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An Analysis of Sustainable Website Designs by Indian Universities

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Abstract: This study assesses the level of sustainability found in Indian university websites. The study compares the sustainability of 868 websites of universities across India using the URL https://ecograder.com/, which provides a consolidated score on how "green" each website is. Various parameters have been tabulated and statistically analyzed. The research findings demonstrate that most Indian university websites rank far below the sustainability levels expected based on contemporary technological and environmental concerns. Though the websites sustainability scores can be easily determined, this study goes on to provide consolidated values and helps benchmark website sustainability. Insights of the study reveal an urgent need for Indian universities to create sustainable websites and set an example for other sustainable initiatives. The study uses a particular tool to calculate the university websites consolidated sustainability scores. Other individual tools may be used for an in-depth measure of each sustainability parameter. The study shows that universities exhibit sustainability issues, and their websites are a prime example. Being a fertile ground for sustainability principles and having adequate knowledge of technology, universities need to follow sustainability principles in every aspect and support the industry in creating a greener environment.

Keywords: Higher Education Institutions, Indian Universities, score, sustainability, website.

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INTRODUCTION

The Internet and web pages have become the focal point of the modern global economy. Web pages are today a digital business card for companies and organisations. Once considered a luxury, promoting on the Internet has become necessary, particularly for Higher Education Institutions (HEI). The Internet has radically changed the way students and institutions seek out and select each other. So, it has forced universities to rethink how they market prospective students through their websites. Universities that prioritise an excellent user experience on their websites see a distinct return on investment. Hence, there is a need for universities to have attractive, engaging and easily navigable information. The best university websites have high definition images, videos of their campus and infrastructure, student portals to provide news about special events, course details, calendars and academic resources.

Initially, the Internet connections were slow and technology was limited, so the sites were entirely text-based. However, technology's progress has made web pages more sophisticated and extravagant. But the Internet has become one of the largest electricity consumer. The Internet's carbon footprint is growing out of control, and if it were a country, it would rank sixth in the world for electricity usage (Cook et al., 2014). According to the American Chemical Society, the Internet and cloud services generate over 830 million tons of carbon dioxide, surpassing the air travel industry.

Further, by 2021, the Internet would be one of the largest carbon dioxide emitters. Hence, sustainability has become a big priority. Several influential online companies such as Facebook and Google are shifting towards more energy conscious and renewable energy sources for their data centre and operations. "Today's average web page has surpassed two megabytes in size, leading to slow load times, frustrated users, and a lot of wasted energy" (Frick, 2016). So, fast and efficient web pages with inclusive experience for all users, utilising renewable energy for hosting can reduce the Internet's environmental impact (Frick, 2016).

HEIs are responsible for propagating sustainability concepts among students, industry, and the community and in being forerunners in practising sustainability. Many of the metrics that rank the universities today include energy consumption and green gas emissions. Universities are assessed on how far they successfully deliver the United Nations sustainable development goals (UNSDG). The growing concern on sustainability and various agencies' collective efforts led to the UNSDGs of 2015.

The SDG includes 17 goals that are targeted to be achieved by 2030. Among them, Goal 7 focuses on affordable and clean energy. Goal 12 focuses on responsible consumption and production. Goal 13 is related to climate action (United Nations, 2021). The Times Higher Education World University Rankings included 11 out of 17 SDGs in 2018 to measure the performance of the universities globally. In 2020, it was extended and all the 17 SDGs were included in the performance criteria. The impact ranking by SDG 7 on affordable and clean energy includes research and publications related to energy, policies on the use of clean energy, control on energy consumption and promoting energy efficiency among communities (Times Higher Education (THE), 2021, April 19).

Similarly, The UI GreenMetric World University Ranking begun by Universitas Indonesia in 2010 evaluates 39 indicators under six criteria. As of 2020, 912 universities in 84 countries have participated in the ranking. Energy and Climate change (EC) have the highest weightage. The criteria measure the energy consumption in the campus, the use of renewable energy sources and overall carbon footprint (Universitas Indonesia, 2021).

Transparency in sustainability practices requires disclosing the impact for the benefit of various stakeholders. There is a growing trend of reporting sustainability practices worldwide (Permatasari et al., 2020). Disclosure of such information is known to improve the reputation of the organisation (Usman, 2020). The Global Reporting Initiatives (GRI), an independent international organisation, helps large and small public and private businesses by providing a universal language of communicating the impact consistently and credibly. The reporting includes universal standards (100 Series) and topic-specific standards (200 to 400 Series). The topic-specific standards are grouped into three major areas: economic, environmental and social. The GRI 302 is a specific topic on energy under environmental standards. The details regarding the source of energy, whether self-generated or purchased, renewable or non-renewable, involving efficient use of energy and control on energy usage by upstream and downstream partners are reported under the GRI 302 (GRI, 2018).

Similar reporting standards on sustainability efforts are available for colleges and universities. "The Sustainability Tracking, Assessment and Rating System (STARS) is a transparent, self-reporting framework for colleges and universities to measure their sustainability performance" (STARS, 2020). There are five categories of assessing institutions: Academics, Engagement, Operations, Planning and Administration and Innovation and

Leadership. Under the operations criteria, Greenhouse Gas Emissions (OP2), Building Energy Efficiency (OP 5) and Clean and Renewable Energy (OP 6) deal with the energy and climate change impact.

Universities use websites to communicate sustainability efforts (Dade & Hassenzahl, 2013; Ferrer-Balas et al., 2008). However, the question is, 'Are websites built sustainably?' Global e-sustainability Initiative (GeSI) proposes to look at the environmental impact of ICT in terms such as energy demands of data centres and the energy intensity of the Internet. For implementing and propagating the SDGs, understanding the sustainability practices of the HEI in every aspect becomes imperative. The reporting standards and green metrics make a major emphasis on energy consumption. Using renewable energy consumption also makes this study useful in highlighting the need for Indian universities to develop sustainable websites and contribute to a greener planet.

This study examined the sustainability score of 868 websites of universities across India. They include insights on the page load times, HTTP request overhead, percentage of sight resources shared, MozRank to help score findability of the web page, mobile device optimisation of web pages, availability of bandwidth-hogging Flash files and green hosting. This study is novel and important in many ways. Jones et al. (2017) argued that though the 17 SDGs do not mention ICT, its role in achieving the goals is vital.

METHODS

We use a descriptive methodology for the research, whereby the website's characteristics on the sustainability parameters are described as measured with appropriate tools. For the study, we consider the entire population of Indian universities. The list of universities and their URLs are collected from the Ministry of Human Resource Development (MHRD) and University Grant Commissions (UGC) websites. A total of 935 universities were listed (Table 1). There are 409 state universities, 127 deemed to be universities, 50 central universities and 349 private universities in India as of 01.02.2020. Among them, the website URL was not found for 207 universities.

Table 1 Total No. of Universities in the Country as on 01.02.2020

Universities	Total No.
State universities	409
Deemed to be universities	127
Central universities	50
Private universities	349
Total	935

Source**:** https://www.ugc.ac.in/oldpdf/Consolidated list of All Universities.pdf

This study is not a perception based study or use a survey for collecting the data. We use automated web tools for measuring the various phenomena of sustainability. We considered different tools available for measuring website performance. A tool like 'https://website.grader.com/' provides a consolidated performance score based parameters such as Page Speed, Page Size, Page Request, Browser Caching, Minimal Page Redirect, Image Size, Minified JavaScript and CSS, Mobile Support, SEO and Security. However, they do not provide a measure of sustainability. Mightybytes has developed a website, 'https://ecograder.com/' to find out how much greener a website could be. It only requires us to type the website URL in the space given and click the 'Grade

me' button. The sustainability scores for the website will be calculated, and results will be shown (https://www.mightybytes.com/). The Ecograder provides a total score out of 100 on how green the site is. This value is a consolidated score of page speed, the number of HTTP requests, shared resources, findability, design for mobile, use of Flash files and usage of renewable energy. The total score and the score of each component was recorded in a spreadsheet. The list of variables and the coding used to record the variables are presented in Table 2.

Table 2 List of Variables and Their Coding

Parameters	Sub-Scales	Measure	Coding
Page Speed	Google Page Speed Insight Score	Absolute value out of 100	0 to 100
	HTTP Requests	Number of requests	0 to n
	Shared Resources	Percentage of Shared resources	0 to 100
Findability	MozRank	Absolute value out of 10	0 to 10
Design and User Experience	Mobile Optimisation	Is the site optimised for mobile devices?	0 = Not optimised 1 = Optimised
	Avoids Flash	Are Bandwidth-hogging Flash files used or not used?	0 = Flash used 1 = Flash not used
Green Hosting	Green Hosting	Does the provider use renewable energy to host the website?	0 = Not green 1= Purchase green certificate 2= Use renewable energy

During the data collection, 130 URLs were found to be inaccurate. An exercise to collect the missing URL and correct the wrong URLs was undertaken. Some universities with multiple campuses and the same URL were removed, because they yielded the same score. Results were not returned for some websites, because they were inaccessible by the Ecograder or were not functional. After testing all the sites, only 868 results were generated (Table 3).

Table 3 Statistics about Sampled Universities

Universities	Total No.	Percent among University categories	Percent of total
State universities	384	93.89	44.2
Deemed-to-be universities	126	99.21	14.5
Central universities	43	86.00	5.0
Private universities	315	90.26	36.3
Total	868	92.83	100.0

Among the samples, there are 384 state universities, which cover 93.89 per cent of the state universities and make up about 44.2 per cent of the total sample. 126 universities cover 99.21 per cent of the deemed-to-be-university and make 14.5 per cent of the full sample. There are 43 central universities assessed, which make up 86 per cent of the total central universities and 5 per cent of the total sample. Almost 315 private universities

covering 90.26 per cent of all private universities are tested, making 36.3 per cent of the full sample. The data is statistically analysed, and the results are presented in the next section.

RESULTS AND DISCUSSION

The data is analysed on the type of university for comparison and the entire sample to understand the sustainability of Indian university websites. Firstly, the total sustainability score is analysed. The results are presented in Table 4. The results show that Indian universities' websites have a minimum sustainability score of 14 out of 100 and a maximum of 83 out of 100. The average total score is 48.78, with the median and mode of the scores at 49. This shows that the Indian university websites are low on sustainability.

Table 4 Statistics on Total Sustainability Score

	Central	State	Deemed	PVT	Entire Sample
N	43	384	126	315	868
Min	22.00	14.00	22.00	23.00	14.00
Max	70.00	83.00	79.00	81.00	83.00
Mean	46.37	49.54	48.04	48.04	48.78
Median	45.00	50.00	47.00	47.00	49.00
Mode	37.00	55.00	45.00	45.00	49.00
SD	11.54	11.27	10.94	10.94	10.49
ANOVA – Post Hoc Multiple comparison – Sig. Values (p)					
Central					F= 1.728 P=0.160
State	0.060				
Deemed	0.368	0.163			
PVT	0.216	0.184	0.688		

Central universities have the lowest total sustainability scores among all the universities, with a maximum of 70, mean of 46.37, a median of 45 and a mode of 37.00. Deemed-to-be-universities and private universities have almost the same sustainability scores. State universities have a better sustainability score with a maximum score of 83, a mean of 49.54, a median of 50 and a mode of 55.00. These values show that even state universities do not have better sustainable websites. The difference between the university categories is tested using ANOVA and shows no significant difference between each category (F= 1.728 P=0.160).

The individual components of sustainability factors are also assessed. Table 5. provides the results of the component factors. The speed of insight score of Indian university websites ranged from zero to a hundred with a mean of 42.17. This shows that Indian university websites lack the Google page speed Insight. The numbers of HTTP requests were in the range of 1 to 246, with a mean value of 89.11. Higher HTTP request shows a longer response time of the websites leading to more bandwidth requirements that consume energy. The percentage of shared resources ranged from 0 to 100, with a mean of 31.21. This shows that Indian university websites are using very low shared resources. The findability score ranges from 0 to 6.5 on a scale of 10 with a mean value of 3.58, which is a very low score. Since findability is low, it takes a lot of energy to reach a website.

Table 5 University Type-wise Scores of Speed and Findability

		Central	State	Deemed	PVT	Total
Page Speed- Google Page Speed Insight Score	N	43	384	126	315	868
	Mean	44.12	43.78	40.63	40.57	42.17
	Median	42.00	47.00	39.00	41.00	43.00
	Mode	0.00	0.00	0.00	0.00	0.00
	SD	26.314	26.908	26.625	25.766	26.432
	ANOVA – Post Hoc Multiple comparison – Sig. Values (p)					
	Central					F= 1.079
	State	0.937				P= 0.357
	Deemed	0.455	0.246			
	PVT	0.410	0.111	0.984		
Page Speed - Number of HTTP Request		Central	State	Deemed	PVT	Total
	N	43	384	126	315	868
	Mean	81.30	69.98	87.49	114.14	89.11
	Median	84.00	62.50	82.00	106.00	82.00
	Mode	7.00[a]	47.00	35.00	112.00	47.00[a]
	SD	40.097	43.308	47.198	57.769	53.192
	ANOVA – Post Hoc Multiple comparison – Sig. Values (p)					
	Central					F= 46.467
	State	0.155				P= 0.000
	Deemed	0.479	0.001			
	PVT	0.000	0.000	0.000		
Page Speed - Percent of Site Resources Shared		Central	State	Deemed	PVT	Total
	N	43	384	126	315	868
	Mean	36.61	38.29	32.39	21.36	31.21
	Median	11.00	14.00	9.00	7.00	9.00
	Mode	0.00	100.00	0.00	0.00	0.00
	SD	42.395	43.012	41.120	31.941	39.707
	ANOVA – Post Hoc Multiple comparison – Sig. Values (p)					
	Central					F= 11.208
	State	0.789				P= 0.000
	Deemed	0.541	0.141			
	PVT	0.016	0.000	0.007		
Findability-MozRank		Central	State	Deemed	PVT	Total
	N	43	384	126	315	868
	Mean	4.47	3.79	3.64	3.19	3.58
	Median	4.50	4.00	3.90	3.3000	3.70
	Mode	4.40	3.70	0.00	3.60	0.00
	SD	0.929	1.276	1.570	1.180	1.318
	ANOVA – Post Hoc Multiple comparison – Sig. Values (p)					
	Central					F= 20.561
	State	0.001				P= 0.000
	Deemed	0.000	0.251			
	PVT	0.000	0.000	0.001		

The components of sustainability factors are also assessed among the different university types. Table 5 also presents the university type-wise scores of Speed and Findability. Central universities have a maximum of 88 out of 100 on the Google Page Speed and an average of 44.15, which is the highest among different universities. Private universities have a Google Page Speed ranging from 0 to 100 and a mean value of 40.57, which is the lowest among different universities. State universities have a range of 0 to 100 and a mean of 43.78. Deemed universities have a range from 0 to 95 and a mean of 40.63. It is found that across all university types, the Google Page Speed is low. The ANOVA results show that there is no difference among the university categories.

On the number of HTTP requests, private universities had a maximum of 246 requests and an average of 114.14, which is the highest. We find that private universities have higher overheads due to the number of HTTP requests. Though the mean HTTP requests of state universities are the lowest at 69.98, their maximum requests are high at 242. Similarly, the deemed-to-be-universities have a minimum of five, a maximum of 220 HTTP requests and a mean of 87.49. At the same time, central universities have a minimum of seven and a maximum of 165 HTTP requests with a mean of 81.30. Indian university websites need to allocate more resources and reduce their number of HTTP requests. The ANOVA results showed that the private universities had higher HTTP requests.

All the different categories of universities have 0 to 100 per cent of shared resources on their websites. The mean value of central universities' shared resources is 36.61 per cent, for state universities it is 38.29 per cent, for deemed-to-be universities it is 32.39 and for private universities it is 21.36. We conclude that all the categories of universities have lower shared resources. State universities have higher shared resources, and private universities have lower shared resources among the universities. Private universities were significantly different from other universities.

The results show that central universities have a higher findability score with a mean value of 4.47 on a 10-point MozRank. The minimum and maximum values of the findability score are 2.40 and 6.40, respectively. Private universities have a lower mean value of 3.19 and a maximum of 5.60, which is the lowest among the university categories. State universities have a mean value of 3.79, and deemed universities have 3.64 on the findability score. However, deemed universities have a maximum score of 6.50 that is higher than state universities, which have a maximum score of 5.90 on findability. There was a significant difference among the universities on the findability scores.

Table 6 shows that 77.1 per cent of the Indian university websites are optimised for mobile phones, and 94.6 per cent of the sites did not have Flash content. These numbers show a better configuration of the Indian university websites. On the contrary, 89.6 per cent of the websites are not hosted by servers using green energy. Only 3.5 per cent of the sites are hosted by servers that use green energy. However, 6.9 per cent of the websites are hosted by servers that at least purchase green credits.

Table 6 also presents the cross-tabulation of design experiences such as mobile optimisation and Flash content and green hosting among the different categories of universities. Around 90 per cent of private universities have websites optimised for mobile devices. Deemed universities have 75.4 per cent of websites optimised for mobile. However, central and state universities have 32.6 per cent and 32 per cent of the websites not optimised for mobile phones. Chi-square significance shows that mobile optimisation is dependent on the category of universities. The results show that 69.8 per cent of the central university websites have Flash files. However, most of the state universities (97.4%), deemed universities (96%), and private universities (99.4%) do not have Flash content. Chi-square significance shows that the use of Flash is dependent on the category of universities.

One hundred per cent of the central university websites are not hosted using green energy. State universities are a little better, with 6.5 per cent hosted by servers purchasing green credits and 2.3 per cent hosted using green energy. Private universities have better green hosting, with 8.3 per cent hosted by servers purchasing green credits and 4.8 per cent hosted using green energy. Similarly, deemed universities have 7.1 per cent of websites run by hosts purchasing green certificates, and 4.8 per cent are hosted using green energy. Chi-square significance shows that the use of Flash is independent of the category of universities.

Table 6 University Wise Cross-tabulation of Design Experience and Green Hosting

		Central	State	Deemed	PVT	Total
		43	384	126	315	(868)
Mobile Optimisation	Not Optimised for Mobile	14 (32.6%)	123 (32.0%)	31 (24.6%)	31 (9.8%)	199 (22.9%)
	Optimised for Mobile	29 (67.4%)	261 (68.0%)	95 (75.4%)	284 (90.2%)	669 (77.1%)
Pearson Chi-Square value = 50.996, df = 3, Sig 0.000						
Avoids Flash	Flash file Present	30 (69.8%)	10 (2.6%)	5 (4.0%)	2 (0.6%)	47 (5.4%)
	No Flash Present	13 (30.2%)	374 (97.4%)	121 (96.0%)	313 (99.4%)	821 (94.6%)
Pearson Chi-Square value = 368.186, df = 3, Sig. 0.000						
Green Hosting	No Green hosting	43 (100.0%)	350 (91.1%)	111 (88.1%)	274 (87.0%)	778 (89.6%)
	Purchases Green Credits	0 (0.0%)	25 (6.5%	9 (7.1%)	26 (8.3%)	60 (6.9%)
	Uses Green energy	0 (0.0%)	9 (2.3%)	6 (4.8%)	15 (4.8%)	30 (3.5%)
Pearson Chi-Square value = 9.822, df=6, Sig = 0.132						

Netcraft (2021) in January 2021 reported that there are "1,197,982,359 sites across 262,949,225 unique domains and 10,649,817 web-facing computers." In the first week of April 2020, Internet Live Stats (2020) showed that 1.84 billion websites existed when live information was retrieved. It is not a surprise that the Internet consumes more electricity than many countries. As more and more services are being created on the Internet, there is a need to prioritise sustainability requirements in various Internet infrastructure components. The clickclean initiative of Greenpeace has listed the use of green energy among popular Internet services (ClickClean, 2020). The report insists on the advocacy of using renewable energy for Internet services. There is a lack of transparency in energy usage by Internet companies. This study assesses the sustainability initiatives of Indian university websites.

Frick (2016) argued that page speed goes hand-in-hand with sustainability. An efficient website can provide content to its customers quickly, utilising less energy and processing power. Indian university websites were found to have a very low speed of insight for all the categories of websites studied (Central, State, Deemed and Private). Some universities were scoring a perfect 100 on the speed score, and other universities had zero scores. Reducing the page load time and reducing bounce rates will increase the speed. Images need to be optimised for quicker loading of the web page. They will save the byte space and improve the performance as

well. There are various techniques for optimising images, such as dimensions, pixels, quality, and format. Using CSS and web fonts helps in better optimising the images. Minification munging and obfuscation of codes are also recommended for better performance of the websites. "Minification is the practice of removing unnecessary characters from code to reduce its size, thereby improving load times." Whereas, Obfuscation is an alternative optimisation that can be applied to source code… it removes comments and whitespace" and in munging, "function and variable names are converted into smaller strings making the code more compact" (Sounders, 2007).

Other than HTML files, around 80 to 90% of the time invested in loading a web page is utilised for retrieving images, scripts, stylesheets and Flash. The higher the number of HTTP requests, the more is the time and power consumed. Having lower HTTP requests frees up bandwidth requirements. Indian university websites have higher HTTP requests. The lowest HTTP requests are for the state universities, and higher requests are seen for private university websites. The number of HTTP requests can be reduced by limiting the additional components of a website. The dilemma here is the performance and attractive design. A right balance is required in deciding to restrict the HTTP requests. Some means to keep the HTTP request low and performance high are recommended by Sounders (2007). "Using image maps, CSS sprites, inline images, and combined scripts and stylesheets … reduces response times of the example pages by as much as 50%" (Sounders, 2007). Image maps can help multiple URLs to use a single image. CSS sprites are used to combine multiple images into a single image. Stylesheets and combined scripts use CSS and JavaScript. There are tools for caching websites and lazy loading that request components only when required, like the user scrolling the page.

Shared resources utilise already cached resources of other websites or web pages and reduce re-downloading, thus loading the site faster. Indian university websites only use a minimal amount of shared resources. Some universities have 100 per cent shared resources, and other universities have zero per cent. The central, state and deemed universities have a similar level of shared resources; however, private universities use less shared resources. Using shared libraries will help sustainable practices. Many shared resources are available for developers, such as CSS libraries, JavaScript, Google host jQuery, and CDN. "A content delivery network (CDN) refers to a geographically distributed group of servers that work together to provide Internet content fast delivery. A CDN allows for the quick transfer of assets needed for loading Internet content, including HTML pages, JavaScript files, stylesheets, images, and videos" (Cloudflare, 2020).

The above-discussed factors are related to the page speed achieved by faster loading with a lighter website, reducing the number of requests to the servers and using local resources. The other way of saving energy on the Internet is the ability to find the required information quickly. Speedily finding a website reduces the search time and thereby energy consumption. The average findability score for Indian university websites is very low. Even the highest is only 6.5 on a 10 point scale. Many sites even had zero scores. Though private universities have a very low score, the state and deemed universities are also similar. We conclude. that there is a need for increasing the findability scores of Indian university websites. Providing search engine optimisation (SEO) and using better keywords help to find the appropriate content at the top of the search page. Having quality content and linking websites with other sources help in better search engine ranking and increased findability.

The Internet on mobile devices is on the increase. Accessing a website designed for a desktop on a mobile device will be heavier and consume more energy than average. Using a mobile phone in place of a laptop or desktop will also save a lot of energy. Designing a website compatible with different devices and operating systems is necessary for sustainability. Indian university websites have better compatibility with mobile phones. However, central and state universities have a lot of scope for improvement. Responsive website design can be optimised to load quickly and also look better. For designing a website for mobile devices, it is necessary

to understand how people use their device. Content needs to be emphasised over the navigation, and options need to be relevant. There should be clarity and focus (Wroblewski, 2011).

Flash is used in websites for animation, and it requires a Flash player. Using a Flash file on the website consumes a lot of power and takes most of the computers processing power, and slows down the browser. Indian university websites are good in terms of not using heavy Flash content. The only concern is that the websites of central universities, which use a sizable number of Flash content. Using Flash files is also not suitable for mobile devices. Recent advances such as HTML5 and CSS3 provide the same functions as a Flash.

The websites of Indian universities, do not use servers operating on green energy. Not one of the central universities were hosted on servers using green energy. The primary concern about the recent technologies on the Internet is cloud storage and computing. It is estimated that there are about 8.5 million data centres in the world (Statista, 2021) and about 500 hyper-scale data centres in the world (Sverdlik, 2019). "In 2018, the world's data centres consumed 205 terawatt-hours of electricity, or about 1 per cent of all electricity consumed that year worldwide. They consumed 1 per cent in 2010 as well" (Sverdlik, 2020). Cloud computing and enterprise computing also require a lot of servers or clusters of servers. "A server farm is a set of many servers interconnected and housed within the same physical facility. A server farm provides the combined computing power of many servers by simultaneously executing one or more applications or services" (Techopedia, 2016).

For the whole of the Internet to be sustainable, these server farms and data centres' use of power need to be controlled or use renewable power sources. The report on green energy consumption by these data centres is compiled in 'Clicking Clean: Who Is Winning the Race to Build a Green Internet'. This report gives an account of the clean energy index of the data centres of prominent companies. The index is calculated based on the total power consumed and the breakdown of power sources such as natural gas, coal and nuclear energy. The companies are also rated on transparency, commitment to renewable energy and siting policy, renewable energy procurement and advocacy, energy efficiency and greenhouse gas mitigation (ClickClean, 2020). Frick (2016) recommended, "Switching to a green hosting provider powered by renewable energy is the single biggest positive impact your website can make on your company's overall sustainability".

The overall sustainability score of Indian university websites is observed to be very low. Compared to other categories of universities, central universities are found to have low standards of sustainability. As knowledge centres, universities play a vital role in ensuring a sustainable tomorrow (Nejati et al., 2011). However, it is uncertain whether universities are shouldering their social responsibilities or not. Indian universities should be role models for Indian businesses and other organisations and promote sustainability.

CONCLUSION

There is a growing concern on the Internet and related applications consuming a lot more energy than many countries. Universities that educate and create awareness on sustainability need to be role models by practising the creation of awareness. As a beginning, we test the energy consumption of the websites that are the face of universities. This research is based on the website sustainability framework by Frick (2016). The sustainability scores of Indian university websites are collected and analysed. One limitation of the study is that it is not a perception-based study but a metric-based study covering the entire population of universities. There is no need for extrapolation or generalisation of the results within the population. However, similar studies can be taken up among institutions of other countries and in different industries for comparative studies. The next limitation is that we use one specific framework to calculate the sustainability scores of the university websites. The results show that Indian university websites lack sustainability factors and are designed to consume a lot of

energy. There is a scope for Indian university websites to increase the Page Speed, reduce the number of HTTP requests, share the resources among the web pages and make the websites more findable. There is a better note that the sites are mostly mobile friendly and do not contain heavy Flash content. At the same time, Indian universities need to choose servers hosted by green energy to promote sustainability.

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