Faculty of Graduate Studies

Sustainability Assessment in Higher Educational Institutions: Case Study, Birzeit University

تقييم الاستدامة في مؤسسات التعليم العالي: حالة دراسية، جامعة بيرزيت

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إلى أمي

ماجد عوّاد

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Table of abbreviation

AC	Air conditioning
ARWU	Academic Ranking of World Universities.
BAS	Building automation system
BIM	Building information modelling
BMCS	Building management and control systems
BMS	Building management system
BZU	Birzeit University
CCC	Commence, conduct, control
CCTV	Closed Circuit Television
EC	Energy and Climate Change
ED	Education
EDMS	Electronic document management system
FM	Fire master
FMS	Facility management system
HEI	Higher Education institution
HVAC	Heating, Ventilation, and Air Conditioning
IPO	Input-process-output
LED	light emitting diode
NEPA	The National Environmental Policy Act
QS	Quacquarelli Symonds
SD	Sustainable development

SDG	sustainable development goal
SI	Setting and Infrastructure
STARS	Sustainability Tracking, Assessment and Rating System
THE	Times Higher Education
TR	Transportation
UI	University of Indonesia
UN	United nations
UV	Ultraviolent
VPAA	Vice president for academic affairs
VPAF	Vice president for administration and finance
VPCA	Vice president for community affairs
VPCD	Vice president for campus development
VPPD	Vice president for planning and development
VRV	variable refrigerant volume
WMS	Water management system
WR	Water
WRWU	Webometrics Ranking of World Universities
WS	Waste

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Abstract

University sustainability is well recognized for its importance in the higher education community worldwide. The current depth and breadth of higher education sustainable practices and behavior indicates that minimal efforts are made to move toward sustainable development. This research is a natural response to the persisting increase in the worldwide concerns' regarding environmental issues and mutual demands for a transition to a more sustainable society. By evaluating the current level, sharing ideas, benefiting from similar experiences, and utilizing existing concepts and tools from different contexts, a model is proposed to promote sustainability at BZU. In addition, this research identified the weaknesses of BZU in relation to sustainability and provided detailed recommendation. The model is expected to lead BZU to better sustainable environment and could be modified for other higher educational institutions and national institutions to align their processes, procedures and services with a sustainability action plan to develop the skills and practices thus progressing towards sustainable development (SD). This research evaluates the current situation of the university's sustainability overall and provides the steps that the university should follow to stimulate the transformation into a sustainable one. The main findings of this research highlighted the importance of the university sustainability based on the questionnaire responses. Overall there was an emphasis on the importance of the university sustainability. The weighted average

percentage for the importance of the elements was found to be in the range of 40-90%. In addition, the UI GreenMetric assessment measured the current level of sustainability at BZU following the adopted UI GreenMetric guideline. Overall, the results emphasized the need for developing and implementing sustainability measures to raise the sustainability level which were provided as recommendations for each of the six criteria. The total points for the current sustainability level at BZU was found to be 865 of 10000. The main outcome of this research is presented as detailed recommendations and proposed model which could be reflected for future sustainability work plane while accommodating the various activities of the university.

مستخلص

تعكس الاستدامة في مباني التعليم العالي اهمية كبيرة في جميع انحاء العالم. حيث يشير عمق واتساع الممارسات والسلوكيات المتعلقة بالمستدامة في مؤسسات التعليم العالي إلى أن الحد الأدنى من الجهود يُبذل للتحرك نحو التنمية المستدامة. هذا البحث هو استجابة طبيعية للزيادة المستمرة في المخاوف العالمية بشأن القضايا البيئية والمطالب المتبادلة للانتقال إلى مجتمع أكثر استدامة. اعتمد النموذج المقترح لتعزيز الاستدامة في جامعة بيرزيت على تقييم الوضح الحالي ، تبادل الأفكار ، الاستفادة من التجارب المماثلة ، واستخدام المفاهيم والأدوات الموجودة من سياقات مختلفة . بالإضافة إلى ذلك ، فقد حدد هذا البحث نقاط الضعف في جامعة بيرزيت فيما يتعلق بالاستدامة كما قدم مجموعة مفصلة من التوصيات . من المتوقع أن يقود النموذج المقدم في جامعة بيرزيت إلى بيئة افضل استدامة كما ويمكن تعديله لمؤسسات التعليم العالي الأخرى والمؤسسات الوطنية لمواءمة عملياتها وإجراءاتها وخدماتها مع خطة عمل الاستدامة وذلك في سبيل تطوير المهارات والممارسات وبالتالي تحقيق تقدم نحو التنمية المستدامة . يقيم هذا البحث الوضع الحالي لاستدامة الجامعة بشكل عام ويوفر الخطوات التي يجب على الجامعة اتباعها لتحفيز التحول إلى حالة مستدامة. أبرزت النتائج الرئيسية لهذا البحث أهمية استدامة الجامعة بناءً على نتائج الاستبيان. بالإضافة إلى ذلك ، أشار تقييم UI GreenMetric إلى المستوى الحالي للاستدامة في جامعة بيرزيت والتي أكدت على الحاجة إلى تطوير وتنفيذ تدابير الاستدامة لرفع مستوى الاستدامة التي تمت التوصية بها كنتيجة رئيسية لهذا البحث. تم تقديم النتيجة الرئيسية لهذا البحث كتوصيات مفصلة اضافة الى نموذج مقترح يمكن أن ينعكس على مستوى عمل الاستدامة في المستقبل مع استيعاب الأنشطة المختلفة للجامعة.

Chapter 1

Introduction

This chapter serves as an introduction to this research including the problem and thesis statements, the goals and objective of the research. In addition, the chapter introduces the basic concepts of sustainability and its importance.

1.1 Problem statement

Sustainability challenges require major changes and global leadership leaving conventional thoughts, principles, and methods under question. Universities form smaller societies and have direct and an indirect impacts on the environment, therefore they are expected to generate solutions to global problems by conducting research, providing relevant information, and graduating qualified individuals to lead and influence societies positively. As a result, universities make a good role model for sustainability implementation within the larger communities. Sustainability, which has measurable quantities, integrates environmental science into the university's policies, management and various activities. Thus, BZU makes a good model for assessing the current sustainability level and develop a model to enhance the sustainability on campus which will easily be reflected for other businesses and organizations and have a positive impact on the overall society.

1.2 Thesis statement

Whatever it takes to continue surviving without compromising future generations' resources, sustainability actions toward solving global issues will remain the core of higher educational institutions' responsibilities to lead us to the path of transitioning to a sustainable society.

1.3 Research questions

The current research intends to answer the following questions:

- What types of sustainability systems or tools can be used to assess the level of sustainability in the campus?
- What is the current level of sustainability at BZU based on the selected assessment system?
- What is/are the recommendation(s) to improve the current level of sustainability at BZU?
- How will the recommendations be implemented?

1.4 Goal and objectives

The main research goal is to develop a sustainability model for BZU -based on its needs and the provided recommendations- that can be converted into sustainability action plan and could be easily modified to meet the needs of other institutions and organizations.

To achieve the above goals, the research has the following objectives:

- Utilize available information, context knowledge and specified assessment method

- Prioritize the selected elements for further investigation to develop a proposed model
- Evaluate the importance of sustainability elements in the campus environment using various assessment tools/systems
- Evaluate BZU level of sustainability according to the selected assessment leading system indicators based on UI GreenMetric.
- Investigate the possibility of implementing selected applicable elements based on questionnaire and UI GreenMetric for the overall campus improvement and future enhancement.
- Analyze the university's best practices and their contribution to BZU current and future sustainability.

1.5 Introduction to sustainability

Sustainability is a general term that is being applied to many phenomena, for example in the built environment it is applied to transportation, water consumption, waste management, building construction etc. Sustainability is simply defined as fulfilling the needs of current inhabitants without jeopardizing the needs of future generations, while maintaining a balance between economic growth, environmental and social well-being. In order to pursue sustainability, it is important to maintain and create conditions under which the humans and nature exist in productive harmony to suffice current needs and support future generations' needs[1]–[3]. Sustainability is considered one of the biggest challenges during the 21st century worldwide due to the rapid decline in natural

resources, the environmental issues such as global warming, ozone depletion, ecosystem destruction and carbon emissions[4]–[7].

1.6 The importance of sustainability

The National Environmental Policy Act (NEPA) of 1969 declared sustainability "to create and maintain conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations." as national policy and the United States committed to it[8]–[10].

Since NEPA was endorsed, the general's interest in sustainability has been increasing. A main dynamo for driving the sustainability forward is the populations and major investors concern. Nowadays, sustainability is attracting sustainability practitioners who share best practices in an attempt to guarantee the best environmental, and the greatest economic and social impact. Currently, many countries are looking for ways to meet their needs without risking the future generation needs. However, as the number of population continues to increase, humanity is facing other major threats due to climate change, limited energy sources, and increase in waste generation and lack of waste management protocols. Sustainability is a solid solution for the major global issues while advancing the future development.

1.7 Sustainability versus ranking

Sustainability serves the ultimate goal of saving one universe for all. However, ranking serves a specific goal for each of the HEIs which emphasizes the idea of the competition among participating institutions[11]–[13]. While, the elements of ranking varies widely based on each system's priority without any element being of major importance inclusively, the categories of academic sustainability varies slightly between different systems; they all encompass two main categories including environmental impact and social impact. Sustainability has four distinct areas: human, social, economic and environmental – usually referred to as the pillars of sustainability. As a result, not only HEIs are concerned with sustainability, but also sustainability became a main strategic goal and must be fulfilled for each organization within the society.

1.7.1 Sustainability goals

The year 2012 marked the development of sustainable development goals (SDGs) at the United Nations (UN) conference on sustainable development[14]. The main purpose of SDGs was to create a set of global goals, related with the environmental, political and economic challenges that we face as humanity. Later in the year 2015, UN chose by vote 17 specific objectives relevant universally and promoted them to transform the universe to sustainability by the year 2030. Figure 1 shows the SDGs with the ultimate goal of addressing the most urgent interrelated problems worldwide. SDGs are well integrated and cover every aspect of our lives.

Figure 1: Sustainable development goals (SDGs)*[15]*

Since the SDGs development, many systems have been established to ensure sustainability, of particular interest, the development of universities sustainability to reflect positive impact on the larger society. The adopted indicators by any organization for sustainability includes sustainability as a main element. The most adopted sustainability university rankings are QS Sustainability Rankings, THE Sustainability Rankings, Sustainability Tracking, Assessment and Rating System (STARS) and UI GreenMetric World University Rankings [16].

The main criteria for assessing a university are setting and infrastructure, energy and climate change, waste, water, transportation, teaching, education and research [17].

1.7.2 Systems for rankings

The most recognized university rankings include Academic Ranking of World Universities (ARWU), Times Higher Education (THE), Quacquarelli Symonds (QS) and Webometrics Ranking of World Universities (WRWU) [1], [5]–[8]. These ranking systems vary in breadth and depth in terms of benchmarking including academic performance, research, global reputation, web presence and activity, and faculty and students' body diversity. The effectiveness of university rankings systems has been questioned by several entities to conclude what ranking system an institution should follow. The adopted methodology of each of the major university ranking systems is specific when it comes to judging a university's overall quality. For example, while ARWU ranking methodology focuses on research excellence and related elements, the QS rankings have been critiqued for not taking the quality of research and the graduate employment outcomes into account. Similarly, THE ranking is scrutinized for placing a high importance on availability of various citations when assessing a university, an element that can be easily manipulated, and taking into account the monetary income, which is considered irrelevant for most institutions which offer free education for its students. Likewise, the WRWU evaluates universities based on their web presence and activity, which is largely subjective, can be a difficult indicator to measure and is not a priority when it comes to university's quality.

1.8 Academic sustainability

Despite the fact that university ranking has been established for about 30 years including various criteria for evaluation, there is no emphasis on sustainability which has not been addressed in any university ranking system[18]. Nonetheless, in addition to the wide spectrum of the main elements in university ranking, it is crucial to focus on the institutional sustainability which is more important than ranking and a main concern for every HEIs worldwide for the following reasons[19]–[23]:

- Universities form smaller societies and have direct and an indirect impact on the environment, therefore they are expected to have a social responsibility thus generating solutions to global problems by conducting research, providing relevant knowledge, and graduating qualified individuals to lead and influence societies positively [24].
- The increase in population and technology, thus the increase in waste generation, pollution and environmental problems made it very important to address sustainability now and the future
- Universities reflect larger societies because of the many similarities in terms of transportation, energy consumption and number of population. Therefore, universities make a good role model for sustainability implementation within the larger communities[25].

Sustainability, which has measurable quantities, integrates environmental science into the university's policies, management and various activities. Consequently, sustainable universities' educated graduates and knowledgeable employees

influence the overall societal sustainability, which results in reducing environmental footprints and global challenges.

In addition to the major advantages of sustainability mentioned above, raising awareness about sustainability and its related practice within the university community result in enhancing the university's quality and thus improving its ranking worldwide.

Chapter 2

Literature review

This chapter provides literature review for the main concepts of the history of sustainability, history of university ranking and the role of higher education in sustainability and its implementation in Palestinian's higher education institutions.

2.1 History of sustainability

Initially, the history of sustainability goes back to the 18th century when sustainability became a concern and sustainability thinkers got worried about world resource scarcity and the increase in population numbers [26] [27]. Then, sustainability became a public concern due to industrialization in the1970s and its accumulated environmental hazardous such as health and the environment which directly affect human lives [28]. It took many efforts to gather scientists and sustainability thinkers to gather and discuss sustainability and its impact on the environment, economic and humanity and not until after many meetings, conferences, reports and discussions, they reached that both economic development and environmental sustainability are well-integrated [29]. It was not until 1980 where the term "sustainable development" was coined and generally known to the public[28] which came as an outcome of the International Union of Conservation of Nature (IUCN 1980) . Although the issue of sustainability has been well recognized for so many years, people underestimated the impact of this issue, and not until recently, they started to realize to consequences of this worldwide dilemma. "Development that meets the needs of the present without

compromising the ability of future generations to meet their own needs" ([30], page 8) as defined in Brundtland Report integrated economic, social, and environmental dimensions and added directionality for the future to promote constructive creation of a sustainable future.

2.2 The history of university rankings

The expansion in the number of the higher educational institutions (HEIs) since 1980s has caused variation in the trends and the quality of academia delivered by the HEIs. As the number of the universities continued to increase to accommodate the continuous increase in population, it became a necessity to develop systematic approach for assessing the academic institutions and to establish a classification system to build the academic reputation for attracting students and employees to choose among available HEIs. During late 1990s, the technology advancement and the growing power of the internet have triggered the global expansion for the academic sustainability [9]. This expansion caused the growth in students traveling abroad thus causing competition to increase among the average HEIs globally[31][32]. The increase in the number of HEIs and technological advancement steered the universities' worldwide into using systematic platforms for assessing academic programs, evaluating the institution, classifying and labeling (ranking) the HEIs. However, despite all the dynamicity regarding sustainability and ranking, the well-established prestigious golden age universities were not eager about external systematic for university sustainability and ranking since these institutions are committed to excellence and have well-established

internal systems to be eminent way-above and beyond any external systematic ranking[33]. While Ivy League Schools and golden age universities have internal well-established quality assurance systems, newly developed universities must establish a certain level of quality in terms of their academic programs, their services and academic sustainability. Thus, it became a necessity for the majority of average level HEIs to integrate their evaluation through external adopted systems for quality and sustainability to ease their development and compete within the higher education system[34]. As a result, various organizations began to develop different systems for benchmarking universities' overall performance. The idea of external ranking systems seemed very appealing from different perspectives:

- For universities, it was believed this would give universities' management the ability to better manage their institutions and gain more recognition compared to other institutions.
- For governments, the idea was attractive since this benchmarking would help governments in assessing the amounts of funding given to institutions based on their level.

Thus, the ranking served as a catalyst for the HEIs in securing funds for management and future development as well as achieving academic reputation.

2.3 Sustainability in higher education

Albert Einstein's stated, "The significant problems we face cannot be solved at the same level of thinking we used when we created them" [35 , p.1]. Since HEIs are

the breeding place for new thinking and ideas, the role of HE institutions thus comes to play. Subsequently, HEIs are fully equipped with human and physical resources including intelligent minds to lead research and solve worldwide issues, they serve as the dynamo to drive changes and move initiatives forward at the global level. The role of HEIs include education, research, and community service. Through education, HEIs have a significant impact on shaping people's attitudes and beliefs toward sustainability. [36]

Engineers, scientists and business people will collaborate to create, design and fabricate the needs of humankind for a sustainable future society where all its components exist in harmony. In such society, green economy elements will dominate where waste is minimized, recycling is maximized, energy consumption is reduced and the impact of any process on the planet is well evaluated. Unfortunately, current reality does not lead to a sustainable future society which clearly can be seen in the accumulated waste, environmental effects and increased energy consumption which emphasizes Albert Einstein's words above.

2.4 Role of higher education in sustainability

In order to achieve a bright sustainable future and in order to bridge the gap between the current state of the world and the dream future world of the humankind, collaborative efforts at different levels, from different organizations must work collectively to secure the vision for a bright sustainable future. Since HEIs graduates people from all disciplines and professions, therefore HEIs have

the most impact on the overall society, and as a result, must be devoted to the most crucial role in leading sustainable societal changes [37].

What adds to the complexity concern of the sustainability is that it constitutes a multidisciplinary issue while integrating different factors from the environment. This is consistent with Anthony Cortese words "Interactions between populations, human activities, and the environment and strategies, technologies, and policies for a secure, just, and an environmentally sustainable future are among the most complex and interdependent issues with which society must deal" [38],[39 ,p. 16]. In order for the HEIs to play their role in leading sustainability, it is better to be a role model by implementing sustainability systematically within curricula, collaborative work, interdisciplinary partnership, strategies, policies and leadership [40]. Most importantly, recognition of the size of the sustainability crisis worldwide and more importantly, realizing that this catastrophe is due to human values, knowledge, practice, thoughts and perspective which is an issue of education rather than one in education [41].

2.5 Sustainability in Palestinian higher education institutions

Palestinians must promote sustainability in every aspect of their lives in order to contribute to a sustainable future. The best system to initiate sustainable behavior is through the education at very early age [42]. Therefore, it is crucial for Palestinian HEIs to integrate the various theoretical and applied dimensions of sustainability, to prioritize cooperation, and improve the possibility for providing sustainable expertise to contribute for the world economy. Minimal amount of

research has been accomplished regarding sustainability in Palestine when compared to neighboring countries. In order for Palestine to have an effective role, a change must be initiated from within. In this regard, the universities are the best role model for leading the change. HEIs are the main drivers for social transformation towards sustainable development in Palestine, therefore, Universities and colleges are thus called to integrate the applied dimensions of sustainability within their educational programs, to promote collaboration, and to enhance the possibility for providing leadership and expertise to drive the sustainability development in Palestine [43]. Sustainability development is urgent in Palestine which will help achieve sustainable goals and direct the government to better use the available limited resources more efficiently [44].

After reviewing literature regarding the HEIs' role on sustainability in Palestine [40]–[42], the majority of scientists and thinkers agree that universities and colleges are the good organization to lead the process of sustainability since they represent smaller communities to reflect larger communities. Therefore, following their main tasks of education and research, sustainability can be defined and integrated within the two categories to facilitate interrelated sustainability concerns within the curricula, solve related sustainability issues by applying research and lead other organizations and the larger community for sustainability in Palestine [43]. Recently, some of the Palestinian HEIs' recearchers have intitiated evaluation for faculties of engineering for integrating sustainability within their teaching and recearch activities. The study showed variation in imlementing sustainability teaching and research activites among the different faculties. The variation

included different number of coureses related to sustainabilty, different number of sustainability research puplications and different sources for knowledge of sustainability[43][45]. Despite the fact that there are some sustainability activities within the palestinian HEIs, there is still a need to expand on such activites to cover the whole universities including –but not limited to- management, activities, enternal and external processes.

Chapter 3

Research methodology

3.1 Introduction

Within the scope of the previous chapter, relevant information is presented regarding literature review including history of sustainability, university rankings and the various systems associated with it, sustainability in higher education and the effective role of higher educational institutions (HEIs). Of specific importance, the significance of sustainability in Palestinian HEIs was addressed based on collected available literature where some literature also addressed the obstacles to sustainability faced by HEIs.

This chapter's focus is the methodology followed in the research including research design, research approach, data collection tools and methods. In general, this chapter provides guideline of how the study is conducted in order to answer the research questions, pursue the objectives and thus achieve the research main goal [46].

To achieve the chapter's goal, target participants are identified, techniques for sampling and data collection are explained, interviews are conducted and obtained results are collected and tabulated.

3.2 Research work plan

The green campus approach will serve as a practical assessment tool to develop matrices for the main categories. Figure 2 represents a schematic for the various detailed steps followed in this project to achieve the goal of the research.

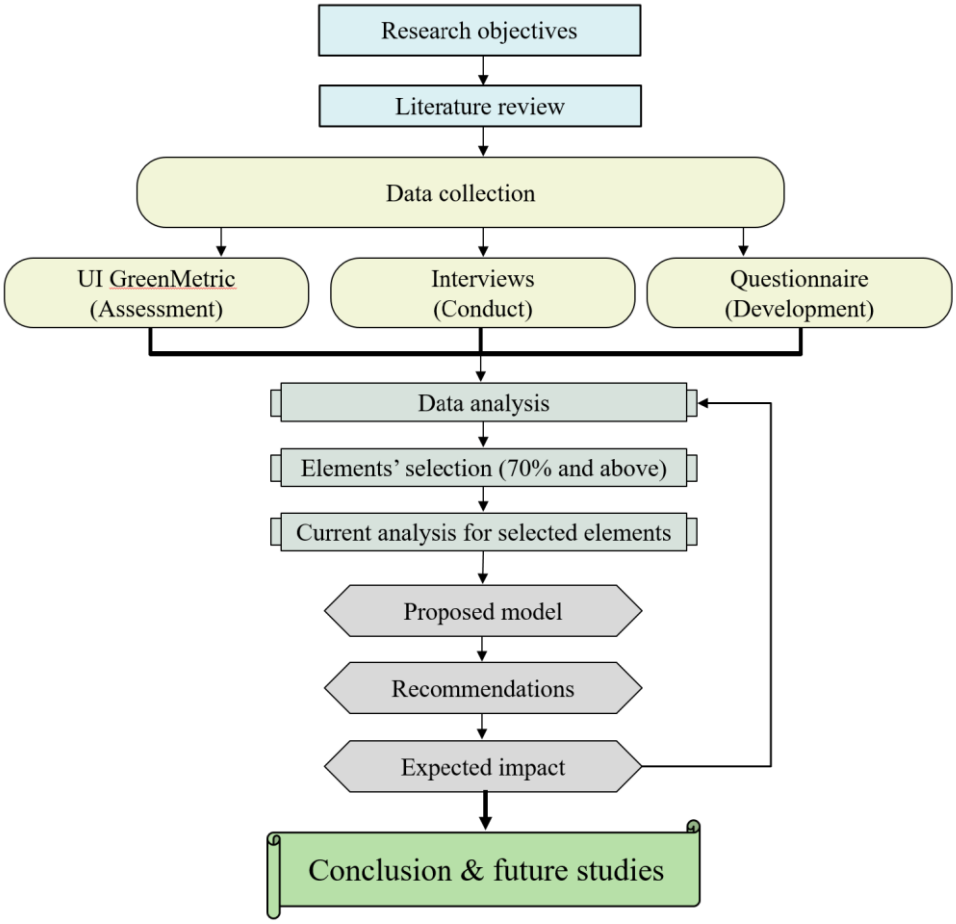

Figure 2: Flowchart for work plan

3.3 Research methods

In order to fulfill the objectives of the research, qualitative research was performed to collect and analyze the data. UI GreenMetric approach and the qualitative research approach are explained below:

3.3.1 UI GreenMetric method

UI GreenMetric system is a well-known model that utilizes different main elements to analyze and measure the sustainability within universities that directly affect

their ranking [47][48]. This research will be based on UI GreenMetric approach and will follow qualitative and quantitative analyses, which will be used to assess the main elements and their contribution to sustainability.

Initially, the documented UI GreenMetric indicators to be used for investigation will be reviewed. Next, indicators will be selected based on the importance and applicability. Later, data will be collected and analyzed to assess the university's sustainability. Finally, a set of recommendations, suggestions and changes will be provided. Data will be collected using a developed questionnaire in addition to interviews and discussions with relevant people within the university. Relevant factual data will be collected from relevant offices in the university and relevant graphs and tables will be generated to analyze the results of the responses. The obtained results will provide a certain indication about the level of sustainability and thus will serve as a guideline for the necessary indicators to be adopted. In addition, the results are expected to steer the university's management in certain direction for each of the categories pertaining to sustainability and will help to decide on relevant procedures, policies, guidelines, academic programs, activities and events to be delivered and implemented as a main part of the university's strategic plan and secure resources for current and future sustainability

3.3.2 Qualitative research method

The qualitative approach in research is empirical (based on facts-findings), uses description rather than explanation, and is highly acknowledged by many researchers [49]. Qualitative approach provides a detailed textual description to represent people's experience in a given issue. The main distinguished features of

qualitative research is its applicability for small number of participants as indicated [50].

In addition, the qualitative research is advantageous since it allows the researchers to provide description of the participants experience whether it supports or contradicts with the initial theory as argued by [49]. Qualitative research approach as distinctive in its nature as it allows the people to comprehend the experience and the nature of the addressed problem in an integrated format. Another advantage of qualitative research that is utilizes the most suitable data collection techniques to achieve the research ultimate goal. It is well documented that qualitative research serves as solid foundation for investigation this type of research since it integrates the theoretical and practical perspectives[51][52].

This qualitative approach is sufficient in this research since it is credible in finding answers to the research questions and offers by providing a complete perception of the research problem being investigated [51][53].

3.4 Research design: case study

In this research, a case study approach is designed and utilized to answer related questions to this study including what, why and how regarding sustainability at BZU. A qualitative approach is used in BZU to explore BZU system over a certain period through collecting detailed data from different sources including questionnaire, interviews, observations, documented data, and reports.

This research design is used due to its appropriateness and ability to provide complete detailed description of BZU and its setting through collecting data at a

certain time. Therefore, there was no accommodation to establish changes in the overall behavior and system within the university during this study, however, recommendations and suggestions will be provided for future implementation.

This analysis of BZU setting will help in shedding the light at BZU in terms of its current sustainability level, challenges subsiding sustainability implementation, and possible ways to move forward.

In implementing this research, it is noteworthy to mention three main conditions including:

- The type of research questions (what, why and how),
- The degree of controlling changes, and
- The period for the study (historical, current and future).

In addition, since minimum number of research articles have been published about sustainability in Palestine[54][55], as well as the emphasis on strategies and consequences, which according to Kezar [56], this constitute good reasons for applying case study approach on BZU .

3.5 Research population and sample

The main goal of this study is to assess the level of sustainability in BZU, determine green campus relevant elements and further integrate the findings as part of sustainability and effective use of BZU resources. The main **intention** is to provide guidelines that lead to processes and strategies in order to make the best use of available resources, identify relevant community members perspective regarding

green campus and sustainability while taking SDGs into consideration as well as adopted behavior in campus greening.

3.5.1 Sampling and sampling size

In this study, participants are selected based on decision-making ability, role in BZU, knowledge in green campuses and sustainability, qualification and expertise in this topic. According to [57], the sample selection criteria is in agreement with non-probability sampling techniques where sample members are selected based on the chosen characteristics above.

To carry on the investigation, the selected participants' roles are directly related to green campus and sustainability under investigation. They are knowledgeable and are actively involved in green campus conservation.

To accomplish the desired outcome, the following participated in providing relevant information:

- Faculty members contributed to questionnaire data
- Engineering office who have documented data regarding BZU operations and main green campus elements
- Testing center
- Head of security and safety
- Vice president for planning and development (VPPD) office
- Vice president for administration and finance affairs (VPAFA) office
- Vice president for academic affairs (VPAA) office
- General service office

- Vice president for community affairs (VPAA) office
- Vice president for campus development (VPCD) office
- The institute for environmental and water studies

Out of the 428 full time faculty members and 393 administrative employees, 114 employees participated in providing related data from faculty members and governance perspective. According to Singh and Masuku [58], 90 respondents will be consistent with 95% confidence level with a 5% margin error. The participants were selected with knowledge and expertise to contribute properly to data collection and data analysis.

3.6 Data collection

For the purpose of this study, Yin's work, which stated six sources of evidence to choose from when investigating a current phenomenon within a naturalistic environment, was adopted [59]. According to Yin, the six sources of evidence include archival records, documents, interviews, direct observations, participants' observations and questionnaires. In this research, the six sources of evidence were used to provide coherent perspective and to better trust the results since one source is not reliable [60]. Interviews and qualitative questionnaire were used to collect information, while UI GreenMetric was used as the basic sources to secure inclusive perspectives. Below is description for each of these forms:

3.6.1 Interviews

The interview of this study consists of interviewees from BZU. 10 individuals were interviewed to discuss the research relevant questions and collect pertinent information. The interviewees are well knowledgeable in sustainability related topics and old managerial positions which help in decision-making and regarding implementing proposed models and enforce approved changes.

3.6.2 Questionnaire

The questionnaire was developed based on UI GreenMetric categories including their various elements as discussed earlier and following the research questions and research objectives. The questionnaire was used to collect related information from various BZU employees and faculty members. The questions were designed to address UI GreenMetric elements that encompass the research questions as stated in chapter 1. A selected committee validated the questionnaire to ensure appropriateness and to satisfy research objectives.

Questionnaire questions were also designed based on the literature as addressed in chapter 2. The main aim was to learn about the importance of UI GreenMetric categories and their applicability in BZU as main pillar of sustainability. The questionnaire was self-administered, completed questionnaires were collected from participants, and data was analyzed. The questionnaire administration commenced in January and ended in May of 2023.

3.7 UI GreenMetric assessment.

UI GreenMetric is open to global participation, available to HEIs in both developed and developing nations, and is expected to add to the scholarly conversation on sustainability in education and campus greening. Additionally, it must support university-led social change in line with sustainability objectives [61]. With an emphasis on the efforts of the university and partners on sustainability issues, the 2018 UI GreenMetric subject "Universities, Impacts and Sustainable Development Goals (SDGs)" aims to advance cooperation improvement in the campus sustainability [62]. The UI GreenMetric covers the following categories:

1. **Setting and infrastructure (SI)**

The campus setting and infrastructure will give a general idea of its propensity for a green atmosphere. This signal will finally reveal whether or not green campus is a respectable college. The intention is to encourage the participating colleges to offer more green open space for preserving and greening the environment as well as renewable energy sources.

2. **Energy and climate change (EC)**

The college's attention to energy consumption and climate change concerns is the most weighted indicator. In the questionnaire, several indicators for areas of special concern are determined, such as the use of energy-saving tools, smart building implementation, renewable energy policy use, total energy use, energy conservation programs, elements of green building, climate change adaptation and mitigation, greenhouse gas reduction policies, and the amount of carbon. With

these measures, universities are encouraged to increase their efforts to improve building energy efficiency and to be more attentive about the type and source of energy.

3. **Waste (WS)**

Waste processing and recycling activities play an important role in developing a sustainable environment. The university staff and student's activities on campus generate large amount of waste. Thus, some waste management and recycling programs should be of the university's main concerns, such as the recycling program, toxic waste recycling, organic waste processing, inorganic waste treatment, sewage disposal, and campus policies to reduce the use of paper and plastic usage.

4. **Water (WR)**

Another major factor in the UI GreenMetric standard is water consumption on campus. The goal is to increase campus water saving, develop conservation initiatives, and maintain habitat. Among the requirements are water conservation initiatives, water recycling programs, water usage efficiency programs, and the use of treated water.

5. **Transportation (TR)**

Campus transportation system has a significant impact on campus carbon emissions and level of pollution. Transportation policies that restrict vehicles

number inside campus, as well as the usage of campus buses and bicycles, will promote a healthier environment. In addition, the adoption of pedestrian policy will inspire BZU to walk instead of driving. The utilization of ecologically friendly public transportation on campus will minimize carbon emissions.

6. Education (ED)

Education and research is the main service provided by the university. Environmental education and research will expand on university's community knowledge. Thus, implementing sustainability related courses, as part of the curriculum will help student develop knowledge about the principle of environmentally friendly and shape their behavior and responsibility toward the environment. In addition, encouraging research related to sustainability will promote sustainability within BZU and influence the decision making nationally.

3.8 Data analysis

The collected data was treated and analyzed as categories and corresponding elements to avoid the ambiguity of presenting and comprehending general data. Various techniques were applied to present the data in order to facilitate the interpretation of the information. Data collected from the questionnaire and interviews were analyzed manually. The data was presented using figures, tables, charts hierarchal charts, and mapping techniques. The variation in presenting the obtained data gives the ability to better structure the obtained data in a way that achieves research objectives.

3.9 Ethical considerations

The current study is conducted in line with internationally standards, methods and techniques and covers certain ethical concerns. An information letter was provided as the cover page of the questionnaire where brief information about the scope of the study.

All participants voluntary completed the questionnaire and provided data, as they deem necessary.

Ethical considerations of this research are in line with those adopted by BZU. Initially, the proposal was submitted to the supervisor, and then was presented for the program committee for evaluation and approval. Anonymity was maintained during data collection and data treatment. Anonymity and confidentiality were ensured through compiling and data analysis

Chapter 4

Data presentation, analysis and interpretation

4.1 Introduction

The previous Chapter detailed the process of research conduction. It mainly included research methods, research design, work plan, sampling, participants' participation and selection, data collection, data analysis, research ethics.

This Chapter presents the essential obtained information in a clear and concise way to communicate the findings based on the implemented research methodology. The chapter involves processing and analyzing the data to derive meaningful understandings for the obtained data. Next, the data will be interpreted. Then, the obtained results will be used to assess the level of sustainability in BZU through conducting interviews with various leadership offices, collecting questionnaire results obtained from employees and current scoring based on UI GreenMetric evaluation. The obtained responses are analyzed and interpreted relative to the research objectives stated in a previous chapter. Finally, the results were utilized effectively to draw conclusions and provide meaningful recommendations in a later chapter.

4.2 Methods of data collection

The principal instruments used for data collections were interviews, UI GreenMetric evaluation and questionnaire. Excel software was mainly used to analyze data collected, generate relevant figures and identify patterns and trends related to the university sustainability. Since the number of interviewees was small,

data collected from the interviews was analyzed manually. All of the interviews and questionnaires were examined and were considered valid for analysis.

4.2.1 Interviews

As motioned in chapter 3, 8 interviews were conducted in person as follows:

Table 1: Data collection from interviewees.

Office	Form of dada	Role
vice president for academic affairs	Interview, questionnaire	Managerial
vice president for planning and development	Interview , questionnaire	Managerial
vice president for community affairs	Interview , Questionnaire	Managerial
vice president for administrative and financial affairs	Interview, information provider	Managerial
vice president for campus development	Interview, Questionnaire Information provider.	Managerial,
engineering and general services office	Questionnaire, Information provider	Technical
Testing center	Questionnaire, Information provider	Technical
Safety and security office.	Questionnaire, Information provider	Technical Managerial

The interviews were conducted with the intention to:

- Identify participant's perception based on their positions and influential power within the BZU environment
- Include the current genuine leadership perspective regarding university sustainability

- Check the information collected through the questionnaire
- Provide additional necessary information that support the research objectives and
- Document any unannounced actions which might have an added values to the data analysis

Relevant information about the interviews are tabulated in Table 1 below including the position of the interviewee, the dates, times and durations for each. The interviews were in a form of face-to-face one-on-one basis to allow for an in-depth interaction. The interviews took place during the period from February to May 2023 in the BZU campus as tabulated in Table 2.

Table 2:Interviews general information

Meeting information	**Findings**
academic affairs office Date: 11/4/2023 Time:12.00 Duration: 30minutes	Some of the courses included the concept of sustainability
planning and development office Date:11/4/2023 Time:11:00 Duration: 50 minutes	-The concept of sustainability is extremely important to the university campus -The university's strategic plan focused on the need to implement the sustainability principle on campus

community affairs office Date: 13/4/2023 Time: 10:00 Duration 40 minutes	-There are no activities dedicated to sustainability within the university There are no community activities related to sustainability
administrative and financial affairs office Date: 13/4/2023 Time: 11:00 Duration: 30 minutes	-There is no dedicated budget for sustainability -Part of the maintenance budget can be considered appropriate in terms of sustainability
campus development office Date: 13/4/2023 Time: 9:00 Duration: 60 minutes	-it is important to apply sustainability concepts for the university campus -it is importance to provide pedestrian paths and spaces for activities on campus -It is important to consider environmental aspects when designing campus buildings including building orientation and architectural green elements.
engineering and general services (many visits)	-Provided information regarding the area of the campus and the number of buildings. -An energy-saving lighting system has been installed in the recent buildings -There are a number of rain water storage reservoir inside the university campus, where the water was used for toilets only, and plants are not irrigated from them -There are a number of car parking area for students inside campus

	-most of the boilers used for heating are old and no modern heating systems have been installed (e.g. VRV, VRF) -recent buildings are provided with some of smart buildings requirements of, noting that they cannot be considered smart buildings

4.2.2 Questionnaire

The questionnaire was delivered to about 150 employees whose positions varied within the university to include the majority who can contribute to the importance of this research. 114 questionnaires were collected after completion. The actual copy of the questionnaire is provided in Appendix A. The detailed responses to the questionnaire are presented in Table 3 with the level of importance using Likert scale. The table highlights the results obtained from the questionnaire regarding the importance of the sustainability related elements. The majority of the responses were supportive of the university sustainability and its implementation wide-across the university. The responses clearly encourage the immediate implementation of the sustainability activities and developing each of the needed processes and procedural guideline to ensure implementation. In general, the majority of the responses varied from neutral to very important. It is clear from the table that there are various responses per question with more emphasis directed toward observed physical outcomes for the majority of the questions.

Table 3: Questionnaire detailed responses

	Question	Very important (5)	important (4)	Neutral (3)	unimportant (2)	very unimportant (1)	weighted percentage
1	University sustainability	78	36	0	0	0	93.7
	Setting and Infrastructure (SI)						
2	Area on campus covered in forest vegetation	53	61	0	0	0	89.3
3	Budget allocation for university sustainability	60	28	26	0	0	72.3
4	Annual maintenance	57	29	28	0	0	70.4
5	Facility accessibility for disabled and maternity	30	60	14	10	0	68.4
6	Facilities security and safety	38	54	22	0	0	71.2
7	Health infrastructure/facilities	45	53	9	7	0	76.7
8	Conservation: plant (flora), animal (fauna), and wildlife	36	42	24	12	0	61.1
	Average of weighted percentages						72.77
	Energy and Climate Change (EC)						
9	Energy efficient appliances usage	79	33	2	0	0	92.5
10	Smart buildings implementation	65	47	2	0	0	90
11	Renewable energy sources on campus	52	52	10	0	0	82.1
12	Elements of green building implementation	59	43	12	0	0	81.9
13	Greenhouse gas emission reduction program	25	69	20	0	0	70.4
14	Offering innovative program(s)	22	90	2	0	0	82.5
	Average of weighted percentages						83.23
	Waste (WS)						
15	Implementing recycling programs for university's waste	52	60	2	0	0	87.7

16	Program to reduce the use of paper and plastic on campus	72	40	2	0	0	91.2
17	Waste (organic, inorganic, toxic) treatment program	47	55	12	0	0	79.8
18	Sewage disposal	32	68	14	0	0	75.8
	Average of weighted percentages						83.63
	Water (WR)						
19	Water conservation program & implementations	63	41	10	0	0	84.0
20	Water recycling program implementation	70	35	9	0	0	86.0
21	Water efficient appliances usage	67	37	10	0	0	84.7
22	Wastewater treatment and consumption	33	75	6	0	0	81.6
23	Water pollution control	46	59	9	0	0	81.8
	Average of weighted percentages						83.62
	Transportation (TR)						
24	Shuttle services	35	30	35	12	2	51.8
25	Zero Emission Vehicles (ZEV) policy on campus	19	38	49	8	0	43.3
26	Program to limit or decrease the parking area on campus	25	39	38	10	2	49.3
27	Initiatives to decrease private vehicles on campus	26	61	7	16	4	65.6
28	Pedestrian path on campus	41	53	10	8	2	73.2
	Average of weighted percentages						56.64
	Education and Research (ED)						
29	Offering courses/subjects related to sustainability	38	74	2	0	0	85.3
30	Research funds dedicated to sustainability research	46	56	12	0	0	79.6
31	Scholarly publications on sustainability	40	36	38	0	0	60.4
32	Events related to sustainability	34	50	30	0	0	64.9
33	Student organizations related to sustainability	16	78	20	0	0	68.8

34	University-run sustainability website	12	74	26	2	0	62.5
35	Importance of university sustainability report	39	48	27	0	0	67.9
36	Cultural activities on campus related to sustainability	2	60	44	8	0	43.9
37	University program(s) to improve teaching and learning	42	54	10	8	0	74.7
38	Importance of sustainability community services	34	70	10	0	0	78.9
39	Importance of sustainability-related startups	40	42	32	0	0	64.6
	Average of weighted percentages						68.32

In addition, it is obvious that the questions involving theoretical, processes and lengthy procedures were not getting as much attention by the respondents. This difference could be attributed to one or more of the followings:

- BZU community is a believer of the change and strive to see the outcome of the proposed change rather than reading the documented theories about the needed changes.
- BZU community has previous knowledge about university's sustainability due to some previous sustainability initiatives however there were clear gaps in sustaining the sustainability to achieve the desired results.
- BZU community is unaware of the amount of work that needs to be incorporates to reach a certain level of sustainability including decision making, procedural aspects, regulations and policy development processes due to miscommunication with the university management.

The last column presents the weighted percentage for each of the questions which range from lower 40s to high 90s which emphasized the importance of this study. To find the weighted average, the number of responses for each of the Likert score is multiplied by its weight, then the results are added. The sum of the variables are then divided by the sum of the total points multiplied by 100. The weighted average was calculated based on the following equation:

$$\%\, weighted\ average = \frac{\sum_{n=1}^{5} number\ of\ respones}{total\ points}\ \text{x } 100\% \ldots\ldots (1)$$

Where n is Likert scale weight from 1 to 5. For example, the weighted average for question 2 (Area on campus covered in forest vegetation) calculated as below:

$$\%\, weighted\ average = \frac{(53 * 5) + (61 * 4)}{114 * 5}\ \text{x}\ 100\% = 89.3$$

The tabulated results establish solid foundation to serve as guidance through the proposed sustainability model in terms of its basic elements: dynamos and approaches.

Figure 3 shows the weighted percentages obtained for each question, as listed on the x-axis, of the setting and infrastructure category. It is clearly indicated that 5 elements in the SI category have weighted percentage of 70% or above. Area of forest vegetation has the highest weighted percentage which might be due to the positive impact the community experience daily, while wildlife conservation has the lowest weighted percentage which might be due to the underestimation of its value within the environment.

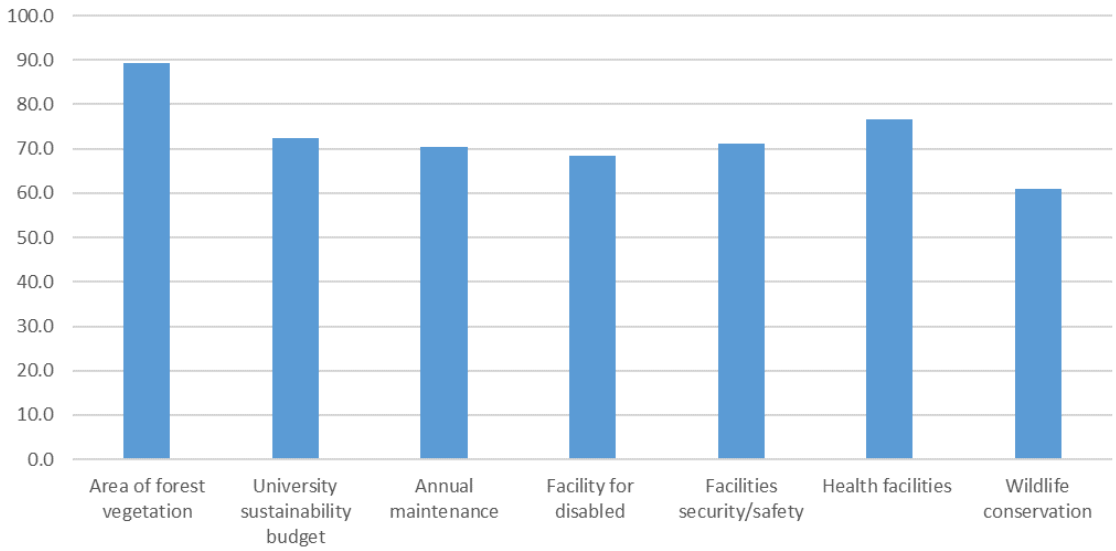

Figure 3: Weighted average for Setting and Infrastructure (SI)

Figure 4 shows the weighted percentages obtained for each question as listed on the x-axis of the energy and climate change category. It is clearly indicated that

all the questions in the EC category have weighted percentage of 70% or above which might be due to direct impact BZU community experiences and the increased awareness toward energy and climate change worldwide.

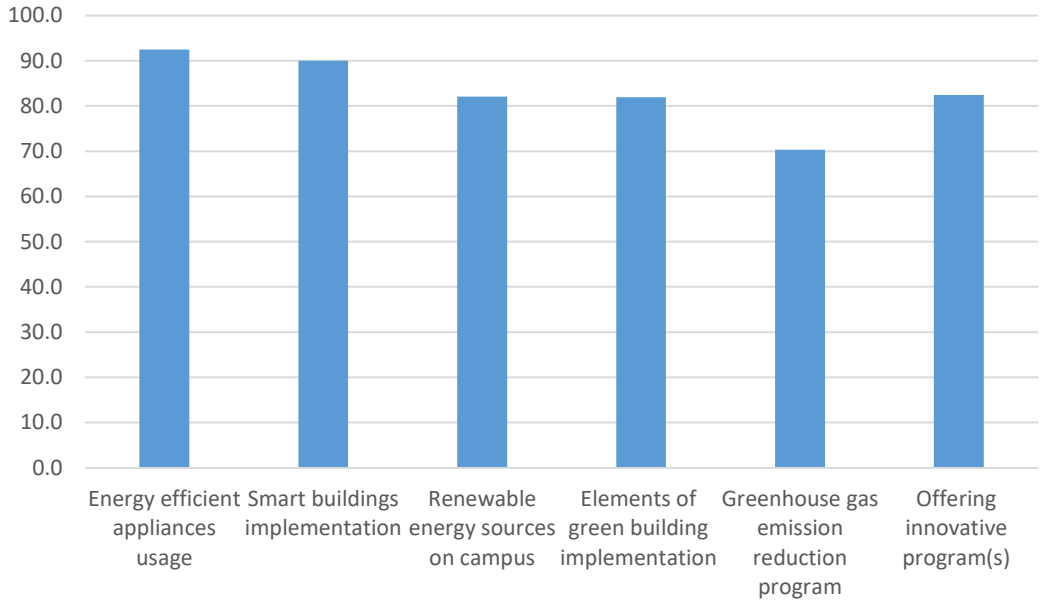

Figure 4: Weighted average for energy and climate change (EC)

Figure 5 shows the weighted percentages obtained for each question as listed on the x-axis of the waste category. Similar to the energy and climate change category, all the questions in the WS category have weighted percentage of 70% or above which might be due to its generality and its direct effect in the health and environment.

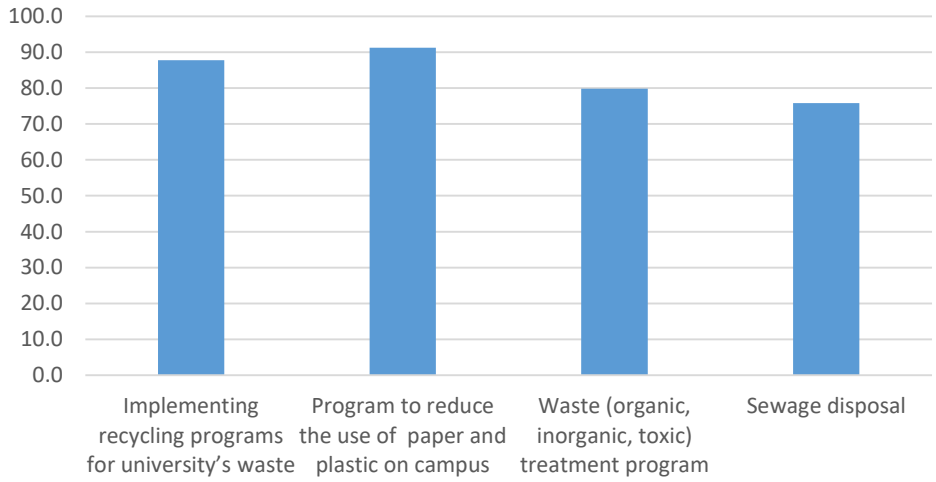

Figure 5: Weighted average for waste (WS)

Figure 6 shows the weighted percentages obtained for each question as listed on the x-axis of the water category. Similar to the EC and WS, all the questions in the WR category have weighted percentage of 70% or above which might be due to core importance in our daily life and its scarcity.

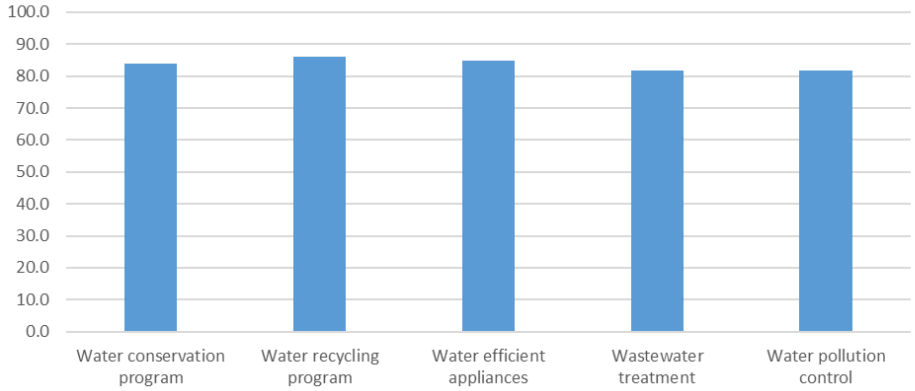

Figure 6: Weighted average for water (WR)

Figure 7 shows the weighted percentages obtained for each question as listed on the x-axis of the transportation category. Unlike the rest of the categories, only one question in the TR category has weighted percentage of 70% or above which

might be due to the need of pedestrian path on the daily basis during walking within campus, while the other elements are either irrelevant or non-applicability within BZU environment.

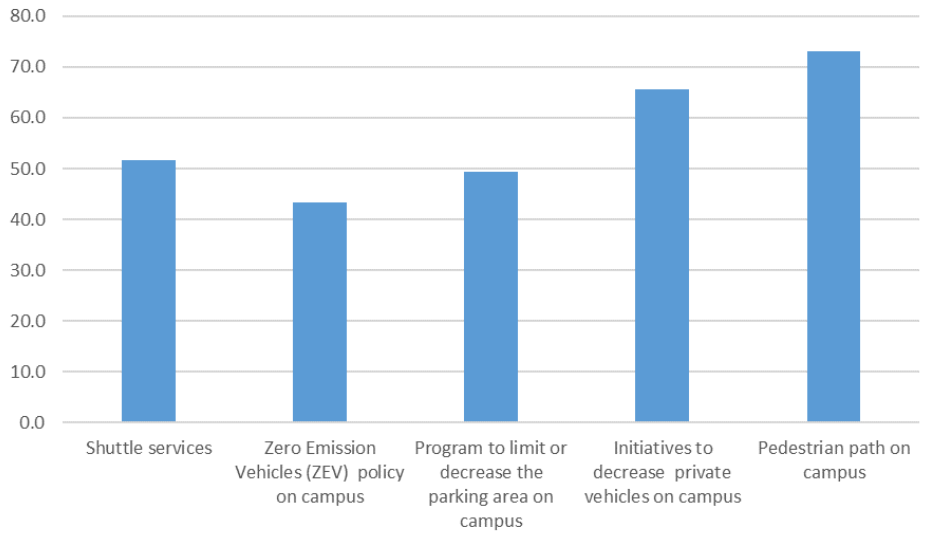

Figure 7: Weighted average for transportation (TR)

Figure 8 shows the weighted percentages obtained for each question as listed on the x-axis of the education and research category. Four questions in the ED category has weighted percentage of 70% or above which might be due the nature of service provided by BZU (i.e. teaching and research) while there is underestimation for other non-educational activities.

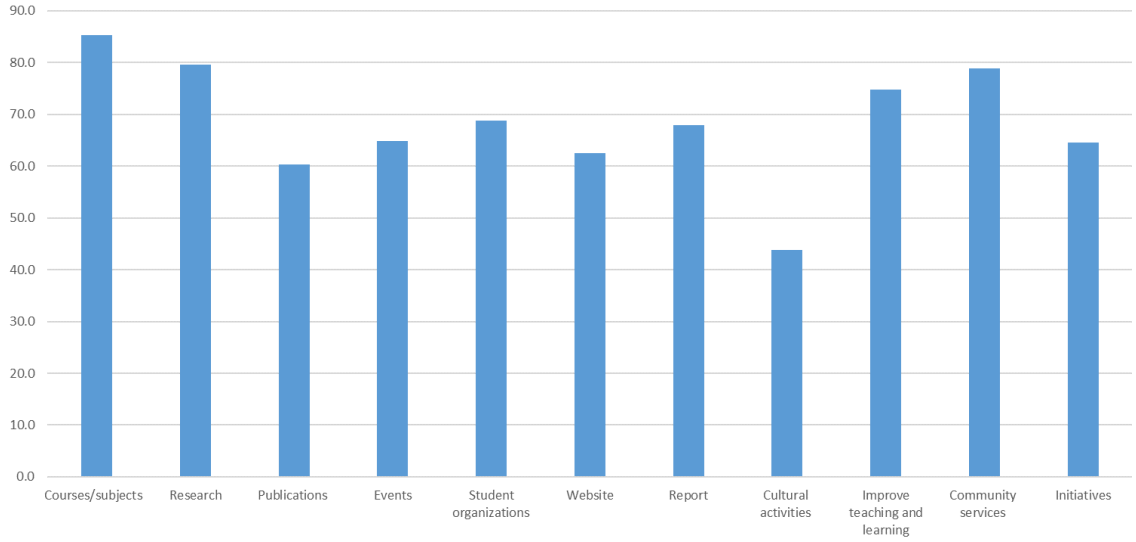

Figure 8: Weighted average for education (ED)

In summary, the average for the weighted averages of all questions is 73.5% with 25 questions resulted in weighted averages of 70% or above distributed across the six categories. Therefore, to be inclusive in terms of categories and allow for various elements to begin with, questions with weighted averages of 70% and above where considered for further investigation to be included in the proposed model. This step is not intended to underestimate the value for each of the questions; rather, it intends to focus on specific more appealing elements within each category to facilitate and promote the change forward. In addition, this segmentation for the investigation in a gradual form helps ensure that an action is being implemented rather than a reaction fades away.

4.2.3 UI GreenMetric analysis

Table 4 lists the UI GreenMetric setting and infrastructure category and its elements including their allocated points. The total maximum possible score for SI category is equal to 1500 and is assigned 15% weight[63] .

Table 4: UI GreenMetric for SI for BZU

Indicator	Points	BZU level	BZU points
Setting and Infrastructure (SI)--15%	**1500**		
The ratio of open space area to the total are	200	0.05	10
Total area on campus covered in forest vegetation	100	0.05	5
Total area on campus covered in planted vegetation*	200	0.05	10
Total area on campus for water absorption besides the forest and planted vegetation*	100	0.05	5
The total open space area divided by total campus population	200	0.05	10
Percentage of university budget for sustainability efforts*	200	0.05	10
Percentage of operation and maintenance activities of building in one year perio	100	0.05	5
Campus facilities for disabled, special needs and or maternity care	100	0.75	75
Security and safety facilities	100	0.5	50
Health infrastructure facilities for students, academic and administrative staff's wellbeing	100	0.5	50
Conservation: plant (flora), animal and wildlife (fauna), genetic resources for food and agriculture secured in either medium or long-term conservation facilities	100	0.05	5
Total points	**1500**		**230**

To explain further, each of the elements is assigned a score as well as different percentages based on current level as provided by UI GreenMetric. To determine the score for each element, the determined level of current achievement (assigned percentage) is multiplied by the assigned score for that particular element. The score for each category is simply the sum of the elements' individual scores for that category. The overall score is simply the sum for all six categories. For example, the score of the element described in "health infrastructure facilities for students, academic and administrative staff's wellbeing" is calculated as follows:

The current is equivalent 0.5 and has a maximum of 100 points

The current score is = 0.5 * 100 = 50 points

The data was collected for all elements following the UI GreenMetric criteria. The complete tabulation for the UI GreenMetric categories is provided in Appendix C. The percentage for each category is calculated by dividing the obtained score for the category divided by the max score allocated for that category multiplied by weight for that category. Hence, the percentage for the SI category is equal to (230/1500) * 15% = 2.3%

Table 5 summarizes all the UI GreenMetric categories and their allocated maximum points. The total maximum score possible for all categories is equal to 10000 distributed as it appears in the allocated column in Table 4. The third column headed with BZU UI points lists the total points obtained for BZU based on UI GreenMetric current level.

Table 5: UI GreenMetric categories and their maximum points

Category	Points by UI GreenMetric	Weight % UI GreenMetric	BZU points/ UI GreenMetric	%UI GreenMetric
SI	1500	15	230	2.3
EC	2100	21	200	2
WS	1800	18	0	0
WR	1000	10	200	2
TR	1800	18	160	1.6
ED	1800	18	75	0.75
Sum	**10000**	**100**	**865**	**8.65**

It is obvious from the tabulated results in Table 4 that BZU does not follow UI GreenMetric as a guideline for assessing university sustainability[63]. The majority of these result have very low scores overall. These results should serve as one motivation for adopting a custom made model for sustainability that fits the specific needs of BZU. These results are not indicative of underestimating the importance and benefits of implementing sustainability measures, on the contrary, BZU has some advanced sustainability elements which can be seen clearly within the campus such as solar energy station as a renewable energy source. However, it seems like BZU lack commitment in terms of centralization and systematization to take action in decision making and enroll in extensive application of sustainability action plan rather than performing fragmented, irregular and unmonitored sustainability implementation wide-across the university. This explanation is confirmed by the absence of sustainability office, sustainability budget allocation, sustainability action plan and annual sustainability report.

4.2.4 Summary for UI GreenMetric and questionnaire

The data analysis was taken a little further to present the responses obtained from the questionnaire with weighted averages 70% or above and the UI GreenMetric using similar scales. Table 6 summarizes the outcome of this analysis. To do so, the average of the weighted percentages obtained from the questionnaire (as they appear in Table 3 for the elements of each category was calculated. Next, the obtained average was converted to points scale by calculating the product of the average for each category and the total points allocated by the UI GreenMetric.

Finally, the percentage based on the findings from the questionnaire was calculated similarly by finding the product of the ratio of the obtained points and the allocated percentage by UI GreenMetric

Table 6: Summary for UI GreenMetric and questionnaire results

Category	Points*	Weight %*	**UI GreenMetric BZU results**		**Questionnaire**		
			Points	**%UI**	**Average**	**Points**	**% Q**
SI	1500	15	230	2.3	72.77	1091.4	10.91
EC	2100	21	200	2	83.23	1747.5	17.47
WS	1800	18	0	0	83.63	1505.5	15.05
WR	1000	10	200	2	83.62	836.1	8.3
TR	1800	18	160	1.6	56.64	1019.4	10.19
ED	1800	18	75	0.75	68.32	1229.6	12.29
Sum	**10000**	**100**	**865**	**8.65**		**7429.5**	**74.29**

*The weight % and the points are adopted based on the GreenMetric for comparison purposes

For example, the calculation for setting and infrastructure (SI) category is calculated as below:

Average for weighted averages for all elements in the SI is

Average = (89.3 + 72.3+ 70.4 + 68.4 + 71.2 + 76.7 + 61.1)/ 7 = 72.7

The points (based on questionnaire) = (72.7/100) * 1500 = 1091.4

The percentage (based on questionnaire) = (1091.4/1500) * 15% = 10.9 %

The above calculation was repeated for each of the categories and the obtained results are tabulated in terms of points as well as percentages in the table. It is clear that there is a huge gap between the points and percentages allocated by the UI GreenMetric and the equivalent points based on the questionnaire results which reflect the community professional opinion regarding importance of university sustainability. To visualize the obtained results bar charts for each of the category is obtained in terms of percentages which is shown in Figure 9. It is obvious from the figure that there is consistency in the gap between the questionnaire results and UI GreenMetric.

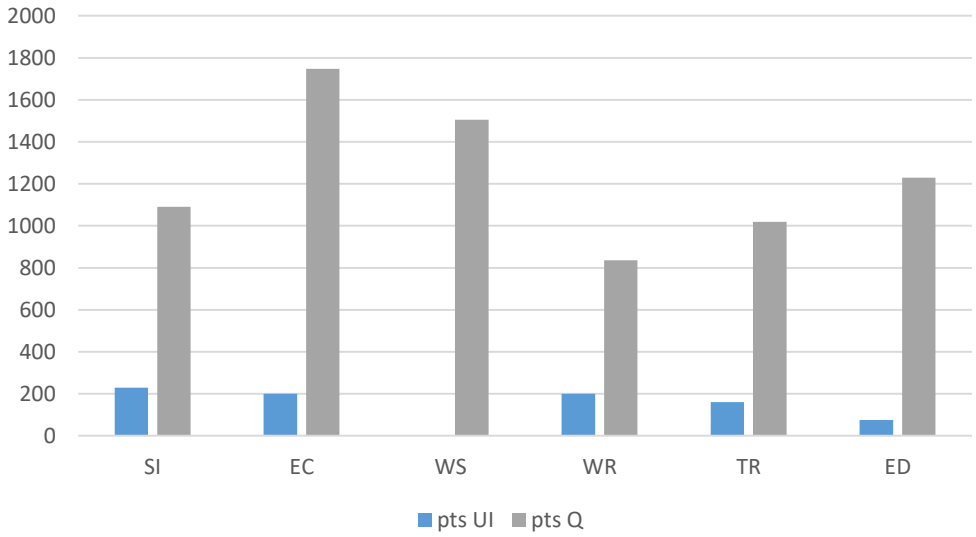

Figure 9: Summary of GreenMetric and questionnaire categories' percentages

In addition, the sum of the points for the total categories as obtained by each method is shown in Figure 10 for comparison where the difference is well represented.

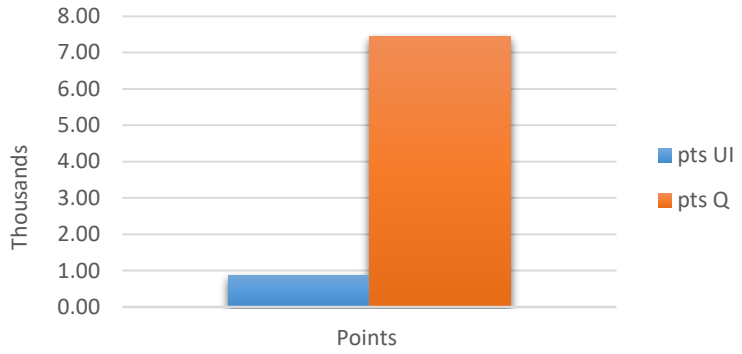

Figure 10: Total points using GreenMetric and questionnaire

The results reflected in the table above and figures 9 and 10 serve as a motivation for inaugurating sustainability at BZU. This motivation steered thinking about the following questions:

How to implement sustainability and what should be included as sustainability is implemented?

To answer the above question, a model must be developed and implemented in the very near future to avoid falling behind. This model must be comprehensive and covers theoretical as well as technical aspects of all activities within the university. This model can be thought of as a car where the dynamo of the car must be charging efficiently in order to steer the car and drive properly. Similarly, the dynamos of the university at various levels must carry on their role of directing the university efficiently in order to steer the university using various approaches to succeed in implementing sustainability within the university. To establish the basis for the model, detailed description of the current situation for each element of the questionnaire with a 70 % score or more was analyzed.

4.3 Challenges faced during data collection

Although the study is specific for BZU and there are general sustainability practice, it can be generalized to other universities or organization with no much variation. The suggestions, recommendation and proposed model can be adapted and evaluated within similar environments nationally and internationally to better utilize the natural environment, energy, and water resources. There are a number of challenges faced during data collection including:

- Absence of proper sustainability structure in the organization which led to poor coordination as well as lack of institutional sustainability reference to provide necessary information which affects data collection. For example, there is no available data about the emission of harmful gases during the previous years.
- Further, there is no approved sustainability annual report to document necessary data regularly.
- There was no benchmarking followed by BZU for sustainability which leads to poor implementation and improper execution of sustainability programs and activities.
- The lack of proper execution was challenging when it comes to sustainability programs and unavailability of measuring tools/devices to provide current measures.
- There was a limited number of knowledgeable contributors to the data collection process which reflects poor sustainability awareness

Chapter 5

Findings and proposed model

5.1 Introduction

In general, this chapter will serve as a bridge to connect the goal with the findings while documenting any obstacles and shortcomings. This chapter aims to assess the findings of the study as outlined in chapter four. Based on the findings, suggestions and recommendations are provided to commence sustainability implementation following a proposed model. At the end of the chapter, limitation of the research will be addressed. This chapter is important in combining the different parts of the research together including research objectives, documented literature, research methodology, data collection techniques and data analysis.

5.2 Analysis for current situation

Table 7 below represents the current situation analysis for each of questionnaire elements with a score 70% or more. The analysis is consistent with the evidence presence as requested by UI GreenMetric. The last column relates the elements to the proposed approach based on the related functions.

Table 7: Analysis for current situation

Element with 70% or above from the questionnaire	Current situation
Security and safety facilities	Below are the security and safety facilities available at BZU: - CCTV at the all gates and main entrances for certain buildings - Firefighting system including fire sprinklers in certain location, fire hydrants in all buildings, CO_2 fire extinguishers and FM200 for electric boards. - Smoke alarm system for specific locations within the buildings
Health infrastructure/ facilities	BZU has its own healthcare clinic to provide health service for BZU community where students and university's staff can go and benefit. The clinic provides first aid service, general practice medicine, emergency services, dental clinic, laboratory testing and medicine dispense for students. The clinic is located on campus and within reach to all BZU community including students, faculty members and employees. The services are provided by certified personnel.

Energy efficient appliances usage	Although there are some evidential sources regarding energy efficient appliances usage such as LED lamps, fans, heaters and AC systems, BZU must realize the importance of efficient appliances' usage through initiating energy management and documenting data regarding the percentage of energy savings as well assessing the energy consumption to figure out the energy savings due to energy efficient appliances usage.
Smart building implementation	Despite the fact that the questionnaire responses emphasized the importance of smart building implementation (a score of 90%), which was also discussed in the interviews. Automation, safety, energy, water, indoor environments and lightening are the core elements of smart building implementation. In addition, this element is highly recognized by other adopted sustainability systems, unfortunately the current situation at BZU is as follows: -The majority of the existing buildings are old and not prepared for smart building elements to be implemented -The renovation process is costly, rare and usually not inclusive

	-The newly constructed building includes fragmented elements of the smart building elements criteria, however, does not meet the threshold of the smart building elements. -Allocation of fund is a challenge for the smart building elements to be implemented
Renewable energy sources in campus	BZU has recently inaugurated photovoltaic power station on campus as renewable energy source. In addition, BZU has: - 259 KW solar system on the rooftop of Omar Aggad Engineering Building - 50 KW solar panel on the roof of Samih Darwazah Institute for Pharmaceutical Industries. - Total of five roofs including Samih Darwazah Institute for Pharmaceutical Industries, the annex of the Institute of Law Building, Omar Aggad Engineering Building, and the engineering workshops. This commitment helped in reducing the cost of the university's electricity consumption by approximately $100,000per year.
Elements of green building implementation as reflected in all	Despite the fact that the questionnaire responses emphasized the importance of elements of green building implementation as reflected in all construction and renovation policies and obtained a score of 82%, which was also discussed in the interviews. In addition, this element

construction and renovation policies	is highly recognized by other adopted sustainability systems, unfortunately the current situation at BZU is as follows: - There are no policies or set of standards to be followed at BZU - The green building concept is not well addressed during the construction of new buildings and/or the renovation of any existing buildings
Greenhouse gas emission reduction program	BZU has been using renewable energy for electricity that reduces purchased electricity
Number of the innovative program(s) in energy and climate change	Although there are some evidential sources regarding energy efficient and climate change activities such as initiating LED lamps usage, BZU must realize the importance of systematizing and implementing innovative programs to promote environmental improvements. These programs vary to include CO_2 reduction, greenhouse gas emission and any other innovative energy and climate change.
Recycling program for university waste	BZU uses a local recycling company, which allow participating units to accumulate recyclable paper. This program is limited only to paper recycling which is compiled and collected upon

	request. BZU does not have any recycling programs for plastic, aluminum and E-waste which is usually dumped in the regular waste containers without any management.
Program to reduce the use of paper and plastic on campus	Although BZU consumes large amounts of paper, there are no programs to encourage paper reduction or paperless systems in the working environment. Individual social responsibility toward sustainable environment is what motivates some individuals to take action such using 2-side paper when printing, rechecking data before printing, using E-copies when applicable, Currently, there are no policies to enforce paper reduction usage.
Organic waste treatment	Although BZU generates large amounts of organic waste from cafeterias and the café shops, there is no clear role for BZU in monitoring and /or supervising the organic waste treatment. The cafeterias and café shops manage the organic waste individually without any reference to the organic waste policy or protocol to be followed or emphasized upon contract signature. The tenants of such places do not encounter any penalties for not managing the organic waste properly. Most likely, the organic waste ends up delivered to the municipality dumping areas

	outside the campus without any further treatment. The output of this system contributes negatively to the environment and increases the amounts of CO_2 gases within the environment.
Inorganic waste treatment	Although BZU generates large amounts of inorganic waste from cafeterias and the café shops, there is no clear role for BZU in monitoring and /or supervising the inorganic waste treatment. The cafeterias and café shops manage the inorganic waste individually without any reference to the inorganic waste policy or protocol to be followed or emphasized upon contract signature. The tenants of such places do not encounter any penalties for not managing the inorganic waste properly. Most likely, the inorganic waste ends up delivered to the open dump outside the campus without any further treatment. The output of this system contributes negatively to the environment and ecosystem since it does not biodegrade. The BZU tenants and community are not aware of the collection and recycling processes of the inorganic waste.
Toxic waste treatment	Although BZU generates amounts of toxic waste from teaching and research labs, it does not adopt any protocols or enforce any policy for toxic waste treatment. The toxic waste originated by labs is mostly dumped in the sinks without any supervision form any trained personnel. No

	instruction is provided for waste packaging, labeling, or compliance with any adopted national (if any) or international regulations and fill documents in line with national and international regulations.
Sewage disposal	BZU does not have any processes for removing and converting the toxic substances of sewage. BZU has no obligation to make provision for the emptying of those sewers, normally through sewage treatment works as adopted by Palestine public sewers systems which is simply the open dumping.
Water conservation program implementation	The rainwater arrives at 13 Rain water reservoirs underground and collected to be used for toilets' flushing within the campus.
Water recycling program implementation	BZU has no programs for water recycling except for using rain water for toilet flushing. BZU could invest in other water recycling programs with beneficial purposes such as landscape irrigation, and replenishing a ground water conserve in rain water reservoirs.
Water efficient appliances usage	Currently, BZU does not promote water efficiency usage for promoting the sustainable use of water. These programs reduce the waste of domestic water. While using solutions that enable

	comprehensive reductions in the waste of domestic water. Implementing water-efficient measures enhances save on water, energy, and costs. Some of these programs include hand-washing taps, toilet flush and automatic taps.
Consumption of treated water	BZU does not have any water treatment programs and therefore does not consume any treated water.
Water pollution control in campus area	BZU implements an adopted protocol to follow-up with water pollution and performs regular check for domestic water ready to use.
Pedestrian path policy on campus	BZU does no promote pedestrian path policy on campus with no distinct separation between road for vehicle and pedestrian path. In addition, BZU does not meet any standards for pedestrian paths. This type of policy not only promote designing a good campus, but also a 'sustainable' policy creates a comfortable environment.
Number of courses/subjects related to sustainability offered	BZU has the following academic programs directly related to sustainability and the environment:

	-Master Program in Sustainable Engineering in Production (Joint Program with An-Najah University) -Master Program in Environmental Biology -Master Program in Water and Environmental Sciences -Master Program in Water and Environmental Engineering -Master program in renewable energy management -Bachelor program in environmental engineering The above list is taken from the university catalogs for 2022/2023 academic year as posted on Ritaj In addition, BZU has embedded sustainability into 82 courses' related to sustainability as it appear in the titles and or content in the courses' description offered by the university. The list of courses appears in Appendix B. The list of courses is taken from the university catalogs for 2022/2023 academic year as posted on Ritaj

Total research funds dedicated to sustainability research (in US Dollars)	Although BZU has a specified budget for research, it does not have an allocated funds dedicated for sustainability.
Number of university program(s) to improve teaching and learning	BZU has adopted some of the programs to enhance teaching and learning, promote distance learning, encourage collaboration and establish mutual benefits locally, regionally and internationally. BZU invested in E-learning to keep up with the changes within the teaching and learning environments. In addition, professors have choice between Moodle, and other platforms such as zoom to eliminate some of technological constraints. Other activities such as workshops and symposiums could be beneficial in terms of improving teaching and learning in addition to developing new and highly specific skills to move towards reaching the 17 SDGs as a result of shared information and communicating diverse teaching and learning methodologies

Number of sustainability community services project organized and/or involving students	BZU does not have any sustainability community services project organized and/or involving students. Some of these projects include carpooling to and from university to reduce the cost, pollution reduction through private and public investment in energy conservation and audits within the campus and the community. Another example includes new custom-made product development to through engaging students and professors to encourage industries and manufacturers to develop environmentally friendly products through government's enforcement and municipal R&D assistance.

5.3 Mapping findings to research objectives.

As stated in chapter 1, the main aims of this study were to assess BZU various elements based on the criteria adopted from UI green metric (including education, transportation, water, waste, setting and infrastructure and energy and climate change). The main suggestions and recommendation based on the findings will be developed in order to utilize efficient resource usage at BZU through developing a sustainability model. In order to fulfill this aim, the investigation was steered with specified objectives. Mapping research objectives and findings as in Table 8:

Table 8: Mapping findings to research objectives

Research intended objective	Research findings
Utilize available information, context knowledge and specified assessment method	- The findings resulted in questionnaire development based on UI GreenMetric sustainability assessment (refer to appendix A)
Prioritize the selected elements for further investigation to develop a proposed model	- The findings indicated 25 elements with 70% weighted average were prioritized for developing proposed inclusive model (refer to table 2). The model includes four different categories including education, research, internal and external approaches. - The findings revealed that financial, human and physical resources are at the top to execute the

	proposed model effectively (refer to figure 11, table 2). - The findings revealed that there are main dynamos to drive the success of implementing the model (refer to figure11).
Evaluate the importance of sustainability elements in the campus environment using various assessment tools/systems	- The interviewees emphasized the importance of the UI GreenMetric elements to improve the sustainability (refer to table 2).
Evaluate BZU level of sustainability according to the selected assessment leading system indicators based on UI GreenMetric	- The findings measured the current level of sustainability based on the evidential guidelines adopted from the UI GreenMetric (refer to appendix C).
Investigate the possibility of implementing selected applicable elements based on questionnaire and UI GreenMetric for the overall campus improvement and future enhancement.	- The findings allocated a list of recommendation to facilitate sustainability implementation including the most impactful activities in the energy consumption, climate change, waste management, water resources and setting and infrastructure, which anticipates expenditure reduction on water and energy.

	- The findings revealed that the implementation of the proposed recommendations will impact BZU future sustainability.
Analyze the university's best practices and their contribution to BZU current and future sustainability	- The findings revealed best practices such as raising awareness, collaboration and monitoring as the main activities for community engagement to drive behavioral change.

5.4 Proposed model

The proposed model as it appears in Figure 11, is created based on the findings from the results collected and is intended to provide guidance for implementing core sustainability elements to transform BZU into sustainable university. The model relies on the main pillars of BZU activities including education, research, BZU community, and external larger community. The model is integrative and includes best practices to foster sustainability implementation. The model is enclosed within a mechanistic framework to ensure the monitoring and evaluation of implementing the model.

5.4.1 Description for the proposed model

The proposed model is an integrative model based on the below main findings:

- The results obtained from the questionnaire with high percentage values (70% and above).
- The UI GreenMetric points for each of the elements (covers six categories: SI, EC, WR, WS, TR and ED).
- Interviews with main offices.

The model includes:

- The institutional effectiveness and the academic effectiveness, both of which are encapsulated within a framework to include the drivers (dynamos) for sustainability.
- Within the framework, the model presents the main approaches to be implemented while involving all stakeholders at various levels as well as the BZU community

Although the basic ideas for sustainability are similar between different countries, there are some variation regarding institutional concepts and strategies. University culture affects sustainable development through influencing the commitment to sustainability among its various components (management, employees and students). Similar to other organizations, BZU contributes to global issues on a day-to-day basis as a result of its daily activities, meanwhile, BZU strives to become a sustainable HEI and to lead other organizations within the larger society to contribute to provide solutions for environmental issues and attain sustainable development within its various functions at all levels. In general, the model is proposed in a cyclical pattern due to the nature of the sustainability dynamicity. The arrows represent the dynamos including leadership, social network,

participation, teaching and learning, research and management performance. The dynamos bring together university leadership, university activities, university community and the society. The four quarters represent the main approaches under the responsibility of the university to cover all its activities at the academic and the institutional levels. The dynamos encapsulate the approaches to represents the importance of teamwork in any of the activities or programs. The cyclical shape reflects the nature of the continuous motion to ensure sustainability and enhancement. This section explains the detailed components of the proposed model:

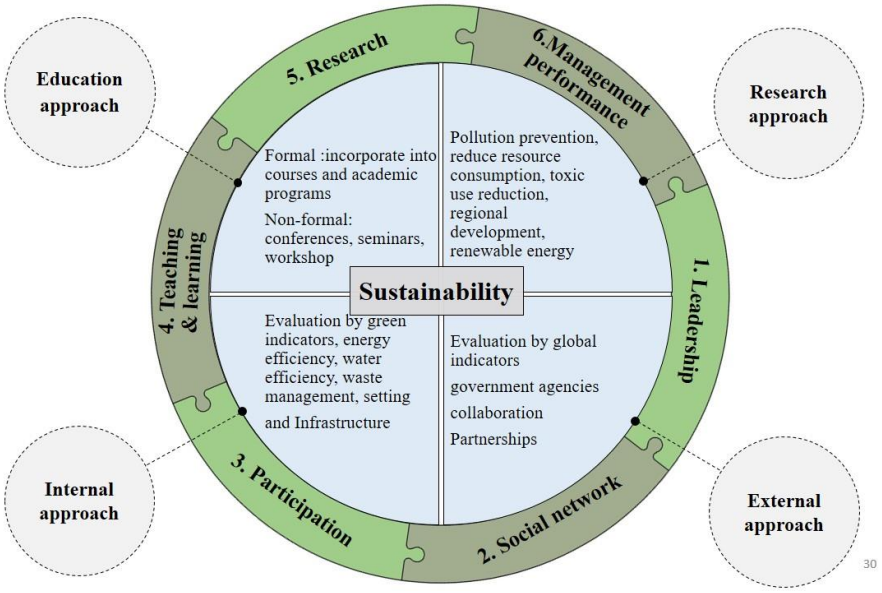

Figure 11: Proposed model diagram

5.4.1.1 Dynamos for the proposed model

In order to achieve the goal of sustainable BZU, the proposed model is inclusive and incorporates the main elements influencing BZU movement toward sustainability:

5.4.1.1.1 Leadership

Leadership is main building block for fostering and progressing toward sustainability [64]. University leadership constitutes a major role in order to move the university toward sustainability by integrating sustainability-based activities within the university's strategic plan, goals, policies, procedures, research and education [65]. Similarly, BZU leadership has a core role of developing the mission, vision, and the strategic plan to oversee all university processes and achieves its preset goals.

5.4.1.1.2 Social network

Social network is a main element in reaching for BZU community and the larger community as well as all relevant stakeholders in order to initiate sustainability communications, establish sustainability relations and progress to advance BZU overall sustainability. The availability of the various social network applications facilitate and speed the process of sharing relevant information regarding sustainability at the community, national, regional and international levels [66][67]. In addition, social network is a very effective tool in raising awareness and influencing decision-making at various managerial levels. as well as various governmental levels as needed [68]. For BZU to enhance its sustainability, it

should establish, develop and sustain effective relationships with stakeholders and create partnerships and collaborations for mutual benefits regarding sustainability. As a result, social network changes the individuals' attitude, builds community capacity to influence decisions making, and motivates leaders to make better decisions toward sustainability issues and concerns within the larger society [69].

5.4.1.1.3 Participation

Active involvement in all sustainability activities within BZU community ensure transforming BZU to a sustainable one [70][71]. This level of participation partake the community in the decision making process for the change, raises the level of awareness, disseminate the available information, changes the attitude toward sustainability and incorporates social responsibility to make a difference. The community engagement employ information, consultation and legitimize the decision-making process [72]. Thus, BZU community-inclusive participation spreads a culture of sustainability within the larger community and establishes high level of the community's confidence in the leadership resulting in high level of social responsibility toward sustainability in various sectors of the society.

5.4.1.1.4 Teaching and learning

It is well known that humans' behavioral change is driven by changing minds' perspective. The role of universities in transforming toward sustainability relies deeply on nurturing the learning processes delivered within their communities. To achieve sustainability transformation, BZU should focus on sustainability as an

ethos within its adopted teaching strategies. Sustainability is an integrated, innovative and interdisciplinary subject [73] that need active participation to address sustainability as a gateway for the future rather than another issue to be added to the educational system [74]. Integrating sustainability in education and learning will enhance students' fundamental knowledge, improve their skills and add to their values regarding current sustainable development and other environmental sustainability issues [75]. This will drive behavior change and promote positive attitude, which are proactive toward sustainability behaviors nowadays and for the future.

5.4.1.1.5 Research

The multidisciplinary nature of sustainability research serves as an opportunity to look for solutions for current environmental global issues and challenges. The nature of these global issues enable the researched to tackle the problems from various perspectives and provides comprehensive solutions leaving no gaps [25]. These solutions are the outcomes of collaborative work between different researchers within a higher educational institution or as a result of cooperation between different organization regionally or internationally [76]. As a result, research generates mutual learning and creates solutions systemic understanding for existing and any upcoming global challenges [77][78]. Research have a genuine role in developing people's creativity, sharing ideas, considering the views of the various stakeholders [25]. Thus, creating a leveraging shared-opinion about the

engagement of BZU community, stakeholders, governments and other related sectors in sustaining the universe to produce knowledge.

5.4.1.1.6 Management performance

The role of management performance is crucial in accelerating university sustainable development through effective leadership, social networking, active participation, overseeing teaching and learning, providing a space for research and motivating collaboration at different institutional, national, regional and international levels [79]. To keep the sustainability wheel rolling, BZU strives to establish sustainability mechanisms by aligning its objectives with anticipated outcomes as adopted in the strategic plan while cautiously monitoring progress and correct any deviations immediately [80]. BZU should keep its institutional effectiveness maintained regularly at both administrative and academic levels to advance its sustainability.

All of the above dynamos will be effective once all participating people have committed to sustainability and emphasized in all sustainability studies. These are considered the main points for institutional change to achieve sustainability through active participation in various sustainability activities.

5.4.1.2 Approaches for the proposed model

As presented in Figure 11, the model is inclusive and utilizes four approaches for sustainability within BZU: education, research, internal and external activities.

Below is a detailed description of each approach.

5.4.1.2.1 Educational approach

The educational approach focuses on academic related activities as the main method to highlight the knowledge, skills, communication skills, competencies to develop the students' attitude during their studies [48]. Sustainability pedagogies are unique due to their difference from traditional education. Sustainability subject is diverse and includes experiential learning education processes, cooperation, and relies on environmental and community as learning resources. Universities invest in quality education to equip students with core knowledge, values and necessary skills to promote graduates' thinking in solving existing environmental issues and motivate them in taking initiative to trigger transformation for better sustainable future [81] [82]. As recommended by some researchers, it is crucial for HEIs to integrate sustainability educational courses, academic programs and related academic activities within their curricula as an effective way to share ideas, collaborate and promote sustainability culture for future generation [79][83]. The proposed models incorporates different aspects of education including formal, non-formal and informal education as to deliver core knowledge and basic skills as needed. Educational courses and academic programs must take into account the multidisciplinary nature of existing environmental issues such as sustainability and other global concerns, therefore, by providing interdisciplinary courses and programs, such as sustainable development program or society and sustainability course, student will gain practical skills as well as multi perspectives' approach to facilitate problem solving, leadership, decision-making and partaking initiatives [84]. As a result, sustainability education influences the implementation of

sustainability related activities in the university settings due to enhancing students' knowledge regarding sustainable development. This will ultimately change the attitudes toward over all environmental issues within the university and the larger community.

5.4.1.2.2 Research approach

Whether scientific or institutional, no one denies the core role of research in aiding decision-making for policy advocates at the institutional, national and international levels. Therefore, research is an important tool and contributes significantly toward making changes and economy's growth [85] [86]. From a scientific perspective, research is a ubiquitous process where researchers retrieve learning resource from theoretical perspective and integrate available knowledge to find solutions for existing environmental sustainability issues at different scales [87][88]. From an institutional perspective, related research activities explore the various functions adopted by the university and the level of their implementation. Regular institutional research evaluates the performance of the institutional from strategic, management and leadership perspectives [89]. As a result, this type of research provides the institution with information about its performance in comparison with other institutions and steers the management to adopt necessary changes in order to enhance its overall performance. The outcome of the continuous institutional research triggers cultural changes, influence the leadership decision-making and reflect to better integrate within the society and participate actively in providing solution to existing sustainability issues as well as other global issues.

5.4.1.2.3 Internal institutional approach

Campus community campus life and represents a smaller community of the larger society, that is, it consumes resources and generates wastes continuously. Simultaneously, the main service of a university is to provide educational services, among others, and be a major part in developing the society and enhancing the economic development. Based on the findings, building construction and renovation, energy efficiency, water efficiency, health, safety, security, pedestrian areas, sustainability budget, sustainability officer, waste and environmental management are presented clearly in the model and should be addressed by the university. Additionally, the findings promote the model to provide possible ways for intervention, implementation or improving related processes.

5.4.1.2.4 Integrated external approach

The fourth approach is the integrated external approach where the focus is on the wider community and global outreach. This approach focuses on various outreach activities including mass media, collaboration and partnership with governmental and private sectors at the national, regional and international levels. Partnerships and collaborations trigger people's creativity and create a diverse vantage point of driven by services at the university. Based on the findings, university sustainability requires collaboration and partnership between different stakeholders including, government, education sector, health sector, industrial sector, private sector transportation and agriculture, media, international organizations are well

presented in the proposed model and should be addressed on a priority basis by BZU.

5.5 Expected impact of the proposed model

This research discovered that there is a model that can be implemented to initiate sustainability at BZU, which could serve as the driver of sustainability activities and lead BZU to become a leader university within the larger community through utilizing different approaches including academic, research, internal and external as well as involving all BZU community.

The most obvious activities proposed in the model are based on the current performance. Taking a close look at the current situation for BZU, the sustainability assessment uncovered that BZU has been executing various sustainability development activities. Generally recognizable, BZU had executed few reusing programs including collecting rainfall water for reuse and had constructed number of rain water reservoirs. In addition, BZU has inaugurated solar plant as renewable energy. In addition, the findings also showed that there is a persistent need for committing to develop and implement an instructive sustainability action plan to tackle few of the world's most pressing concerns.

Based on this research, the recommendation as derived from the findings, serve as strides to help identify innovative and effective ways to drive sustainability forward. It has been documented that applying innovative programs, headed by committed leadership as well as facilitated by education and research, serve as a foundation for enhancing universities' sustainability[90][91]. Researchers argue

that improved best practices regarding sustainability including energy consumption, waste management, resources' recycling and reuse and spreading a sustainable cultural behavior will reduce sustainability global challenges [92]–[95].

Therefore, it is of great importance to initiate implementation of the proposed model and assess its impact continuously. Table 9 shows a reflection for implementing the proposed recommendations which were provided for elements with 70% or above from the questionnaire responses. Although, this section provides a look into the future for what would happen if BZU implements the partial recommendation as provides, it is expected that the impact will be evident for all elements of the questionnaire. In addition, this expected the impact on BZU sustainability, postulates that the impact of the total sustainability score will increase exponentially. The tabulated data shows the elements with the lowest expected enhancement as a result of moving by one degree.

Table 9: Summary of current, expected and questionnaire points.

Category /element	**Maximum points**	**BZU current**		**BZU expected**		**Questionnaire**	
	Points	**score**	**point**	**score**	**points**	**Importanc**	**score**
						%	
SI							
SI 1	200	0.05	10	0.25	50	89	179
SI 6	200	0.05	10	0.5	100	72	145
SI 7	100	0.05	5	0.5	50	70	70
SI 9	100	0.5	50	1	100	71	71
SI 10	100	0.5	50	0.5	50	77	77
Total	**700**		**125**		**350**		**363**
EC							

EC 1	200	0.25	50	0.75	150	93	185
EC 2	300	0.25	75	0.5	150	90	270
EC 3	300	0.25	75	0.5	150	82	246
EC 6	200	0	0	0.75	150	82	164
EC 7	200	0	0	0.5	100	70	141
EC 9	100	0	0	0.5	50	83	83
Total	**1300**		**200**		**750**		**1088**
WS							
WS 1	300	0	0	0.25	75	88	263
WS 2	300	0	0	0.75	225	91	274
WS 3	300	0	0	0.25	75	80	239
WS 4	300	0	0	0.25	75	80	239
WS 5	300	0	0	0.25	75	80	239
WS 6	300	0	0	0.25	75	76	227
Total	**1800**		**0**		**600**		**1482**
WR							
WR 1	200	0.25	50	0.75	150	84	168
WR 2	200	0	0	0.5	100	86	172
WR 3	200	0	0	0.75	150	85	169
WR 4	200	0	0	0.25	50	82	163
WR 5	200	1	200	1	200	82	164
Total	**1000**		**250**		**650**		**836**
TR							
TR 8	300	0	0	0.5	150	73	220
Total	**300**		**0**		**150**		**220**
ED							
ED 1	300	0.05	15	0.25	75	85	256
ED 2	200	0.05	10	0.25	50	80	159
ED 9	100	0	0	0.5	50	75	75
ED 10	100	0	0	0.5	50	79	79
Total	**700**		**25**		**225**		**569**
	5800		**600**		**2725**		**4558**

It is obvious from the table that there is variation in the total points between the current, the expected and the questionnaire for each of the categories. For the SI category, there is a minor difference between the questionnaire and between the expected impacts, while for the rest of the categories there difference between the questionnaire and between the expected impacts. The column headed by points indicates the points allocated for each element as assigned by UI Green Metric. The columns by BZU current represent the score for each of the assigned element and the corresponding points. The columns headed by BZU expected represent the hypothesized points calculated based on the changes according to the postulated new score after implementing the recommendations. The last two columns represent the questionnaire results for the assigned elements after assessing the importance (as appears in the questionnaire) and their corresponding score after converting the importance to its equivalent points by calculating the product of the importance and the allocated points for each of the assigned elements. For example, to convert the points for element SI 1:

Points SI = percentage * allocated points

= 0.89 * 200 = 179

Figure 12 presents the percentage for the SI category obtained from the current BZU assessment, the questionnaire results, and the expected impact based on successful implementation of some or all of the recommendations. As can be seen from the figure, the expected impact paves the way for BZU to enhance its sustainability through implementing the proposed recommendations for this specific category.

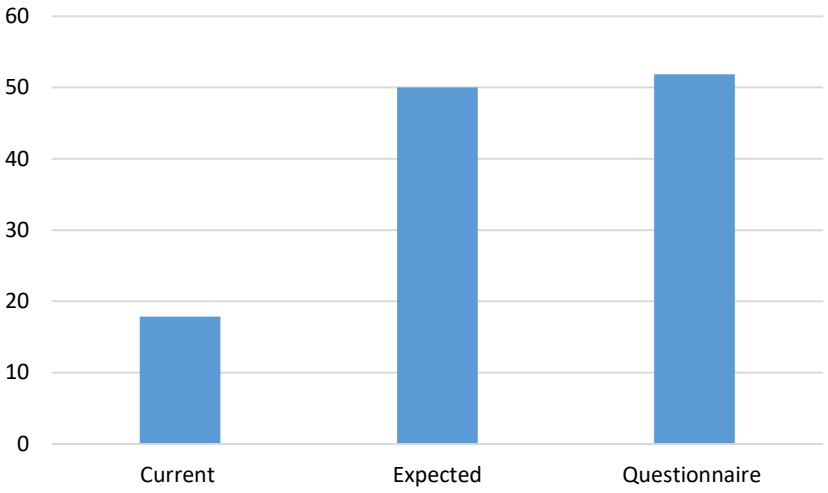

Figure 12: Percentage for the Setting and Infrastructure (SI) for the expected impact

Figure 13 presents the percentage for the EC category obtained from the current BZU assessment, the questionnaire results, and the expected impact based on successful implementation of some or all of the recommendations.

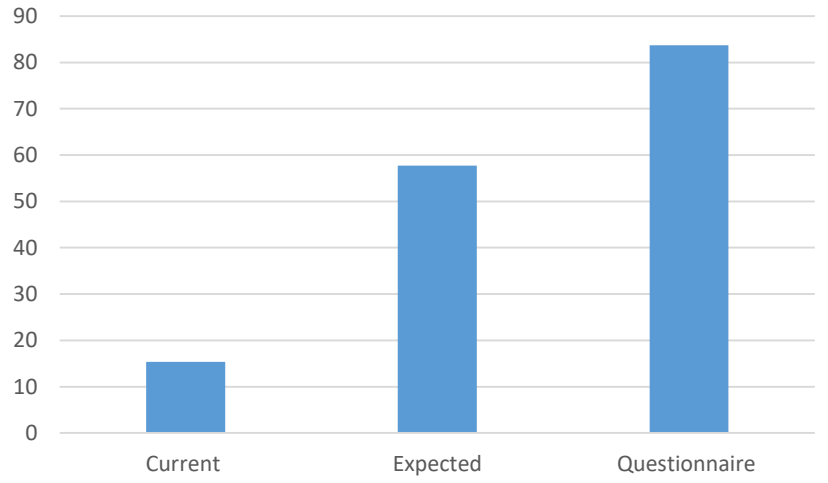

Figure 13: Percentage for the education (EC) for the expected impact

As can be seen from the figure, the expected impact appears as a step in securing sustainability through implementing the proposed recommendations for this

specific category. The difference between the expected and questionnaire could be attributed to the difference in the theoretical evaluation and the challenges faced during the implementations.

Similarly, Figure 14 presents the percentage for the WS category obtained from the current BZU assessment, the questionnaire results, and the expected impact based on successful implementation of some or all of the recommendations.

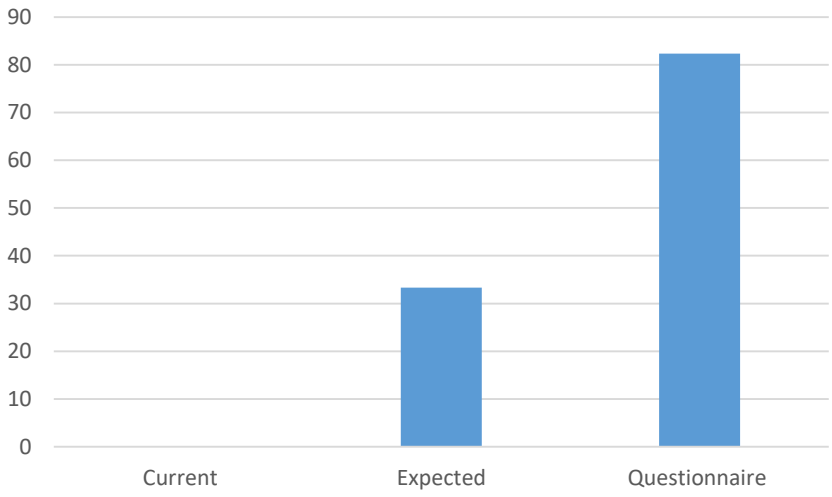

Figure 14: Percentage for the waste (WS) for the expected impact

It is clearly noticeable that there is no current implementation of any related systematic activities or programs for waste management at BZU. This might be due to the fact that there is no specific responsible personnel/office to adopt the necessary protocols and oversee their implementation within BZU as well as these are challenging tasks to handle internally in the absence of national policy and regulation. Meanwhile, there was a great attention given to this criterion in the collected results of the questionnaire. This might be due to the fact that the impact of this category is easily visualized by the members of BZU irrespective of their

positions and/or roles. From the graph, it shows that implementation of the proposed recommendations regarding this category could facilitate sustainability enhancement in this regard.

Similarly, Figure 15 presents the percentages for the WR category obtained from the current BZU assessment, the questionnaire results, and the expected impact based on successful implementation of some or all of the recommendations.

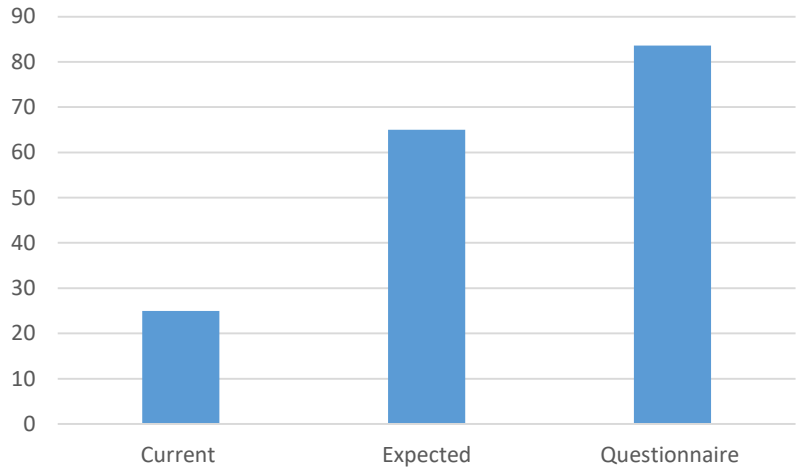

Figure 15: Percentage for the water (WR) for the expected impact

The Figure clearly demonstrates that there is current water related sustainability programs for reusing or recycling of water. This might be due to the driving force by the Mother Nature which provides rain during winter. In addition, the water scarcity due to political situation motivates BZU to adopt certain methods for water reuse when possible. However, these implemented programs do not reach the questionnaire expectation as presented in the figure. This percentage could be improved by continuous monitoring, commitment from BZU management and investing in other programs and or activities as recommended. Figure 16 presents

the percentages for the TR category obtained from the current BZU assessment, the questionnaire results, and the expected impact based on successful implementation of some or all of the recommendations.

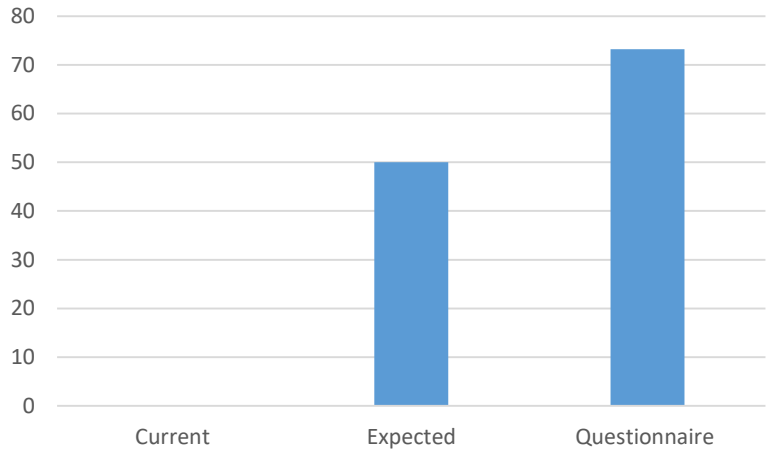

Figure 16: Percentage for the transportation (TR) for the expected impact

The Figure clearly shows no current activities regarding transportation is implemented to enhance BZU sustainability. This figure specifically addresses the presence of the pedestrian path, which was the only element that obtained above 70% in the questionnaire response. This might be due to direct impact on the circulation which is dramatically affected by the continuous increase of number of vehicles in the campus on daily basis. The proposed changes in the recommendation regarding this element will definitely have a positive impact once implemented and bring the expected percentage much closer to BZU community hopes.

Figure 17 presents the percentages for the ED category obtained from the current BZU assessment, the questionnaire results, and the expected impact based on successful implementation of some or all of the recommendations.

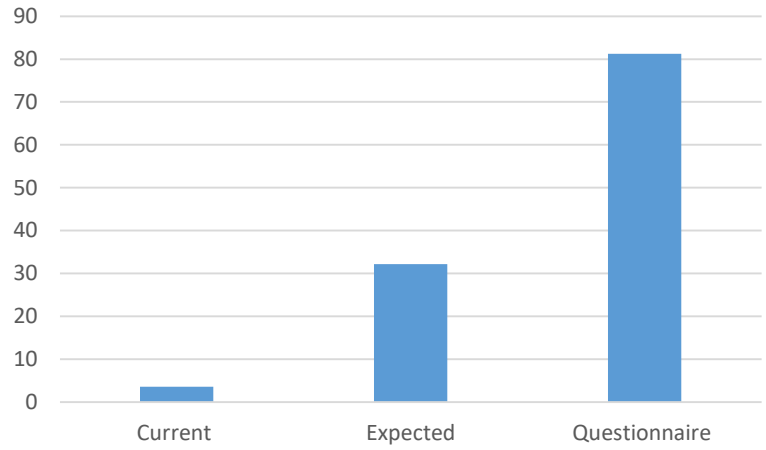

Figure 17 Percentage for the education (ED) for the expected impact

The Figure clearly shows variations between the three levels. This might be due to the fact that there is no allocated budget directed for sustainability research as well as underestimating the value of teaching sustainability related courses. The figure calls for emphasis on proposed activities related to education and other related activities which will result direct impact on applying systematic scientific approach to solve global issues and provide role model citizens.

Figure 18 represents the overall percentages of the related elements (with score 70% and above) for the current BZU assessment, the questionnaire results, and the expected impact based on successful implementation of some or all of the recommendations

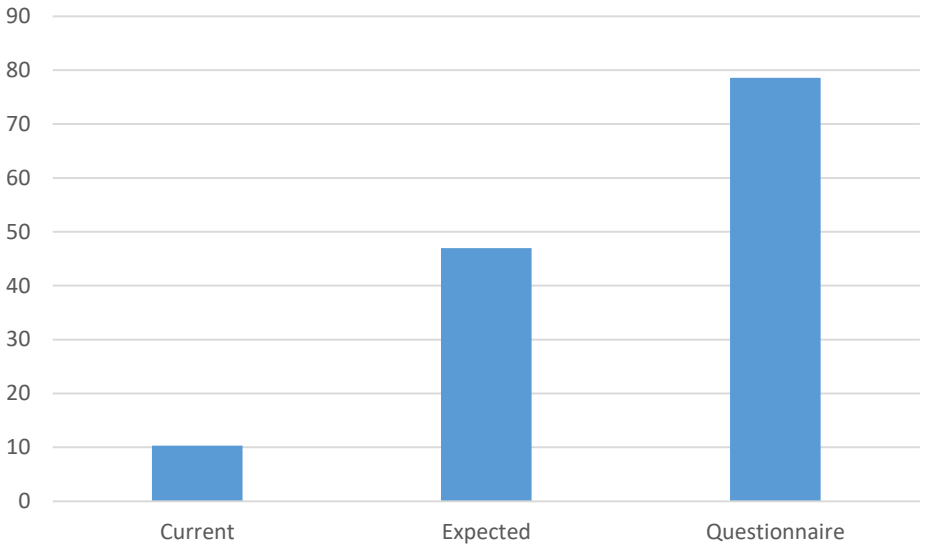

Figure 18: Comparison between overall Percentages for expected impact

Overall, there is a variation in the total scores obtained for the current, expected and the questionnaire. This is consistent with the figures for each of the individual categories. This figure encourages implementing different related elements from various categories which will contribute positively to reach the questionnaire goal and establish a solid foundation to develop BZU's sustainability.

Chapter 6

Recommendations

6.1 Introduction

In the previous chapter, the collected data was thoroughly analyzed and the findings were evaluated to assess the findings and prioritize them. The situation was analyzed for each of the selected elements. This chapter aims to provide two types of detailed recommendations:

- Proposed operational recommendations: based on the findings of the questionnaire for elements with 70% weighted average or more, and
- Proposed approaches' recommendations: based on the approaches adopted in the proposed model

The recommendations based on approaches will lead the implementation of the operational recommendations.

6.2 Proposed operational recommendations

This research has shed light on more questions rather than answers regarding sustainability and green campus in BZU in specific and HEIs in Palestine in general. The sustainability research is lacking in the HEIs with minimum published research on the topics. Based on the research investigation and through the findings, suggestions and recommendations are provided for SI, EC, WS, WR, TR and ED in tables 10 – 15 respectively:

Table 10: Recommendations for Setting and Infrastructure (SI)

Element with 70% or above from the questionnaire		
Recommendations: based on questionnaire analysis, interviews and UI GreenMetric.	Resources	Limitation/challenges
Setting and infrastructure (SI)		
Security and safety facilities		
-Supply fire alarm systems to every building including smoke detectors, gas detectors and heat detectors. - Install Smart monitoring sensors for Gas leakage - Control room to control and monitor the various intrusion and firefighting system -Supply and install FM200 for the electrical boards/rooms -Supply and install CCTV systems to cover public spaces, system To be connected with the proposed control room. - supply and install glass break sensors for high importance buildings and spaces. - Supply and install motion sensors to detect movement in specific area.	Financial Human Physical	Availability of financial funds Administrative approval Ethical issue for invading privacy Technical issues

-Perform periodic training programs for fire alarm and practice the adopted evacuation according to fire exit layout -Ensuring that the fire exit doors are in line with the related standards. - checking the fire extinguishers and replacing them when needed. - Replace existing fire exit doors with doors that include push panic par. -Perform continuous periodic maintenance for all safety and security systems in all units, departments and surrounding communities. -Update guides for safety and security through annual events and hold workshops for educating BZU community to protect the environment. - Sensor based safety solutions (labs & across the campus).		
Health infrastructure/ facilities		
-Deliver periodic first aid training -Conduct health activities regularly	Financial Human Physical	Availability of financial funds Administrative approval

Figure 19 represents the input-process-output (IPO) diagram for the SI category based on the provided recommendations. In the diagram, the prioritized elements represent the input that are the basis for the recommendations; the proposed model as well as the recommendations, the approaches, the dynamos and needed resources represent the process which is required to go through in order to achieve the ultimate output as represented by the expected impact. Similarly, Figures 20 – 24 represent the IPO model for EC, WS, WR, TR and ED respectively.

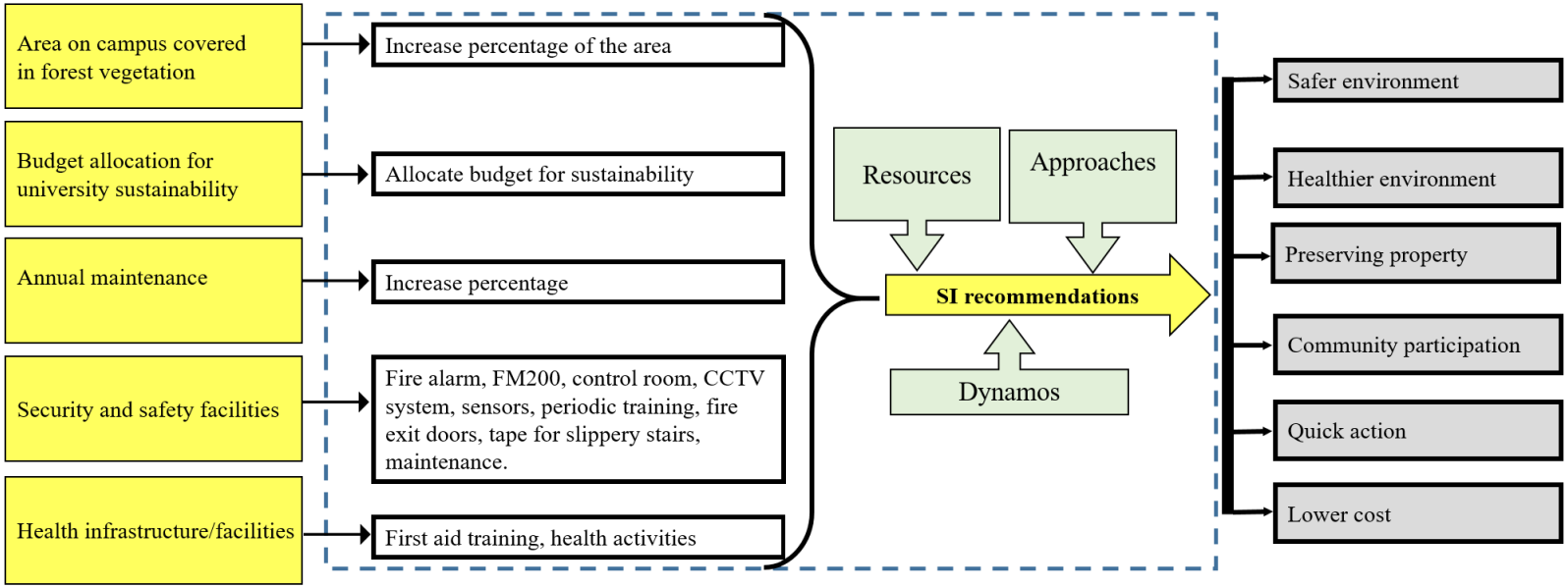

Figure 19: IPO for Setting and Infrastructure (SI)

Table 11: Recommendations for energy and climate change (EC)

Element with 70% or above from the questionnaire		
Recommendations: based on questionnaire analysis, interviews and UI GreenMetric.	Recourses	Limitation/challenges
Energy and climate change (EC)		
Energy efficient appliances usage		
-Supply and replace existing lights with LED efficient lighting. -Commit to minimizing energy use overall. To do so, specified programs such motion-sensors should implemented in all buildings to maximize energy efficiency in BZU. -Replace existing HVAC systems with more energy efficient systems such as VRV systems.	Financial Human Physical	Availability of financial funds Administrative approval Technical issues

-Perform continuous periodic maintenance for all appliances in all units, departments and surrounding communities.		
Smart building implementation		
- Supply campus buildings with the followings systems: building Management systems (BMS),Building information modelling (BIM) , Building Automation System (BAS) , Facility Management System (FMS) - Supply motion sensing lights, fans, ACs -Supply Smart security across the campus (e.g. Sensor based CCTVs). - Supply Smart meters to measure water consumption in campus. - Connect drip irrigation and sprinklers with timer control to have efficient water management and reduce the consumption of water. - Supply Facility for video conference calls/classes in each department - Initiate program to monitor carbon footprint of the campus. - Install solar cell enabled lighting using LEDs in Classrooms. - Install smart electronic switches for classes and departments.	Financial Human Physical	Availability of financial funds Administrative approval Technical issues

- Adopt water management system. (WMS) -Supply campus with smart management of electricity, smart management of water resources, smart maintenance scheduling.		
Renewable energy sources in campus		
Establish new sources of renewable energy such as biogas production from biomass	Financial Human Physical	Availability of financial funds Administrative approval Technical issues
Elements of green building implementation as reflected in all construction and renovation policies		
Future construction: -planning for Passive design including: • Orientation of the buildings • Solar passive features • Shape and form of buildings. • Thermal insulation for roof and exterior walls.	Financial Human Physical	Availability of financial funds Administrative approval Technical issues

• Apply shading elements on the south facades to limit heat from summer sun. • The design should provide natural ventilation for the spaces of the building. • The design of the building should provide natural lighting . -Manage campus construction or demolition location to Reduce on-site and off-site industrial impacts -Preserve the surrounding environment during construction. -Energy efficient: : the design should take in consideration: • Energy efficient led lights/appliances to be included during tendering phase. • Insulating external walls to improve thermal efficiency and minimize the consumption of energy.		

• Installing double Glazing for windows and curtain walls that will reduce heat loss/ heat gain and therefore energy consumption for cooling and heating. • Applying heat reflecting roof paints and roof insulation material minimize heat/cold and that will reduce energy costs for heating and cooling Operation phase: • Maintenance • Energy management Existing campus buildings: • Maintenance. • Replacing lights with led lights		

• Replacing windows with double glazing windows.		
Greenhouse gas emission reduction program		
-Adopt and implement plan to reduce greenhouse gas emission -Promote future emissions reductions by focusing on energy efficient design in new buildings -Deliver workshops to disseminate information about greenhouse gas emission, best practices and collaborative forum to discuss ideas on-campus energy consumption -Develop steering committee to focus on community engagement, awareness and goal creation within the campus - Maintain and enhance efficient operation of existing building systems.	Financial Human Physical	Availability of financial funds Administrative approval Technical issues
Number of the innovative program(s) in energy and climate change		

- Substitute diesel used for heating with lower-carbon alternatives such as biomass (as renewable energy sources). -Apply indoor quality comfort during the design process in future buildings including air quality, natural ventilation, humidity and temperature. -Develop new and advanced systems to monitor indoor quality comfort elements -Maintain and enhance efficient maintenance systems & operation within existing building	Financial Human Physical	Availability of financial funds Administrative approval Technical issues

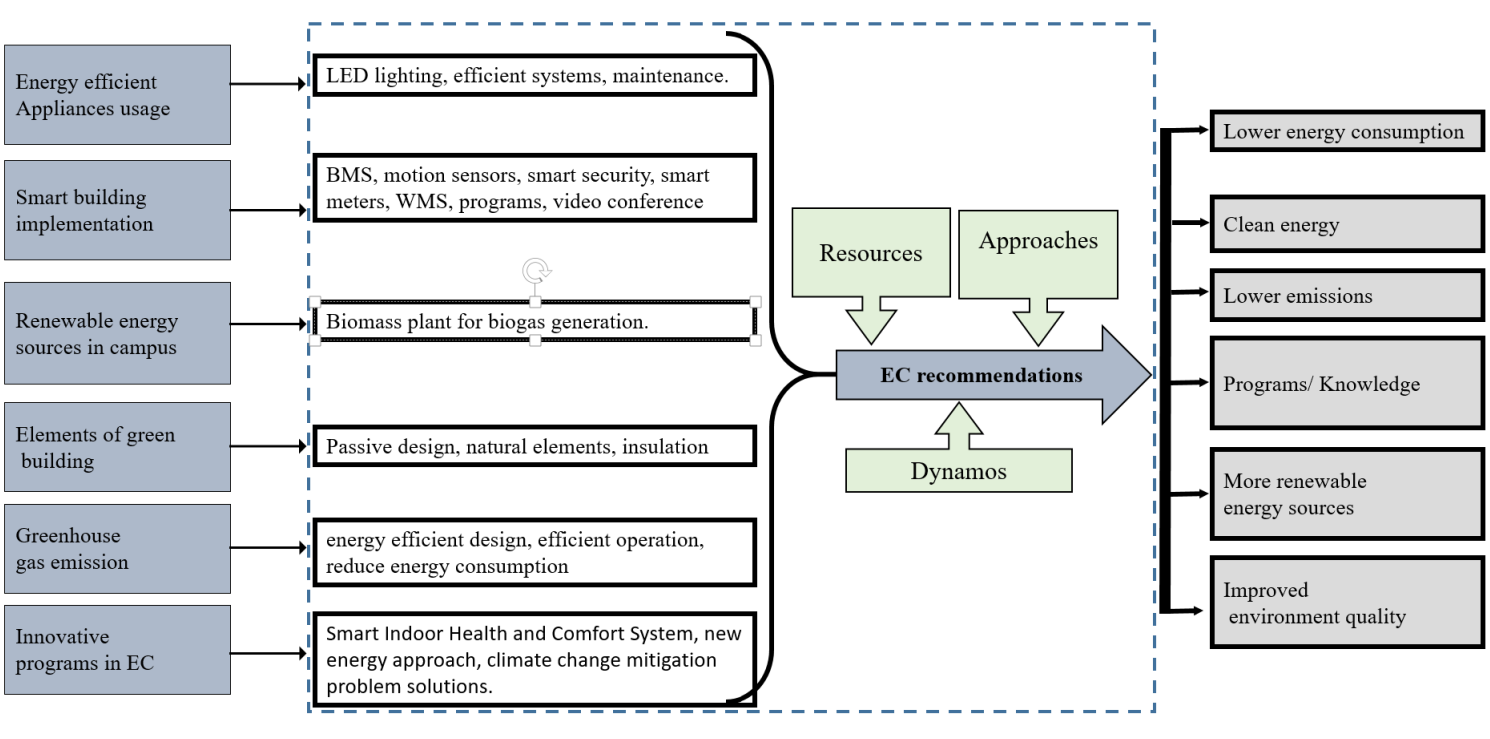

Figure 20: IPO *for energy and climate change (EC)*

Table 12: Recommendations for waste (WS)

Waste (WS)		
Element with 70% or above from the questionnaire		
Recommendations: based on questionnaire analysis, interviews and UI GreenMetric.	Recourses	Limitation/challenges
Recycling program for university waste		
-Invest in available / applicable systems to recycle university waste and convert it to natural fertilizer -Recycle organic solvents using rotary evaporator	Financial Human Physical	Availability of financial funds Administrative approval Technical issues
Program to reduce the use of paper and plastic on campus		
-Develop and implement a policy to reduce paper and plastic within the campus. -Adopt and support processes and policies to reduce paper usage including utilizing electronic document management system (EDMS), use two sides when printing, recheck data before printing, use online system instead of hard copy.	Financial Human Physical	Availability of financial funds Administrative approval Technical issues

Organic waste treatment		
-Develop and adopt a policy for organic waste management and treatment. -Control and manage organic waste using several protocols including separating wastes into different categories. -Accumulate the organic waste in assigned containers and deliver them to the proper dumping sites. -Recycle organic waste into biodiesel energy as part of the research done by master of renewable energy program.	Financial Human Physical	Availability of financial funds Administrative approval Technical issues
Inorganic waste treatment		
-Separate inorganic waste into categories according to adopted protocol and contract approved company to manage inorganic waste.	Financial Human Physical	Availability of financial funds Administrative approval Technical issues
Toxic waste treatment		
-Collect toxic waste and classify it according to adopted protocols	Financial Human	Availability of financial funds

-Purchase and place proper inorganic waste container within the campus in proper locations such as faculty of science labs, faculty of pharmacy, health and nursing professions labs and research labs as needed. -Hand over the collected waste to an authorized company for further treatment -Raise awareness regarding inorganic waste impact on the environment	Physical	Administrative approval Technical issues
Sewage disposal		
-Rehabilitate existing sewage treatment plant	Financial Human Physical	Availability of financial funds Administrative approval Technical issues

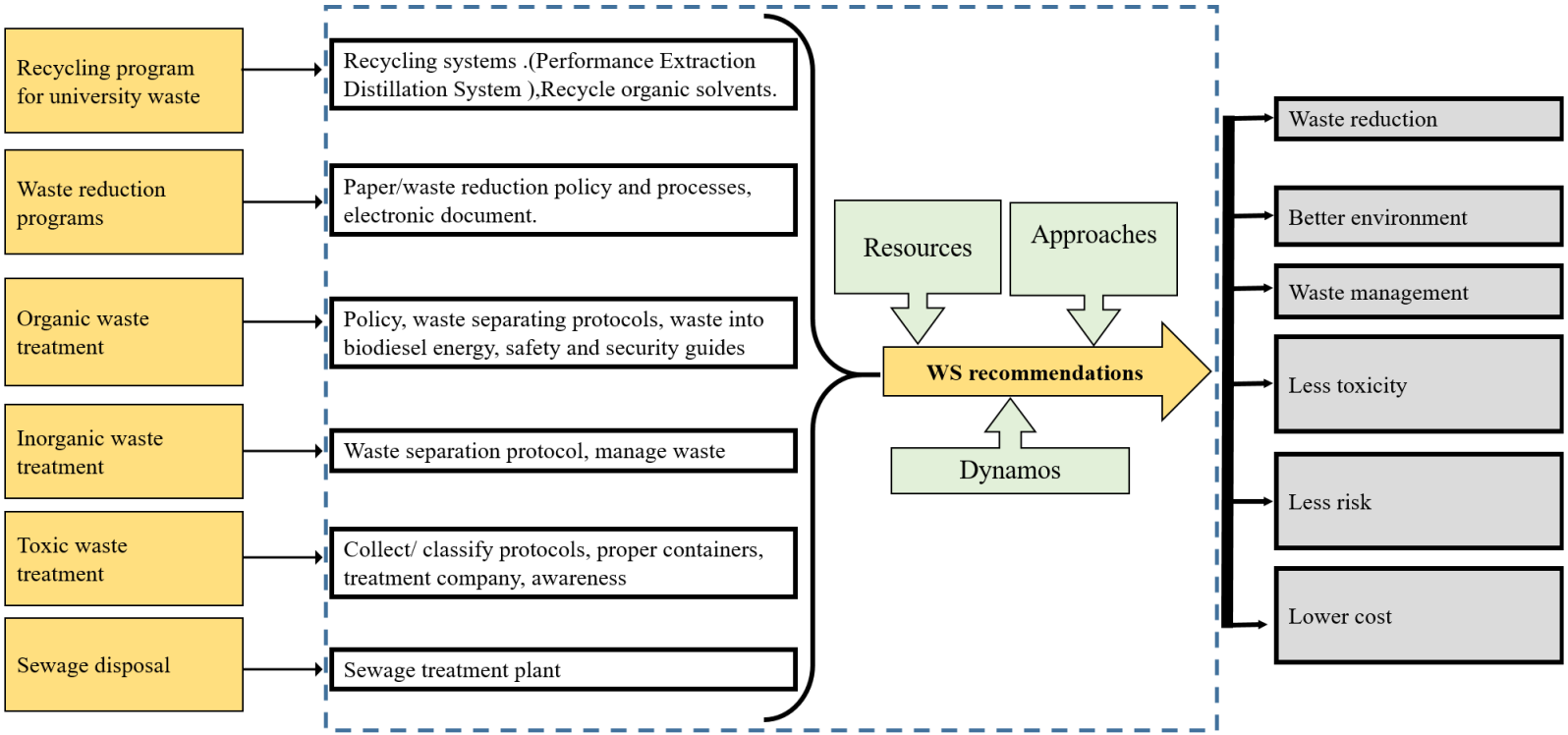

Figure 21: IPO for waste (WS)

Table 13: Recommendations for water (WR)

Water (WR)		
Element with 70% or above from the questionnaire		
Recommendations: based on questionnaire analysis, interviews and UI GreenMetric.	Recourses	Limitation/challenges
Water conservation program implementation		
-Develop or follow purchasing standards for water efficiency. -Deliver water conservation training or workshops for BZU community -Adopt an interactive program, overseen by the office of VPAF, for active regular scheduled maintenance that detects and repairs equipment, and fixtures as soon as they occur. -Detect and repair leak of underground water pipework	Financial resources Human resources Physical resources	Availability of financial funds Administrative approval Technical issues

-Install building management and control systems (BMCS) to monitor water uses through water use displays in all buildings -Harvest rainwater from BZU buildings' roofs and other surfaces and reuse it for irrigation, toilet flushing and other applicable activities. -Increase the number of rain water reservoirs around the newly constructed buildings (Shouky Shaheen building) - Analyze the water saving level each month. - Yearly workshop/meeting for the improvement of data collection.		
Water recycling program implementation		
-Develop a policy for water recycling and reuse action plan to promote water reuse and address local barriers such as technical, institutional, and financial.	Financial resources Human resources Physical resources	Availability of financial funds Administrative approval

-Use recycled water for irrigation, toilets and other applied activities		Technical issues
Water efficient appliances usage		
-Install automatic sensor faucets in all buildings -Install high-efficient dual flush toilets in all bathrooms -Develop and implement maintenance schedule to detect and repair equipment, and fixtures, as they occur to maintain their efficiency.	Financial resources Human resources Physical resources	Availability of financial funds Administrative approval Technical issues
Consumption of treated water (wastewater)		
-Rehabilitate and operate the wastewater treatment station in BZU - Develop or adopt and implement program for wastewater treatment -Install water purification systems or devices in student complex building especially in restaurants and café shops. -Treat harvested rainwater to use for drinking and cooking, preferably at the student complex building using filtration for sediments particles'	Financial resources Human resources Physical resources	Availability of financial funds Administrative approval Technical issues

removal, then disinfection the harvested water using chlorine or UV light.		
Water pollution control in campus area		
-Update the existing policy and continue its implementation to check for any contaminations -Implement mechanisms for controlling all types of waste dumbing to reduce water pollution within the campus such as proper treatment of chemical and toxic wastes generated by labs on campus. - Secure waste management protocols and spaces for different types of waste to minimize risk of waste spillage or leakage underground.	Financial resources Human resources Physical resources	Availability of financial funds Administrative approval Technical issues

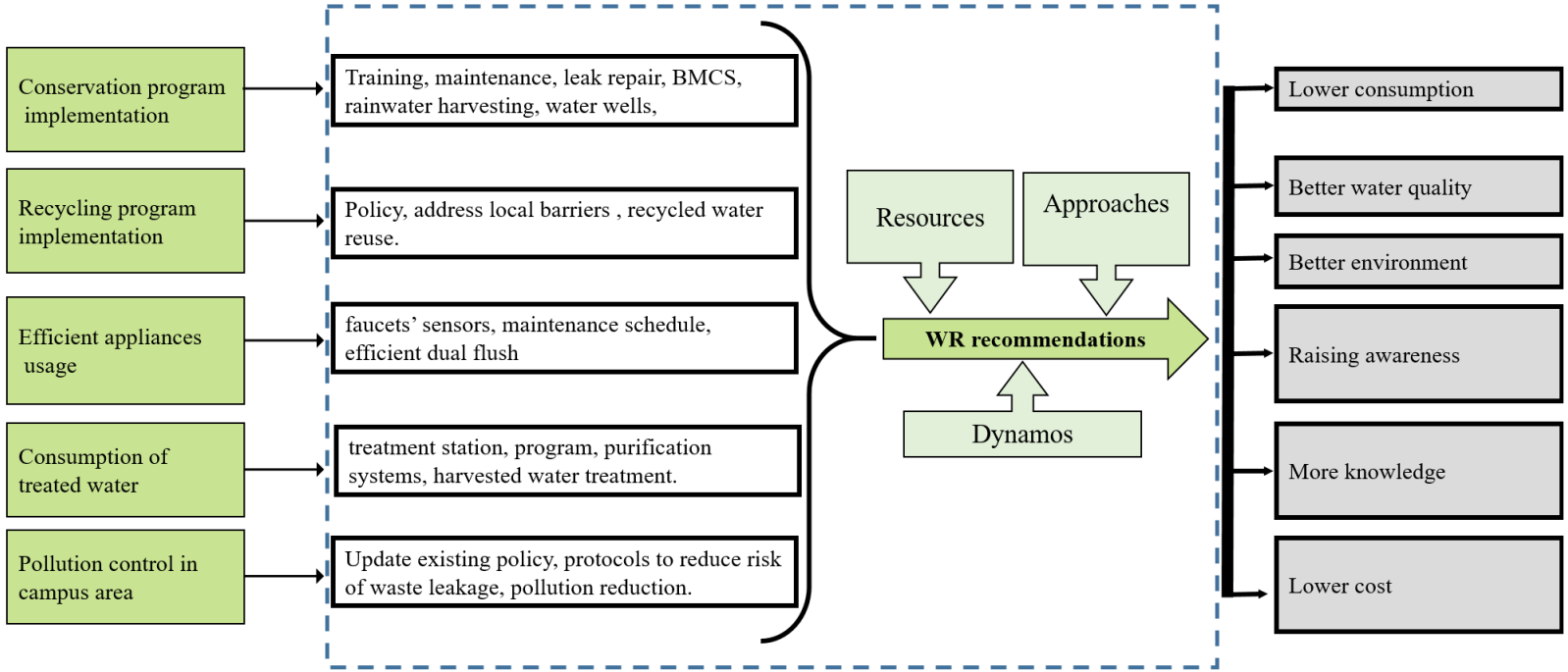

Figure 22: IPO for water (WR)

Table 14: Recommendations for transportation (TR)

Transportation (TR)		
Element with 70% or above from the questionnaire		
Recommendations: based on questionnaire analysis, interviews and UI GreenMetric.	Recourses	Limitation/challenges
Pedestrian path policy on campus		
-Allocate and design properly pedestrian areas that give priority to students, in addition to wide public paths for walking. -Establish rest areas with benches in walking baths, -Design canopies that form proper area for students and protect them from sun heat.	Financial resources Human resources Physical resources	Availability of financial funds Administrative approval Technical issues

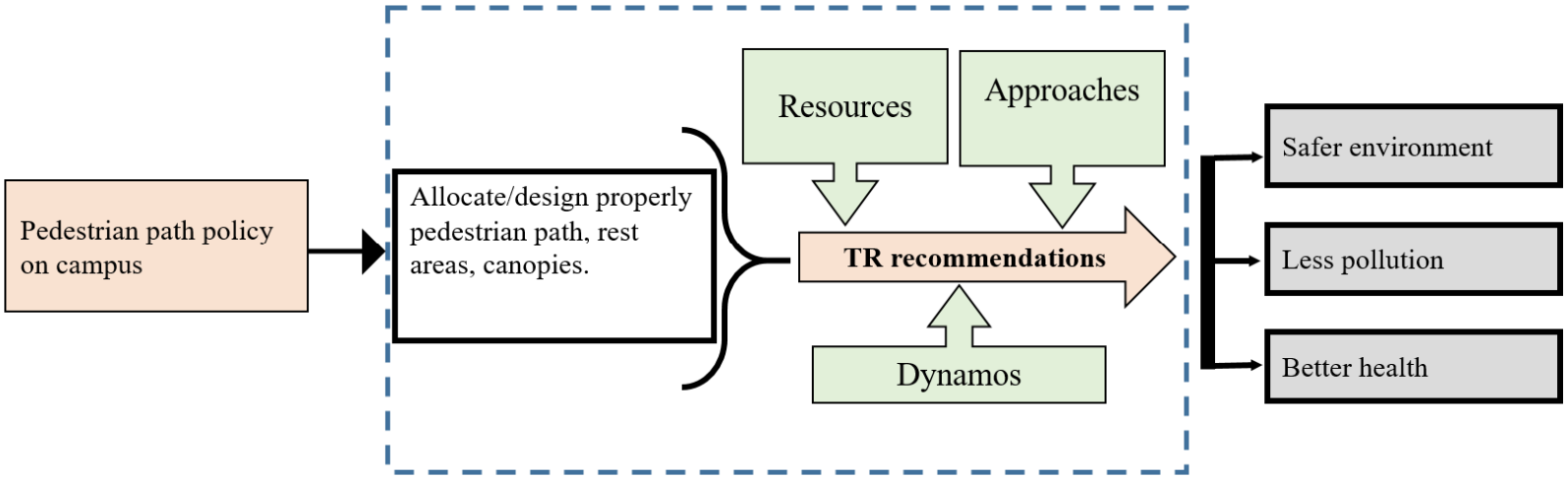

Figure 23: IPO for transportation (TR)

Table 15: Recommendations for education (ED)

Education and research (ED)		
Element with 70% or above from the questionnaire		
Recommendations: based on questionnaire analysis, interviews and UI GreenMetric.	Recourses	Limitation/challenges
Number of courses/subjects related to sustainability offered		
-Increase the number of courses offered related to sustainability in order to increase the ratio of the sustainability courses within the university. -Develop and offer specific course with the suggested names “introduction to university sustainability” and “citizenship” at the bachelor level to strengthen and develop students as good role models citizens with skills in learning and best practices within the framework of the university’s identity to develop students’ citizenship nationally and worldwide.	Financial resources Human resources Physical resources	Availability of financial funds Administrative approval Technical issues

Total research funds dedicated to sustainability research (in US Dollars)		
-Allocate specified funds for sustainability research	Financial resources	Availability of financial funds Administrative approval
Number of university program(s) to improve teaching and learning		
-Establish an annual academic sustainability calendar overseen by the assigned office (sustainability office in collaboration the VPAA office) and includes regular activities directed toward teaching and learning. -Establish helpdesk group for facilitating electronic communication to exchange knowledge. -Deliver academic lectures, workshops and symposiums for BZU and the community involving sustainability	Financial resources Human resources Physical resources	Availability of financial funds Administrative approval Technical issues
Number of sustainability community services projects organized and/or involving students		

-Establish an annual sustainability calendar overseen by the students' deanship and includes regular activities directed toward academic and nonacademic activities. -Perform nonacademic activities directed toward social responsibility and raising awareness such as running, competitions and fundraising for sustaining BZU. -Deliver academic activities for students involving sustainability such as seminars, workshops, lectures and webinars delivered by experienced people nationally and internationally. -Encourage international cultural exchange programs for students to share knowledge and benefit from best practices regarding sustainability around the world.	Financial resources Human resources Physical resources	Availability of financial funds Administrative approval Technical issues

-Deliver an annual thematic program such as “BZU & sustainability” over a week (for example around earth day) where it involves academic and nonacademic about a major theme per year. -Initiate partnerships with schools, local government, ministries, local businesses and organizations to collaborate in leading sustainable development within the society and influence decision-making. -Develop student environmental center to spread a culture of sustainability		

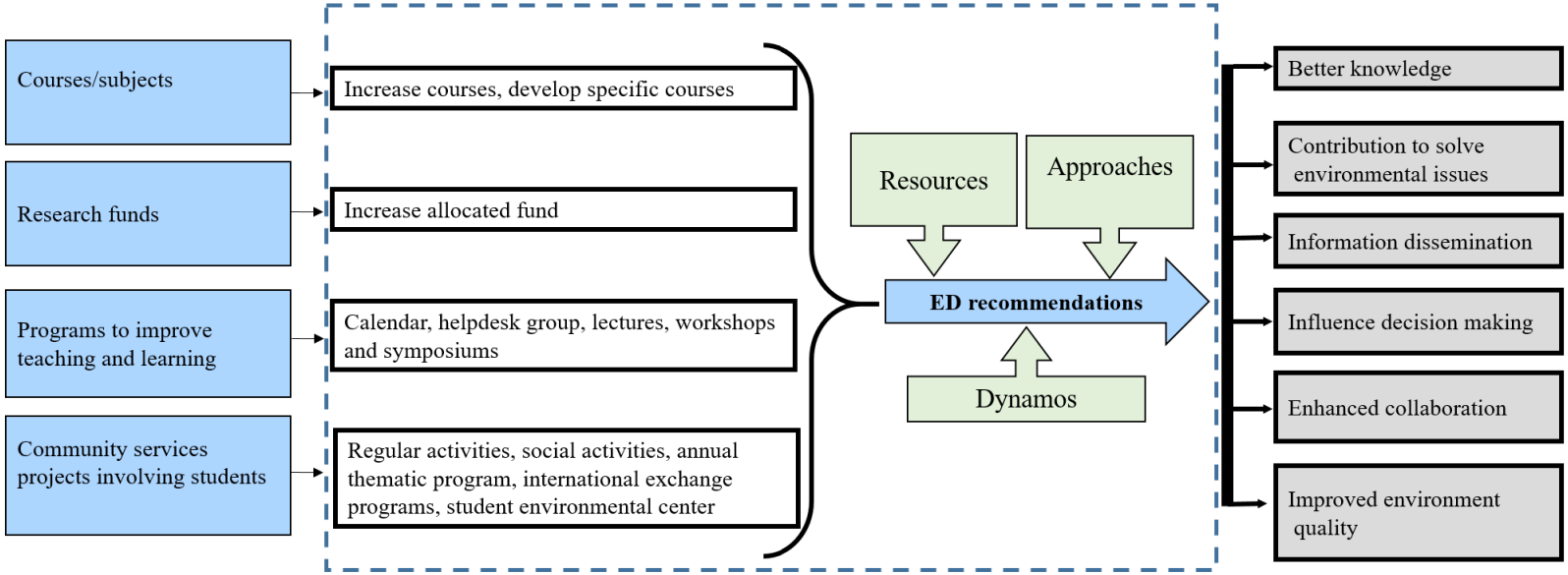

Figure 24: IPO for education (ED)

6.3 Main recommendations

The below table 16 summarizes the prioritized recommendations, urgently needed to serve as an emergency sustainability plan, to begin with immediately based on university needs, overall results and as deduced by the researcher

Table 16: Main recommendations

Recommendations	KPI
Establish sustainability office	Operational sustainability office with a minimum of one employee.
Allocate sustainability budget	Larger than 5 % of the university total budget.
Firefighting systems	
Energy efficient appliances	Larger than 50% of the university appliances.
Waste management system	Waste Recycling: partial (larger than 1% to 25% of waste). Waste Reduction: 2 programs. Waste treatment: partial (larger than 1% to 25% of waste).
Water management system	Water conservation: Larger than 25 - 50% water is conserved Water recycling: 25 - 50% water is recycled. Larger than 25 - 50% of water-efficient appliances installed Larger than 25 - 50% treated water consumed
Pedestrian path	Pedestrian path is available, designed for safety and convenience

6.4 Proposed approaches' recommendations

This section highlights the main recommendations for each of the approaches as described in the proposed model.

6.4.1 Education approach

6.4.1.1 Include sustainability in academic curricula

BZU should go beyond developing specialized sustainability strategy to develop its students' values to enrich the society. Therefore, BZU should incorporate main principles of sustainability within the curricula at different levels to teach students and accustom them to the various issues concerning green campus and

sustainability. In addition, sustainability and green campus must be encouraged and should be encompassed within proposals and research projects developed by faculty members to help solve related sustainability and environmental issues. Graduate courses and specialized programs could be further developed in the discipline of sustainability. For example, a general education course could be offered as a supplementary course for all university students where sustainability is addressed in details. Obligating students to be involved in a sustainability course will change the behavior of the students and promote them to conduct themselves in a professional manner, which can possibly result in motivating future innovators to tackle basic current and future environmental issues. This is the result when sustainability is integrated as a main part of the academic curriculum.

6.4.2 Recommendations: research approach

6.4.2.1 Collaboration and partnership

Internal and external collaboration brings experts from various disciplines together to tackle persisting issues. The action of cooperation equip BZU community and leadership with innovative competencies and additional knowledge and promote outreach nationally and internationally will establish credibility for BZU researchers as well as contribute to improve the economic and environmental performance of BZU. Thus, the role of collaboration in enhancing the overall

sustainability should not be underestimated, but rather, should be complemented and supported and promoted with other institutions as needed.

6.4.3 Recommendations: internal institutional approach

6.4.3.1 Sustainability budget

Sustainability budget allocation to accommodate green campus needs and meet the university threshold in promoting sustainability within the campus. Despite the number of sustainability activities delivered or amount of resources needed, there must be a budget to cover for any incurred expense. It is noteworthy that changing to green campus is very challenging and demanding with difficult tasks to achieve overall. The university may execute green economy businesses to develop BZU in this direction. BZU may further establish new sustainability or green project to cover BZU fiscal demands partially or fully regarding sustainability. For example, campus paper and plastic recycling project would immensely provide for sustainability around the campus and promote collective social responsibility within BZU community.

6.4.3.2 Commitment to sustainability

Commitment is the first step toward change. This recommendation could be summarized through establishing sustainability policy or action plan in line with international standards and follow best practices to implement, monitor and evaluate periodically. For example, BZU could establish a BZU 2030 sustainability strategy consistent with SDGs to address environmental concerns, accountability and social responsibility toward the planet. To do so, measureable

and realistic sustainability goals are identified based on university priority. Then, the main elements for achieving the preset goals are categorized and needed resources are allocated. Next, the key performance indicators are measured during the implementation of the sustainability strategy over specified time and the results are obtained and evaluated. This will help in prompting social responsibility in collective manner. Although there is more than one committee for providing suggestions and recommendations, there is no centralization for implementing, monitoring and evaluating university's sustainability, which usually becomes a burden of a committee, which results in lack of trust since committees are not decision maker within the university. Thus, any recommendations and suggestions by the committees wind up on someone's desk with no value. envisioning a BZU 2030 sustainability strategy will facilitate implementing environmental policies in Palestine in general and promote BZU sustainability in particular which will change the behavior of BZU community toward green campus thus driving the behavior of the Palestinian community forward toward sustainability overall.

6.4.3.3 Establish sustainability standards for new buildings

This recommendation requires BZU to adopt standards for any new buildings including all building components during the different construction phases. These adopted standards will prioritize sustainability in designing and constructing future buildings in the campus. The adoption on standards for new construction indicates that well-planned building design will minimize energy demand due to precise calculations for the electricity consumption, needed hot and cold water, and total

maintenance cost during a preset time. It is noteworthy to confirm that reducing the energy consumption by a campus community is as more important than increasing the level of the energy demand resulting in balancing between the demand and supply.

6.4.3.4 Conserve energy within campus

This recommendation is based on minimizing energy in existing buildings and the surroundings in BZU. When creating a sustainable campus, it is crucial for BZU to commit to minimizing energy use overall. To do so, specified programs should implemented to enhance energy efficiency in BZU. Energy savings comes from various areas in the campus such as building design, continuous maintenance and various departments and surrounding communities. It is crucial not to underestimate developing sustainable campus and the rewards associated with such development. For example, BZU will benefit from LED efficient lighting, operated motion-sensors that control the operation of lights and air conditioning.

6.4.3.5 Sustain the sustainability

Achieving the sustainability goals is merely the beginning of a long journey for adopting and maintaining the sustainability that should become a lifestyle within BZU community. Raising awareness about green campus and sustainability within BZU community and within the larger community through delivering extracurricular activities about related environmental issues related to sustainability such as climate change and capacity building.

6.4.3.6 Create sustainability office

BZU should consider dedicating sustainability office headed by qualified leadership and equipped with all necessary resources including fiscal, human and fully equipped to be responsible for initiating, conducting and maintaining sustainability. This office will serve as point of contact to coordinate and promote all related sustainability activities. In addition, the office should be responsible for instigating collaborative activities within the university and with other HEIs and related organizations within the community.

6.4.4 Recommendations: integrated external approach

6.4.4.1 Develop sustainability website

BZU should look into developing a website for sustainability to enhance the knowledge on sustainability within its community and the larger community. This website will highly influence common people thinking about sustainability and spread information about relevant sustainability topics such as conserving energy, recycling, reducing carbon emission and harvesting renewable energy. This website should be accessed through the main website and should be dedicated to publicize the university's sustainability activities. In addition, the website must display university's achievement and share periodic reports related to green campus and sustainability. A well-designed, informative and well-shared website

will bridge the sustainability information gap among community and thus improve overall behavior toward sustainability and green campus.

6.5 Contribution and implication

The implications and transformations due to sustainability practices play an important role in transforming the society thus playing a major role in promoting learning based on educating new generations of leaders who believe in sustainability and its positive impact on the community. As a result, future scientists, engineers and professionals will be motivated to design technology and economic activities that promotes sustainability rather than ignoring the natural environment [31]. Consequently, the overall quality of human health will be enhanced and environment degrading will be minimized. In addition, communities will better understand the cycles of products and services, and the wastes' generation and its management, thus environmental footprint will be minimized. This will result in comprehending the sustainability within the various sectors leading current and future humans' generations to meet their basic needs and follow meaningful work which will give people the opportunity to realize their full potential personally and socially. Figure 25 represents the research impact in a gradual manner beginning from the university throughout the universe. Hence, this research will have clear implications from micro scale to macro scale with major influence at the following dimensionalities:

- University: this research will establish a level for institutional cultural sustainability including defining main pertaining elements, improve its physical

environment and enhance capacity building within the university, facilitate collaboration for interdisciplinary methodologies, modify existing sustainability approaches to meet the university demands, and contribute to enhance the university's sustainability ranking environment

- Community: raise awareness of environmentally sustainable development and its main elements; involve relevant stakeholders within and outside the university and present a role model for the society hoping to reflect on other major organizations
- National: influence decision makers' to initiate higher level for developing sustainability policies, provide solutions to existing major problems at the national level such as energy saving, waste management and water management and recycling.
- International: contribute to the sustain the universe by adhering to SDGs

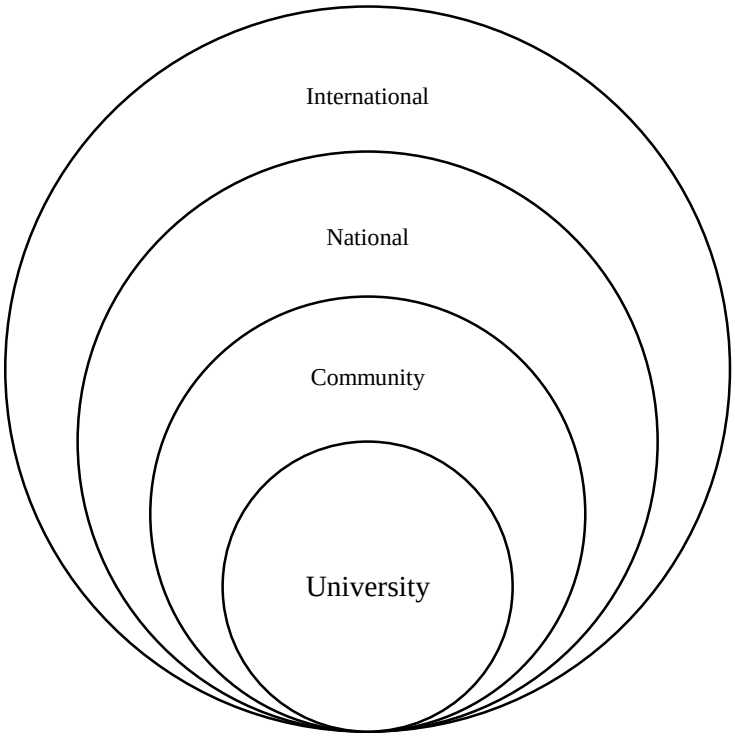

Figure 25: Various sustainability dimensionalities

This study focused on analyzing the current level of BZU sustainability, the fundamental role of the university in implementing green campus elements and possible challenges and future direction. Therefore, this study has unique contribution which are inclusive. It motivates sustainability thinking and paves the road for green campus initiative in teaching and learning at different levels. It pulls together theoretical perspective and current practice to promote green campus initiative and align them to establish sustainability practice at BZU. This study gives the actual information, obstacles, and recommendations and proposes a new model that benefits the university and the overall society. This study presents an integrated model for sustainability that enhances environmental sustainability

practices within the four levels. In addition, it is motivating to foresee that all the four levels are benefiting from sustainability's systems, processes, and efficient practices on issues regarding sustainability.

6.6 Commence, conduct, control (CCC) action plan

Figure (26) demonstrates the relationship between commence, conduct and control, henceforth CCC cycle. This serves as a control process to make sure the actions are being met within BZU regulations.

The figure identifies the levels for action to be taken for each of the components as follows:

- Commence: is the first level of CCC plan indicating an initiation which needs research to decide best choice or practice, establish standards, solution, design, model …etc.
- Conduct: is the second level of the CCC plan indicating implementation (such as preparation, technical issues, logistics …etc.) of the selection from the first level (commence) which could be technical.
- Control: is the third level of the CCC plan indicating measuring performance, correcting deviations, monitoring, evaluation and management to ensure implementation and enhancement.

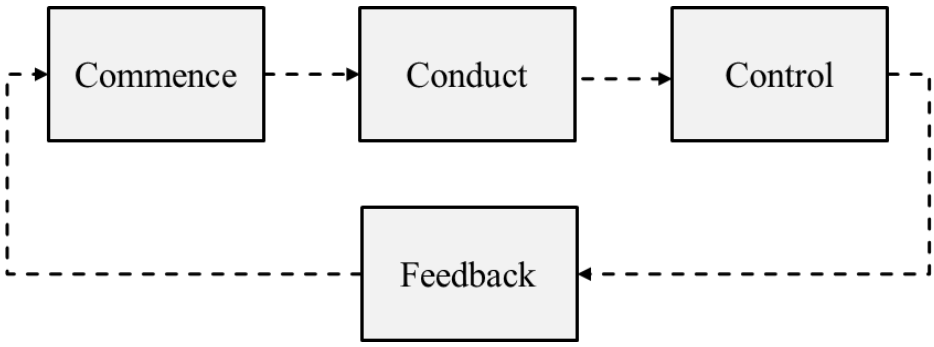

Figure 26: Scheme for CCC action plan

The categories with the needed levels in the CCC plan and the actions needed in order to improve sustainability which could serve as a sustainability action plan are illustrated in figures (27-32).

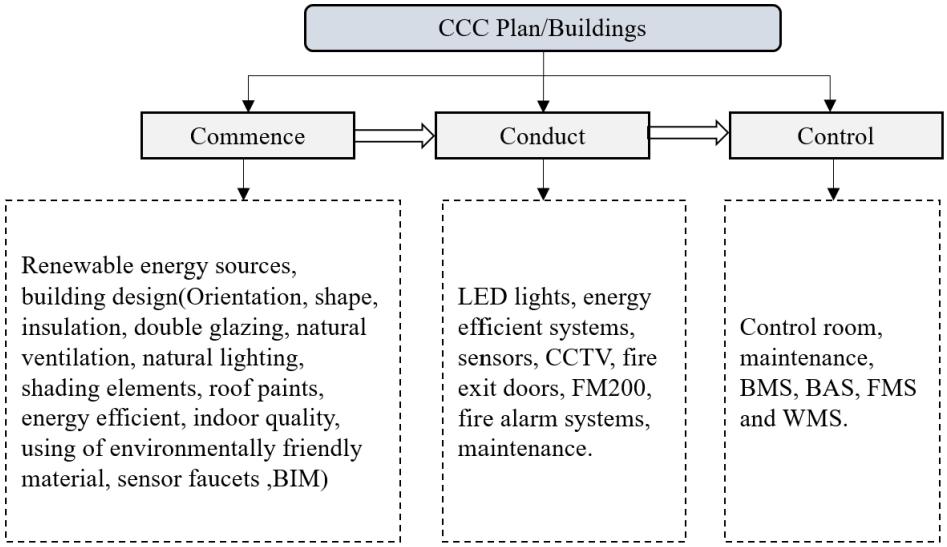

Figure 27: CCC Plan for buildings

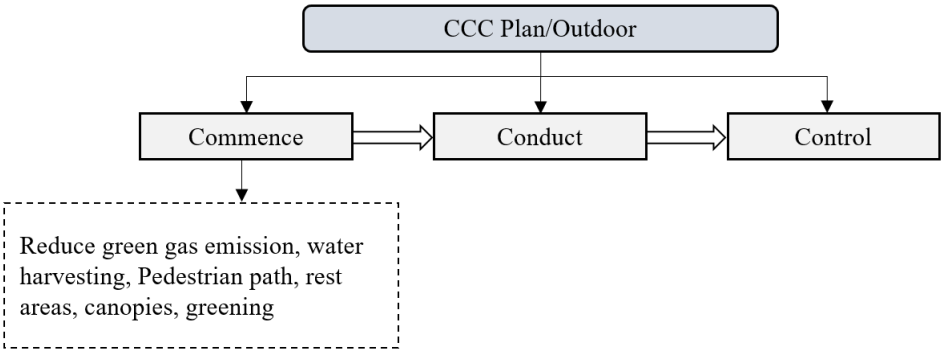

Figure 28: CCC Plan for outdoor

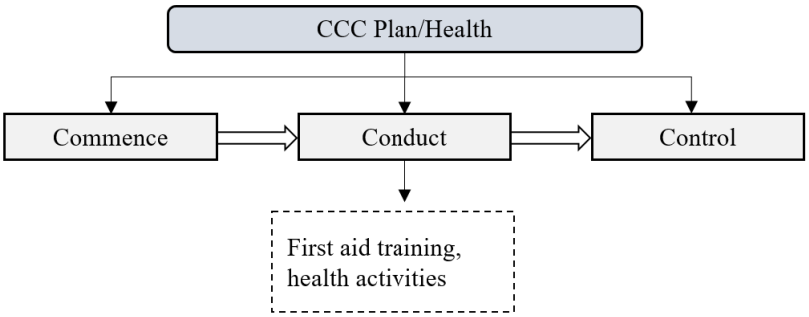

Figure 29: CCC Plan for health

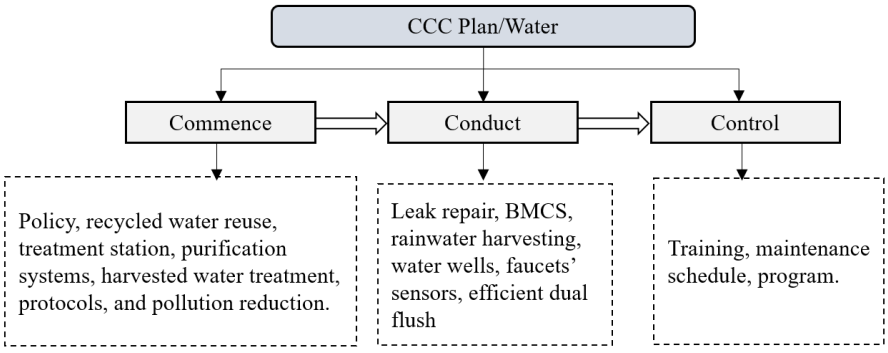

Figure 30: CCC Plan for Water

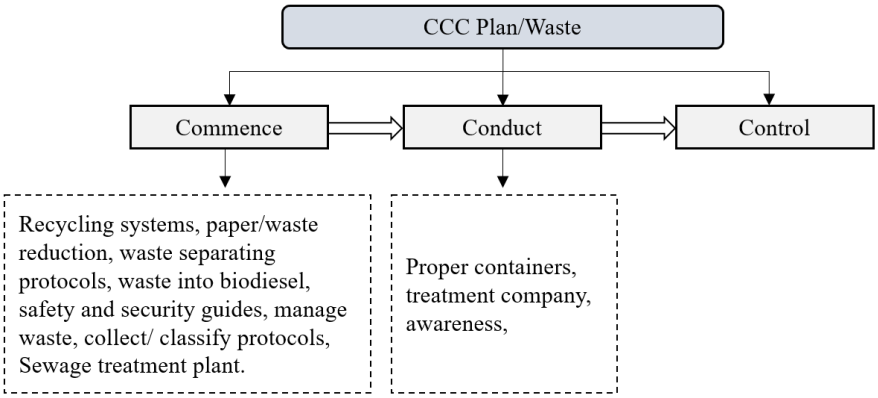

Figure 31: CCC Plan for waste

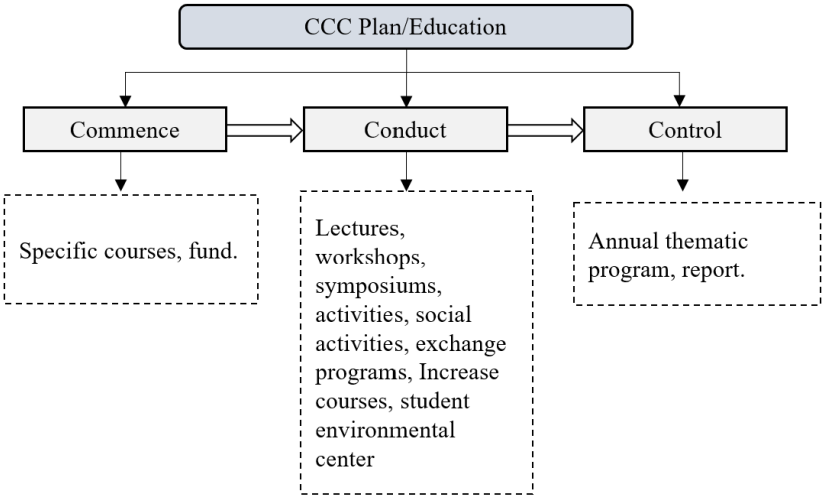

Figure 32: CCC Plan for education.

Chapter 7

Barriers to sustainable campus

7.1 Introduction

In the previous chapter, we presented thoroughly the collected the information, analyzed the data and discussed the results. In this chapter, we highlight the main barriers in implementing and achieving sustainability within BZU campus. It is very well documented that there are challenges and obstacles that affect the level of implemented sustainability that also will be reflected on the recommendation as well as the proposed model.

7.2 Barriers and challenges

7.2.1 Reduction in demanded energy in new buildings

Reduction in energy demands in new buildings and facilities is evident since it lack presence of adopted criteria, policies and well documented procedures. In addition, there is some evident for experiences and expertise in practices to attempt reducing demanded energy in newly constructed buildings. Energy saving in new constructed building has an outstanding contribution in the case where processes are in place for reviewing, calculating and monitoring the overall consumption and saving. This barrier constitute a long-term approach and requires high level of commitment in addition to efficient monitoring and continuous evaluation, which makes it not applicable and not very common.

7.2.2 Necessity of applied innovation in building design

Continuous applied innovation and advanced research to experiment with innovation and latest technology in energy reduction in necessary for HEIs to serve as a good role model. To do so, committed researchers and effective strategic plan is important to carry on with this goal. Although BZU researchers are up-to-date on technology, innovation through building design is not generally practiced since it requires large amounts of financial resources which results in lack of sustainability developments which is changing continuously and quickly.

7.2.3 Sustainability expenses

BZU has limited flexibility in its annual budget which usually results in prioritizing available resources. While consistent sustainability retrofitting program save a good amount of money and energy on the long run, initial monetary investment is required. In addition, dedicated researchers are needed to carry on with this mission. Thus, the allocation of expense needed for carrying on sustainability retrofitting programs for new or existing building is a challenge for BZU buildings preventing it from looking into achieving sustainability in general.

7.2.4 Lack of commitment

BZU hierarchal authority is arranged in different levels and decisions made go from one level to another for approval. Within the different level, there are various perspectives regarding any discussed issue resulting in debating about relevant issues instead of making applicable decisions. There results in variation in decision making among academic departments, administration departments and councils at different levels. This complexity in direct decision-making power results in

fluctuations in holding the privilege when it comes to deciding based on the nature of the dilemma and who is considered to be the decision-maker. As this continues within HEIs in general, lack of commitment appears in some issues such as sustainability. The lack for commitment is clearly presented in the lack of policies, action plan, courses, programs and any pertaining green campus activities. Otherwise, sustainability will be continuously delivered and systematically monitored instead of delivering fragmented activities sporadically.

7.2.5 Lack of sustainability strategic vision

BZU relies on diverse strategic plan which is influenced by various factors and is in line with the national strategic plan. BZU initiatives are dynamic and are affected by governmental decisions thus, continuity in strategic plan in general and in sustainability initiative in specific are usually carried for short time excluding the quality of the plans. As a result, the sustainability vision lasts for shorter time and lacks continuity and long term vision which form a main barrier to sustainability and green campus regarding planning and implementing.

Chapter 8

Conclusion and future studies

8.1 Conclusion

Universities are at the core of leading changing to drive societies forward and solve global issues. Universities are role model which represents smaller communities that resembles larger communities in terms of behavior, resource consumption and waste generation. In addition, universities are places where scientists and researchers investigate various issues and offer solution to different types of global issues. It is mainly the engineers who find solutions to existing problems and develop renewable energy answers. For example, architects design buildings to achieve sustainability within the setting and infrastructure. In addition, they provide advice for government regarding governmental policies as well as decision-makers to reduce energy demand. The presence of knowledge, research, internal and external support within BZU inspire innovation that will initiate sustainability within its various categories coherently. The impact of this initiation will drive change, not only bounded by its gates, but beyond its borders to have an impact locally, nationally, and internationally.

The study intended to investigate the sustainability at BZU through collecting relevant data, select relevant elements, analyze the current situation of these elements and provide a sustainability model that fits the needed criteria for BZU. This exploratory examination is the first to provide comprehensive model for sustainability enhancement at BZU. In addition, it provides a glance into the future after executing the model in a futuristic manner and postulate the expected impact.

Despite the fact that there are many obstacles down the road, this investigation recommended solid recommendations which could be easily transformed into sustainability action plan to facilitate its implementation as well as its monitoring. A well-noted mandate of this study is its call for managing as well as avoiding exploitation its various limited resources through offering solutions in terms of activities regarding sustainability and their impact on societies through collaboration and community engagements.

The study findings displayed in depth recommendations to guide the direction of implementing sustainability at BZU. The study confirms that all stakeholders should be involved in university' sustainability.

This study serves as a wake-up call for BZU community. Although it is not too late to take action and start changing now, the gap will become bigger and it will very difficult to catch up with the rest of leading universities at a later stage.

8.2 Future studies

This study focused on the importance of university sustainability and the role resources' utilization as an integral part of the global environmental sustainability. Overall, any future investigation is dynamic and driven by the availability of various resources as well as allocating time and effort to regulate and oversee all related activities. This study proposed an inclusive model as a foundation for sustaining BZU. A good research is not the one that answers one question, but rather, is one that generates many questions with multiple tasks for the future. The followings form a list of related tasks to be considered for future investigation:

- The model should be implemented, monitored and evaluated in a cyclical manner to ensure enhancement.
- Although the questionnaire was inclusive and covered all categories adopted worldwide, the provided recommendations were limited to those elements that obtained 70% weighted average or above based on the collected data. For future studies, the recommendations could be expanded to include elements with lower averages (for example 50% or above).
- In addition, it is worth noting that the recommendation provided within this study could be easily utilized to derive a sustainability action plan for the future implementation. This action plan could serve as a guide for a future sustainability office to develop procedures, regulations, policies and adopt international accepted protocols to guide BZU sustainability and offer decision-makers solutions to existing national issues.

It is important to emphasize that the findings of this study are valuable once they are implemented, overseen, and evaluated periodically using UI GreenMetric to ensure continuous enhancement and positive behavioral change toward sustainable universities and sustainable societies.

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Appendices

Appendix A: Questionnaire for UI GreenMetric at BZU

Question	Very important 5	Important 4	Neutral 3	Unimportant 2	Very unimportant 1
Indicate the level of importance for each of the below:					
Setting and Infrastructure (SI)					
1. University sustainability	◯	◯	◯	◯	◯
2. Area on campus covered in forest vegetation	◯	◯	◯	◯	◯
3. Budget allocation for university sustainability	◯	◯	◯	◯	◯
4. Annual maintenance	◯	◯	◯	◯	◯
5. Facility accessibility for disabled and maternity	◯	◯	◯	◯	◯
6. Facilities security and safety	◯	◯	◯	◯	◯
7. Health infrastructure/facilities for students' and academic and administrative staff' wellbeing	◯	◯	◯	◯	◯
8. Conservation: plant (flora), animal (fauna), and wildlife	◯	◯	◯	◯	◯

Energy and Climate Change (EC)					
9. Energy efficient appliances usage	◯	◯	◯	◯	◯
10. Smart buildings implementation	◯	◯	◯	◯	◯
11. Renewable energy sources on campus	◯	◯	◯	◯	◯
12. Elements of green building implementation as reflected in all construction and renovation policies	◯	◯	◯	◯	◯
13. Greenhouse gas emission reduction program	◯	◯	◯	◯	◯
14. Offering innovative program(s) / activities in energy and climate change	◯	◯	◯	◯	◯
Waste (WS)					
16. Implementing recycling programs for university's waste	◯	◯	◯	◯	◯
17. Program to reduce the use of paper and plastic on campus	◯	◯	◯	◯	◯
18. Waste (organic, inorganic, toxic) treatment program	◯	◯	◯	◯	◯
19. Sewage disposal	◯	◯	◯	◯	◯
Water (WR)					
20. Water conservation program & implementations	◯	◯	◯	◯	◯

21. Water recycling program implementation	◯	◯	◯	◯	◯
22. Water efficient appliances usage	◯	◯	◯	◯	◯
23. Wastewater treatment and consumption	◯	◯	◯	◯	◯
24. Water pollution control	◯	◯	◯	◯	◯
Transportation (TR)					
25. Shuttle services	◯	◯	◯	◯	◯
26. Zero Emission Vehicles (ZEV) policy on campus	◯	◯	◯	◯	◯
27. Program to limit or decrease the parking area on campus	◯	◯	◯	◯	◯
28. Initiatives to decrease private vehicles on campus	◯	◯	◯	◯	◯
29. Pedestrian path on campus	◯	◯	◯	◯	◯
Education and Research (ED)					
30. Offering courses/subjects related to sustainability	◯	◯	◯	◯	◯
31. Research funds dedicated to sustainability research	◯	◯	◯	◯	◯
32. Scholarly publications on sustainability	◯	◯	◯	◯	◯

33. Events related to sustainability	◯	◯	◯	◯	◯
34. Student organizations related to sustainability	◯	◯	◯	◯	◯
35. University-run sustainability website	◯	◯	◯	◯	◯
36. Importance of university sustainability report	◯	◯	◯	◯	◯
37. Cultural activities on campus related to sustainability	◯	◯	◯	◯	◯
38. University program(s) to improve teaching and learning	◯	◯	◯	◯	◯
39. Importance of sustainability community services project organized and/or involving students	◯	◯	◯	◯	◯
40. Importance of sustainability-related startups	◯	◯	◯	◯	◯

Appendix B: Diesel tanks at BZU campus

Diesel tanks at BZU campus		
Building	Diesel tanks	Capacity
Faculty of Science Building	1	15
Omar Aggad Engineering Building	2	50
Gabi Baramki Building- University Administration	1	15
Abdul Rahman Al-Juraysi Building- Faculty of Business and Economics	1	15
15Engineering workshops	1	10
Azeez Shaheen University Clinic	1	10
Institute of Law Building	1	15
Sheikh Rashid Bin Said Al-Maktoum Building	1	15
Naseeb Azeez Shaheen Building for Graduate Studies	1	10
Physical Education Building	1	15
Library Annex	1	10
Kingdom of Bahrain Building for Women's Studies	1	10
Azeez Shaheen Building- Faculty of Arts	1	10
Najjad Zeenni Information Technology Center of Excellence	1	10
Said Khoury Building for Development Studies	1	10
Walid and Helen Kattan Building- University Presidency	1	10
Faculty of Pharmacy, Nursing and Health Professions Building	1	10
Mohammad Omran Bamieh Building- Faculty of Education Building	1	10
Mohammad Masrouji Building for Media	1	3T gas
Munib Rashid Masri Building for Information Technology	1	3T
Samih Darwazah Institute for Pharmaceutical Industries	nill	
Naseeb Azeez Shaheen Auditorium	nill	
Maintenance and Stores Building	nill	
Student Council Building	nill	
Riad Tawfik Al-Sadik Faulty of Law and Public Administration	1	3T
Ali El-Haj Stadium	nill	
Zuheir Alami Building- Engineering Office and General Services Building	1	1T
Samir Abdulhadi Building- Faculty of Science\ Mathematics Wing	1	3T
Omar Abdulhadi Building- Faculty of Business and Economics	1	3T
Samir Aweidah Building- Faculty of Art, Music and Design	1	3T
University halls building	nill	

Appendix C: The complete tabulation for current BZU scores based on UI GreenMetric

Indicator	Points	BZU score	BZU points
Setting and Infrastructure (SI)--15%	**1500**		
The ratio of open space area to the total are	200	0.05	10
Total area on campus covered in forest vegetation	100	0.05	5
Total area on campus covered in planted vegetation*	200	0.05	10
Total area on campus for water absorption besides the forest and planted vegetation*	100	0.05	5
The total open space area divided by total campus population	200	0.05	10
Percentage of university budget for sustainability efforts*	200	0.05	10
Percentage of operation and maintenance activities of building in one year period	100	0.05	5
Campus facilities for disabled, special needs and or maternity care	100	0.75	75
Security and safety facilities	100	0.5	50
Health infrastructure facilities for students, academic and administrative staff's wellbeing	100	0.5	50
Conservation: plant (flora), animal and wildlife (fauna), genetic resources for food and agriculture secured in either medium or long-term conservation facilities	100	0.05	5
Total points	**1500**		**230**
Energy and Climate Change (EC)--21%			
Energy efficient appliances usage	200	0.25	50
Smart buildings implementation	300	0.25	75
Number of renewable energy sources in campus	300	0.25	75
The total electricity usage divided by total campus population (kWh per person)	300		0
The ratio of renewable energy production divided by total energy usage per year	200		0
Elements of green building implementation as reflected in all construction and renovation policies	200	0	0
Greenhouse gas emission reduction program	200	0	0
The total carbon footprint divided by total campus population	200		0
Number of innovative program(s) in Energy and Climate Change	100	0	0
Impactful university program(s) on climate change	100	0	0
Total points	**2100**		**200**
Waste (WS) --18%			
Recycling program for university waste	300	0	0

Program to reduce the use of paper and plastic on campus	300	0	0
Organic waste treatment	300	0	0
Inorganic waste treatment	300	0	0
Toxic waste treatment	300	0	0
Sewage disposal	300	0	0
Total points	**1800**		**0**
Water (WR)--10%			
Water conservation program & implementations	200	0.25	50
Water recycling program implementation	200	0	0
Water efficient appliances usage	200	0	0
Treated water consumed	200	0	0
Water pollution control in campus area	200	1	200
Total points	**1000**		**250**
Transportation (TR)--18%			
The total number of vehicles (cars and motorcycles) divided by total campus population*	200		0
Shuttle services	300	0	0
Zero Emission Vehicles (ZEV) policy on campus	200	0	0
The total number of Zero Emission Vehicles (ZEV) divided by total campus population	200	0.05	10
The ratio of the ground parking area to total campus area	200		0
Transportation program designed to limit or decrease the parking area on campus for the last 3 years (from 2018 to 2020)	200	0	0
Number of transportation initiatives to decrease private vehicles on campus	200	0	0
Pedestrian path on campus	300	0.5	150
Total points	**1800**		**160**
Education and Research (ED)--18%			
The ratio of sustainability courses to total courses/subjects	300	0.05	15
The ratio of sustainability research funding to total research funding	200	0.05	10
Number of scholarly publications on sustainability	200	0.25	50
Number of events related to sustainability	200	0	0
Number of student organizations related to sustainability	200	0	0
University-run sustainability website	200	0	0
Sustainability report	100	0	0
Number of cultural activities on campus	100	0	0

Number of university program(s) to improve teaching and learning	100	0	0
Number of sustainability community services project organized and/or involving students	100	0	0
Number of sustainability-related startups	100	0	0
Total points	**1800**		**75**
	10000		**915**

Appendix D: Total area of buildings at BZU

Building	Area(m^2)
Faculty of Science Building	10260
Omar Aggad Engineering Building	12500
Engineering workshops	1790
Yusuf Ahmad Al Ghanim Library	6128
Gabi Baramki Building- University Administration	2025
Kamal Nasir Hall	2216
Abdul Rahman Al-Juraysi Building- Faculty of Business and Economics	4500
Azeez Shaheen University Clinic	663
Institute of Law Building	2865
Sheikh Rashid Bin Said Al-Maktoum Building	3053
Diana Tamari Sabbagh Center	1855
Naseeb Azeez Shaheen Building for Graduate Studies	1518
Kingdom of Bahrain Building for Women's Studies	1839
Physical Education Building	2768
Azeez Shaheen Building- Faculty of Arts	6450
Najjad Zeenni Information Technology Center of Excellence	1220
Said Khoury Building for Development Studies	3611
Walid and Helen Kattan Building- University Presidency	1773
Faculty of Pharmacy, Nursing and Health Professions Building	4937
Mohammad Omran Bamieh Building- Faculty of Education Building	5030
Mohammad Masrouji Building for Media	2943
Munib Rashid Masri Building for Information Technology	4232
Samih Darwazah Institute for Pharmaceutical Industries	1215
Naseeb Azeez Shaheen Auditorium	2839
Maintenance and Stores Building	840
Student Council Building	135
Riad Tawfik Al-Sadik Faulty of Law and Public Administration	5200
Ali El-Haj Stadium	1020
Zuheir Alami Building- Engineering Office and General Services Building	1004
Samir Abdulhadi Building- Faculty of Science\ Mathematics Wing	1450
Omar Abdulhadi Building- Faculty of Business and Economics	2650
Samir Aweidah Building- Faculty of Art, Music and Design	5508
Shouky Azeez Shaheen building/ university halls building	

Appendix E: UI GreenMetric Guidelines.

No	Category and Indicator	Point	Score	Weighting
1	**Setting and Infrastructure (SI)**			**15%**
SI 1	**The ratio of open space area to the total area***	**200**		
	≤ 1%		0.05x200*	
	> 1 - 80%		0.25×200	
	> 80 - 90%		0.50×200	
	> 90 - 95%		0.75×200	
	> 95%		1.00×200	
SI 2	**Total area on campus covered in forest vegetation***	**100**		
	≤ 2%		0.05x100*	
	> 2 - 9%		0.25×100	
	> 9 - 22%		0.50×100	
	> 22 - 35%		0.75×100	
	> 35%		1.00×100	
SI 3	**Total area on campus covered in planted vegetation***	**200**		
	≤ 10%		0.05x200*	
	> 10 - 20%		0.25×200	
	> 20 - 30%		0.50×200	
	> 30 - 40%		0.75×200	
	> 40%		1.00×200	
SI 4	**Total area on campus for water absorption besides the forest and planted vegetation***	**100**		
	≤ 2%		0.05x100*	
	> 2 - 10%		0.25×100	
	> 10 - 20%		0.50×100	
	> 20 - 30%		0.75×100	
	> 30%		1.00×100	
SI 5	**The total open space area divided by total campus population***	**200**		
	≤ 10 m^2/person		0.05x200*	
	> 10 – 20 m^2/person		0.25×200	
	> 20 – 40 m^2/person		0.50×200	
	> 40 – 70 m^2/person		0.75×200	
	> 70 m^2/person		1.00×200	
SI 6	**Percentage of university budget for sustainability efforts***	**200**		
	≤ 1%		0.05x200*	
	> 1 - 5%		0.25×200	
	> 5 - 10%		0.50×200	
	> 10 - 15%		0.75×200	
	> 15%		1.00×200	
SI7	**Percentage of operation and maintenance activities of building inone year period**	**100**		
	≤ 25%		0.05x100*	
	> 25 - 50%		0.25×100	
	> 50 - 75%		0.50×100	
	> 75 - 99%		0.75×100	
	100%		1.00×100	

SI8	**Campus facilities for disabled, special needs and or maternitycare**	**100**		
	None		0	
	Policy is in place		0.25×100	
	Facilities are in planning stage		0.50×100	
	Facilities are partially available and operated		0.75×100	
	Facilities exist in all buildings and are fully operated		1.00×100	
SI9	**Security and safety facilities**	**100**		
	Passive security system		0	
	Security infrastructure (CCTV, emergency hotline/button) availableand fully function		0.25×100	
	Security infrastructure (CCTV, emergency hotline/button, personnel,fire extinguisher, hydrant) available and fully function		0.50×100	
	Security infrastructure available and fully function and securityresponding time for accident, crime, fire and natural disaster more than 10 minutes		0.75×100	
	Security infrastructure available and fully function and security responding time for accident, crime, fire and natural disaster less than 10 minutes		1.00×100	
SI10	**Health infrastructure facilities for students, academic and administrative staff's wellbeing**	**100**		
	Health infrastructure (first aid) is not available		0	
	Health infrastructure (first aid, emergency room, clinic and personnel) are available		0.25×100	
	Health infrastructure (first aid, emergency room, clinic andcertified personnel) are available		0.50×100	
	Health infrastructure (first aid, emergency room, clinic, hospitaland certified personnel) are available		0.75×100	
	Health infrastructure (first aid, emergency room, clinic, hospital and certified personnel) are available and accessible for public		1.00×100	
SI11	**Conservation: plant (flora), animal and wildlife (fauna), geneticresources for food and agriculture secured in either medium or long-term conservation facilities**	**100**		
	Conservation program in preparation		0.05x100*	
	Conservation program 1-25% implemented		0.25×100	
	Conservation program 25-50% implemented		0.50×100	
	Conservation program 50-75% implemented		0.75×100	
	Conservation program fully implemented		1.00×100	
	Total	**1500**		
2	**Energy and Climate Change (EC)**			**21%**
EC 1	**Energy efficient appliances usage**	**200**		
	< 1%		0.05x200*	
	1 - 25%		0.25×200	
	> 25 - 50%		0.50×200	
	> 50 - 75%		0.75×200	
	> 75%		1.00×200	
EC 2	**Smart building implementation**	**300**		
	< 1%		0.05x300*	

	1 - 25%		0.25×300	
	> 25 - 50%		0.50×300	
	> 50 - 75%		0.75×300	
	> 75%		1.00×300	
EC 3	**Number of renewable energy sources in campus**	**300**		
	None		0	
	1 source		0.25×300	
	2 sources		0.50×300	
	3 sources		0.75×300	
	> 3 sources		1.00×300	
EC 4	**The total electricity usage divided by total campus population (kWh per person)**	**300**		
	≥ 2424 kWh		0.05x300*	
	> 1535 - 2424 kWh		0.25×300	
	> 633 - 1535 kWh		0.50×300	
	> 279 - 633 kWh		0.75×300	
	< 279 kWh		1.00×300	
EC 5	**The ratio of renewable energy production divided by total energyusage per year**	**200**		
	≤ 0.5%		0.05x200*	
	> 0.5 - 1%		0.25×200	
	> 1 - 2%		0.50×200	
	> 2 - 25%		0.75×200	
	> 25%		1.00×200	
EC 6	**Elements of green building implementation as reflected in allconstruction and renovation policies**	**200**		
	None		0	
	1 element		0.25×200	
	2 elements		0.50×200	
	3 elements		0.75×200	
	> 3 elements		1.00×200	
EC 7	**Greenhouse gas emission reduction program**	**200**		
	None		0	
	Program in preparation		0.25×200	
	Program(s) aims to reduce one out of three scopes emissions		0.50×200	
	Program(s) aims to reduce two out of three scopes emissions		0.75×200	
	Program(s) aims to reduce all three scopes emissions		1.00×200	
EC 8	**The total carbon footprint divided by total campus population**	**200**		
	≥ 2.05 metric ton		0.05x200*	
	> 1.11 - 2.05 metric ton		0.25×200	
	> 0.42 - 1.11 metric ton		0.50×200	
	> 0.10 - 0.42 metric ton		0.75×200	
	< 0.10 metric ton		1.00×200	
EC 9	**Number of innovative program(s) in Energy and Climate Change**	**100**		
	None		0	
	1 program		0.25×100	
	2 programs		0.50×100	

	3 programs		0.75×100	
	More than 3 programs		1.00×100	
EC 10	**Impactful university program(s) on climate change**	**100**		
	None		0	
	Program in preparation		0.25×100	
	Provide training, educational materials and activities forsurrounding communities		0.50×100	
	Provide training, educational materials and activities for surrounding communities and at national level		0.75×100	
	Provide training, educational materials and activities for surrounding communities, at national, regional, and internationallevel		1.00×100	
	Total	**2100**		
3	**Waste (WS)**			**18%**
WS 1	**Recycling program for university waste**	**300**		
	None		0	
	Partial (1 - 25% of waste)		0.25×300	
	Partial (> 25 - 50% of waste)		0.50×300	
	Partial (> 50 - 75% of waste)		0.75×300	
	Extensive (> 75% of waste)		1.00×300	
WS 2	**Program to reduce the use of paper and plastic on campus**	**300**		
	None		0	
	1 program		0.25×300	
	2 programs		0.50×300	
	3 programs		0.75×300	
	More than 3 programs		1.00×300	
WS 3	**Organic waste treatment**	**300**		
	Open dumping		0	
	Partial (1 - 25% treated)		0.25×300	
	Partial (> 25 - 50% treated)		0.50×300	
	Partial (> 50 - 75% treated)		0.75×300	
	Extensive (> 75% treated)		1.00×300	
WS 4	**Inorganic waste treatment**	**300**		
	Burned in open		0	
	Partial (1 - 25% treated)		0.25×300	
	Partial (> 25 - 50% treated)		0.50×300	
	Partial (> 50 - 75% treated)		0.75×300	
	Extensive (> 75% treated)		1.00×300	
WS 5	**Toxic waste treatment**	**300**		
	Not managed		0	
	Partial (1 - 25% treated)		0.25×300	
	Partial (> 25 - 50% treated)		0.50×300	
	Partial (> 50 - 75% treated)		0.75×300	
	Extensive (> 75% treated) or campus produces a minimum amountof toxic waste		1.00×300	
WS 6	**Sewage disposal**	**300**		
	Untreated into waterways		0	
	Treated conventionally		0.25×300	
	Treated technically for reuse		0.50×300	
	Treated technically for down cycling		0.75×300	

	Treated technically for up cycling		1.00×300	
	Total	**1800**		
4	**Water (WR)**			**10%**
WR 1	**Water conservation program and implementation**	**200**		
	None		0	
	Program in preparation		0.25×200	
	1 - 25% implemented at early stage (i.e., measurement of potentialsurface runoff volume)		0.50×200	
	> 25 - 50% water conserved		0.75×200	
	> 50% water conserved		1.00×200	
WR 2	**Water recycling program implementation**	**200**		
	None		0	
	Program in preparation		0.25×200	
	1 - 25% implemented at early stage		0.50×200	
	> 25 - 50% water recycled		0.75×200	
	> 50% water recycled		1.00×200	
WR 3	**Water efficient appliance usage**	**200**		
	None		0	
	Program in preparation		0.25×200	
	1 - 25% of water efficient appliances installed		0.50×200	
	> 25 - 50% of water efficient appliances installed		0.75×200	
	> 50% of water efficient appliances installed		1.00×200	
WR 4	**Treated water consumed**	**200**		
	None		0	
	1 - 25% treated water consumed		0.25×200	
	> 25 - 50% treated water consumed		0.50×200	
	> 50 - 75% treated water consumed		0.75×200	
	> 75% treated water consumed		1.00×200	
WR 5	**Water pollution control in campus area**	**200**		
	Policy and preparation		0.05x200*	
	Design and construction		0.25×200	
	Guideline standard available and initial implementation		0.50×200	
	Full implementation and monitored occasionally		0.75×200	
	Full implementation and monitored regularly		1.00×200	
	Total	**1000**		
5	**Transportation (TR)**			**18%**
TR 1	**The total number of vehicles (cars and motorcycles) divided bytotal campus population***	**200**		
	≥ 1		0	
	> 0.5 - 1		0.25×200	
	> 0.125 - 0.5		0.50×200	
	> 0.045 - 0.125		0.75×200	
	< 0.045		1.00×200	
TR 2	**Shuttle services**	**300**		
	Shuttle service is possible but not provided by university		0	
	Shuttle service is provided (by university or other parties) andregular but not free		0.25×300	
	Shuttle service is provided (by university or other parties) and the university contributes part of the cost		0.50×300	

	Shuttle service is provided by university, regular, and free		0.75×300	
	Shuttle service is provided by university, regular, and zero emission vehicle. Or shuttle use is not possible (not applicable)		1.00×300	
TR 3	**Zero Emission Vehicles (ZEV) policy on campus**	**200**		
	Zero Emission Vehicles are not available		0	
	Zero Emission Vehicles use is not possible or practical		0.25×200	
	Zero Emission Vehicles are available, but not provided by university		0.50×200	
	Zero Emission Vehicles are available, provided by university andcharged		0.75×200	
	Zero Emission Vehicles are available, and provided by university free		1.00×200	
TR 4	**The total number of Zero Emission Vehicles (ZEV) divided by totalcampus population***	**200**		
	≤ 0.002		0.05x200*	
	> 0.002 to ≤ 0.004		0.25×200	
	> 0.004 to ≤ 0.008		0.50×200	
	> 0.008 to ≤ 0.02		0.75×200	
	> 0.02		1.00×200	
TR 5	**The ratio of the ground parking area to total campus area***	**200**		
	> 11%		0	
	> 7 - 11 %		0.25×200	
	> 4 - 7 %		0.50×200	
	> 1 – 4 %		0.75×200	
	< 1%		1.00×200	
TR 6	**Transportation program designed to limit or decrease the parking area on campus for the last 3 years (from 2019 to 2021)**	**200**		
	None		0	
	Program in preparation (i.e., feasibility study and promotion)		0.25×200	
	Program resulting in less than 10% decrease in parking area		0.50×200	
	Program resulting in 10 - 30% decrease in parking area		0.75×200	
	Program resulting in more than 30% decrease in parking area or parking area reduction reaching its limit		1.00x200	
TR 7	**Number of transportation initiatives to decrease private vehicleson campus**	**200**		
	No initiative		0	
	1 initiative		0.25×200	
	2 initiatives		0.50×200	
	3 initiatives		0.75×200	
	> 3 initiatives, or initiative is no longer required		1.00×200	
TR 8	**Pedestrian path on campus**	**300**		
	None		0	
	Pedestrian paths are available		0.25×300	
	Pedestrian paths are available, and designed for safety		0.50×300	
	Pedestrian paths are available, designed for safety and convenience		0.75×300	
	Pedestrian paths are available, designed for safety, convenience,and in some parts provided with disabled-		1.00×300	

	friendly features			
	Total	**1800**		
6	**Education and Research (ED)**			**18%**
ED 1	**The ratio of sustainability courses to total courses/subjects**	**300**		
	≤ 1%		0.05x300*	
	> 1 - 5%		0.25×300	
	> 5 - 10%		0.50×300	
	> 10 - 20%		0.75×300	
	> 20%		1.00×300	
ED 2	**The ratio of sustainability research funding to total research funding**	**200**		
	≤ 1%		0.05x200*	
	> 1 - 8%		0.25×200	
	> 8 - 20%		0.50×200	
	> 20 - 40%		0.75×200	
	> 40%		1.00×200	
ED 3	**Number of scholarly publications on sustainability**	**200**		
	0		0	
	1 – 20		0.25×200	
	21 – 83		0.50×200	
	84 - 300		0.75×200	
	> 300		1.00×200	
ED 4	**Number of events related to sustainability**	**200**		
	0		0	
	1 – 4		0.25×200	
	5 – 17		0.50×200	
	18 - 47		0.75×200	
	> 47		1.00×200	
ED 5	**Number of student organizations related to sustainability**	**200**		
	0		0	
	1 – 2		0.25×200	
	3 – 4		0.50×200	
	5 - 10		0.75×200	
	> 10		1.00×200	
ED 6	**University-run sustainability website**	**200**		
	Not available		0	
	Website in progress or under construction		0.25×200	
	Website is available and accessible		0.50×200	
	Website is available, accessible, and updated occasionally		0.75×200	
	Website is available, accessible, and updated regularly		1.00x200	
ED 7	**Sustainability report**	**100**		
	Not available		0	
	Sustainability report is in preparation		0.25×100	
	Available but not publicly accessible		0.50×100	
	Sustainability report is accessible and published occasionally		0.75×100	
	Sustainability report is accessible and published annually		1.00x100	
ED 8	**Number of cultural activities on campus**	**100**		
	None		0	
	1 event per year		0.25×100	

	2 events per year		0.50×100	
	3 events per year		0.75×100	
	More than 3 events per year		1.00x100	
ED 9	**Number of university program(s) to improve teaching andlearning**	**100**		
	None		0	
	1 Program		0.25×100	
	2 Programs		0.50×100	
	3 Programs		0.75×100	
	More than 3 programs		1.00x100	
ED 10	**Number of sustainability community services project organizedand/or involving students**	**100**		
	None		0	
	1 project		0.25×100	
	2 projects		0.50×100	
	3 projects		0.75×100	
	More than 3 projects		1.00x100	
ED 11	**Number of sustainability-related startups**	**100**		
	None		0	
	1 – 5 startups		0.25×100	
	6 – 10 startups		0.50×100	
	11 – 15 startups		0.75×100	
	More than 15 startups		1.00x100	
	Total	**1800**		
	TOTAL	**10000**		

Note: Light green indicates new questions introduced in 2022

: Asterisk (*) indicates new scorings introduced in 2022