SIMPLE PAYBACK EVALUATION UPON REPLACEMENT OF A DOMESTIC TRADITIONAL WITH A RENEWABLE SPACE CONDITIONING DEVICE.

University of Fort Hare
Together in Excellence

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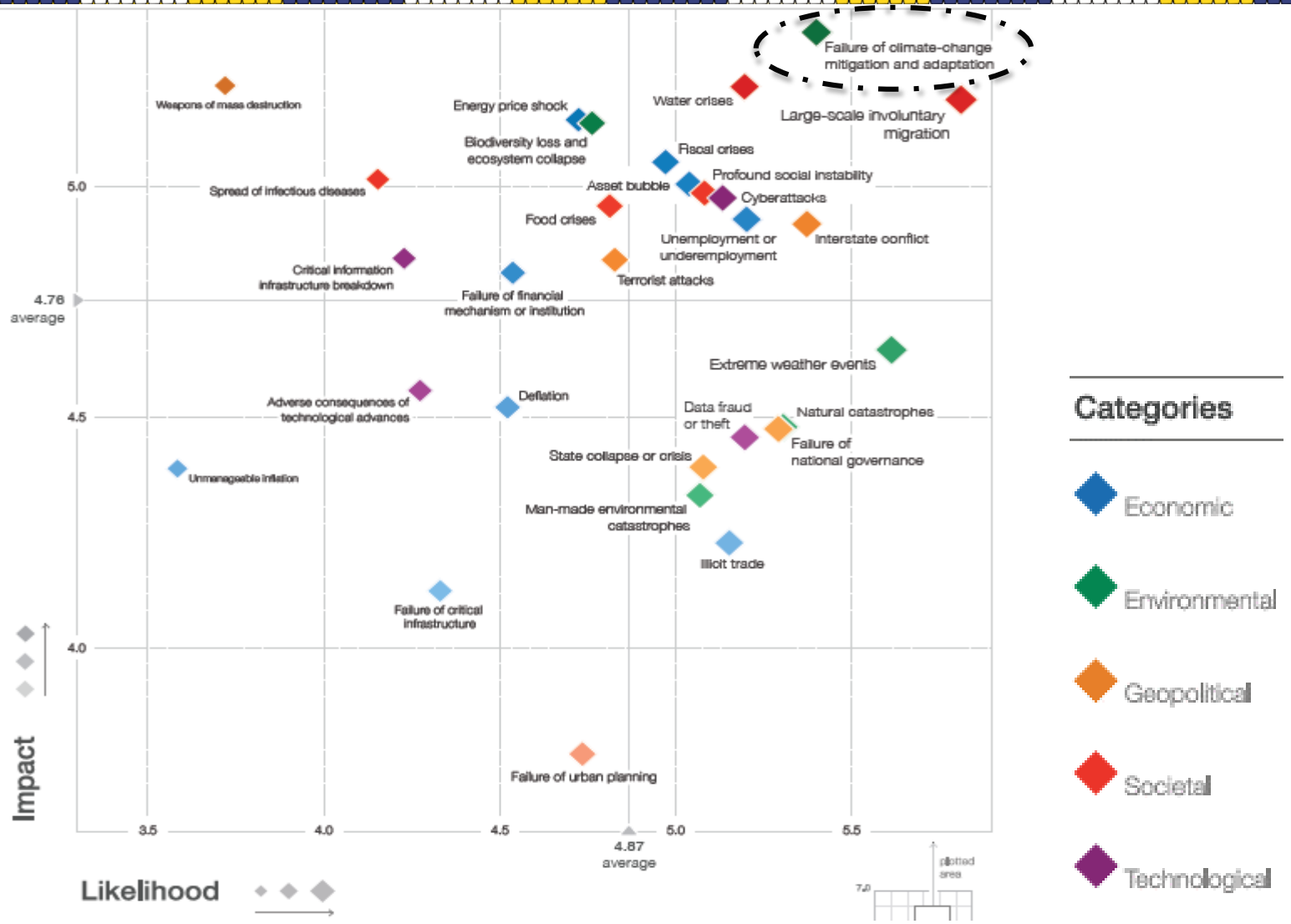
Outline

- Introduction
- Aim and Objectives
- Research Methodology
- Results
- Conclusion

Introduction – Global Risks Landscape 2016



Introduction cont…

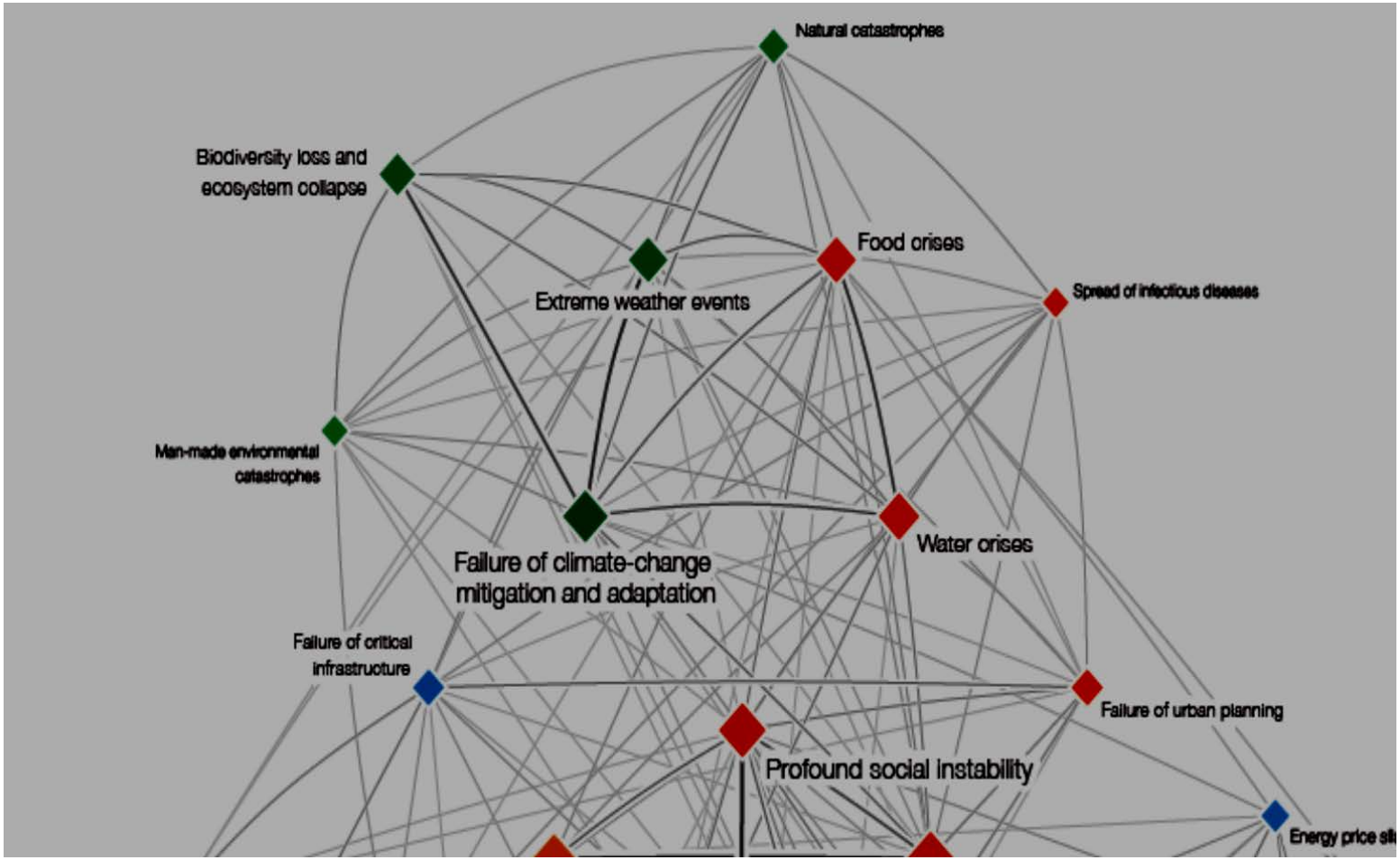


Figure 2: Immediate global risks originating from climate change

Introduction cont…

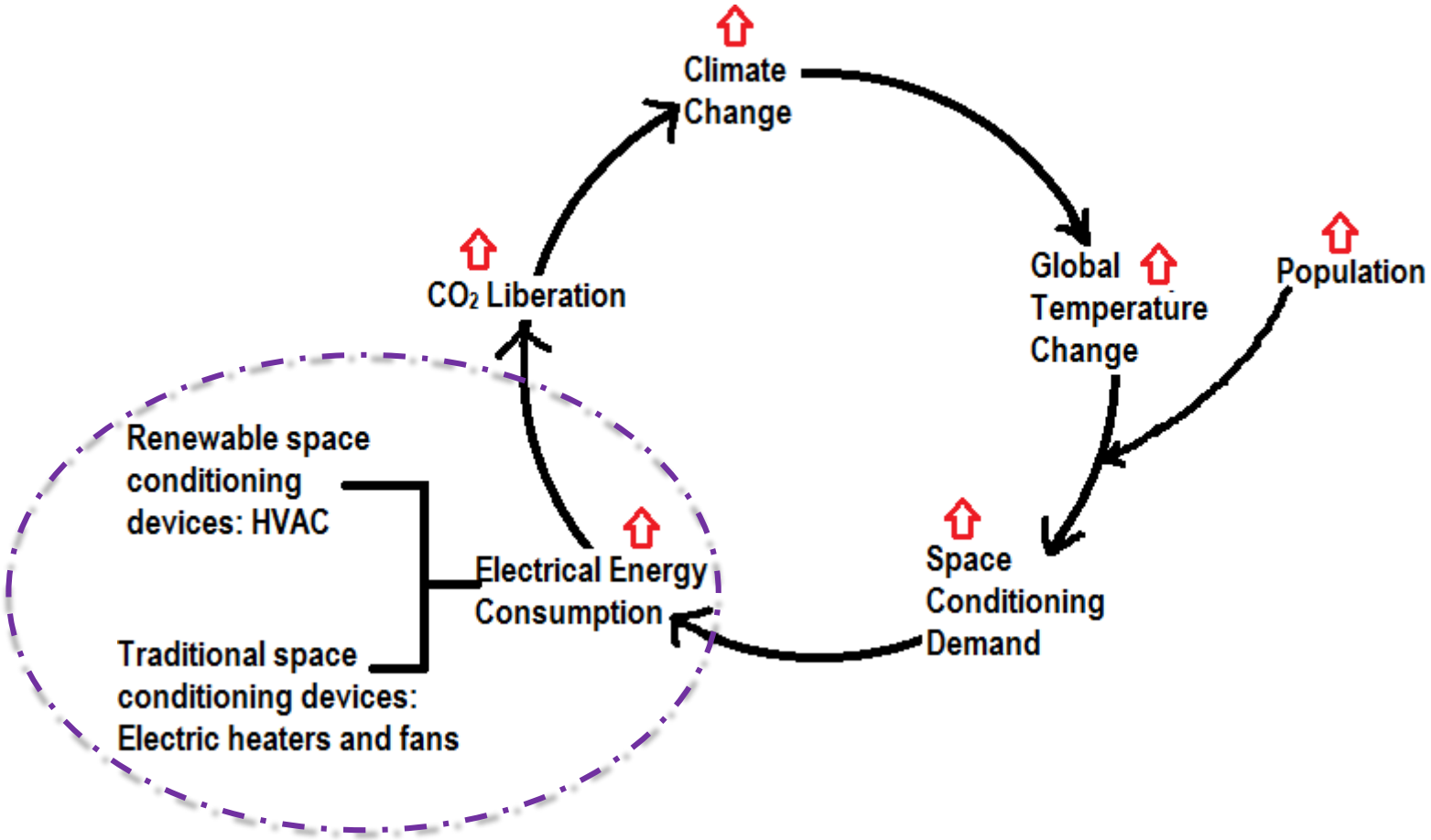


Figure 3: Climate change cycle for space conditioning

Aim and Objectives

Increase the awareness on the potential energy savings and long term benefits embedded in replacing a fan and a heater with a split-type AC in a residential sector

This will be achieved by

- Monitoring the energy consumption and performance of the AC system during both winter and summer
- Deducing the performance of the traditional space conditioning devices from that of the AC
- These monitored performances are then compared and the difference computed which is the energy savings.

Research Methodology

- The AC, heater and fan for 8.43x4.25x3.00m^3 house was sized
- The daily consumption of the fan and heater was deduced from that of the AC using AC heating and cooling COP (COP_h and COP_c)

Where

$$E_{dH} = E_{dh} \times COP_h$$

$$E_{dF} = E_{dc} \times COP_c$$

$$E_{sav} = E_{fh} - E_{ac}$$

E_{dH} = daily heater energy

E_{dF} = daily fan energy

E_{dh} = daily AC heating energy

E_{dc} = daily AC cooling energy

E_{sav} = total yearly energy savings

E_{fh} = total yearly fan and heater consumption

E_{ac} = total yearly AC consumption

Research Methodology cont…

- In the AC was installed temperature sensors and energy meters as shown in fig 2
- Data was logged in 5mins interval for a period of 6months (May – December) and later integrated to daily average in 30mins interval
- For the experiment, the AC ran daily for a monitoring interval of 07:00 to 22:00
- This is the assumed time interval for room activities
- The heating and cooling set temperature was 27^{o}C and 25^{o}C respectively

Research Methodology cont…

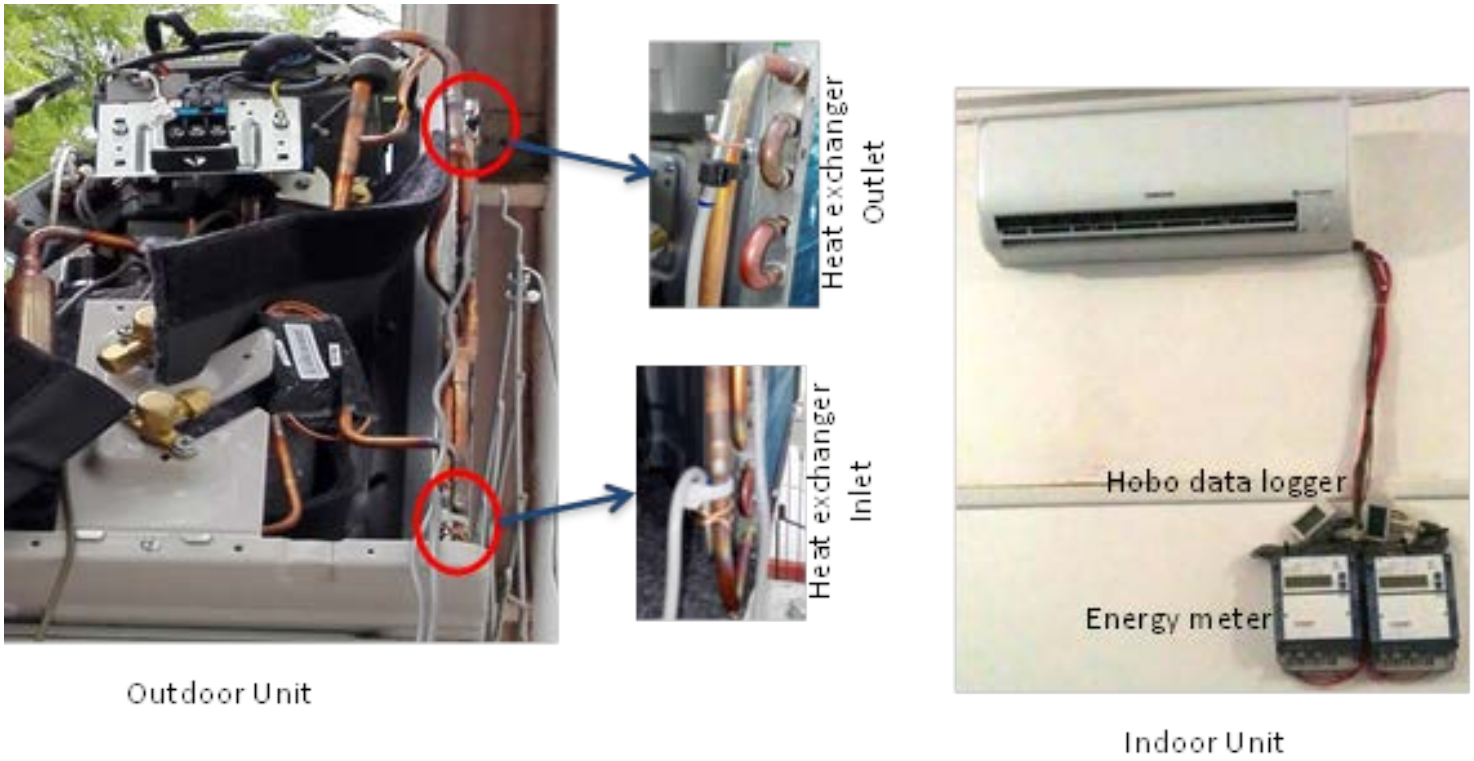


Figure 5: Photo of DAS

Research Methodology cont…

Table 1: Per kWh values for emission and water consumption

Parameter	**H_2O (l)**	**CO_2 (kg)**	**NO_x (kg)**	**SO_x (kg)**
Qty/kWh	1.41	0.92	0.0042	0.0083

Results – Winter Performance

- Ambient temperature for an average winter day is between 8°C and 22°C.
- The daily heating demand ranges from 0.45kW to 0.7kW.

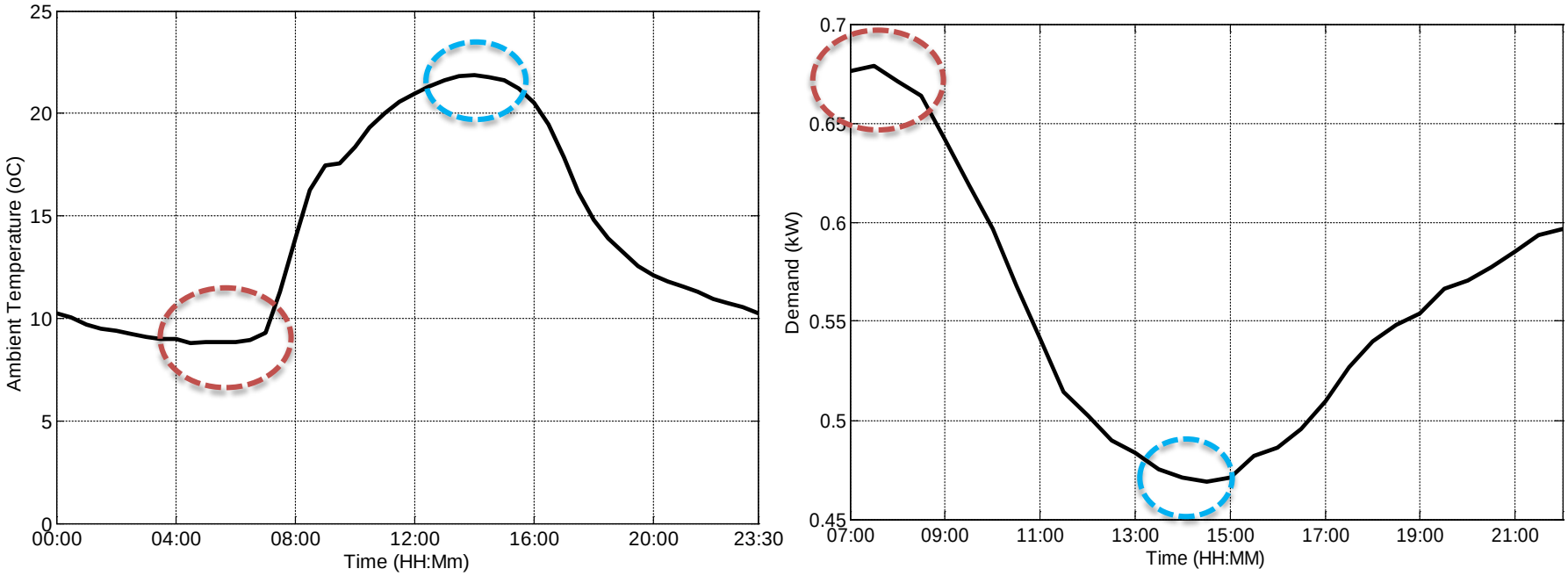
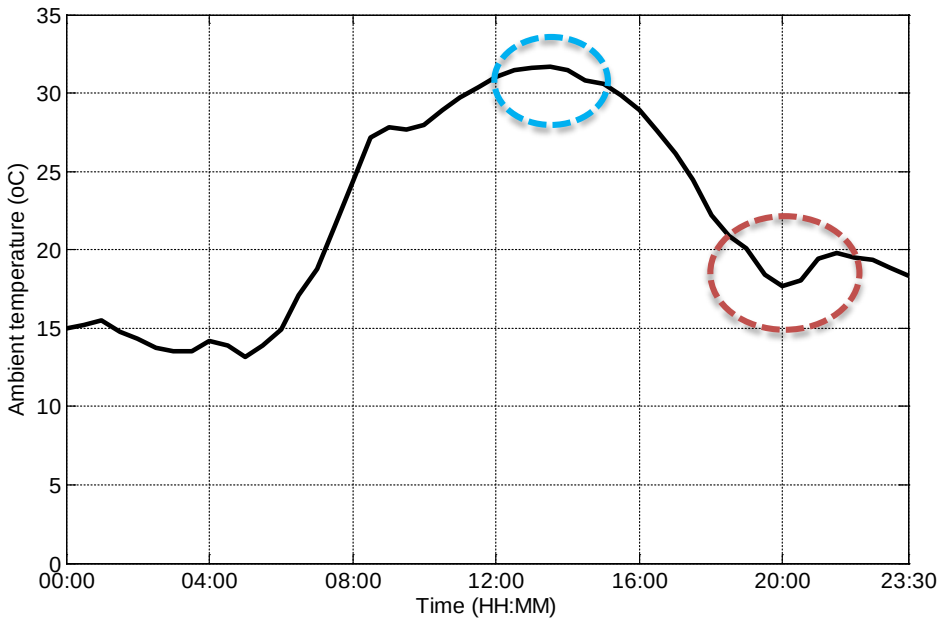


Figure 6: Average winter day ambient temperature and demand profile

Results – Summer Performance

- Ambient temperature for an average summer day is between 12 and 32°C
- Average day demand ranges from about 0.08kW to 0.8kW.



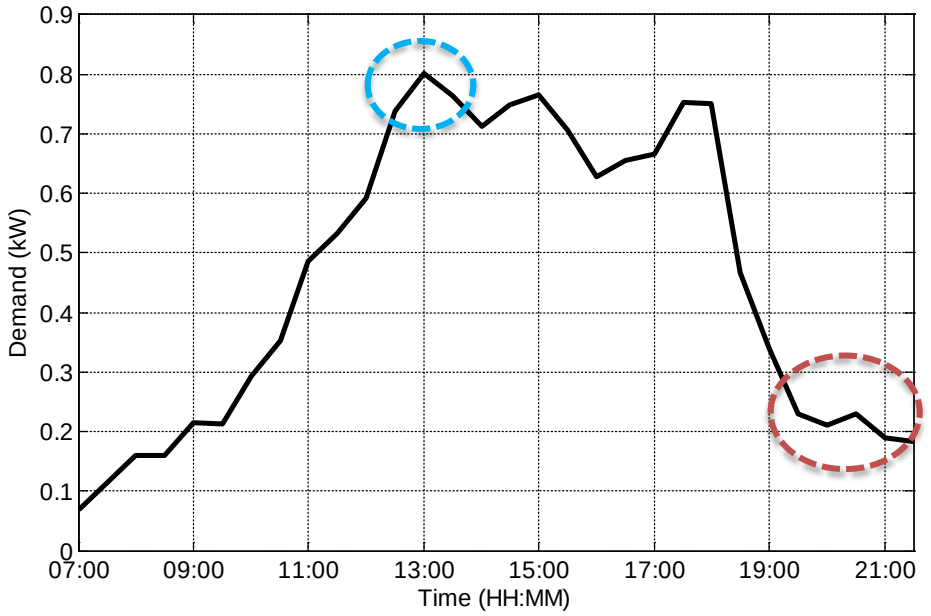


Figure 7: Average summer day ambient temperature and demand profile

Results – Energy Computations

- Daily average COP_h and COPc were respectively 2.1 and 2.26

Table 2: Summary of heating and cooling energy consumption

Duration	Traditional Device Energy (kWh)		HVAC Energy (kWh)	
	Heating	Cooling	Heating	Cooling
Daily	17.58	2.58	8.37	1.14
Months with 30 days	1,054.80	227.04	502.20	100.32
Months with 31 days	1,634.94	319.92	778.41	141.36
Yearly Heating Total	**2,689.74**	**546.96**	**1,280.61**	**241.68**

- Yearly winter E_{sav} is 1,409.13kWh (52.4%) and for a Eskom flat rate of R1.30, it is equivalent to R1,831.9

- For summer, yearly energy saving is 305.28kWh (55.8%) equivalent to R396.9

Results – H_2O & CO_2 Emission Reduction

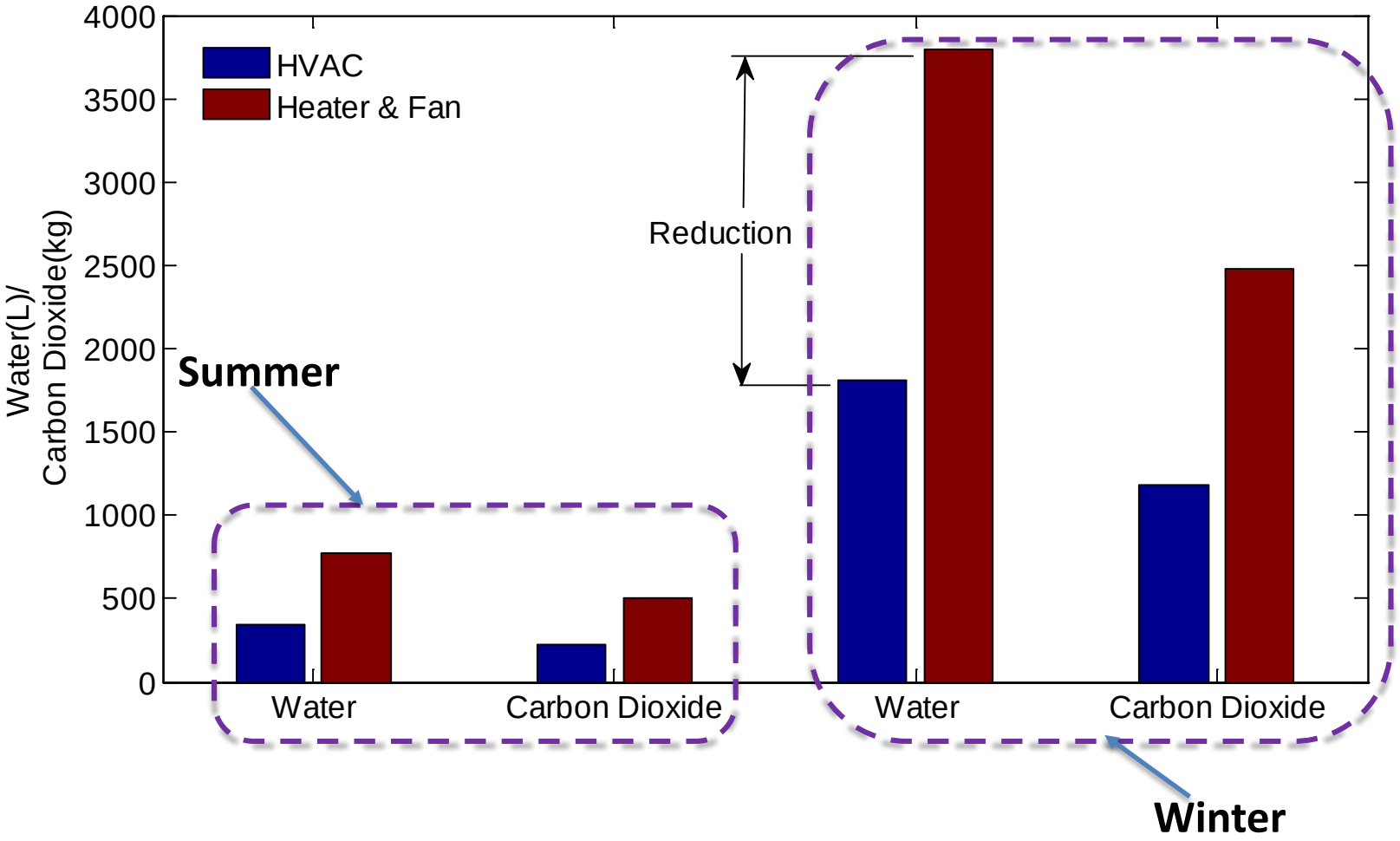


Figure 8: H_2O and CO_2 reduction bar chart for both devices

Results – SO_x and NO_x Reduction

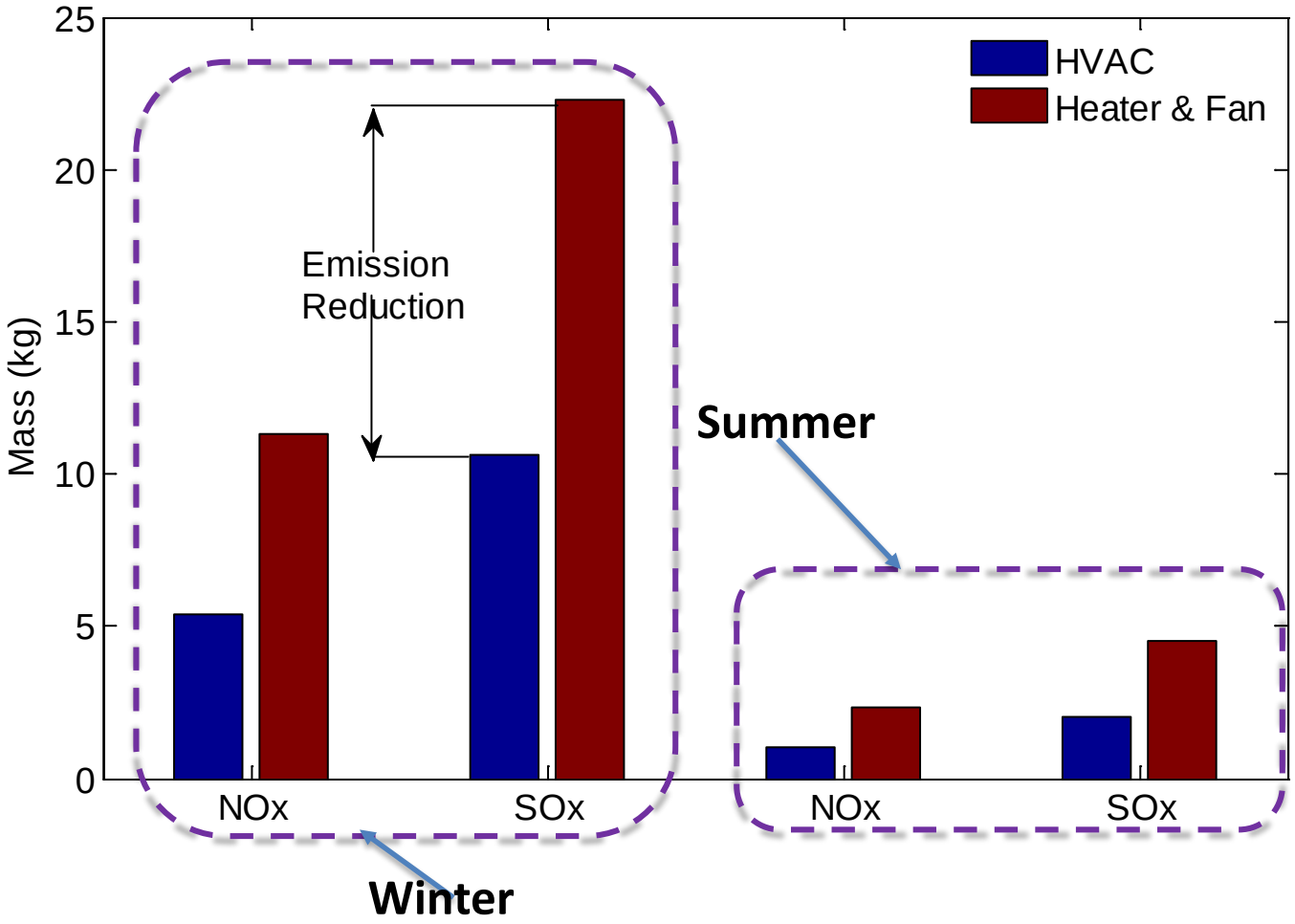


Figure 9: SO_x and NO_x reduction bar chart for both devices

Results – Winter Performance cont…

Table 3: Yearly GHGs, CO_2 emission and water consumption for entire space conditioning

	H_2O (l)	CO_2(kg)	NO_x(kg)	SO_x(kg)
Summer Reduction	1,986.80	1,296.40	5.91	11.70
Winter Reduction	430.44	280.85	1.29	2.53
Annual Reduction	**2,417.24**	**1,577.25**	**7.20**	**14.23**

- 52.4% and 55.8% reduction in GHG emission and water utilisation due to the replacement in winter and summer respectively
- Total yearly energy savings is 1,714.41kWh (52.9%), with monetary equivalence of R2,228.9 per annum when a split-type AC represents a heater and fan
- The payback of the system was computed to be about 4.9years as long as simple maintenance of constantly cleaning the filters is done monthly

Conclusion

Replacing heaters and fans with a split-type AC in the residential sector significantly reduces cost of energy consumption, production and national and global environmental hazards.

Though little, it will contribute to reducing the annual 2% water consumption by Eskom so as to combat water crisis

More savings will be achieved supposing the analysis is carried out over a 24hour period

It is recommended that a 24hour cooling and heating analysis be done to have a clearer picture on the total daily consumption and payback period

Acknowledgement

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Closing Remarks

THANK YOU

For your kind attention!!!