

Proposed Standards for Promoting the Concept of Sustainable Universities in the Kingdom of Saudi Arabia

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Abstract:

Sustainability presents a significant challenge given the environmental, social, and economic challenges facing societies worldwide. Enhancing the environmental efficiency of university buildings requires continuous efforts and integrated collaboration. By adopting modern technologies and sustainable practices, universities can effectively contribute to environmental protection and support sustainability globally. A sustainable campus necessitates standards and requirements aimed at reducing indoor heat gain, conserving energy, water, and fuel, and lowering costs. Through these sustainable practices, the overall health of users can be improved, which is reflected in the quality of the educational process and related activities, as well as the expected positive impact on the behavior and performance of students and all staff within the sustainable campus. This research aims to study the standards and requirements for sustainable universities in the Kingdom of Saudi Arabia and discuss related points within the context of the university campus, while providing an analysis of what has been achieved, ongoing development efforts, and how to improve the carbon footprint performance of buildings. This was achieved through an analytical study of the standards and requirements for sustainable universities and a proposal for their application to Saudi universities. Quantitative analytical methodology was adopted, employing a pilot study using Design Builder version 7.0 to simulate a case study related to the private colleges in Buraidah. This simulation aimed to assess the feasibility of reducing the carbon footprint and promoting the application of university sustainability principles.

1. Introduction

Universities occupy a pivotal position in driving sustainable development in a world facing serious and unprecedented challenges, where climate change is having a clear impact on the planet. With increasing awareness and international and global efforts to confront climate change and the emergence of the concept of sustainable universities,[1] these institutions are not without their complex challenges, such as globalization, digitalization, and marketing, which necessitate following an integrated strategic approach.[2] Since sustainable development is based on the principle of meeting the needs of the present generation

without compromising the ability of future generations to meet their own needs, sustainable universities act as microcosms of society, capable of achieving leadership and prosperity for their communities.[3] This status and influence are achieved through their fundamental roles in education, scientific research, and serving the local and global community. In addition, universities play a pivotal role in promoting the conservation of materials and resources and protecting the environment by prioritizing the application of the concept of sustainability. These institutions enjoy a unique position that enables them to achieve a balance between environmental, social, and economic dimensions in their various orientations. Addressing environmental, social, and economic

challenges constitutes a vital and central responsibility of universities. To achieve these goals, improving infrastructure is an ongoing priority for universities. The success of building a sustainable university depends on the unified commitment of the entire academic community and requires the development of clear and implementable policies. These policies should include integrating sustainability principles into educational programs, scientific research initiatives, and infrastructure development in line with the Sustainable Development Goals and establishing a collaborative culture through partnerships to raise awareness. By applying these standards, Saudi universities have the potential to become global leaders in the field of sustainable universities and to contribute significantly to achieving national and international sustainable development goals. Metrics such as GreenMetric are essential tools for assessing and guiding universities' strategic decisions regarding sustainability. However, most of these rankings focus on specific areas such as research output, teaching quality, or environmental efforts alone. There is an urgent need to broaden the scope of these metrics to promote a more comprehensive approach that addresses cultural and structural developments within sustainable universities. [4] Achieving sustainable change in higher education requires integrated strategies that link curriculum design with sustainable campus environments, community engagement models, and research priorities. Clear vision and mission statements are essential for each institution to achieve this transformation toward sustainability. Universities must define their strategic objectives and promote educational reforms that seamlessly integrate with sustainability-focused research. [5] Furthermore, strengthening engagement with stakeholders becomes crucial for achieving a broad impact.[6],[7] The Education for Sustainable Development program promotes the shift from traditional rote learning to a more dynamic and discovery-based framework that links theoretical knowledge with practical applications.[8] This approach transforms the educational process into one in which students play a vital and pivotal role in shaping a sustainable future. Empowering students in this way is essential for preparing a generation equipped to effectively and skillfully address the pressing challenges of sustainability in its various dimensions.[9]

2. Literature review:

Although sustainability is still a relatively new concept, it has recently garnered significant attention from universities. The goal is to find a

balance between what colleges and the university community need to do to care for the land and people. Sustainability became more prominent in university policies from around 2005 and gained momentum after 2008, as noted by Leadstone, Wright, and Sherin in 2015 [10]. Colleges are moving towards sustainability, with some viewing it as a big, all-encompassing issue, while others focus on things like society, the economy, or the environment, according to Jankowska and Marcom (2010). [11] These days, with all the global problems we face, universities must rethink how they do things that can promote sustainability in education. The goal is to graduate students who can help society, protect the environment, and improve the quality of life, as Al-Khalaileh stated in 2016. [12] A number of studies indicate that sustainable universities are extremely important for helping local and natural cities, and other studies say that every individual in the university needs to be involved to maintain sustainability and ensure our ability to meet our current and future needs (Bajracharya et al., 2009). [13] Further studies conducted by Al-Khatib et al. in 2024[14] show that green universities can help build knowledge and develop things. This can happen through learning by doing, conducting research, and community engagement, making the university better and helping us transition to societies that implement green standards. [15] Reports and studies in the United States show that some problems still exist. The University Environment State Report stated that the lack of adequate public transportation poses a problem for campus sustainability [16]. A survey of 59 American universities that signed the Talwar Declaration showed that they performed well in key areas such as recycling, but faced difficulties in larger areas such as access to renewable energy and encouraging people to use other modes of transportation. [17] Studies have also shown that how a university is managed significantly impacts its sustainability. University leadership can either facilitate or hinder the implementation of sustainability plans and the fulfillment of their requirements. Good leadership that engages everyone is key to achieving the university's sustainability goals. [18]

3. Research Problem:

Educational institutions, especially higher education institutions, are an important element in supporting sustainable development, which makes achieving educational sustainability an inevitable necessity. Saudi Arabian universities have recognized this important role and strive to fulfill

their social responsibilities and contribute to achieving the sustainability goals. Some universities have taken the lead in adopting the concept of a sustainable university. The plan for university education in the Kingdom of Saudi Arabia, "Horizons 2029", also emphasized the importance of working towards sustainability based on three main pillars: social, economic and environmental sustainability. This study aims to promote sustainability and identify the extent to which it has been achieved in Saudi universities. It also answers the following research questions:

4. Research Questions:

- 1- 1. How can sustainability requirements be met in Saudi universities?
- 2- What are the criteria for sustainable universities?
- 3- How can the carbon footprint of Saudi universities be reduced?

1- Objectives:

- 1- Identifying the standards for sustainable universities and implementing them in Saudi universities.
- 2- Working to improve the carbon footprint of Saudi university buildings.

2- Hypothesis:

Balancing the financial, social, and environmental parts of what universities do, along with using green methods and new tech, can really help make sustainability a reality. So, Saudi universities can really help protect the environment and back worldwide sustainability pushes.

5. Research Methodology:

To achieve our research objectives, we will begin with a theoretical framework. We will review previous research, examining its findings and their relevance to our study. This involves identifying gaps in previous work and extracting key insights. Next, we will employ an analytical approach to investigate how universities in Saudi Arabia contribute to environmental sustainability. We will assess their success in achieving sustainability goals. We will utilize data and statistics, conducting a simulation using Design Builder v7.0 on private colleges in Buraidah. This simulation aims to demonstrate their carbon footprint reduction and adherence to environmental regulations. The results will then be analyzed and compared, facilitating the achievement of research objectives and integrating insights from previous studies. Finally, we will share our findings. This will contribute to our goal of promoting sustainability in Saudi universities.

6. The first axis-The theoretical framework for sustainable development:

1- The concept of sustainable development:

Sustainable development is all about making sure we have what we need today without messing things up for people in the future. It's about finding a good balance between money, the environment, and how we treat each other. [19]

2- Characteristics of Sustainable Development:

- **Comprehensiveness:** Sustainable growth touches every part of life money, people, and nature.
- **Balance:** It tries to even out what we need from the economy, society, and nature.
- **Justice:** It's about sharing resources and chances equally among everyone.
- **Sustainability:** It looks after nature, so there's enough for our kids and grandkids.
- **Participation:** It pushes people to get involved when decisions are being made.
- **Time dimension:** It takes care of what we need now but also protects what future people will need, too.
- **Integration:** It knows that money, society, and nature are all linked.

3- Elements for Sustainable Development:

- **Good Admin Staff:** Solid Admin teams keep things running smoothly on projects.
- **Money:** Gotta have the funds to keep projects going.
- **Teach and Spread the Word:** Get people to understand sustainability matters.
- **New Ideas and Tech:** Push for innovative ways to hit targets.
- **Team Up Globally:** Share know-how and give resources to help development.
- **Laws and Rules:** Laws that back sustainable ideas.
- **Invest in Smart:** Put money into making human and natural resources sustainable.
- **Fairness and Getting People Involved:** Promote fairness and get the public involved.

4- Dimensions of Sustainable Development:

To have sustainable growth, you need to think about three main things that all link together: money, people, and the world around us. Each one is super important if we want things to be fair and balanced for the long haul.

1- Economic Dimension:

It's all about developing the economy in a way that benefits everyone, now and in the future. This means increasing work efficiency, providing decent job opportunities, and helping people live better

lives. It also means protecting our resources, distributing wealth fairly, and fostering new and innovative ideas.

2- Social Dimension:

It's all about fairness: everyone deserves a fair chance at healthcare, education, employment, and housing. The main goals are to eradicate poverty and hunger, achieve equality for all, and protect people's rights.

3- The Environmental Dimension:

It's all about using resources sustainably and keeping our environment healthy. This means addressing climate change, keeping our air, water, and soil clean, and protecting forests. We also support initiatives like renewable energy, environmentally friendly waste management programs, and sustainable agriculture.

- The Importance of Integration between Dimensions:

For things to last, you must balance people, the planet, and prosperity. None can be achieved without others. You cannot grow the economy if you ruin the land or ignore people. You cannot improve society if the economy is weak or the environment is destroyed. And you cannot protect the land if people are treated unjustly. So, for a prosperous future, you must combine these three things.

7. Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) are like a big plan to make the world a better place for everyone. They're based on science and reports, and they're meant to guide the world to reach these goals by 2030. Basically, the United Nations came up with these 17 goals in 2015 to fix problems like poverty, inequality, climate change, and to bring peace and justice. [20] , [21] Here's a quick look at each goal:

1. End poverty.
2. End hunger.
3. Make sure everyone is healthy.
4. Give everyone good schooling.
5. Make sure everyone is equal, men and women.
6. Give everyone clean water.
7. Make energy cheap and clean.
8. Good jobs for everyone and make the economy grow.
9. Better industry and new tech.
10. Make things fairer for everyone.
11. Make cities better.
12. Buy and make stuff responsibly.
13. Fix the climate.

14. Protect sea life.

15. Protect land life.

16. Peaceful societies with justice for everyone.

17. Work together to achieve these goals.

8. The second axis - Sustainability in higher education institutions:

- The concept of a sustainable university:

It is an institution of higher education that seeks to reduce negative environmental, economic and social impacts on health to the lowest possible level. This is achieved by investing its resources and core functions in teaching, research, awareness, participation, and supervision, with the aim of supporting society in its transition to sustainable lifestyles. [22]

Motivations for Adopting Sustainable University:

The experiences of some international universities in adopting the principles of sustainable universities:

1- The Sustainable University:

Sustainable universities are organizations that strive to achieve sustainable development in all their activities and decisions. These universities aim to provide a sustainable learning environment that promotes social and environmental responsibility among students, academic members, and staff. Sustainable universities are examples of the practical application of the concept of sustainable development and enhance awareness of the importance of sustainability in societies.

The Concept of the Sustainable University: A higher education institution works to minimize negative environmental, economic, and societal impacts on health when utilizing its resources and core functions of teaching, research, awareness, partnership, and supervision, to help society transition to sustainable lifestyles. [23] Velasquez et al. (2006) proposed a model for a sustainable university based on the necessity for the university to adopt a clear vision of sustainability. Based on this vision, a sustainability mission is formulated, and objectives and policies are developed to contribute to its promotion. Mujahid, D. A., & Dr. Abeer. (2020) [17].

Since universities are key to making our world more sustainable, both when it comes to teaching and in society in general, a bunch of groups worldwide have popped up to push for sustainability in higher education. The biggest ones are:

- **The Talloires Declaration (1990):** [24] So, this is a voluntary agreement from a group called University Leaders for a Sustainable Future (ULSF). It's been signed by 430 university presidents from 50 countries. They want to push environmental awareness and sustainability through research, education, getting the word out, and making good policies.

- **Kyoto Declaration 1993:** [25]

The International Association of Universities (IAU) officially agreed on this statement at their ninth meeting in Kyoto, Japan, back in 1993. The statement said it's vital for universities to get better at doing research that lines up with the ideas of long-term sustainability. It also pushed for getting the word out about caring for the environment, both at universities and in general. The statement suggested that schools check how they're running things to be sure they're doing what's best for sustainability.

- **UNESCO Conference on Higher Education in the Twenty-First Century 1998:** [26]

The conference showed how important universities are for making things sustainable. They train people to be ready for different jobs, do research to learn new things, and give society experts who can help with culture, community, and the economy. This all points to a worldwide push to include sustainability in colleges and make universities leaders in making things sustainable.

2- Sustainable Universities Goals: [27], [28], [29],[30]

1. Reducing Environmental Impact: Green universities try to use less energy and water, cut pollution, and recycle as much as they can. They're all about using the Earth's resources wisely.

2. Promoting Social Justice: These schools want everyone to have a fair shot. They push for diversity, give equal chances, and work with locals to fix social and money problems.

3. Sustainable Education and Research: Campuses weave going green into what they teach and research. Students get to learn about the Earth's woes and come up with fresh, Earth-friendly fixes.

4. Community Engagement and Partnerships: Universities build good relationships with their area, businesses, governments, and charities. They work together, swap know-how, and pitch in to fix problems and help the Earth.

5. Empowering and Engaging Students: Schools want students to get involved! They let them decide things, help with research,

and offer internships to get real-world practice.

6. Innovation and Green Technology: Campuses believe in new inventions and green tech fixing our problems. They come up with and use up-to-date tech for energy, travel, and greener buildings.

7. Awareness and Education: These universities try to get the word out about going green to staff and the public. They put on events and hand out info about it.

8. Leadership and Corporate Responsibility: Schools know they need to step up and lead when it comes to sustainability. They commit to it, put it in their rules, and set aside money for it.

9. Financial Sustainability: Universities aim to make their money last by finding lasting income streams, handling their funds wisely, and teaming up with businesses that care about the Earth.

10. Assessment and Sustainable Progress: Schools are serious about seeing how well they're doing with sustainability. They look at what's working, what's not, and how they can get better by checking out their buildings, how they work, and their programs.

11. Transparency and Disclosure: Universities are working to be more open about their sustainability efforts. They post reports, share what they learn, and work with groups all over the globe.

12. Cultural Sustainability: Keeping culture alive is key for universities. That means saving old traditions, promoting understanding and respect and making culture affordable for everyone.

3- The benefits and importance of achieving sustainable universities including: [31],[32]

1. Environmental Improvement: These schools try to cut down on waste and use resources wisely. That means less pollution and better care for nature.

2. Education and Awareness: They're great places to learn about how to live and work in a way that helps the Earth. They also back research to find cool new solutions for problems.

3. Financial and Economic Balance: These schools are careful with their money, which helps them stick around for the long haul.

4. Social Responsibility: They care about the people around them and try to make things better in their communities. They value everyone and want to give everyone a fair shot through learning and research.

5. Resource Efficiency: These schools are smart about how they use energy and water. They recycle and compost, too.

6. Collaborative Partnerships: They team up with governments, businesses, and local groups to make things more sustainable. This helps spread good ideas and create a more sustainable future.

4- Sustainable university requirements:[33],[34],[35]

for improving the environmental efficiency of buildings in universities in the Kingdom of Saudi Arabia include a set of measures necessary to achieve their goals:

1. Check Current Efficiency: The university should check its buildings' energy, resources, and waste. Surveys can point out what needs fixing.

2. Green Design: When building, use green materials. Good insulation and airflow are important. Use energy savers like LED lights and good heating and cooling.

3. Better Insulation: Add insulation to old buildings to keep heat in – or out. Insulated windows and better wall/roof insulation cut energy waste.

4. Renewable Energy: Use more renewable energy. Solar panels can make power, and solar systems can heat and cool.

5. Water Management: Save water by using low-flow faucets and toilets. Collect rainwater for watering plants. Recycle water for things like flushing.

6. Waste Management: Set up a good waste system in buildings. Use bins to sort waste. Push recycling and keep trying to make waste management better.

7. Awareness and Training: Teach everyone about eco-efficiency and going green. Run events, workshops, and handing out info to get people involved.

8. Track Progress: Keep an eye on how buildings perform environmentally. Use systems to track energy, water, and waste. Find ways to improve things and act.

9. Team Up: Work with the community to share eco-efficiency ideas. Partner with groups and do teamwork to reach goals.

5- Improving transparency and revelation in sustainable universities about their initiatives can be achieved through a few effective methods: [36], [37], [38], [39], [40],

1. Update sustainability reports often: Universities should put out reports regularly that show how far they've come with their sustainability plans. These reports should cover goals, how things are going, and what's

being done about the environment, community, and money stuff. Put these reports where everyone can see them on the university website.

2. Get involved with worldwide stuff: Join big, worldwide groups that push for openness, like the University Sustainability Reporting Framework, or use worldwide rules for talking about sustainability.

3. Post info on the website: Universities should have lots of info on their websites about what they're doing for sustainability, research projects, and community work.

4. Talk to the locals: Chat with the people around you and those involved by holding meetings and workshops to talk about sustainability plans and answer questions.

5. Get an outside opinion for more trust: Have someone from outside look at your sustainability work. It makes things more open and proves you're getting somewhere with sustainability.

6. Get students and teachers involved: Encourage students and teachers to jump in on sustainability plans and decisions through projects or group work.

7. Listen to what people say: Ask students, teachers, staff, locals, and businesses what they think through surveys, group talks, or regular chats.

8. Be clear about buying stuff: Be more open about how you buy things by choosing stuff that's good for the environment and people. Also, create rules that push for sustainability, like saving energy and cutting down waste.

9. Team up with others: Work with other schools and groups to share ideas and do research projects together, making things more open.

10. Teach and spread the word: Make sustainability a part of what's taught and hold events to get people thinking about being open and joining in.

11. Keep tabs on things and tell everyone: Create ways to watch and measure how well the university is doing with its sustainability goals. Share the results in yearly reports and on different platforms. This shows you're responsible and gets people to stay involved.

6- The UI Green Metric is a global ranking that checks out how green schools are based on what they do for sustainability and to protect the environment. They look at six main things to decide the rankings:[41],[42],[43],[44],[45]

- 1. Infrastructure:** Check if the university's buildings and grounds meet green standards.
- 2. Energy and Climate Change:** What's being done to use less energy and switch to renewables?
- 3. Waste:** How the university handles trash, wastewater, and recycling.
- 4. Water:** How the university manages water and cuts back on water use.
- 5. Transportation:** Are there green transportation policies on campus?
- 6. Education and Research:** How many programs and research projects focus on environmental issues?

3- There are many universities around the world that have successfully implemented these measures to enhance transparency and disclosure regarding their sustainability initiatives:

1. University of California, Davis:

As a prominent research institution dedicated to sustainability and environmental conservation, this university undertakes numerous initiatives to promote sustainable practices both on campus and in the neighboring community. Here is an overview of some major sustainability efforts at UC Davis: [47],[48],[49]

- **Renewable Energy:** The university wants to use more renewable energy like solar and wind and less fossil fuels. It also wants to save energy in all its buildings.
- **Sustainable Buildings:** Campuses are made to be sustainable. They use eco-friendly stuff and smart landscaping.
- **Waste Management:** The university has good waste and recycling programs and wants everyone to recycle right.
- **Sustainable Transportation:** The university is pushing for sustainable transport by offering bikes and promoting public transport and electric cars.
- **Education:** The university holds events to teach people about sustainability and they have courses about it too.
- **Green Buildings:** UC Davis makes its buildings super sustainable with designs that save energy and water.
- **Water Management:** They are always working to save water by utilizing methods that cut down on consumption.
- **Green Spaces:** The campus has parks and areas that protect wildlife.
- **Smart Tech:** The university uses tech to control energy use, like lights and air conditioning.
- **Innovation:** The university motivates students to work on projects that improve protecting the environment. [50],[51],[52],[53],[54],[55],[56]

2- Harvard University:

This university is all about being green and open. They put out yearly reports with all the details on their eco-friendly projects, plus they back research and new ideas. The university provides comprehensive information on its website about its sustainability initiatives, such as natural resource conservation and renewable energy.

Harvard's going green with a few cool things:

- **Switching to Renewables:** They're putting solar panels all over the place to use more green energy.
- **Eco-Friendly Buildings:** They're big on using materials and designs that save energy when they build.
- **Recycling Stuff:** They've got recycling programs and want everyone to sort their trash.
- **Getting Around Green:** They push bikes, buses, and electric cars to cut down on pollution.
- **Teaching Green Habits:** They run events to get people to think about the environment.
- **Top-Notch Green Buildings:** Buildings are built to be super energy-efficient and save water.
- **Smart Water Use:** They're catching rainwater and reusing water to be water-wise.
- **Keeping Parks Nice:** Campus parks are important, so they're keeping them up and even trying out sustainable farming.
- **Tech that Saves Energy:** They're using tech to keep an eye on energy use and cut pollution.
- **Green Research:** They back up studies and fresh ideas to help fix environmental problems. [57],[58],[59], [60],[61],[62],[63]

4- Improve carbon footprint to enhance sustainability through simulation with Design Builder v7.0

Buraydah Private Colleges is considered one of the leading educational institutions in the Kingdom of Saudi Arabia, having been established in the city of Buraydah in the Qassim region in 1428.

1- The first case: Comparison of Simulation results of carbon dioxide emissions for a model building of the Buraydah Private Colleges, with different orientations compared to the base case with a 20 cm thick wall. As shown in Figure (12):

Analysis of Figure (12) reveals that carbon dioxide (CO₂) emission rates vary significantly based on building orientation. Simulation results indicate that the highest annual CO₂ emission rate for a model building of the Buraydah Private Colleges occurs with **the Eastward orientation**.

With a 20 cm thick red brick wall, this orientation results in an emission rate of 43.02 tons per square meter, the highest among all the studied orientations. In contrast, **the northward orientation** shows the lowest emission rate at 41.04 tons per square meter, reflecting a 4.6% decrease compared to the northward orientation. **The southward orientation** records an annual CO₂ emission rate of 41.08 tons per square meter, while **the westward orientation** records 42.69 tons per square meter.

- 2- **The second case:** Comparison of simulation results for carbon dioxide emissions. A model of the Buraydah Private Colleges, with different orientations, with the addition of a green roof treatment, a green wall, and a 20 cm thick wall, as illustrated in Figure (13).

By Analyzing Figure (13), it becomes evident that carbon dioxide (CO₂) emission rates fluctuate based on orientation. The simulation results reveal **the westward orientation** of A model of the Buraydah Private Colleges, with different orientations, with the addition of a green roof treatment, a green wall, a 20 cm thick wall, reaching **an annual rate of 38.13 tons per square meter**. This represents the peak CO₂ emissions among all observed orientations for these units. In contrast, **the northward orientation** records **the lowest emission rate, with 36.72 tons** per square meters annually, marking a 3.7% reduction compared to the westward orientation. Meanwhile, **the southward orientation** produces an annual CO₂ emission rate of 37.55 tons per square meter, and **the eastward orientation** stands slightly lower at **37.91 tons per square meter**.

Comparison of simulation results for carbon dioxide emissions of a model building of the Buraydah Private Colleges, with different orientations before and after adding green roof treatment, green wall, 20 cm thick wall. presents Figure (14)

By analyzing Figure (14), it becomes clear that carbon dioxide (CO₂) emission rates vary depending on the direction. Comparison of simulation results reveal **a westward orientation** for the model of the Buraydah Private Colleges in the base case of a 20 cm thick wall, with an annual emission rate of 42.69 tons per square meters. The second case, with the addition of a green roof, a green wall, a 20 cm thick wall, reduces emissions, bringing the annual emission rate to 38.13 tons per square meter. **With a reduction rate of 10.7%.**

- Comparison of simulation results reveal **a northward orientation** for the model of the Buraydah Private Colleges in the base case of a

20 cm thick wall, with an annual emission rate of 41.04 tons per square meters. The second case, with the addition of a green roof, a green wall, a 20 cm thick wall, reduces emissions, bringing the annual emission rate to 36.72 tons per square meter. **With a reduction rate of 10.5%.**

- Comparison of simulation results reveal **southward orientation** for the model of the Buraydah Private Colleges in the base case of a 20 cm thick wall, with an annual emission rate of 41.08 tons per square meters. The second case, with the addition of a green roof, a green wall, a 20 cm thick wall, reduces emissions, bringing the annual emission rate to 37.55 tons per square meter. **With a reduction rate of 8.6%.**

- Comparison of simulation results reveal **eastward orientation** for the model of the Buraydah Private Colleges in the base case of a 20 cm thick wall, with an annual emission rate of 43.02 tons per square meters. The second case, with the addition of a green roof, a green wall, a 20 cm thick wall, reduces emissions, bringing the annual emission rate to 37.91 tons per square meter. **With a reduction rate of 11.9%.**

9. Discussion of the Results:

Sustainability in universities is a topic of great importance, as it focuses on multiple and influential aspects. Here's why focusing on sustainability is important for universities:

1. **Social Liability:** Universities are key players in their cities. They can drive things like equitable social practices, environmental stewardship, and a better economy for everyone. When universities adopt an environmentally friendly approach, they show others how to do it, encourage them to think about problems, and train students to make a difference.

2. **Educating Future Groups:** Universities can teach students about the importance of sustainability. They can encourage them to make smart choices, both now and in their future careers. By integrating sustainability into their classes and activities, universities can help students become leaders in this field.

3. **Resource Efficiency:** Universities consume a lot of resources. By using resources wisely, reducing waste, and minimizing pollution, they can help protect nature and reduce their carbon footprint.

4. **Innovation and Research:** Sustainability opens new avenues for ideas and research. Think solar energy, sustainable agriculture, and environmentally friendly technologies. Universities can be centers of innovation, developing solutions that help the world become more sustainable.

5. Academic Quality and Effectiveness: When universities prioritize sustainability, they can become better schools overall. They will also attract students and researchers interested in the planet and people. This can lead to partnerships with other organizations focused on sustainability.

5- Proposed Standards for Promoting the Concept of Sustainable Universities in the Kingdom of Saudi Arabia

The significance of sustainability within universities extends beyond environmental stewardship; it also underscores their commitment to social responsibility and their pivotal role in fostering sustainable development across diverse dimensions. By addressing environmental, economic, and social challenges, universities play a key role in preparing generations capable of driving positive and sustainable change.

To advance sustainability initiatives in Saudi universities, a strategic, well-structured framework can be implemented, encompassing the following actions:

1. Defining a Clear Vision and Commitment: Align sustainability objectives with the university's overarching goals, embedding them into institutional policies and strategies.

2. Establishing a Sustainability Team: Create a collaborative group of faculty, staff, and students to lead and implement impactful sustainability programs.

3. Conducting Comprehensive Assessments: Evaluate resource usage, waste management practices, and the university's broader influence on the local community.

4. Upgrading Infrastructure: Adopt sustainable technologies, such as renewable energy systems and efficient ventilation and lighting solutions, to make campus operations more eco-friendly.

5. Promoting Awareness and Education: Host workshops, lectures, and seminars to deepen understanding of sustainability principles among all university members.

6. Incorporating Sustainability into Curricula: Embed sustainability-related topics across disciplines and encourage research projects that address sustainability challenges.

7. Enhancing Resource Management: Optimize water, energy, and waste management processes while developing sustainable campus transportation options.

8. Supporting Sustainability Research: Foster innovation by funding and prioritizing research projects focused on sustainability.

9. Building International Collaborations: Partner with global institutions and organizations specializing in sustainability to exchange expertise and knowledge.

10. Monitoring and Evaluating Progress: Implement performance metrics to regularly measure efforts, assess outcomes, and drive continuous improvement.

By adopting this comprehensive approach, Saudi universities can play a transformative role in promoting sustainable development. They have the potential to serve as exemplary models of sustainability, inspire societal progress and foster a culture of thoughtful, long-term change.



Figure 1 Research Methodology



Figure 2 Dimensions of Sustainable Development



Figure 3 Sustainable Development Goals (SDGs)



Figure 4 Sustainable Universities Goals

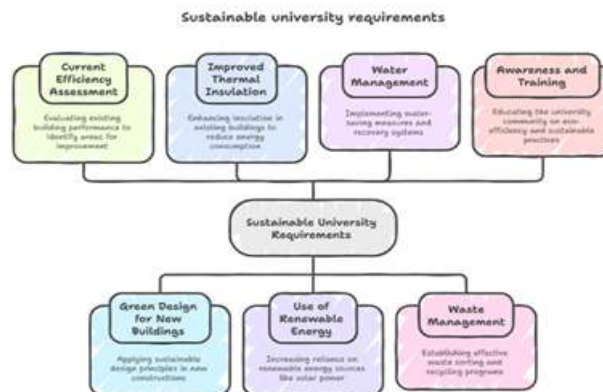


Figure 5 Sustainable university requirements



Figure 6 Improving transparency and revelation in sustainable universities



Figure 7 The UI Green Metric evaluat universities is based on six main criteria



Figure 8 University of California, Davis – (USA)



Figure 9 Harvard University – USA



Figure 10 The campus and buildings of Buraydah Private Colleges in Buraydah City, Al-Qassim Province, Kingdom of Saudi Arabia [46]

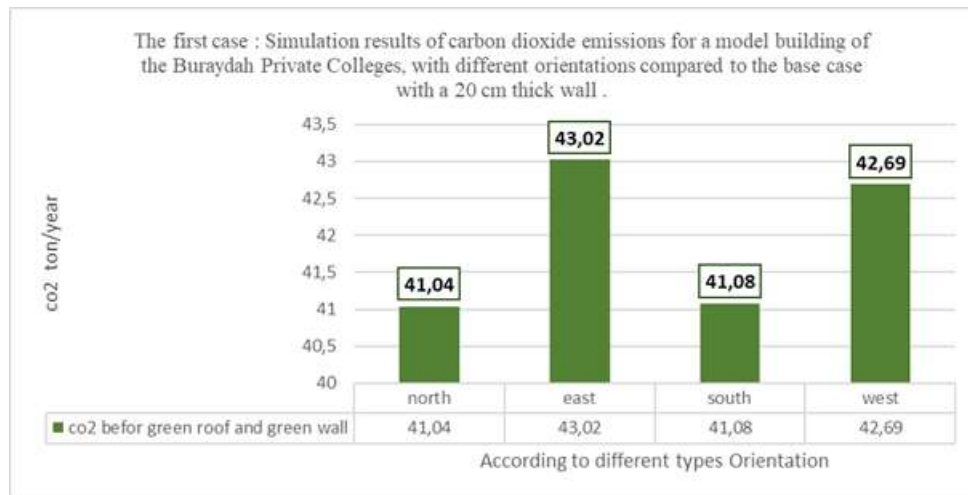


Figure 12. Comparison of Simulation results of carbon dioxide emissions for a model building of the Buraydah Private Colleges, with different orientations compared to the base case with a 20 cm thick wall.

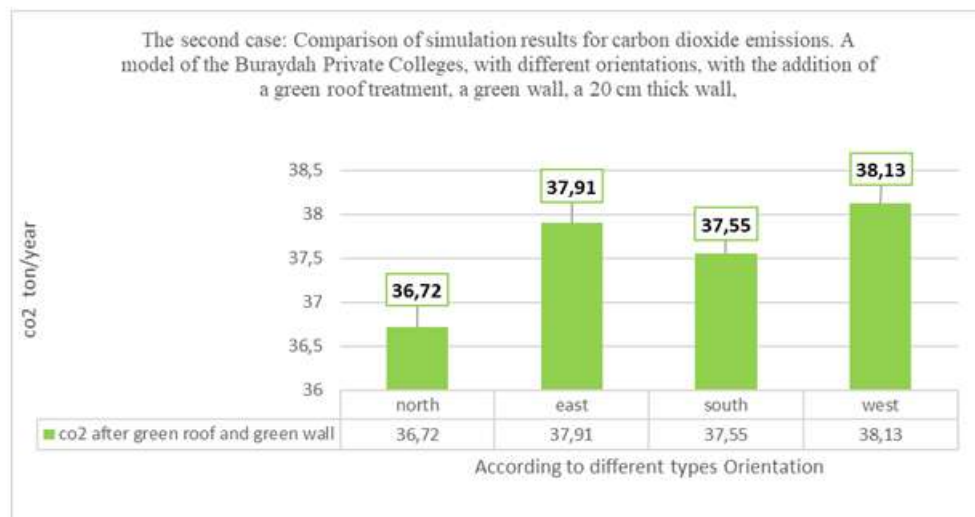


Figure 13 Comparison of simulation results for carbon dioxide emissions. A model of the Buraydah Private Colleges, with different orientations, with the addition of a green roof treatment, a green wall, a 20 cm thick wall.

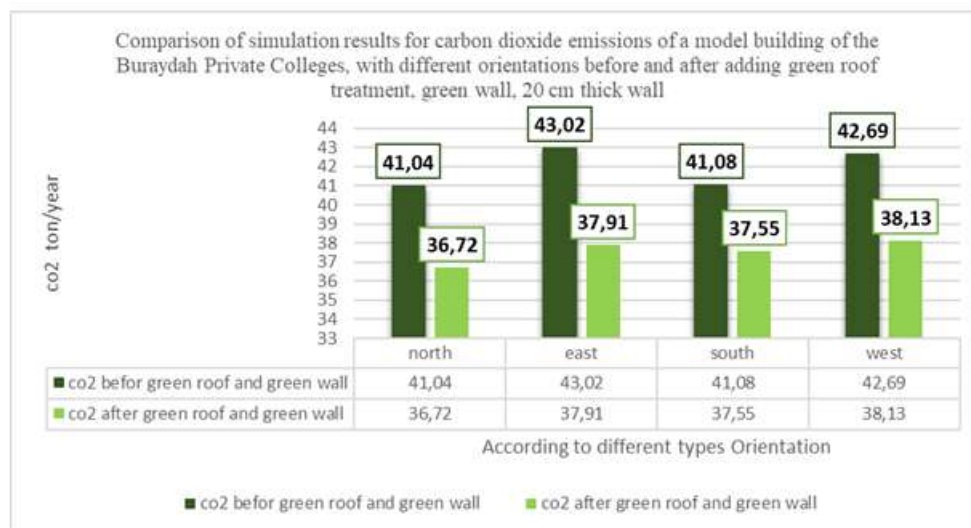


Figure 14. Comparison of simulation results for carbon dioxide emissions of a model building of the Buraydah Private Colleges, with different orientations before and after adding green roof treatment, green wall, 20 cm thick wall.

10. Recommendations:

To create an effective action plan for promoting sustainability within universities, consider the following steps:

- 1. Formulate a dedicated sustainability team:** Establish a multidisciplinary working group with representatives from various departments, colleges, and relevant institutions within the university. This team will be responsible for evaluating the current state of sustainability efforts and determining key priorities.
- 2. Evaluate the current situation:** Conduct a thorough analysis of the university's sustainability practices, identifying strengths, weaknesses, and areas in need of improvement.
- 3. Engage the university community:** Actively involve students, faculty, staff, and local stakeholders to understand their perspectives, needs, and expectations regarding sustainability at the university. Collect insights through surveys, focus groups, workshops, or forums.
- 4. Define priorities:** Based on assessment and community feedback, establish clear priorities for the sustainability agenda. These could include enhancing energy efficiency, increasing awareness among the university population, or advancing research and innovation in sustainable practices.
- 5. Design a comprehensive action plan:** Develop a detailed plan with specific, achievable, and measurable objectives. Outline necessary initiatives and projects assigning precise roles and responsibilities along with timelines for their completion.
- 6. Implement and monitor progress:** Execute the action plan in collaboration with the sustainability team and stakeholders. Continuously monitor outcomes, measure performance indicators, and verify progress toward targets.
- 7. Promote communication and transparency:** Keep students, staff, and the broader community informed about the action plan, its progress, and results. Ensure there are accessible channels to gather feedback and suggestions to enhance ongoing efforts.
- 8. Periodically review and evaluate:** Reassess the action plan on a regular basis to confirm the achievement of set goals and detect areas needing adjustments. Use these evaluations to make data-driven improvements.
- 9. Foster innovation and growth:** Encourage creativity and forward-thinking solutions to address environmental, social, and economic challenges. Explore opportunities like integrating clean technologies, advancing sustainable policies, or promoting cutting-edge research in relevant fields.
- 10. Build partnerships and collaborate:** Leverage external networks by partnering with local communities, businesses, NGOs, and other universities. Such collaborations can facilitate knowledge-sharing, access to resources, and strengthened collective actions toward sustainability objectives.

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