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Faculty of Engineering, Built Environment and Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie / Lefapha la Boetšenere, Tikologo ya Kago le Theknolotši ya Tshedimošo

1956 – 2016 60 years of Engineering Education

A RADIO FREQUENCY IDENTIFICATION (RFID) ENERGY EFFICIENCY MODEL FOR RESIDENTIAL BUILDINGS.

8th Renewable Energy Postgraduate Symposium,2017

By
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Presentation Outline

- Epicentric role of Energy efficiency.
- Sectoral energy consumption in South Africa as at 2012.
- RFID technologies and Energy efficiency.
- RFID energy efficiency model.

Conclusion

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ANALYTICAL FRAMEWORK

- Review the RFID technology advancement.
- Evaluate the energy efficiency practices .
- Design and Implement a RFID electricity efficiency system

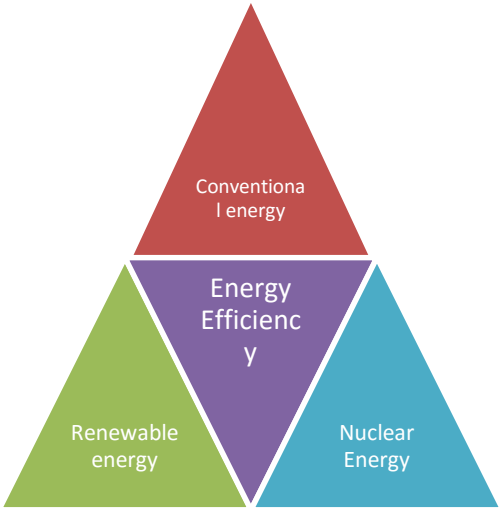
Introduction

- The sustainability of renewable energy significantly depends on the efficiency of the consumption.
- Average statistics across the world shows that energy consumption in residential buildings takes up the largest proportion of world‘s energy generation.
- The residential usage of electricity accounts for the bulk of consumption in Africa due to her rising population, and urbanization.

Introduction

Indeed, electricity plays the most prominent role in the economic growth, progress, and advancement, cum poverty alleviation, and security.

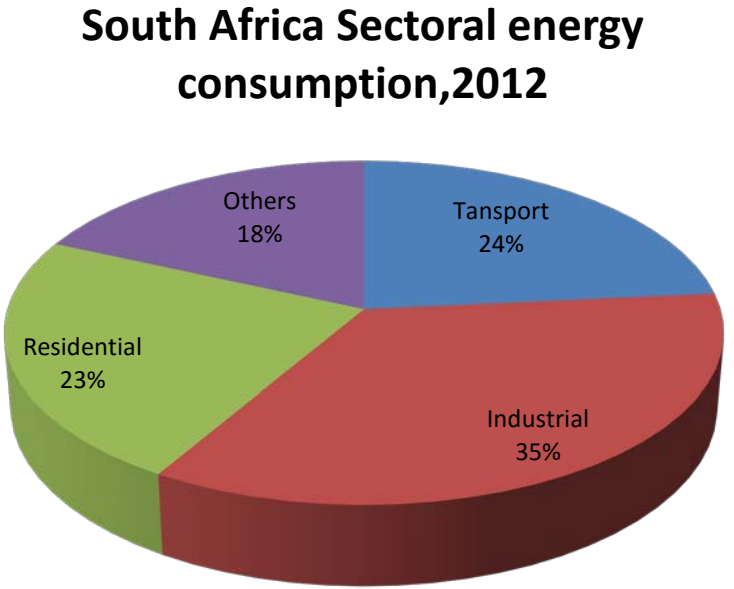
Energy efficiency is at the center of renewable and conventional energy consumption.



50% of household electricity is used for lighting, television, radio, HVAC, refrigeration, and ironing (Reiss and White, 2002).

Electricity saving is not just about saving money, it includes the resources used to generate electricity from the supplier, preventing fire accident, and protecting the environment and lives.

In the year 2013, there were 42,343 fires incidences that were reported in South Africa out of which 8.86% were attributed to electrical faults. Residential fire incidences account for more than R1-billion of the cost while industrial fire accounts for R478-million. (Crown, 2016).



RFID technologies and Energy efficiency.

- **Most other energy efficiency technologies have not been able to address the issue of Standby power often associated with electricity consumption.**

RFID technologies and Energy efficiency.

- Standby power is electricity used by appliances and equipment while they are switched off or not performing their primary functions.
- In 2007, International Energy Agency (IEA) reported that developed country families fail to remove the plug and wasted standby power which accounts for around 5% to 10% of the total electricity consumption. (Wang and Yang, 2014). The standby power for every family was nearly 30 kWh in a month and this resulted in the emission of 16kg carbon dioxide (CO_2) to the environment.
- Standby power accounts for almost 1% of world carbon dioxide emissions. This poses a grave danger to our environment as it serves as a threat to energy sustainability and facilitates greenhouse effect. To achieve further energy efficiency, all the power outlets should be automatically shut down while the user takes away the RFID card.

RFID is being used in diverse applications such as:

Aviation

Construction and facility Management

Health

Retailing

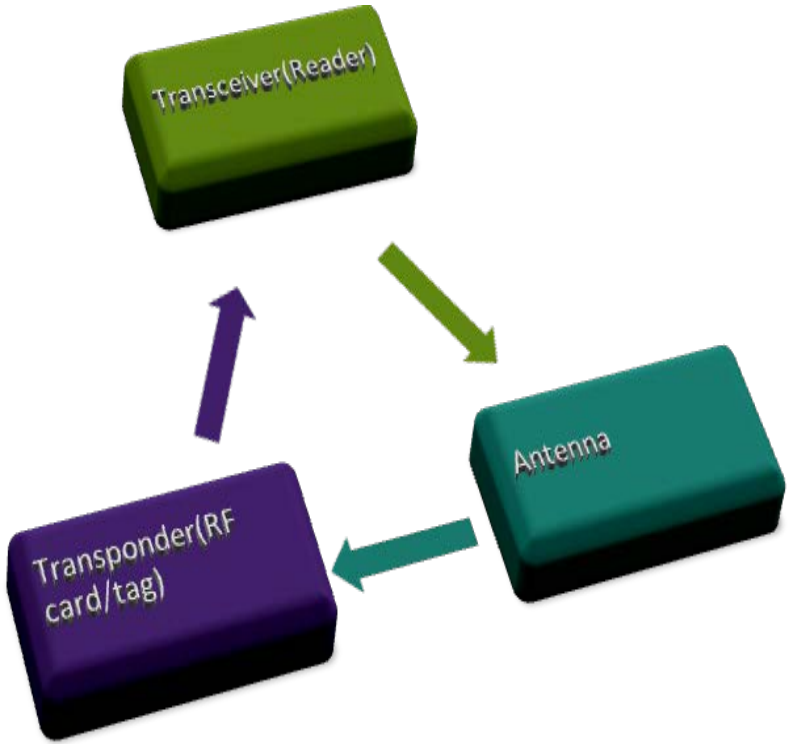
Logistics and security

Library system

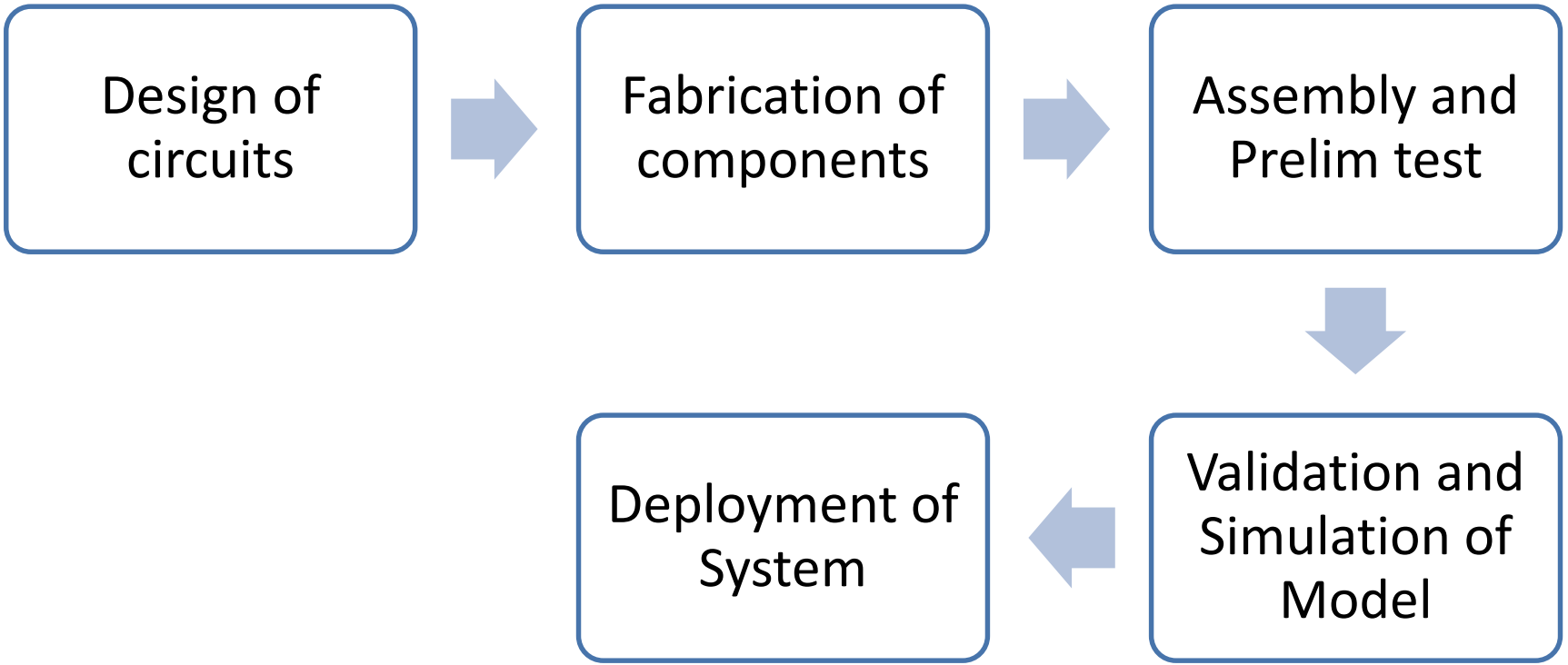
Access control

Race timing, among others.

Main components of a RFID system



RFID ENERGY EFFICIENCY MODEL



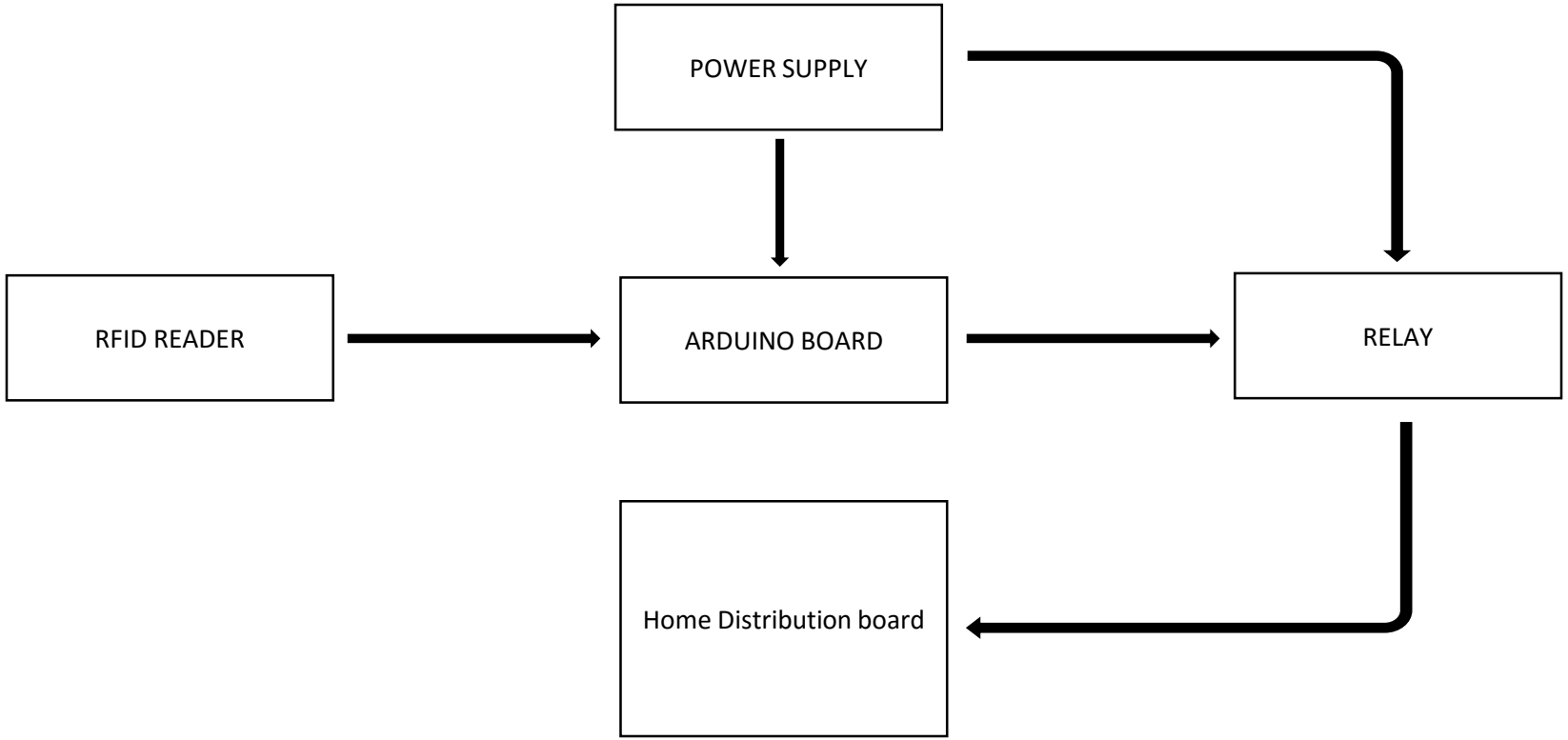
RFID Implementation for residential building

- In the design and installation of the RFID energy saving power switch for the Duplex home considered in this study, two main parts were considered: circuitry and wiring, and programming of the microcontroller and RFID system.
- The energy consumption in the homes was studied both with and without RFID.
- In implementing the RFID system, card reader placed at the entrance of the room was used to verify the identity of the individual entering the house as a genuine householder through the use of a RFID card

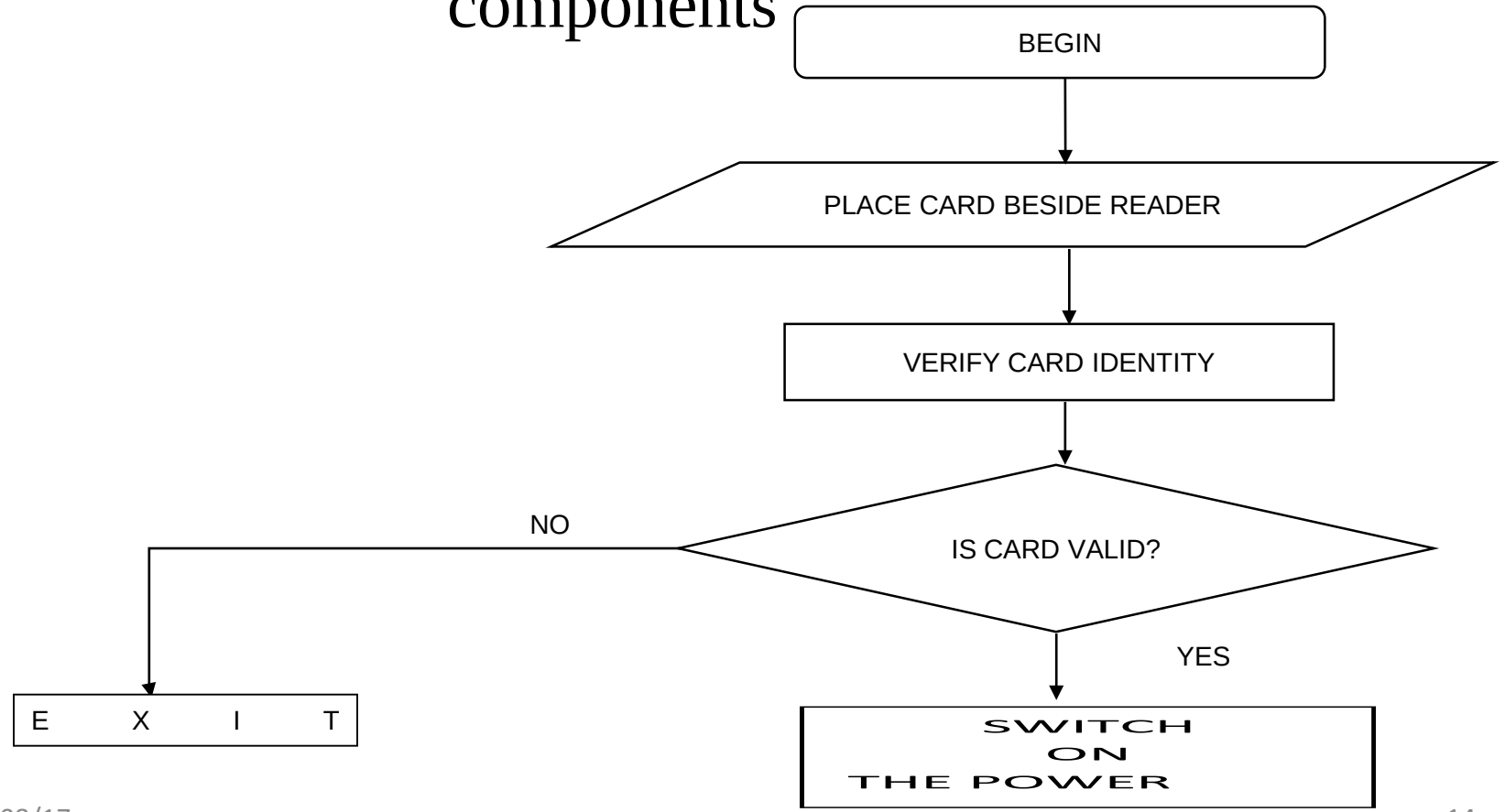
RFID Implementation for residential building

- Upon verification, the reader triggered a relay mechanism (in the normal Open state) through an Arduino unit which closes the circuit, thereby allowing power supply into the room.
- In order to turn off the power supply, the identification card will have to be placed out of range of the reader to trigger the relay to return to its initial state.

Block diagram of interconnection between main components



Block diagram of interconnection between main components



List of Home appliances in a duplex

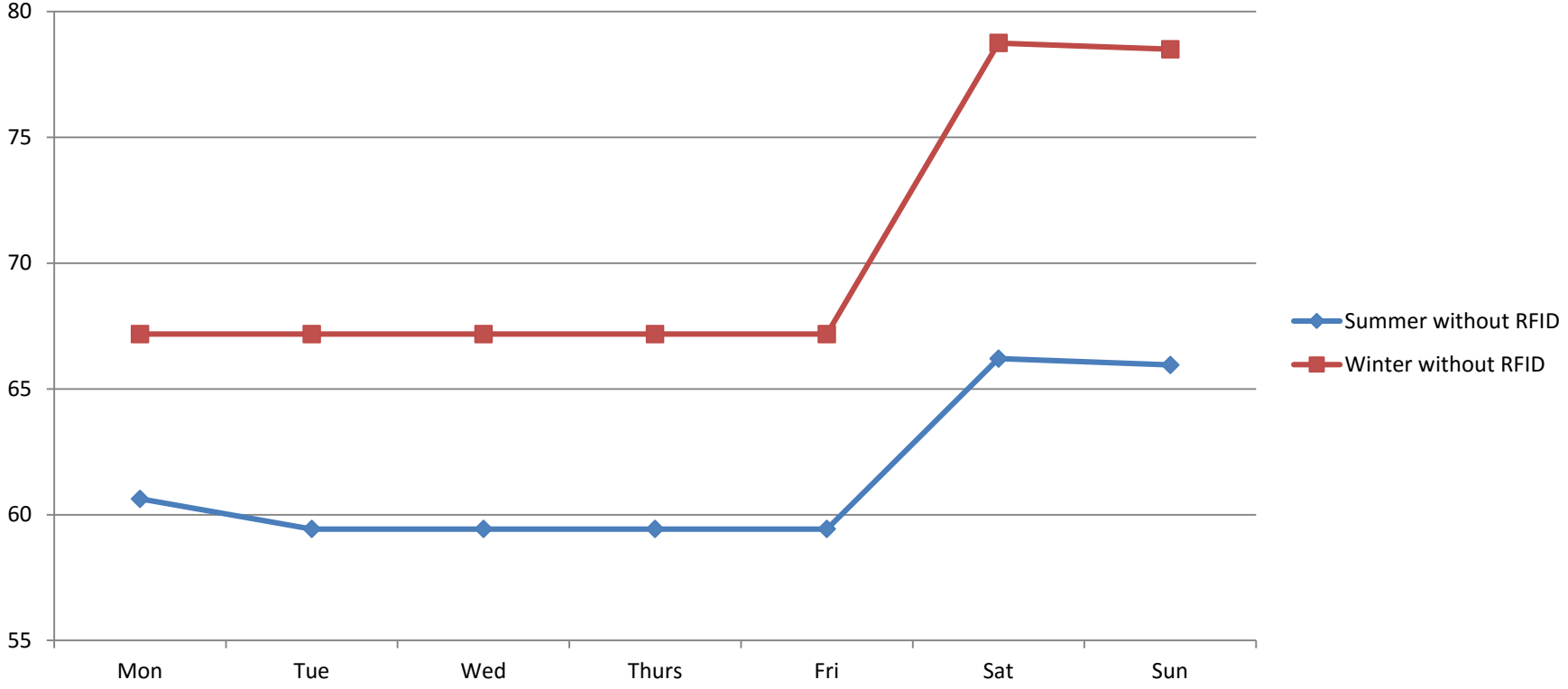
Appliances	Power rating (W)	Quantity	Total Wattage (W)
Water heater(Geyser)	4000	1	4000
LED lighting	20	20	400
Pressing Iron	1200	2	2400
Washing machine	500	1	500
Electric kettle	1200	1	1200
Electric cooker	3000	1	3000
Air-conditioning system	1750	3	5250
Laptop computers	100	6	600
Desktop computers	100	1	100
DVD Player	35	1	35
DSTv pay station	10	1	10
Television 25”	150	1	150
Microwave	600	1	600
Home theatre	35	1	35
Refrigerator	400	1	400
Vacuum cleaner	200	0	0
Smartphone charger	4	3	12
Toaster	800	1	800
Electric heater	2000	1	2000

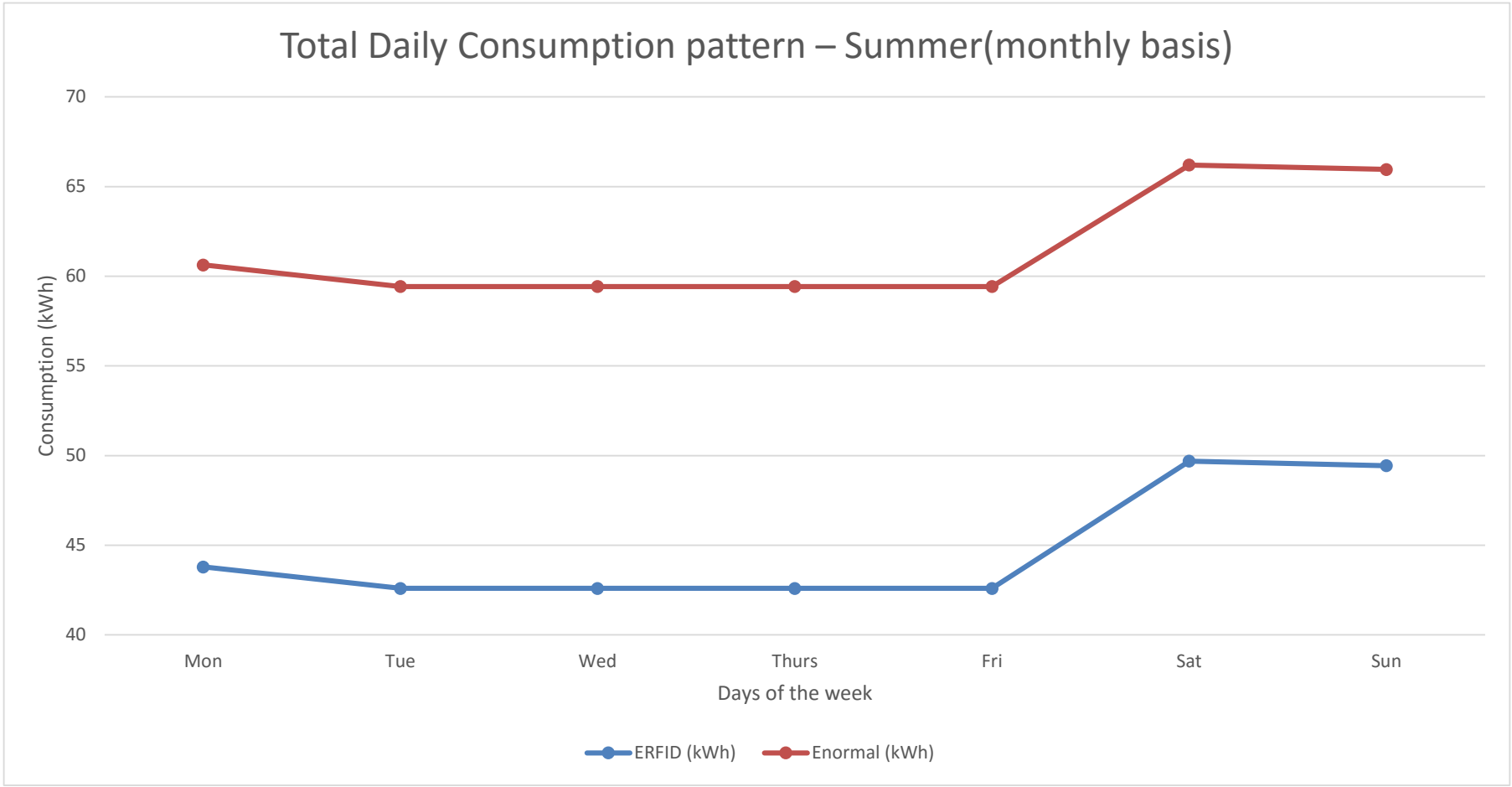
In order to evaluate the amount of electricity saved by the RFID system (in percentage),

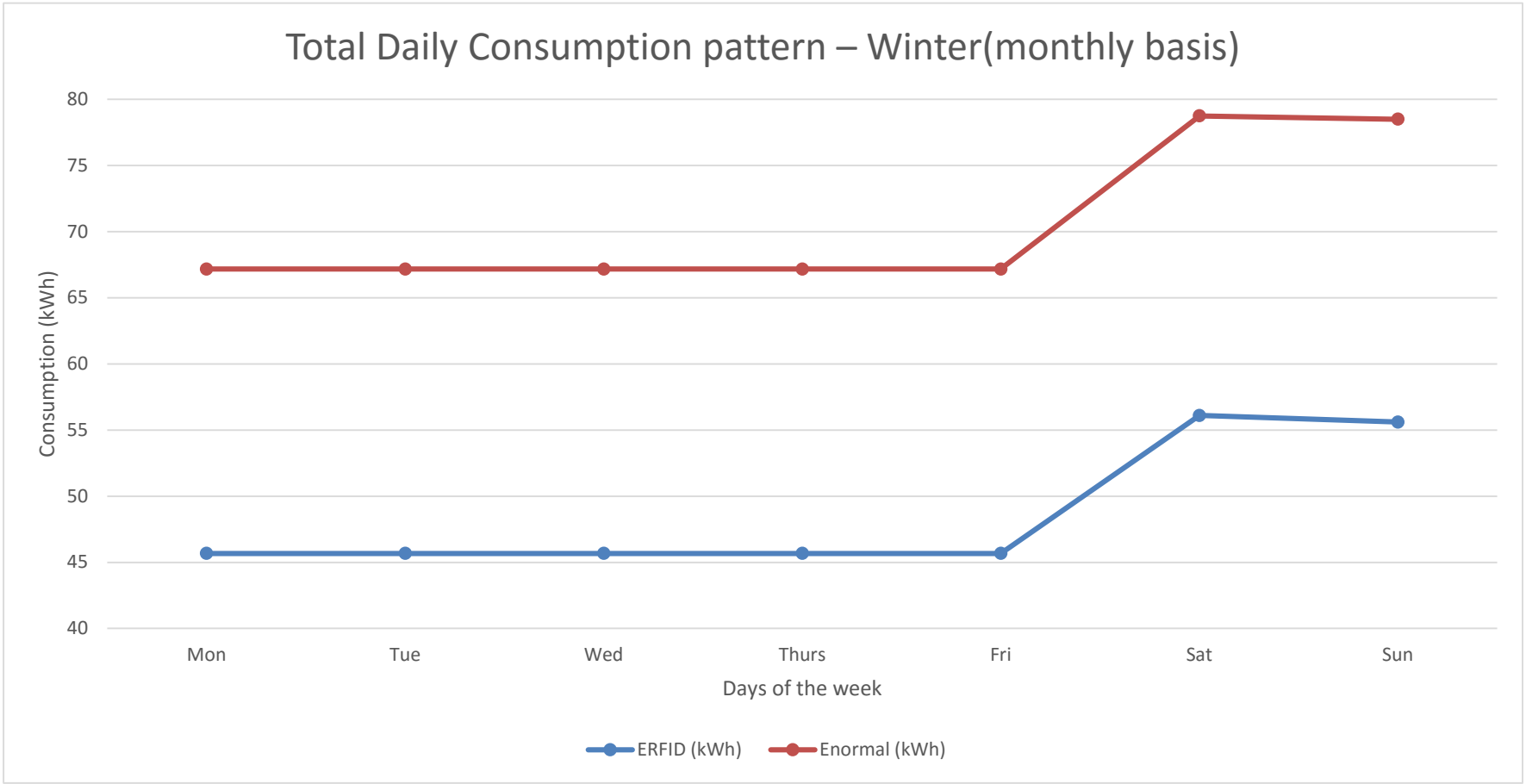
The consumption pattern was computed from estimating the number of hours of use of the above-listed home appliances.

The daily pattern of energy consumption for summer(September to May) and winter (June to August)

Total Daily electricity consumption for winter and summer without RFID on monthly basis




Total Daily Consumption pattern – Summer(monthly basis)
70
65
60
55
50
45
40
Consumption (kWh)
Mon
Tue
Wed
Thurs
Fri
Sat
Sun
Days of the week
ERFID (kWh)
Enormal (kWh)


Total Daily Consumption pattern – Winter(monthly basis)
80
75
70
65
60
55
50
45
40
Consumption (kWh)
Mon
Tue
Wed
Thurs
Fri
Sat
Sun
Days of the week
ERFID (kWh)
Enormal (kWh)

Electricity Savings Estimation

Summer (September – May)

Amount of energy saved in a Month = $E_{normal} - E_{rfid}$

$$\frac{E_{normal} - E_{rfid}}{E_{normal}} \times 100\%$$

$$\frac{430.49 - 313.31}{430.49} \times 100\%$$

$$= 2.72\%$$

This shows the system can save energy up to an estimated value of 2.72%.

= 430.49 – 313.31kWh

= 117.18kWh

The total Monthly cost savings considering the price of R1.82 per kWh = 117.18 * R1.82 = R213.27

Percentage energy saved in a month = 2.72%

Winter (June-August)

Amount of energy saved in a month = = 493.14 – 340.06kWh

= 153.08kWh

Taking the cost of electricity to be R1.82 per kWh and assuming that the cost per kWh is constant for the month, the total monthly cost savings.

= 153.08 * R1.82 = R278.61.

$$\frac{E_{normal} - E_{rfid}}{E_{normal}} \times 100\%$$

Percentage energy saved in a month =

= 3.10**%**

This shows the system can save energy up to an estimated amount of 3.10%.

Average yearly consumption without RFID

Energy consumption for a year (summer and winter) period is;

$$= (430.49x9) + (493.14x3) = 3874.4 + 1479.42kWh$$

$$= 5353.83kWh = 5.354MWh$$

Yearly savings from implementing the RFID system

$$= 5353.83kWh - 3839.97kWh$$

$$= 1513.86kWh$$

This is equivalent to a yearly percentage savings of

$$\frac{1513.86\text{kWh}}{5353.83\text{kWh}} \times 100$$

$$= 28.276\% \approx 29\%$$

If we assume an unlikely scenario whereby the unit cost of electricity does not change over the space of 5years, the total savings on the consumption in kWh;

$$= 5 \times 1513.86kWh = 7569kWh$$

Conclusion

- An articulated and vigorously pursued energy efficiency policy measures in South Africa can result in enormous savings in electricity consumption over a period of time.
- This would subsequently eradicates the demand for the additional power plant and its attendance cost.
- Energy efficiency addresses most of the highlights of the Sustainable development Goal (SDG).Since an efficient consumption reduces the economic pressure, and benefits the environment with respect to climate change and eventually leads to poverty eradication among the citizens.

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