.1	5.6	0.622	148.1	60.0	3.1	0.417	150.1	60.0	3.4	0.456	156.9	59.5	3.7	0.420
282	153.4	58.8	5.2	0.508	149.9	60.0	3.1	0.338	154.7	60.0	3.4	0.416	153.3	59.6	3.8	0.504
283	148.8	59.4	4.9	0.463	149.4	60.0	3.2	0.415	151.5	59.9	3.5	0.474	148.6	59.8	3.7	0.489
284	150.4	59.3	4.7	0.430	147.8	60.0	3.3	0.347	150.6	59.7	3.8	0.510	147.9	59.6	3.6	0.450
285	152.4	59.5	4.8	0.454	148.3	60.0	3.2	0.378	148.9	59.6	3.7	0.381	149.3	59.8	3.2	0.417
286	148.7	59.3	4.8	0.453	145.2	60.0	3.1	0.439	148.3	59.6	3.5	0.490	146.1	60.0	3.3	0.374
287	145.9	59.3	4.4	0.487	148.7	60.0	3.1	0.471	145.0	60.0	3.2	0.417	148.4	59.9	3.3	0.365
288	150.2	59.5	5.0	0.520	146.6	60.0	3.4	0.479	146.7	59.7	3.7	0.448	146.5	59.9	3.4	0.460
289	145.9	59.2	5.2	0.649	141.6	60.0	3.2	0.471	148.4	59.5	3.8	0.468	143.4	59.8	3.6	0.483
290	148.8	59.2	4.8	0.552	142.0	60.0	2.9	0.427	146.5	59.6	3.7	0.484	146.6	59.4	4.7	0.564
291	146.6	59.2	5.0	0.541	145.0	60.0	3.3	0.470	143.7	59.7	3.4	0.385	148.5	58.8	4.6	0.482
292	142.0	59.3	4.2	0.437	141.1	60.0	3.3	0.488	140.9	59.8	3.5	0.418	143.6	59.0	4.1	0.505
293	140.2	59.6	4.4	0.483	143.4	60.0	3.0	0.429	142.3	59.7	3.3	0.434	142.8	59.2	3.5	0.476
294	143.2	59.8	4.1	0.422	142.9	59.9	3.4	0.387	140.7	60.0	3.3	0.396	140.9	59.7	3.5	0.407
295	142.7	59.8	4.3	0.476	144.1	59.6	3.5	0.445	139.1	60.0	3.2	0.420	143.8	59.7	3.5	0.415
296	140.7	59.8	4.1	0.377	139.7	59.6	3.2	0.486	143.0	60.0	3.2	0.424	144.8	59.4	5.1	0.923
297	139.0	59.6	4.1	0.404	139.6	60.0	3.1	0.417	141.2	59.8	3.4	0.391	145.8	59.0	4.0	0.524
298	139.5	59.7	3.9	0.388	139.3	60.5	2.9	0.420	139.5	59.6	3.6	0.411	141.7	59.6	3.7	0.507
299	138.4	59.8	4.1	0.440	137.3	60.0	2.8	0.443	142.8	59.3	3.6	0.464	141.2	59.1	3.5	0.515
300	137.9	59.6	4.1	0.391	137.1	60.4	2.8	0.362	140.2	59.6	3.6	0.514	139.7	59.5	3.4	0.466

198.9	58.4	8.8	0.944	255.0	49.3	8.9	0.840	248.9	49.2	8.8	0.870	62.7	33%	225
189.2	58.9	7.9	0.970	252.1	49.3	8.8	0.990	242.2	49.2	8.8	1.140	63.1	33%	226
186.3	59.3	6.9	0.985	245.5	49.2	8.8	0.960	241.1	49.2	8.8	0.990	56.3	30%	227
189.7	58.9	7.0	0.942	246.8	49.2	8.7	0.930	244.7	49.3	8.8	0.900	58.1	31%	228
186.7	59.3	6.2	0.587	251.9	49.3	8.8	1.050	247.9	49.4	8.8	0.870	63.4	34%	229
184.8	59.4	6.4	0.865	250.4	49.3	8.8	1.020	237.1	49.3	8.8	0.990	61.1	32%	230
185.6	59.6	6.0	0.579	245.3	49.3	8.7	1.110	239.6	49.2	8.7	0.810	55.4	29%	231
187.1	59.4	6.3	0.817	240.0	49.4	8.6	1.050	249.3	49.4	8.7	1.020	47.8	25%	232
181.3	59.4	7.0	1.020	235.8	49.3	8.7	1.140	238.7	49.3	8.6	1.020	39.8	20%	233
185.4	59.2	7.6	1.001	243.5	49.2	8.7	1.080	238.6	49.2	8.7	0.930	48.3	25%	234
185.2	59.1	7.6	0.984	241.8	49.3	8.6	1.110	248.1	49.3	8.7	1.110	54.6	29%	235
185.7	59.2	7.2	0.985	243.9	49.4	8.6	0.870	243.9	49.3	8.5	0.840	57.9	31%	236
187.2	59.2	6.9	0.955	236.9	49.2	8.6	1.080	244.8	49.2	8.6	0.990	47.7	25%	237
179.9	59.3	6.4	0.969	237.4	49.3	8.5	0.990	235.6	49.3	8.5	1.140	51.8	28%	238
186.4	59.6	6.4	1.000	239.5	49.2	8.5	1.050	232.6	49.2	8.4	0.930	55.7	30%	239
185.3	59.5	6.2	0.839	237.5	49.4	8.4	1.260	241.1	49.3	8.5	0.870	59.7	34%	240
178.8	59.5	6.1	0.545	231.2	49.3	8.5	1.050	236.9	49.1	8.4	0.990	49.2	27%	241
179.9	59.5	5.4	0.473	237.5	49.3	8.5	0.870	232.4	49.3	8.5	0.840	56.2	31%	242
180.9	59.6	5.7	0.530	238.5	49.2	8.4	0.990	236.8	49.4	8.5	0.990	59.0	33%	243
178.8	59.4	7.0	1.000	233.5	49.3	8.4	1.080	234.3	49.4	8.4	0.930	47.7	26%	244
177.5	59.2	7.3	0.958	236.2	49.3	8.3	0.990	234.1	49.4	8.3	1.020	60.0	34%	245
179.7	59.2	5.9	0.533	229.4	49.2	8.4	0.840	231.3	49.4	8.3	1.020	52.6	30%	246
173.2	59.3	5.8	0.541	236.8	49.4	8.3	1.020	233.2	49.2	8.3	0.900	55.6	31%	247
178.5	59.3	6.0	0.541	237.0	49.3	8.3	0.900	231.5	49.4	8.3	0.990	57.2	32%	248
173.8	59.7	5.1	0.525	233.4	49.4	8.2	0.990	226.8	49.2	8.2	1.230	55.7	31%	249
175.4	59.6	5.1	0.459	224.5	49.3	8.1	0.960	227.1	49.3	8.2	0.900	49.6	28%	250
173.5	59.8	5.0	0.461	228.1	49.5	8.2	0.930	223.6	49.4	8.1	0.900	54.9	32%	251
172.6	59.8	5.0	0.482	231.6	49.4	8.1	0.930	224.4	49.3	8.2	1.020	61.7	36%	252
172.9	59.7	5.2	0.472	231.6	49.4	8.1	0.870	224.4	49.3	8.1	0.960	58.6	34%	253
169.6	59.5	5.3	0.506	235.1	49.3	8.1	0.900	230.3	49.3	8.1	1.020	64.2	38%	254
171.0	59.6	5.3	0.527	229.3	49.4	8.1	0.870	227.0	49.3	8.0	0.900	58.6	34%	255
176.5	59.5	5.3	0.507	229.6	49.4	8.1	0.960	223.3	49.4	8.0	0.900	61.5	37%	256
176.0	59.6	4.8	0.504	220.6	49.4	7.9	0.840	228.6	49.3	8.0	0.870	50.6	30%	257
168.0	59.8	4.9	0.552	222.0	49.4	8.0	0.960	223.3	49.5	7.9	0.900	56.4	34%	258
170.0	59.7	5.2	0.530	222.5	49.4	7.9	0.840	224.8	49.4	8.0	0.840	58.2	35%	259
166.0	59.5	4.6	0.526	222.0	49.4	7.9	0.930	222.9	49.3	7.9	1.020	54.4	32%	260
168.5	59.9	4.7	0.471	218.2	49.5	7.9	1.050	215.2	49.4	7.9	0.870	50.9	30%	261
162.5	59.8	4.9	0.531	218.6	49.5	7.8	0.990	221.9	49.4	7.8	0.870	51.7	31%	262
164.1	59.7	4.6	0.512	216.8	49.4	7.8	0.840	219.4	49.5	7.9	0.900	52.3	32%	263
165.1	59.8	4.7	0.491	220.5	49.4	7.7	0.870	212.3	49.3	7.7	0.960	56.7	35%	264
161.9	59.7	4.8	0.537	214.2	49.5	7.8	0.870	215.7	49.5	7.8	0.840	50.3	31%	265
162.0	59.7	4.7	0.514	210.6	49.4	7.7	0.780	213.1	49.4	7.6	0.840	49.9	31%	266
161.1	59.7	4.5	0.513	211.3	49.4	7.6	0.810	210.5	49.4	7.6	0.750	47.0	29%	267
160.9	59.5	5.3	0.529	218.1	49.5	7.6	0.990	213.2	49.5	7.6	0.900	53.1	32%	268
167.2	59.2	5.9	0.560	216.1	49.4	7.5	0.840	214.8	49.5	7.6	0.990	53.7	33%	269
161.5	59.1	5.9	0.488	213.0	49.5	7.5	0.930	206.8	49.5	7.5	0.960	47.1	28%	270
160.5	59.0	5.7	0.632	207.5	49.5	7.5	0.990	208.7	49.5	7.6	0.750	46.1	29%	271
160.8	59.2	5.5	0.549	208.9	49.5	7.5	0.930	206.9	49.5	7.5	0.870	46.9	29%	272
158.1	59.1	5.3	0.624	203.8	49.4	7.4	0.900	210.9	49.5	7.5	0.990	42.2	26%	273
155.2	59.6	4.2	0.558	207.0	49.5	7.5	0.840	204.7	49.5	7.5	0.840	47.7	30%	274
153.9	59.8	4.4	0.512	206.2	49.4	7.4	0.720	209.8	49.6	7.4	0.840	48.7	31%	275
157.9	59.9	4.4	0.453	205.6	49.5	7.3	0.840	205.0	49.5	7.4	1.020	49.3	32%	276
155.1	59.8	4.3	0.377	206.3	49.6	7.3	0.870	206.7	49.5	7.2	0.810	52.8	34%	277
152.4	60.0	4.2	0.393	202.5	49.4	7.4	0.990	203.2	49.5	7.3	0.840	42.6	27%	278
151.4	60.0	4.3	0.442	203.4	49.5	7.2	0.960	204.3	49.5	7.2	0.750	49.2	32%	279
147.7	59.8	4.4	0.437	202.6	49.6	7.2	0.690	205.8	49.6	7.2	0.750	47.6	31%	280
153.4	59.5	5.2	0.584	203.1	49.4	7.2	0.990	199.9	49.6	7.2	0.840	44.8	28%	281
151.4	59.6	4.6	0.519	202.0	49.6	7.2	0.780	202.3	49.6	7.1	0.870	48.6	32%	282
151.0	59.5	4.5	0.528	201.5	49.6	7.1	0.900	199.1	49.6	7.2	0.870	52.7	35%	283
145.7	59.8	4.3	0.513	199.2	49.4	7.1	0.810	199.4	49.6	7.2	0.810	48.8	32%	284
148.7	59.9	4.1	0.475	199.3	49.6	7.0	0.840	199.1	49.6	7.0	0.840	46.9	31%	285
146.6	60.0	4.1	0.508	199.5	49.5	7.0	0.810	195.6	49.5	7.0	0.780	50.8	34%	286
147.5	59.9	4.2	0.450	196.0	49.6	7.1	0.810	197.2	49.5	7.0	0.720	50.1	34%	287
143.5	59.9	4.1	0.450	196.1	49.5	6.9	0.990	198.1	49.5	7.0	0.750	45.9	31%	288
146.0	60.0	4.0	0.419	194.6	49.5	7.0	0.780	193.7	49.5	7.0	0.810	48.7	33%	289
146.7	59.8	4.4	0.437	196.5	49.5	6.9	0.810	194.2	49.5	6.9	0.840	47.7	32%	290
145.1	59.7	4.0	0.424	191.1	49.6	6.9	0.840	198.6	49.6	6.8	0.690	44.5	30%	291
140.5	60.0	3.9	0.411	191.2	49.6	6.9	0.750	193.4	49.6	6.9	0.720	49.2	35%	292
141.6	60.0	3.8	0.434	188.8	49.6	6.8	0.840	188.9	49.6	6.7	0.840	48.6	35%	293
141.9	60.0	3.8	0.420	189.6	49.6	6.8	0.720	188.8	49.6	6.9	0.780	46.4	32%	294
140.3	60.0	3.8	0.404	192.1	49.7	6.8	0.690	185.8	49.5	6.7	0.660	49.4	35%	295
138.1	60.0	3.8	0.431	188.3	49.6	6.7	0.810	189.2	49.6	6.7	0.720	47.6	34%	296
136.3	60.0	3.6	0.354	183.1	49.6	6.7	0.780	191.8	49.6	6.7	0.720	44.1	32%	297
141.0	60.0	3.7	0.317	184.0	49.4	6.6	0.810	187.6	49.5	6.6	0.750	44.5	32%	298
140.5	60.0	3.9	0.389	184.5	49.5	6.7	0.660	183.9	49.6	6.6	0.720	46.1	33%	299
139.7	59.9	3.9	0.393	183.8	49.6	6.5	0.660	181.7	49.6	6.6	0.780	45.9	33%	300

301	141.6	59.8	4.3	0.440	136.8	60.5	2.7	0.327	135.4	59.8	3.1	0.427	137.0	59.7	3.3	0.497
302	140.0	59.5	4.4	0.440	133.5	60.5	2.8	0.332	136.8	60.0	3.1	0.390	137.5	59.9	3.1	0.460
303	137.0	59.5	4.2	0.448	132.9	60.4	2.7	0.498	136.6	60.0	2.9	0.420	135.6	59.7	3.2	0.423
304	135.6	59.7	4.0	0.383	134.0	60.6	2.7	0.391	137.3	60.0	2.9	0.368	135.4	59.8	3.2	0.401
305	139.1	59.6	4.9	0.497	131.7	60.5	2.7	0.371	130.7	60.0	2.9	0.360	136.4	59.7	3.5	0.458
306	137.8	59.3	4.4	0.477	132.4	60.6	2.6	0.362	134.5	60.0	3.2	0.420	136.5	59.6	3.2	0.326
307	136.2	59.1	4.8	0.528	129.4	60.6	2.6	0.313	135.5	59.8	3.4	0.457	132.1	59.8	3.1	0.338
308	134.5	59.3	4.5	0.456	130.9	60.5	2.7	0.337	132.0	59.9	3.1	0.372	133.0	59.9	3.0	0.344
309	137.7	59.3	4.2	0.454	128.9	60.5	2.5	0.319	130.1	60.0	2.9	0.351	132.7	59.9	3.0	0.367
310	135.1	59.3	4.1	0.484	129.3	60.8	2.7	0.396	130.9	60.0	2.9	0.378	131.0	60.0	2.9	0.340
311	133.5	59.6	4.0	0.475	129.8	60.6	2.6	0.266	130.3	60.0	2.9	0.378	128.1	60.0	2.9	0.351
312	132.2	59.8	3.7	0.341	131.3	60.6	2.6	0.312	130.7	60.0	2.8	0.370	131.4	60.0	2.9	0.372
313	132.2	59.9	3.8	0.421	129.2	60.6	2.6	0.317	131.1	60.0	2.8	0.357	127.1	60.0	2.8	0.391
314	129.7	59.8	3.7	0.384	127.5	60.0	2.8	0.413	129.9	60.4	2.7	0.363	128.0	60.0	2.9	0.354
315	129.5	59.9	3.7	0.367	126.7	60.3	2.6	0.382	129.4	60.0	2.8	0.396	129.4	60.0	2.9	0.349
316	127.4	59.8	3.7	0.366	125.3	60.5	2.6	0.321	127.1	60.0	2.8	0.363	129.8	60.0	2.8	0.374
317	128.0	60.0	3.6	0.354	124.8	60.6	2.6	0.389	127.3	60.0	2.8	0.358	127.9	60.0	2.9	0.312
318	127.2	60.0	3.4	0.364	125.6	60.6	2.6	0.433	128.5	59.8	3.2	0.481	125.9	60.0	2.8	0.291
319	127.8	60.0	3.6	0.422	125.6	60.7	2.5	0.406	129.9	59.6	3.3	0.509	127.0	60.0	2.7	0.305
320	125.1	59.9	3.7	0.431	126.9	60.7	2.6	0.388	127.2	60.0	2.8	0.458	126.0	60.0	2.7	0.350
321	126.6	60.0	3.3	0.408	126.2	60.0	2.7	0.348	127.3	60.0	3.2	0.518	124.7	60.0	2.7	0.371
322	124.5	60.0	3.7	0.476	123.9	60.0	2.6	0.412	123.5	60.0	2.7	0.444	124.1	59.8	3.2	0.447
323	123.9	59.9	3.6	0.419	123.3	60.1	2.6	0.406	123.5	59.8	3.0	0.436	128.8	59.5	3.2	0.488
324	124.8	59.6	3.7	0.423	124.5	60.5	2.7	0.284	125.3	60.0	2.8	0.319	125.7	59.6	3.3	0.509
325	123.6	59.7	3.8	0.392	124.6	60.0	3.0	0.381	124.6	60.0	2.7	0.397	124.9	59.8	3.0	0.496
326	125.5	59.8	3.7	0.370	124.6	59.9	2.9	0.341	124.7	59.8	3.1	0.470	124.7	59.8	2.8	0.414
327	124.5	59.5	3.7	0.386	122.8	59.9	2.8	0.326	123.9	59.8	2.8	0.453	124.5	60.0	2.9	0.428
328	121.8	59.9	3.5	0.316	122.5	60.3	2.5	0.349	120.0	60.1	2.8	0.323	125.8	59.8	3.1	0.360
329	124.0	59.9	3.5	0.418	119.9	60.5	2.5	0.362	123.4	60.0	2.7	0.344	122.8	59.6	3.0	0.382
330	121.6	60.0	3.3	0.293	121.4	60.0	2.6	0.371	123.8	59.9	2.9	0.361	122.8	59.5	3.1	0.347
331	119.5	60.0	3.3	0.347	121.4	60.0	2.9	0.417	122.5	59.9	2.9	0.403	124.4	59.4	3.0	0.403
332	120.9	60.2	3.3	0.347	121.5	60.0	2.6	0.333	119.2	59.9	2.8	0.342	122.8	59.5	2.8	0.334
333	121.1	60.0	3.3	0.340	120.2	60.1	2.5	0.309	124.1	59.9	3.0	0.428	120.6	60.0	2.8	0.310
334	122.2	60.1	3.4	0.306	118.5	60.4	2.4	0.374	122.1	59.6	3.0	0.456	121.9	59.7	2.9	0.361
335	118.4	60.0	3.3	0.309	118.2	60.6	2.3	0.369	120.0	60.0	2.5	0.415	120.9	59.8	2.7	0.365
336	120.4	59.9	3.3	0.309	119.7	60.5	2.6	0.373	118.6	60.0	2.7	0.356	117.9	60.0	2.5	0.353
337	118.6	60.0	3.2	0.289	118.9	60.1	2.6	0.416	119.7	60.0	2.7	0.334	116.9	60.5	2.5	0.447
338	119.5	60.0	3.3	0.334	119.7	60.1	2.3	0.471	118.1	60.0	2.8	0.353	119.8	60.1	2.7	0.464
339	119.0	59.9	3.1	0.348	120.2	60.4	2.5	0.338	120.4	59.9	2.9	0.338	120.0	60.3	2.4	0.465
340	118.0	60.0	3.3	0.365	116.5	60.4	2.5	0.352	119.9	59.6	2.8	0.308	119.0	60.2	2.7	0.449
341	117.7	60.1	3.0	0.343	119.3	60.5	2.4	0.354	119.0	60.0	2.6	0.383	117.4	60.0	2.6	0.353
342	116.9	60.0	3.3	0.357	114.8	60.4	2.3	0.426	119.2	60.0	2.7	0.371	117.2	60.0	2.7	0.399
343	118.1	59.8	3.3	0.277	115.4	60.5	2.3	0.394	117.2	59.8	2.8	0.364	114.6	60.2	2.5	0.286
344	117.4	59.9	3.2	0.329	116.1	60.5	2.3	0.411	119.7	59.5	2.8	0.356	116.9	60.0	2.7	0.321
345	117.5	59.9	3.3	0.326	115.2	60.6	2.3	0.424	115.9	59.7	2.8	0.378	118.8	59.8	2.8	0.351
346	116.6	59.9	3.2	0.337	113.9	60.6	2.3	0.459	117.5	59.9	2.5	0.332	118.2	60.0	2.6	0.421
347	117.6	59.9	3.4	0.346	115.2	60.5	2.3	0.466	116.5	60.0	2.7	0.346	116.9	59.8	2.6	0.387
348	119.6	59.7	3.6	0.341	115.0	60.6	2.4	0.357	115.6	60.2	2.5	0.340	115.2	59.9	2.7	0.318
349	116.4	59.6	3.4	0.402	115.2	60.5	2.3	0.269	115.5	60.0	2.6	0.278	115.7	60.0	2.5	0.342
350	118.4	59.6	3.4	0.390	112.1	60.4	2.3	0.320	115.8	60.0	2.6	0.337	117.5	60.0	2.7	0.365
351	117.3	59.8	3.5	0.430	116.2	60.6	2.3	0.350	115.9	59.8	2.8	0.363	116.8	59.8	2.5	0.339
352	114.1	59.9	3.2	0.412	117.5	60.3	2.5	0.289	117.5	59.5	2.8	0.370	116.9	59.9	2.8	0.367
353	116.4	59.9	3.1	0.363	115.3	60.2	2.4	0.375	115.8	59.9	2.5	0.364	117.8	59.5	2.8	0.424
354	116.2	59.9	3.5	0.405	115.3	60.5	2.2	0.330	114.5	60.1	2.4	0.266	117.3	59.5	2.7	0.343
355	117.0	59.6	3.8	0.479	112.4	60.4	2.3	0.381	115.1	60.2	2.5	0.332	115.5	60.0	2.5	0.298
356	118.2	59.4	3.5	0.386	115.1	60.5	2.3	0.299	113.0	60.2	2.5	0.330	114.3	60.0	2.5	0.335
357	116.1	59.6	3.3	0.476	116.3	60.4	2.4	0.301	113.1	60.2	2.5	0.344	114.5	60.2	2.4	0.307
358	114.2	59.7	3.5	0.493	113.3	60.4	2.2	0.402	115.6	60.3	2.5	0.308	116.5	60.0	2.6	0.301
359	115.1	59.9	3.3	0.440	115.1	60.6	2.4	0.433	113.7	60.0	2.6	0.272	116.3	59.9	2.8	0.356
360	115.1	59.9	3.1	0.356	114.2	60.4	2.3	0.272	114.6	60.1	2.5	0.362	114.8	59.9	2.7	0.346
361	114.5	60.0	3.2	0.359	112.7	60.4	2.3	0.351	113.2	60.2	2.5	0.402	115.4	59.6	2.7	0.440
362	113.9	59.9	3.2	0.351	112.9	60.4	2.4	0.363	115.4	60.2	2.3	0.322	113.6	59.4	2.9	0.480
363	115.1	60.0	3.1	0.356	113.8	60.3	2.4	0.313	114.4	60.3	2.5	0.360	115.0	59.6	2.7	0.453
364	114.7	60.0	3.3	0.410	113.9	60.4	2.2	0.409	112.9	60.2	2.4	0.283	114.8	59.7	2.8	0.502
365	114.5	59.9	3.2	0.357	114.4	60.4	2.5	0.420	113.1	60.2	2.5	0.370	112.9	59.4	2.8	0.515
MAX	214.2	60.4	11.2	1.041	206.8	60.8	5.8	1.008	206.8	60.5	6.6	1.025	208.4	60.6	9.7	1.035
MIN	113.7	48.2	3.0	0.277	111.0	59.4	2.2	0.241	112.9	58.9	2.3	0.266	112.9	53.9	2.3	0.285
AVE	158.4	59.0	5.6	0.602	155.4	60.1	3.4	0.426	156.8	59.8	3.8	0.487	158.0	59.2	4.7	0.551

138.3	59.8	4.0	0.359	185.4	49.6	6.6	0.900	184.2	49.5	6.6	0.900	43.8	31%	301
139.6	59.7	4.1	0.438	185.0	49.4	6.6	0.720	180.5	49.6	6.6	0.720	45.0	32%	302
136.4	59.8	4.0	0.421	185.6	49.6	6.5	0.720	183.4	49.7	6.5	0.720	48.6	35%	303
138.0	59.7	3.9	0.365	183.1	49.7	6.5	0.780	173.7	49.6	6.4	0.750	47.5	35%	304
134.7	60.0	3.8	0.394	180.7	49.6	6.4	0.810	183.6	49.6	6.5	0.840	41.6	30%	305
135.1	59.8	4.1	0.415	178.8	49.6	6.4	0.720	177.6	49.7	6.4	0.780	41.0	30%	306
137.2	59.4	4.2	0.479	181.6	49.5	6.4	0.690	178.6	49.6	6.4	0.690	45.4	33%	307
136.5	59.4	4.2	0.513	179.1	49.6	6.4	0.870	177.3	49.6	6.3	0.750	44.6	33%	308
136.1	59.6	4.3	0.501	178.4	49.6	6.4	0.810	178.9	49.6	6.3	0.660	40.7	30%	309
132.7	59.5	3.7	0.388	175.2	49.6	6.2	0.600	173.0	49.6	6.3	0.720	40.1	30%	310
131.7	60.0	3.7	0.440	175.8	49.6	6.3	0.720	174.5	49.6	6.3	0.780	42.3	32%	311
130.9	59.9	3.6	0.395	174.5	49.7	6.3	0.690	176.3	49.6	6.3	0.930	42.3	32%	312
128.2	60.0	3.5	0.307	173.7	49.5	6.2	0.720	173.7	49.8	6.3	0.870	41.5	31%	313
127.4	60.0	3.5	0.347	173.9	49.5	6.3	0.720	177.9	49.6	6.2	0.810	44.2	34%	314
128.4	60.0	3.4	0.379	171.6	49.7	6.2	0.690	171.1	49.8	6.1	0.870	42.1	33%	315
128.5	60.4	3.4	0.400	172.4	49.6	6.1	0.630	174.0	49.7	6.2	0.690	45.0	35%	316
127.5	60.3	3.3	0.456	173.3	49.6	6.2	0.690	172.2	49.7	6.1	0.810	45.3	35%	317
127.5	60.3	3.3	0.409	170.5	49.7	6.1	0.660	170.2	49.7	6.2	0.900	43.3	34%	318
126.3	60.3	3.3	0.396	172.3	49.7	6.0	0.750	171.1	49.7	6.0	0.600	44.5	35%	319
124.8	60.0	3.3	0.466	170.6	49.7	6.1	0.630	170.9	49.7	6.1	0.690	45.5	36%	320
125.1	60.5	3.3	0.507	168.8	49.7	6.1	0.750	168.6	49.7	6.0	0.720	42.2	33%	321
125.6	60.3	3.2	0.521	168.8	49.7	6.0	0.660	168.4	49.7	6.1	0.810	44.3	36%	322
123.4	60.4	3.4	0.478	169.5	49.7	6.0	0.840	167.7	49.7	6.0	0.600	45.6	37%	323
123.3	60.0	3.8	0.505	166.5	49.7	6.0	0.720	168.3	49.6	6.0	0.630	41.7	33%	324
122.2	59.9	3.5	0.498	168.3	49.7	5.9	0.660	165.9	49.6	6.0	0.630	44.7	36%	325
125.5	60.0	3.5	0.375	170.0	49.7	5.9	0.720	166.6	49.8	5.8	0.660	44.5	35%	326
120.8	60.0	3.6	0.437	164.9	49.7	6.0	0.660	165.7	49.7	6.0	0.600	40.4	32%	327
121.8	60.0	3.3	0.375	167.6	49.7	5.9	0.600	166.2	49.7	5.9	0.600	45.8	38%	328
122.7	60.2	3.3	0.361	164.3	49.7	5.9	0.630	165.1	49.7	5.9	0.810	40.3	33%	329
122.2	60.0	3.3	0.317	164.7	49.8	5.8	0.570	165.7	49.7	5.8	0.570	43.1	35%	330
121.3	60.2	3.2	0.304	162.2	49.6	5.8	0.630	166.1	49.7	5.8	0.720	42.7	36%	331
119.9	60.3	3.2	0.344	162.5	49.8	5.8	0.720	161.9	49.7	5.9	0.660	41.6	34%	332
121.2	60.4	3.1	0.376	160.6	49.8	5.8	0.570	163.3	49.8	5.8	0.690	39.5	33%	333
120.2	60.3	3.2	0.378	163.9	49.7	5.8	0.660	163.1	49.7	5.8	0.660	41.7	34%	334
120.7	60.0	3.2	0.378	163.0	49.7	5.8	0.570	158.7	49.8	5.7	0.780	44.6	38%	335
119.7	60.0	3.5	0.459	162.0	49.7	5.7	0.720	160.9	49.7	5.7	0.630	41.6	35%	336
121.0	60.0	3.3	0.358	163.5	49.7	5.8	0.660	161.6	49.7	5.8	0.630	44.9	38%	337
119.0	59.9	3.3	0.323	161.9	49.7	5.7	0.600	160.1	49.7	5.7	0.600	42.4	35%	338
117.7	60.0	3.2	0.260	158.6	49.8	5.7	0.570	158.8	49.7	5.7	0.750	39.6	33%	339
118.8	60.2	3.1	0.405	158.5	49.6	5.8	0.600	160.5	49.7	5.7	0.570	40.5	34%	340
115.7	60.3	3.1	0.449	157.6	49.8	5.6	0.780	159.5	49.7	5.7	0.720	39.9	34%	341
119.2	60.2	3.1	0.412	160.5	49.7	5.7	0.690	158.5	49.8	5.7	0.630	43.6	37%	342
119.8	60.4	3.1	0.344	159.1	49.8	5.6	0.570	158.2	49.7	5.7	0.720	41.0	35%	343
116.0	60.2	3.1	0.323	155.3	49.7	5.6	0.660	156.2	49.8	5.6	0.780	37.9	32%	344
116.9	60.3	3.1	0.296	157.4	49.7	5.6	0.690	156.9	49.7	5.6	0.570	39.9	34%	345
118.2	60.2	3.1	0.355	156.9	49.8	5.7	0.600	159.1	49.7	5.6	0.570	40.3	35%	346
115.8	60.2	2.9	0.387	157.5	49.7	5.6	0.570	156.1	49.8	5.6	0.630	39.9	34%	347
116.3	60.3	3.1	0.429	157.3	49.7	5.6	0.570	156.4	49.7	5.6	0.600	37.7	32%	348
116.4	60.3	3.0	0.273	157.5	49.7	5.6	0.750	158.9	49.8	5.6	0.570	41.1	35%	349
115.0	60.4	2.9	0.333	155.3	49.8	5.5	0.540	156.3	49.7	5.6	0.630	36.9	31%	350
115.0	60.3	3.2	0.411	156.4	49.7	5.6	0.660	155.6	49.7	5.6	0.660	39.1	33%	351
115.8	60.1	3.0	0.368	158.9	49.7	5.5	0.720	154.7	49.7	5.5	0.630	44.8	39%	352
115.1	60.1	3.2	0.419	156.1	49.8	5.6	0.630	152.6	49.7	5.6	0.720	39.7	34%	353
117.0	60.0	3.3	0.406	157.4	49.8	5.6	0.810	155.9	49.7	5.6	0.660	41.2	35%	354
114.8	59.7	3.2	0.364	156.8	49.7	5.6	0.660	155.3	49.7	5.6	0.720	39.8	34%	355
115.4	60.0	3.2	0.293	157.6	49.8	5.5	0.720	154.8	49.8	5.6	0.690	39.4	33%	356
114.4	59.9	3.2	0.355	154.3	49.7	5.5	0.660	151.9	49.8	5.5	0.630	38.2	33%	357
115.9	60.0	3.2	0.391	156.3	49.7	5.5	0.660	154.3	49.8	5.5	0.660	42.1	37%	358
115.4	60.0	3.2	0.371	155.2	49.8	5.6	0.690	155.9	49.7	5.5	0.540	40.1	35%	359
115.0	60.0	3.2	0.314	155.9	49.8	5.5	0.510	155.3	49.7	5.6	0.720	40.8	35%	360
115.5	59.9	3.2	0.268	154.0	49.8	5.5	0.660	155.5	49.7	5.6	0.600	39.5	34%	361
115.4	59.9	3.1	0.275	155.7	49.7	5.5	0.660	154.9	49.8	5.5	0.630	41.8	37%	362
114.9	60.0	3.2	0.376	152.4	49.8	5.5	0.720	157.1	49.7	5.5	0.660	37.3	32%	363
114.1	60.0	3.1	0.382	157.9	49.7	5.5	0.570	154.2	49.7	5.5	0.630	43.2	38%	364
112.2	60.2	3.0	0.315	156.3	49.7	5.5	0.720	154.5	49.7	5.5	0.630	41.8	37%	365
210.3	60.6	10.3	1.020	268.4	49.8	9.4	1.350	272.7	49.9	9.4	1.230	74.9	41%	MAX
112.2	51.7	2.9	0.260	152.4	49.1	5.5	0.510	151.6	49.0	5.5	0.540	36.9	19%	MIN
157.2	59.7	4.9	0.552	208.4	49.5	7.4	0.850	208.3	49.5	7.4	0.849	50.0	32%	AVE

F. Consumption and Savings graphs