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Barriers to the Uptake of Renewable Energies in Institutions of Higher Education: Experiences from a Polytechnic in Zimbabwe

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Abstract
There are many financial, institutional, technological and socio-cultural barriers that inhibit institutions of higher education from moving from the pollutant fossil fuels to the renewable energy pathway. But given the prominent position of academia in sustainability studies, it is natural to expect institutions of higher education to take a lead in sustainable practices including clean energy use. The study adopted a qualitative approach and a case study design. Structured interviews were used to collect data from purposively sampled participants which was thematically analysed. This research revealed that social, technological and the lack of policy regulation of the use of renewable energies stood as barriers with a strong sway on the failure of institutional adoption of clean energy. The current higher education landscape which benefits from fossil use, the lack of accountability of institutions to declared commitments and the lack of technical know-how become a hindrance to redirected changes for uptake of solar based solutions. The study recommends that with less polluting and lower tariff energy solutions being made available for adoption to institutions of higher learning, this will create a situation where renewable energy solutions will be an attractive option leading to solar renewable energy uptake.

Keywords: Renewable Energy, Barriers, Enablers, Solar-Energy, Fossil Fuels

1. Introduction
Research points to human activity as the cause of a multiplicity environmental and climatic challenges plaguing the earth, causing hazardous and in some case catastrophic life-threatening consequences. The undesirable effects of human activity include the pollution of air to life threatening levels as well as damaging disruptions to the ecosystems that are unsustainable (Tyagi, Garg & Paudel 2014, Remoundou and Koundouri, 2009) [24, 18]. Energy plays a critical role in the development and sustainability of a nation's economic interplay (Wyllie, Essah & Ofetotse, 2018) [25]. It has a key bearing on all aspects of socio-economic industrial endeavours as well as in daily operations of everyday life. This is true since energy drives all other sectors of the economy, such as construction, agriculture, manufacturing transportation, the environment, water, and so on (Wyllie, Essah & Ofetotse, 2018) [25]. In addition, the future economic growth of a nation is said to be certain when there is a continuous energy supply based on clean energy, which is sustainable as well as affordable. It is thus crucial that all countries should make a drive towards clean, renewable energy if life is to be maintained in a sustainable way (Maiorano, Savan, 2015) [13].

Zimbabwe has struggled with energy challenges since its independence in 1980 till the present. Massive power cuts to all sectors both domestic and industrial for up to 16 hours a day have been experienced (Makonese, Chikowore & Annergarn, 2011 [14]; Makonese 2018). The country has heavily relied on carbon intensive means of electricity generation for household and industrial use. Makonese (2018) insists that about 43% of the country's electricity supply comes from burning coal and wood, while 57% of the country's supply comes from renewable energy, basically from hydropower mainly from the Kariba dam. Within this context, the actual power generation capability in 2019 was less than 1000MW against a peak demand of 1700MW. Zimbabwe currently imports fifty Mega Watts (50 MW) firm power from HCB, Mozambique, and around three hundred Mega Watts (300 MW) non-firm power from ESKOM, South Africa (Ministry of Energy & Power development, 2019) [22].

2. Related Literature
It is estimated that the total economic costs of power shortages in sub-Saharan Africa characteristically range between 1% and 4% of GDP (African Development Bank, 2010) [1]. The bigger damage of use of fossil fuels is the climatic pollution which is

irreversible and leads to bigger problems globally (African Development Bank, 2010) [1]. Various countries are already directly experiencing destructive climate change effects such as excessive droughts including Zimbabwe (Archer and Tadross, 2009) [2] yet for others it is excessive devastating cyclones and tornados as recently experienced in many coastal areas like Mozambique and Madagascar which are close to Zimbabwe (Scholes, & Engel-Brecht, 2021; Byrnes, Brown, Foster &Wagner, 2013) [19, 5]. Solar energy is a viable substitute that can be exploited to better advance the country's energy generation mix since it is clean energy which will not exacerbate adverse climatic changes. In Zimbabwe, the characteristic solar insolation in the country varies between 5.7 and 6.5 kWh m-2 day-1. For the domestic sector, the potential for renewable energy from solar PV and solar water heaters is massive (300 MW). To date, this potential has not been adequately, exploited with only about 1% utilised (Makonese, 2018; Batidzirai, Lysen, van Egmond, van Sark, 2009) [3]. There has been a lot of education and campaigns that have attempted to rally nations, societies and individuals of all walks of life to try and turn around peoples' destructive behaviours of the green planet and replace them with pro-life conserving ones. The rationale for taking this kind of study is that there is no planet B for humans to shift to if they destroy their only habitat. It also does not make sense for humans to have received a life supportive planet and leave it destroyed and inhabitable for future generations (Wyllie, Essah & Ofetotse, 2018) [25]. Having access to clean and reliable electricity means that local institutions and communities enjoy the benefits of cheaper forms of electricity with extended operating hours, mechanisation, product preservation, higher productivity, improved working conditions, communication and education in a socially and environmentally sustainable way. Clean energy practice provides a discernible and authentic dimension to the manner in which institutions can educate students and the public on environmental matters (Makonese, 2018). Institutions of higher learning have not been spared the damaging effects that Zimbabwe has suffered through power outages which range from spoilt experiments, loss of man hours when academics abandon scheduled tasks and virtual meetings, to missed deadlines and targets.

The paper springs from the premise that institutions of higher learning should provide the impetus to solve problems facing the country and society through research, problem solving as well as being exemplary in good environmental and practice as it is principally for that reason that they were set up. Contrary to this expectation, institutions of higher and tertiary education in Zimbabwe are visibly lagging behind in taking up renewable energy options such as solar energy use.

This paper seeks to examine the underlying causes for the apparent failure of institutions of higher & tertiary education to take up solar energy as a renewable and viable option of energy despite the crisis they face regarding their energy needs. The article interrogates why institutions of higher and tertiary education have not seized the opportunity to invest in the uptake of solar as a renewable energy option for servicing their needs in a region where the solar energy is abundant, needed but unexploited. Use of bioenergy in the form of wood fuel has led to deforestation which in turn negatively affects the environment. The foremost and sensible strategy for decarbonisation is to abandon fossil fuels and replace them with renewable energy as the ultimate energy source. Renewable energy is ideal as a sustainable source because it is replenished by the sun at the rate at which it is used (Sorensen, 2000) [21]. The question that guided this study was: Why are institutions of higher learning in Zimbabwe not taking up renewable energy for their operations?

It will be noted that literature shows that there are several barriers to the uptake of solar energy as a renewable option. Barriers are understood simply to be factors that obstruct technology transfer or uptake Nguyen, Ha-Duong, Shrestha, Nadaud, 2010) [16]. Barriers are often very circumstance-specific in a given country. It is often believed that the initial investment input costs in terms of capital for renewable technology are greater per $/kw than those of carbon-based fuels. However, it is also true that renewable energy can provide two-thirds of the over-all global energy requirements, and add to the bigger part of the greenhouse gas release reduction that causes lethal pollution and can account for reducing the global temperature increase to below 2 °C (Gielen, Boshell, Saygin, Bazilian, Wagner, & Gorini, 2019) [10].

3. Theoretical framework

Technology provides new ideas and principles about doing things that are important for the work environments. Use of these tools is determined by technology readiness and technology acceptance in the situation where the challenge exists.

Technology readiness and technology acceptance are used to explain the people's propensity for adoption of new technologies in many fields including energy generation from solar utilising systems. Technology readiness combines application of a positive disposition resulting in innovation processes, and creativity while a negative disposition results in fear and mistrust of technology resulting in uneasiness and rejection. The present study integrates the constructs of technology readiness (TR) and technology acceptance models (TAM) Lin, Shih and Sher, 2007). Lin, Shih & Sher, (2007) further explain that contributors involve technology being viewed as useful and easy to use while inhibitors apply when technology is viewed as difficult to use and not relevant to achieving goals. The TAM model, is suitable in partly explaining barriers for institutions of higher learning in adopting or not adopting new technologies in addition. The adoption of new technology and its use for multi-purposes is determined by its effects on and implications for the institution and the work environment as well as perceptions of its usefulness and ease of its use Lin, Shih and Sher, 2007).

4. Methodology

The study was situated in the interpretive paradigm and thus adopted a qualitative approach and a case study design. The qualitative nature of the enquiry enabled researchers to gain insights into the state and operations of energy use in the context of a polytechnic institution. Five Academics who were lecturers in the various faculties and 3 administrators were purposively selected and interviewed on issues ranging from the continued use of fossil fuels and their impact to the barriers of taking up solar option solutions. This is supported by Creswell, 2014 [6] who argues that determining a suitable sample in qualitative research at the end of the day is based on using one's own judgment and experience in

assessing the quality of the data collected in consideration of how it is intended to be used. Since the case study design allows the researchers to gain understanding of social phenomena from the perspective of the participants in their natural settings (Berger & Luckman, 2014) [4] researchers found it astute to buttress this with a study of documents on policy the institution uses to make decisions on use of energy. This is in line with Susan (2018) [23] who contends that the finest understanding of the qualitative approach is through triangulating data collection techniques. Analysis of data was done thematically based on views by Creswell (2018) [7] and Yin (2016) [26] who reason that data can be consolidated and emerging patterns cemented into themes that reveal the picture of experiences and phenomena in a social setting. As part of ethical considerations, respondents were assured they would not be exposed to harm and were given full information on the purpose of the study as they volunteered. Care was taken to keep their names anonymous and confidentiality and privacy were maintained throughout the study.

Findings and discussion on barriers to institutional uptake of renewable energy

Lack of accountability by tertiary institutions on declared commitments

Given the prominent position of academia in sustainability issues, it is natural to look to higher and tertiary education institutions as models of sustainable practices, including practices related to energy use. However, there is a long history of higher educational institutions failing to action their own sustainability initiatives. They usually have typical justifications for failure to implement their own strategic plans, blaming it all on budgetary constraints. One of the major impediments that consistently keeps higher education institutions from achieving their own sustainability-related goals is a lack of enforcement (Mohammadalizadehkorde, & Weaver (2018) [15]. The institutions craft strategic sustainability-related goals in non-binding pronouncements that are voluntary. In such a situation, failure to achieve a goal does not result in any sort of formal sanction. As such, higher education institutions are free to claim a commitment to sustainability in their public declarations, without having to account or be compelled to demonstrate that commitment in practice. On this issue academics made the following observations:

> *There is complacency, though plans have been made and motivations drawn up to change to solar as a cheap and feasible renewable energy considered non-polluting, the authorities do not feel the drive to action the change. In this technical college things only change if the principal directs the change and so far, he has not been bothered to invest in solar energy. Boards sit and recommend but nothing really happens.*
>
> *There Polytechnic has hosted conferences on sustainability with a lot of research reported on that champion the cause of using clean energy. In line with this thinking, solar systems were showcased with a lot of presentations that sing praises to its advantages but despite the public declarations to make this the path take, there is still use of fossil fuels complimented by the inadequate electricity with its challenges of power-cuts and load shedding.*

Subservience to strong lobby groups with interests in fossil fuel technologies

The energy industry has some very powerful players who have been the mainstay of energy supplies for a long time. These have resources to influence executives at any level of the chain of command. As such it is possible for that kind of influence to be exerted so it weighs heavily against shifting goal posts in favour of what has been in place (Makonese, Chikowore, Annegarn, 2011) [14]. Commenting on this, some academics pointed out:

> *There are powerful companies that have already created goodwill within government and with directors and executives of institutions. Mining companies that produce fossil fuels like coal are a good example and these cannot just look on while their products are side-lined. It is clear that such companies will go to great lengths to use their influence to keep institutions from changing direction to clean energy.*

Over-reliance on coal

The International Energy Agency (2017), estimates that coal supplies a third of global energy needs, which means 40% of electricity; making industries and large institutions mainly coal reliant. This makes it difficult to replace coal as a source of energy, particularly in Zimbabwe which currently has a runaway inflation of 98% in 2008 Garwe (2014) [9]. In addition, there is the prohibitive implication of infrastructural alterations that are required in changing from coal to other renewable sources of energy which causes hesitancy when implementers think of uprooting a system which still works and has a proven long track record in terms of cost and time (Seetharaman, Moorthy, Patwa, Saravanan, Gupta, 2019) [20]. This is particularly so considering the coal infrastructure is in place while that for the alternative RE would still have to be put up. Also, big higher education institutions require high amounts of energy. Coal has a huge net energy output compared to other sources of energy (Fashina *et al*., 2018) [8]. This means that for a unit of coal a lot of energy is produced compared to other sources of energy. Therefore, coal is very efficient for producing the high levels of energy required by institutions for their cooking and water heating, which makes it very difficult to replace it (Fashina *et al*.,2018) [8]. Commenting on this one academic remarked:

> *Coal has been an abundant source of fuel for a long time. It is difficult for old guards among the college administrators to change it for some other system that they may feel has not been tried. They hesitate to adopt new untried technologies in preference to what has always been the practice.*

High initial capital

The initial investment capital for setting up structures for a new solar energy powered system are high. Most components are expensive and these include the solar panels, huge batteries and invertors. The panels have to be large and many in order to produce the wattage for a whole institution which include, lighting for all houses and offices including labs and offices, water heating, fans in hot weather and heating in cold weather, laundry use, refrigeration as well as running borehole pumps. Most components have to

be imported and care has to be taken to buy genuine parts in an industry that has a lot of fake copycats (Makonese, 2018). Remarking on this issue the following observations were made by academics:

Institutions of higher learning always seem to be in problems with budgets that overshoot availed resources. When it comes to the initial capital for purchasing the whole set of infrastructure for solar system components is prohibitive. Institutions are publicly funded and do not always find it easy to raise funds for such a budget.

Hesitation over social priorities other than the deployment of renewable energy technologies

Hesitation to adopt new technologies in preference of what has always been the practice by old guard leaders. This has become a notable barrier because the solar energy option to power the needs of higher education institutions has not only been a solution that is novel to the leaders in these technology institutions but has been demonstrated to be possible and actionable, yet it has not been taken up as (Mohammadalizadehkorde, M. & Weaver, 2018) [15].

Asked to comment on why despite general agreement in the college community that solar was the way to go but still hesitation to implement the change, academics indicated:

The bosses know solar energy is a great possibility that may make power cuts a thing of the past and it comes with lower costs. However, they are stark to their ways always fearing unknown hurdles lurking in the corner. They then go with other projects and continue to hesitate on this one.

Lack of solar energy technological support systems

(Raza, Saula, Islam, Ayub, Saleem, Raza, 2015) [17] insist that availability of skilled technically survey manpower is crucial in the quest to disseminate renewable energy technologies in the country. Due to the predominant economic hardships, Zimbabwe has experienced considerable brain drain of skilled technical labour to better performing economies in the rest of Africa and abroad. Skilled labour is needed for design, installation, operation and maintenance services (Karekezi, Lata, Coelho, 2004) [12]. In addition, the lack of skills and adequate information on renewable energy technologies may have exacerbated perceived doubts and reversed decisions concerning quick roll out of REs in the country. Another challenge is availability of infrastructure for after sales service which is critical for continued use of renewable energy. Underdeveloped extension services for spare parts supply and maintenance services also hinder the continued use of green technologies. The old guards heading institutions of higher learning are aware of this and hence will falter in adopting solar energy options (Makonese, 2018). Reacting to the issue of technological support services administrators were agreed that this was a missing link that could cause complications if they went the solar way. Remarking on this issue they explained:

This is the latest technology and it is not yet tried and tested over a long time. Skilled technicians are also still few and not attracted by the kind of salaries we pay. The lack of support services in the specialised area is worrying because when you run an institution, uncertainty is a risk you cannot take.

Lack of renewable policy at government and institutional level

Lack of consistent policies and regulatory frameworks to support renewable energy has been noted to be a barrier. The lack of policy worsened by a lack of suitable legal and regulatory frameworks for distribution of renewable energy technologies. In Zimbabwe, policies are biased towards carbon fossil fuels, with the government contemplating building more coal power plants in the next decade (Makonese, 2018). Although the government of Zimbabwe has adopted an energy policy, currently there is no specific policy for renewable energy. It should be noted however that Zimbabwe Energy Regulatory Authority (ZERA), in collaboration with the Ministry of Energy and Power Development (MEPD) is currently developing a renewable energy policy. The policy is intended address gaps in the current energy policy such as inducements for increased uptake and investment in renewable energy and legislation. Observations by administrators on lack of policies on renewable energy were that this was not clear cut for them yet. On the issue they pointed out:

Government has digested the need for renewable policies but is yet to produce the frameworks. We will also follow suit when ministry has clear guidelines. When there is policy, we are protected even if things go wrong. We will move with strides if it is cascaded down.

5. Conclusion

The paper identifies seven main barriers to the uptake of solar energy for institutional use. These are lack of accountability by tertiary institutions on declared commitments, subservience to strong lobby groups with interests in fossil fuel technologies, over-reliance on coal, social priorities and hesitation other than the deployment of renewable energy technologies, high initial capital, lack of solar energy technological support systems, lack of coordination and capacity at the policy making level, and hesitation over social priorities other than the deployment of renewable energy technologies. If these are mitigated it would enhance the uptake of solar as a renewable energy and also help to influence uptake in other businesses, in communities as well as turn round the horror of adverse climate change due to pollution.

6. Recommendations

The paper makes the following recommendations in light of insights from the emerging themes in the study

- informing the public about climate change and stressing the positive side-effects of renewable energy technologies, thereby building public support
- making use of international mechanisms to build political momentum forming clean-energy coalitions with powerful groups in society
- communicating support rules as early and clearly as possible, and keeping later adjustments to the rules predictable to maintain investment certainty
- establishing inter-ministerial groups with oversight authority to enhance political coordination
- supporting established energy suppliers in their

discovery of renewable energy tariffs (RETs) as a new business field.

7. References

1. African Development Bank. Committee of Ten Policy Brief: Financing of Sustainable Energy Solutions. Committee of Ten Policy Brief, 2010, 3.
2. Archer ERM, Tadross M. Climate change and desertification in South Africa: Science and response. African Journal of Range & Forage Science. 2009; 26(3):127-131.
3. Batidzirai Lysen B, Van Egmond EH, S Van Sark WG. Potential for solar water heating in Zimbabwe. Renewable and Sustainable Energy Reviews. 2009; 13(3):567-582.
4. Berger P, Luckman T. Rethinking the theoretical base of sociology of religion. Social Construction, Power and Discourse Journal. 2014; 7(3):223-236.
5. Byrnes L, Brown C, Foster J, Wagner LD. Australian Renewable Energy Policy: Barriers and Challenges. Renewable Energy. 2013; 60:711-721.
6. Creswell JW. Research Design: Qualitative, Quantitative and Mixed Methods Approaches (4th ed.). Thousand Oaks, CA: Sage, 2014.
7. Creswell JW, Creswell JD. Research design: Qualitative, quantitative, and mixed methods approaches. Fifth edition. Los Angeles: SAGE, 2018.
8. Fashina A, Mundu M, Akiyode O Abdullah, Sanni L, D Ounyesiga L. The Drivers and Barriers of Renewable Energy Applications and Development in Uganda: A Review, 2018.
9. Garwe EC. Quality assurance challenges and opportunities faced by private Universities in Zimbabwe, 2014. Available at: https://files.eric.ed.gov/fulltext/EJ1060601.pdf
10. Gielen D, Boshell F, Saygin D, Bazilian MD, Wagner N, Gorini R. The role of renewable energy in the global energy transformation. Energy Strategy Reviews. 2019; 24(38):1-13.
11. IRENA. The Framework for NDC Implementation Advancing Renewable Energy in Africa Together with National Climate Plans, International Renewable Energy Agency, Abu Dhabi, 2016f. www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_UMEME_Framework_2016.p df.
12. Karekezi S, Lata K, Coelho ST. Traditional biomass energy: improving its use and moving to modern energy use". In Proceedings of the International Conference for Renewable Energies, Bonn, January, 2004.
13. Maiorano J, Savan B. Barriers to energy efficiency and the uptake of green revolving funds in Canadian universities. Int. J. Sustain. High. Educ. 2015; 16:200-216.
14. Makonese T, Chikowore G, Annegarn HJ. Potential and prospects of improved cookstoves (ICS) in Zimbabwe. In Proceedings of the Domestic Use of Energy (DUE), Cape Town, March 31-2 April, 2011.
15. Mohammadalizadehkorde M, Weaver Universities R. as Models of Sustainable Energy-Consuming Communities? Review of Selected Literature. 2018; 10(5):1-17.
16. Nguyen NT, Ha-Duong MH, Tran TC, Shrestha RM, Nadaud F. Barriers to the adoption of renewable and energy-efficient technologies in the Vietnamese power sector. GMSARN International Journal. 2010; 4(2):89-104.
17. Raza W, Saula H, Islam SU, Ayub M, Saleem M, Raza N. Renewable policy: Barriers and challenges. Renew. Energy. 2015; 60(1):711-721.
18. Remoundou K, Koundouri P. Environmental Effects on Public Health: An Economic Perspective. International Journal of Environmental Research and Public Health Public Health. 2009; 6:2160-2178. -energy-market-study-zimbabwe-2017.pdf [Accessed on July 2021]
19. Scholes R, Engel-Brecht F. Climate impacts in southern Africa during the 21st Century. Report for Global Change Institute University of the Witwatersrand energy resources: Current status and barriers in their adaptation for Pakistan. Journal of Bioprocess. Chemical Engineering. 2021; 3(3):1-9.
20. Seetharaman A, Moorthy Patwa K, Saravanan ND, Gupta SY. Breaking barriers in deployment of renewable energy. Heliyon. 2019; 5(1):1-23.
21. Sorensen AT. Equilibrium price dispersion in retail markets for prescription drugs. Journal of Political Economy, 2000; 108(4):833-850.
22. Ministry of Energy & Power development. Government Printers, Zimbabwe, 2019.
23. Susan, P. Assessing school wellness policies and identifying priorities for action: Results of evaluation, Journal of Health School. 2018; 88(5):359-369.
24. Tyagi S, Garg N, Paudel R. Environmental Degradation: Causes and Consequences. European Researcher. 2014; 81(8):1491-1498.
25. Wyllie JOY, Essah, Ofetotse E. Barriers of solar energy uptake and the potential for mitigation solutions in Barbados. Renewable and Sustainable Energy Reviews. 2018; 91(2):935-949.
26. Yin RK. Qualitative Research from Start to Finish, Second Edition. New York: The Guilford Press, 2016.