Journal of Sustainability Perspectives

journal homepage: https://ejournal2.undip.ac.id/index.php/jsp/

Isfahan University of Technology (IUT): Towards a Green Campus Energy, Climate and Sustainable Development Initiatives at IUT

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Article Info

Received:
15 March 2021
Accepted:
25 May 2021
Published:
1 August 2021

DOI:

Presented in The 6th International (Virtual) Workshop on UI GreenMetric World University Rankings (IWGM 2020)

Abstract Today, many universities are trying to move towards sustainability by observing the principles of environment and green management. In this regard, the issue of green university has been considered by many countries in recent years, and many efforts have been made to join (UIGWURN (UI GreenMetric World University Rankings Network)). Isfahan University of Technology (IUT), as one of the top higher education universities in Iran, has taken fundamental steps to implement "Green Management" and has achieved honors in this regard. Some of the measures taken are extensive educational and research activities in the field of environment as well as executive measures for the university campus, including Xeriscaping, energy efficiency, clean energy use, water consumption management, waste and wastewater management, green buildings, and transportation. The implementation of these measures has led to significant results in reducing water and energy consumption, reduction of all types of pollutions following the use of clean energy, as well as saving consumption costs.

Keyword:

Green University, Green Management, Isfahan University of Technology, Green Metric Ranking

1. Introduction

Today, as centers for knowledge transfer and development in different areas, universities have a pivotal role in society and they are deemed as reference institutions for the development of cultural and environmental activities. In addition, environmental issues are intertwined with the concept of sustainability [1,9].

In regard to sustainability, various strategies at both national and international levels such as "United Nations Sustainable Development Solutions Network", "International Sustainable Campus Network", "Association for the Advancement of Sustainability in Higher Education in the United States", and "Environmental Association for Universities and

Colleges in the United Kingdom" have been emerged. The important topic of "green university" has been raised in recent decades and has been taken into account in the ranking of universities [7]. The criterion of a green university has advanced to the point that some centers and universities in the world have established a kind of ranking, the principal basis of which is the greenness of universities. In the latest Green Metric Ranking 2019 conducted by the University of Indonesia, information was collected from 780 universities in the world in 6 sections. This ranking was based on the actions of universities in areas such as position and infrastructures, energy and climate change, waste management, water consumption, transportation, and education.

2. Statement of the Problem

Isfahan University of Technology, with more than 2300 hectares, is the largest integrated university campus in the country, located 22 km from Isfahan. This university has become one of the two main university hubs of Isfahan province and the center of attention and a model for the country's universities. Isfahan University of Technology has 15.5 hectares of residential space, 4.2 hectares of office space and 106 hectares of educational space. Also, with more than 290 hectares of green space and plantation forests forest, it has the highest per capita green space among the country's universities in the central regions and the arid and semi-arid climates of the country [3]. With utilizing facilities, use of high capacity of the university, managerial foresight and various activities, Isfahan University of Technology has been able to take fundamental steps to implement "Green Management" and gain honors in this regard. Creating a green belt of the university by planting trees around the university in an area of 200 hectares was the first action of the university at the time of its establishment, which had a significant impact on regulating the air and preventing environmental pollution for the university campus, through all these years.

3. Purpose

The purpose of establishing a green university is to implement a green management in that university. This management can be taken as the optimal direction of a set of comprehensive, purposeful and constant studies and actions that take place at different levels of a university to improve and maintain the status of a university in order to achieve a green university. The green management of IUT is administered under the supervision of the University Presidency and by a council consisting of people knowledgeable about basic principles of the environment (the Green Management Leadership Council) to make structure for environmental principles and regulations in different parts of the university. The committee's actions have been outlined and implemented in different phases (Figure 1).

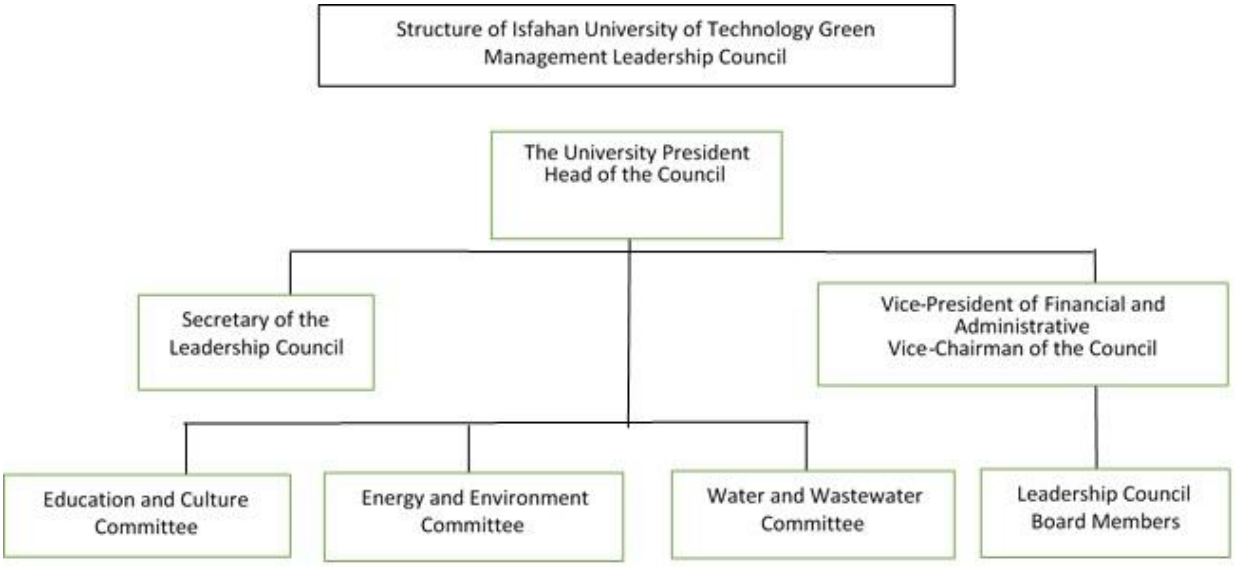

Figure 1: Structure of the Green Management Leadership Council at Isfahan University of Technology

Phase Zero: Developing and presenting a proposal for a green university plan, sketching a roadmap, and producing a conceptual design. Phase one: Identifying the current situation, designing and drawing the desired situation, formulating a strategy and strategic plans to achieve the desired situation according to the current situation. Phase two: The implementation phase, which includes evaluating the theoretical resources and foundations, determining the challenges in the environmental field in the university, including:

1. Environmental management and green utilization: optimization of energy consumption, clean energy use, water consumption management, wastewater management, green building, transportation, waste and Garbage.
2. Green socio-cultural management
3. Educational and research management, developing performance in the related fields

Phase Three: Monitoring and evaluation, including information analysis, constant supervision, comparison of evaluation results with Green University indicators, process modification and performance improvement [10].

4. Practical Measures

Since Isfahan University of Technology is like a small city in terms of location and size, the measures taken in this university are very vast and effective in practical and economic scales. In the direction of joining the world green universities network, many activities have been done based on the Green Metric Ranking indicators at Isfahan University of Technology, some of which will be discussed below.

Etemadi et al. 2019 emphasized the water crisis in arid and semi-arid regions [6] and examined the importance of green landscaping in Isfahan University of Technology [2]. Xeriscaping includes methods that minimize water consumption [8]. This type of landscaping has seven basic principles including comprehensive planning, limiting lawn areas, using xerophyte plants, soil improvement, proper maintenance, efficient irrigation system and use of mulch [2 & 5]. In this regard, scientific solutions for the university's green space with an

area of 290 hectares, including 200 hectares of forest land and 90 hectares on the campus of Isfahan University of Technology, were redesigned based on the principles of Xeriscaping since 2012. For example, before 2011, the university had 16 hectares of lawn, which was redesigned with a comprehensive view on the university campus as the water crisis increased, and based on the importance of the spaces, changes were prioritized in different sections (Figure 2) and this area was reduced to 4 hectares.

Figure 1 - The trend of changes in lawns from 16 to 4 hectares and new landscaping [2]

The amount of water used in the alternative method was reduced from 95 to 19 cubic meters per day, i.e., to one-fifth. Also, in the implemented plan, by reducing the planting area from 19,000 to 6,700 square meters (i.e., to one-third), the amount of water used for irrigation has been reduced from 95 to 4.5 cubic meters per day. According to these numbers, it is clear that in the redesign of the southern boulevard of Isfahan University of Technology, the principles of Xeriscaping are used, and water consumption has been reduced by about 20 times compared to the conventional design. Besides, tree pruning waste as wood mulch to retain moisture has played an effective role in improving the growing conditions of plants and reducing their water requirements.

Another measure taken at Isfahan University of Technology due to the water crisis is to improve the efficiency of irrigation systems. However, because of water shortages in recent years, all of the university wells have dried up. Currently, the only available water sources at the university are treated wastewater and canal water [4]. In such circumstances, water consumption management, i.e., the scientific and principled use of water-based on plant needs using modern high-efficiency irrigation systems in green spaces, was a necessity, but it was not enough. Therefore, due to the time mismatch between access to the canal water and university wastewater with the water needed for plants, there was a need to build a 120,000 cubic-meter water storage pool to create a balance between water supply and demand. For this purpose, a geomembrane pool with a depth of 12 meters and a volume of 120,000 cubic meters was designed and built to manage the supply and demand of water in the green space of the university.

Another measure taken at Isfahan University of Technology is the design and construction of a wastewater treatment package by MBBR method by removing nitrogen and phosphorus using polyethylene tanks (Figure 3).

The advantages of this wastewater treatment system include the following:

* Reducing the executive costs
* Occupying less space
* No need to control and return sludge and reducing sludge production
*Increasing the quality of wastewater due to complete burial of the package and reducing the effect of temperature changes
* Using long-life tanks and less maintenance is required
* No odor as a result of the presence of covered tanks
* Possibility to direct gravity of sewage and completely cover the treatment plant space
* Easy utilization according to the type of tanks, equipment and wastewater treatment process
* Access to all equipment from the ground surface, through manholes without the need to drill and discharge tanks

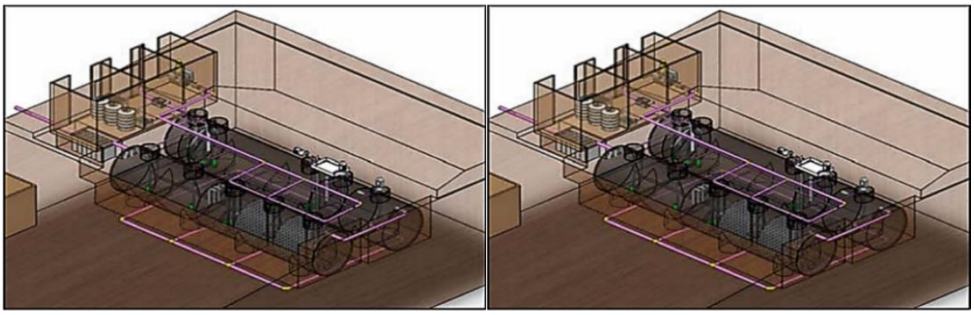

Figure 3. Wastewater treatment package through MBBR method

Other taken measures based on Green Metric Ranking indicators in Isfahan University of Technology are as follows:

1. Energy Consumption Management:
   - Optimization of energy consumption: 30% reduction of energy carriers in residential spaces; creation of green buildings.
   - Use of clean energy: Constructing solar power plants with a capacity of 100 kW, increasing the capacity of water heater system to produce biogas from wastes.
2. Water consumption management: maintaining and improving the green space of the university, despite the water delivered from the canal and dryness of the university water wells; designing and changing the green space system with a Xeriscaping approach.
3. Wastewater consumption management: 40% increase in the rate of wastewater inflow of the university to irrigate green spaces.
4. Resources and waste management: education with the approach of reducing waste production and maximizing waste recycling at sources, reducing paper consumption by 40%, producing 200 tons of organic fertilizer from cut branches, disposal plants, etc. per year.
5. Transportation: Pursuing the construction of Isfahan to Isfahan University of Technology subway line; gradual replacement of worn-out vehicles in the transport fleet; using vehicle management software to organize fuel consumption; and manufacturing and using hybrid bicycles.
6. Education and research: Creating and developing formal training courses in undergraduate and graduate courses in the field of environmental sciences;

establishment of Water and Wastewater Research Center, Research Institute for Biotechnology and Bioengineering; holding workshops and training courses on green management and waste management for residents and academics; presenting strategic plans by committees related to Green University; holding environmental exhibitions to manage water crisis.

7. Green socio-cultural management: Green academic interactions and extracurricular partnerships that include concluding memorandum of understanding with urban management organizations in energy carriers, waste, and smart greenhouse systems.

5. Conclusion

According to the information provided, it can be said that a series of measures were taken during different stages regarding design and implementation procedures, and significant results were achieved. For instance, in the design, implementation and maintenance of green spaces based on the principles of Xeriscaping, in addition to saving water consumption and creating a sustainable green space, landscaping costs were significantly reduced compared to the conventional methods. In addition, the use of solar water heating systems in order to use renewable energy has made an increase in the capacity of these systems from 80,000 liters to 100,000 liters from 2016 to 2018. In the field of energy consumption optimization, according to the activities carried out, we can mention the reduction of energy consumption from April to September 2018 compared to the same period in 2017 (20% electricity, 39% water, 16% gas) as well as a significant reduction in reactive power and its zero cost in bills by installing capacitors. Concerning measures related to water and wastewater management, it should be mentioned that about 40% of the wastewater inflow to the university to irrigate green spaces has been increased. Also, following the measures taken in resource and waste management, the amount of paper consumption has been decreased by about 40% from April to September 2018.

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