Awareness of Electrical Energy as Realization A Conservation In Universitas Negeri Semarang Campus

by D L Setyowati

13
IOP Conference Series: Earth and Environmental Science

Awareness of Electrical Energy as Realization A Conservation In Universitas Negeri Semarang Campus

6
To cite this article: D L Setyowati *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **256** 012046

Awareness of Electrical Energy as Realization A Conservation In Universitas Negeri Semarang Campus

D L Setyowati[1], P Hardati[1], T M P Astuti[2], M Amin[3]

[1]Department of Geography, Universitas Negeri Semarang, Indonesia
[2]Department of Anthropology-Sociology, Universitas Negeri Semarang, Indonesia
[3] Department of Agriculture Engineering, Universitas Negeri Lampung, Indonesia

liesnoor2015@mail.unnes.ac.id

Abstract. The campus citizen in Universitas Negeri Semarang (UNNES) less has to care about and behaved awareness of energy, especially electricity. UNNES has a vision with a conservation perspective, to support this vision, the campus citizens must care and behave energy-saving. The research objectives are: analyzing the concern and management of electrical energy on the UNNES campus. The study was conducted on the campus of UNNES, with variable electricity consumption, energy-saving behavior, concern for energy, and electricity management. Data collection techniques include observation, documentation, interviews (with campus citizen and leaders). Data analysis was done by descriptive, comparative analysis, and calculations. The results of the study support one of the pillars of clean energy conservation on UNNES Campus. Database for supporting energy conservation in the form of physical aspects of energy and non-physical aspects. Forms of energy conservation from non-physical aspects of electricity use include caring and energy-saving behavior, energy consumption, and energy management. The formulation of the concept of electricity energy management can supports conservation on the UNNES campus. It is hoped that through this concept, the leaders of work units at UNNES will always monitor electricity use in their work environment, and remind citizens to always care for and save energy.

1. Introduction

UNNES as a university has initiated to establishing itself as a conservation university in 2009. The establishment of conservation campus requires various principle presented in the form of seven conservation pillars and it became a reference for UNNES campus resident in applying conservation principles. Conservation principles that are formed are the protection, preservation, and utilization of natural resources and cultural arts, and as an eco-friendly implementation. Rector's regulation of Universitas Negeri Semarang Number 6 of 2017 concerning Conservation of UNNES stated that the spirit of conservation is supported by 3 pillars namely value and character, art and culture, natural resources and environment. In the pillars of natural and environmental resources, among others regulates the existence of clean energy on the UNNES campus, related to saving and wise use of energy. Clean energy is energy that can meet current and future needs without being threatened by sustainability, does not have a negative impact on society and the environment over its lifetime.

Energy utilization, especially electricity, has become a mandatory need to support human life. Even electricity has a social role that is able to change people's lifestyles and is considered a symbol of community progress [10]. Along with the increasing number of the population will be followed by

increasing energy needs. Utilization of energy resources continuously will result in environmental damage and the extinction of energy resources, especially those that cannot be renewed. Electrical energy is currently a basic need for the community and including in the education section such as universities. In carrying out academic activities and lectures, electricity plays an important role because all activities depend on electricity. Demand for electricity continues to rise according to their needs. But actually, the pattern of user behavior can be identified as a factor that causes electricity use to continues to increase.

Electricity consumption on UNNES campus relatively, which is919,592.16 Kwh/month, the highest electricity use for air conditioning [4]. The biggest energy usage of buildings in UNNES is an air conditioning system which is50-70%, lighting with electrical energy (artificial) of 10-25% [12]. Several studies on energy and electricity use have been conducted on the UNNES campus. In order to support the conservation vision of UNNES, an energy conservation and energy literacy movement must be formulated for UNNES campus residents. This is supported by research conducted by [11] stated that the conservation movement is a joint work that is not possible to be carried out alone. A conservation movement is a tool, therefore, the advice "only words and deeds", and the verse "what is said to be done, and what is done is said", must be the culmination of the spirit of conservation.

Energy care can be interpreted as the ability to explain the challenges of caring and saving energy [5]. Caring as a form of literacy is intended to develop knowledge and skills to be applied in caring and saving energy. According to [3], caring is a tangible manifestation of empathy and attention. Then empathy and attention will be manifested into actions. The concept of care and awareness according to the Faculty of Social Science [6] is the value of individual characters to respect and appreciate. Awareness is a basic value and caring attitude, acting proactively towards the surroundings. Caring is meant to be self-caring, caring for others, caring for the institution, and caring for the environment. The research objectives are: analyzing the concern in using electricity and the management of electrical energy on the UNNES campus. The research objectives are: analyzing the concern and management of electrical energy on the UNNES campus

2. Research Methods

The study was conducted at the UNNES Campus in Sekaran Village, Gunungpati Semarang District. The research area is in seven (7) work units namely Faculty of Education (FIP), Faculty of Languages and Arts (FBS), Faculty of Social Sciences (FIS), Faculty of Economics (FE), Faculty of Law (FH), Faculty of Mathematics and Natural Sciences (FMIPA), Faculty of Engineering (FT), Faculty of Sport Science (FIK), and Rectorate. Map of the unit working of samples is presented in figure 1.

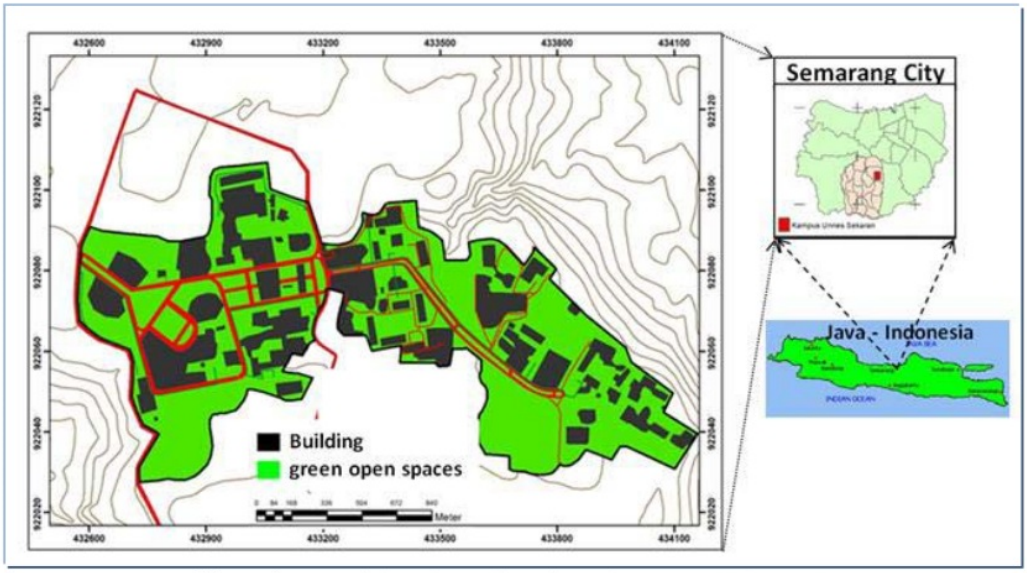

Figure 1. Map of the unit working of samples (UNNES Campus)

The subjects studied were UNNES campus residents, including students, lecturers, administrative staff, campus leaders, and electricity managers. The purposive sampling technique was used to determine the number of samples. The criteria are determined: students in semester 2,4,6, each faculty is taken 30 samples by reason of homogeneous population in the use of electricity. The criteria for lecturers in each faculty are lecturers who are actively teaching in the even semester. The number of samples in each faculty is set are 10 lecturers. Education staff in each faculty are 10 people, for Rectorate units as many as 20 people. Distribution of the number of samples is presented in Table 1.

Table 1. Distribution of the Samples in The research

Institution	Students	Lectures	Staff	Total
FIP	40	10	10	60
FBS	40	10	10	60
FMIPA	40	10	10	60
FIK	40	10	10	60
FT	40	10	10	60
FIS-FH-FE	40	10	10	60
Rektorat	-	-	30	30
Total	240	60	90	390

The objects of the study were: air quality, energy needs, electricity consumption, the behavior of citizens in using electricity, management efforts in monitoring electricity use, and policies related to electrical energy on the UNNES campus. The data to be used is primary data and secondary data. Data collection is done by observation for behavior measurement, interview for measure energy need, documentation, air quality measurement, electricity consumption survey by making pilot solar cells and room lamp automation. Analysis of awareness energy gets by indicators of energy management and behavior campus citizen. The formula is used, awareness energy = f{energy management synergy + energy saving behavior}. Energy management synergy covers self, social, institution, and environmental awareness. Energy saving behavior cover data of knowledge, attitude, behavior on energy use. Primary

data was taken using interview and observation methods to explore energy-saving data and behavior and electricity management on the UNNES campus. Survey and measurement methods to obtain emissions data, air quality, and electricity consumption. The survey was conducted in the midday on the central spot in UNNES. Secondary data in this study were taken using report data or archive documentof energy consumption in UNNES, in the form of land use data (vegetation and building), data on electricity usage in each building on the UNNES campus. Data analysis was carried out descriptively.

3. Research Results and Discussion

3.1. Usage of electricity on the UNNES campus

Electricity is a secondary energy source. That is, electricity is obtained from the conversion of other energy sources. For example, coal, natural gas, petroleum, and nuclear. Other energy sources are primary energy sources. The energy source that we use to make electricity can be an energy source that can be renewed or non-renewed. However, electricity will not be classified as renewable or non-renewable [10]. Almost all sectors of life need electricity supply, such as industrial, commercial sectors, transportation, offices, households, government, and public services. To support the continuity of industrialization and improve the comfort of human life, sufficient electricity is needed [1].

The main problem that exists on the UNNES campus is that electricity often goes out, thus disrupting the lecture process and administrative activities. Often found electricity that is not used but still lit, the air conditioner in the classroom remains lit even though there are no lectures, computers in the administration room are not used and left on. Some of the above events indicate that the concern of UNNES residents for electricity is still low. Actually, efforts can still be made to save electricity usage on campus. However, the habits and behavior of UNNES residents do not care about the use of electricity still has to be improved. Campus residents need knowledge and learning about electrical energy.

The above case indicates that consumption of electricity on the UNNES campus is still high. Electricity consumption is increasing every year, in line with the increasing number of building facilities on the UNNES campus. The results of the 2013 electricity energy consumption survey produced the following information. Electricity needs at UNNES campus are supplied from the PLN network with the category of JTM (Medium Voltage Network) namely 1.1 MVA with a recloser as a 30 A current limiting voltage of 20 KV, to supply travo distribution in 8 Faculties. Distribution of transformer networks in each faculty namely FMIPA Transformer (250 KVA), FBS Transformer (160 KVA), FIP Transformer (160 KVA), old FIS Transformer (160 KVA), new FiIS Transformer (160 KVA), FH Transformer (105 KVA), Putra Rusunawa Transformer (105 KVA), Swimming Pool Transformer (105 KVA), FIK Transformer (105 KVA), old FT Transformer (160 KVA), and new FT Transformer (160 KVA) [2] . UNNES has not routinely collected data on electricity consumption and air quality, let alone measuring carbon emissions. Given these facts, research on electricity consumption and electricity management on campus is important, because the UNNES campus is a conservation campus. Reducing emissions on campus means that UNNES is able to reduce its carbon footprint on campus. The participation of all citizens of UNNES is highly expected so that a management system can be created that can increase the awareness and awareness of UNNES citizens to always save on the use of electricity.

The amount of carbon dioxide emissions resulting from electricity consumption at the UNNES campus is 538,881.06 kg/month or 6,466,571.07 kg/year. The formula for the measure is emission = total electricity consumption x correction factor. The largest area of carbon dioxide emission is in Rectorate Area which is 134.449,03 kg/month or 1,613,388.33 kg/year. As for other areas such as Faculty of Education (FIP) of 43,217.69 kg/month or 518,612.28 kg/year; Faculty of Languages and Arts (FBS) of 58,527.05 kg/month or 702,324.66 kg/year; in the Faculty of Social Sciences (FIS), the Faculty of Economics (FE) and the Faculty of Law (FH) of 131,279.70 kg/month or 1,575,356.46 kg/year; The Faculty of Mathematics and Natural Sciences (FMIPA) of 58,361.80 kg/month or 700,341.63 kg/year, Faculty of Engineering (FT) of 77,355.80 kg/month or 928,269.57 kg/year and the Faculty of Sport Science (FIK) of 35,689.93 kg/month or 428,279.18 kg/year. Details on the number of equipment that uses electrical energy can be seen in Table 2.

Table 2. CO_2 Emission of Electricity Consumption

Faculty	ΣPer month (Kwh)	Emission Factor (Ton/Kwh)	Kg CO2/Year
1	2	3	4=2*3*
FIP	73.750,32	0,000586	518.612,25
FBS	99.875,52	0,000586	702.324,66
FIS,FE,FH	224.026,80	0,000586	1.575.356,46
FMIPA	99.593,52	0,000586	700.341,63
FT	132.006,48	0,000586	928.269,57
FIK	60.904,32	0,000586	428.279,18
Rectorate Area	229.435,20	0,000586	1.613.388,33
	Total =		6.466.572,07

Source: Data Processing Results, 2017.

The amount of carbon dioxide emissions generated from motor vehicles, generators, and electricity at UNNES is 7,862,281.56 kg/year. The largest carbon dioxide emitting area in the FIS, FE, FH is 1.8.30.682.56 kg/year, followed by Rectorate Area which includes G and H buildings, Auditorium, UPT TIK, LP2M, and LP3 of 1,779,915,72 kg/year, FT 1.161.306.56 kg/year, FBS 940.262,20 kg/year, FMIPA 862.318,88kg/year, FIK 653.127,52 kg/year, and FIP Science that is equal to 634,668,08 Kg/year,

Carbon dioxide emissions from electricity consumption are secondary emissions or indirect emissions generated at the study site, but emissions generated at the site of the electricity production at the power plant site. Emissions from electricity consumption are important to study but are not said to be emissions generated at the research site meaning that these emissions from electricity do not have a direct impact on the research site, but have an impact on the location of the electricity they produce.

Based on the total kWh data per year, each faculty is summarized as follows. The Rector Building is at the first level of the largest energy user. The order of users from highest to lowest starts from the Rector-FE-FMIPA-FT-FIS-FBS-FIP-FIK-FH Building. The sequence is obtained from the sum of kWh/year data for all buildings in each faculty. The graph shows a different sequence than the total graph kWh/year because it is influenced by the number of buildings. FMIPA was originally ranked third in the faculty with the biggest energy consumption. However, if the average FMIPA is taken at number seven or it can be said that FMIPA uses the least energy after FT and FBS.

Faculty	Mean kWh/year
FIP	109374.0975
FBS	68024.11125
FIS	125729.76
FMIPA	73394.0475
FT	65455.10417
FIK	78413.836
FE	228327.84
FH	120463.6167
REKTORAT	239285.8157

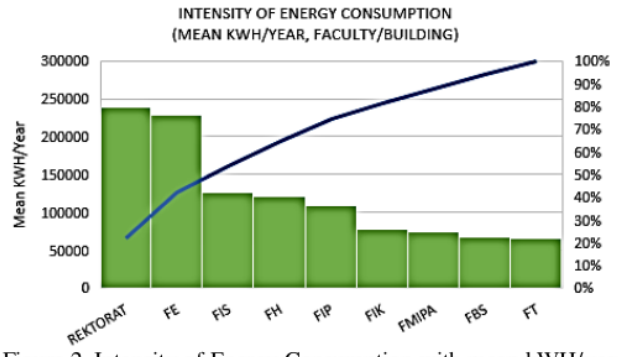

Figure 2. Intensity of Energy Consumption with mean kWH/year

2. *Energy Care Behavior of Residents of UNNES Campus*

Energy is the underlying currency that is necessary for everything humans do in their work and lives and how their behaviors affect the natural environment that supports them [8, 9]. It is an interdisciplinary topic, ranging from scientific concepts and environmental issues at the local level to events across the globe [5]. In this regard, the United States Global Change Research Program [13] described energy

literacy as a part of social and natural science literacy in which related issues could not be understood by using only a science or technology approach.

[7] noted that with education, knowledge is more extensive, but that does not automatically imply increased pro-environmental (energy-related) attitudes or behaviors [14]. After reviewing models to explain such interactions, they proposed a structure where environmental knowledge, values, attitudes, and emotional involvement constituted a "pro-environmental consciousness" that was embedded in broader personal values. It was shaped by personality and internal factors (motivation, the locus of control) and external factors (social and cultural, infrastructure, the political context, economic situations) and pointed toward a nonlinear relationship when cultural and practical concerns were taken into consideration. Such viewpoints were incorporated into the current study.

Habits of students, lecturers, and educational personnel on campus in question, in this case, is a habit of using electricity on campus [15]. The awareness of students in the high class is the awareness of how the students behave in the use of lights in the classroom and the water faucet in the toilet. Meanwhile, for awareness of the use of air conditioning, use of wifi, and usage of fans in the campus is still included in the category of low class. The habits of employees in FIS, FE and FH, FIK and in rectorate have the lowest awareness in electricity usage, FMIPA and LP2M are have a moderate awareness in using electricity, while Employees have awareness in using the highest electricity is the tendon that is in FBS, and Faculty Technique.

FIP and FMIPA students have low awareness in using electricity, awareness of FIS students, FE, FH including moderate, and students from FBS, FT, and FIK have the highest awareness in using electricity in boarding house or at their residence. The analysis of the habits of the lecturers, employees, and students of the UNNES campus is described as follows. Lecturers in FIP and FIS, FE, and FH are lecturers who have a habit in using the lowest electrical energy, FMIPA lecturers have a habit in the use of electricity is, lecturers in FBS, FT, and FIK is a lecturer who has a high electrical use habits or can be said most energy efficient.

The effective attitude of lecturers in the use of electrical energy is divided into 3 classes, namely lecturers from FIS, FE, and FH, FMIPA including low grade, FIP included in the middle class, While included in the affective attitude of high class is a lecturer from FBS, FT, and lecturer from FIK. Employees of FIS and Rectorate are the lowest conscious tendons in using electricity. Employees of FIP, FMIPA, FT, and FIK are employees with moderate awareness in the use of electricity. Employees with the highest awareness of using electricity are FBS and LP2M. The effective attitude of FMIPA students in using electricity is still low, FIP students, FT, FIK have medium awareness attitude of energy use, and students with the awareness of high energy use are students from FBS and FIS, FE, FH.

3.3. Energy Management of UNNES Campus

The Action of Energy Efficiency is increasingly being promoted in various countries as a form of concern about the increasingly difficult access to energy sources [10]. In Indonesia, the availability of energy, especially electricity, is very limited, even in some regions, electricity has not spread evenly. Not only in remote areas, even in big cities, but there is also often an electricity crisis so it is not uncommon for rotating electricity to be forced to do so due to the depletion of electricity availability. The same thing happened on UNNES campus, through research on consumption and emissions on UNNES campus, through literacy to UNNES citizens about caring and saving energy, the knowledge, and awareness of citizens will increase so that energy consumption and emissions on campus can decline and become a clean campus and comfortable.

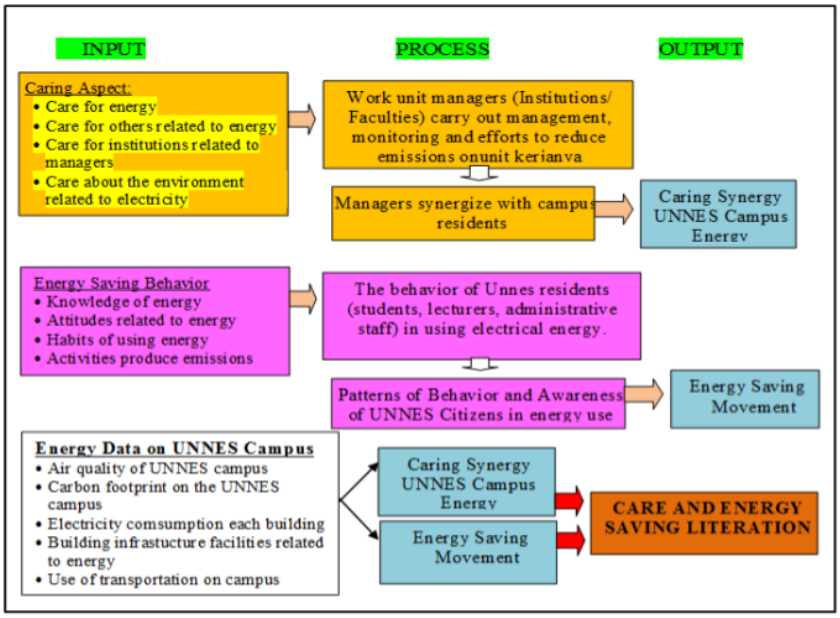

Figure 3. Care and Energy Saving Literacy Modeling Scheme

Based on the above model show that unit working manages, monitor, and effort to reduce emission, the output from caring aspect is the sub model of energy caring synergy on UNNES campus. Study for behavior UNNES citizen for energy using shows the pattern of behavior and awareness result in the sub model of energy saving movement. Both submodel using for care and energy saving literation. This study output the blueprint of energy saving movement as a guide for UNNES Citizen to realization clean energy.

4. Conclusion

Most electricity consumption comes from the use of air conditioning. The use of electricity for air conditioning is the highest use of electricity compared to the use of electricity for other equipment. The awareness of students about energy, the students behave in the use of lights in the classroom and the water faucet in the toilet. Meanwhile, for awareness of the use of air conditioning, use of wifi, and usage of fans in the campus is still included in the category of low class. Energy saving movement on UNNES campus will be realized if there is integration in the management of campus energy facilities with UNNES citizens' behavior patterns that save energy.

References

[1] Akhadi Mukhlis 2009 *Energy Ecology, Recognizing Environmental Impacts in the Use of Energy Sources* (Yogyakarta : Graha Ilmu).
[2] Bangvasi 2014 *Dissemination of Electric Energy Consumption at Semarang State University (UNNES)*. (UNNES Conservation Development Agency).
[3] Boyatzis R and McKee A 2005 *Resonant Leadership* (Boston,Massachussetts: Harvard Business School Press).
[4] Chamid A Setyowati D L Tukidi 2018. Analysis of Availability of Trees as Carbon Emission Absorbers at Unnes Campus *Geo-Image*, **7(1)**: 1-10.

[5] DeWaters J and Powers S 2013 Establishing measurement criteria for an energy literacy questionnaire. *The Journal of Environmental Education*, **44(1)**: 38-55.
[6] Faculty of Social Science 2013 *Social Conservation Guide at the Faculty of Social Sciences, Semarang State University* (Semarang: FIS UNNES Publisher).
[7] Kollmuss A and Agyeman J 2002 Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior. *Environmental education research*, **8(3):** 239-260.
[8] Lean H H and Smyth R 2010 CO_2 emissions, electricity consumption and output in ASEAN. *Applied Energy*, **87(6):** 1858-1864.
[9] Lee L S Lee Y F Altschuld J W and Pan Y J 2015 Energy literacy: Evaluating knowledge, affect, and behavior of students in Taiwan. *Energy Policy*, **76:** 98-106.
[10] Pramudita Intari Dyah 2008 *Energy in the World* (Yogyakarta: CV. Empat Pilar Pendidikan).
[11] Rachman M 2012 Value Conservation and Cultural Heritage. *Indonesian Journal Of Conservation*, **1(1).**
[12] Setyohadi Bambang 2011 Study of Energy Conservation in Semarang State University Campus Buildings, Judging From Natural Aspects of Lighting and Air. *Sainteknol: Jurnal Sains Dan Teknologi*, **9(2).**
[13] The United States Global Change Research Program, 2012.
[14] Wang Y Yang L Han S Li C and Ramachandra T V 2017 Urban CO_2 emissions in Xi'an and Bangalore by commuters: implications for controlling urban transportation carbon dioxide emissions in developing countries. *Mitigation and Adaptation Strategies for Global Change*, **22(7):** 993-1019.
[15] Yavetz B Goldman D and Pe'er S 2009 Environmental literacy of pre-service teachers in Israel: A comparison between students at the onset and end of their studies. *Environmental education research*, **15(4)**: 393-415.

Awareness of Electrical Energy as Realization A Conservation In Universitas Negeri Semarang Campus

ORIGINALITY REPORT

18%	10%	17%	8%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Lung-Sheng Lee, Yi-Fang Lee, James W. Altschuld, Ying-Ju Pan. "Energy literacy: Evaluating knowledge, affect, and behavior of students in Taiwan", Energy Policy, 2015 Publication	5%
2	eprints.poltekkesjogja.ac.id Internet Source	4%
3	E Yandri, R Ariati, A S Uyun, R H Setyobudi, O Anne, H Susanto, Z Vincevica-Gaile. "Implementation of walk-through audits for designing energy management system: A first step towards an efficient campus", IOP Conference Series: Earth and Environmental Science, 2020 Publication	1%
4	www.er-c.org Internet Source	1%
5	S Wantasen, J Luntungan. "Water Resources Management of Lake Tondano in North	1%

Sulawesi Province", IOP Conference Series: Earth and Environmental Science, 2019
Publication

6	D L Setyowati, E Trihatmoko, P A Wijayanto, M Amin. "Simulating water efficiency management at UNNES Campus, Semarang, Indonesia using EDGE application", IOP Conference Series: Earth and Environmental Science, 2020 Publication	1%
7	IKD Nuryana, S R Nurdin, IGPE Prismana, D R Prehanto. "Geographic Information System Mapping of Universitas Negeri Surabaya Facilities (Case Study: Universitas Negeri Surabaya Ketintang)", Journal of Physics: Conference Series, 2020 Publication	1%
8	Submitted to Padjadjaran University Student Paper	1%
9	snmptnundangan.blogspot.com Internet Source	1%
10	digilib.uinsby.ac.id Internet Source	<1%
11	M S Baitul, H Susanto, W Kushartanti, Soegiyanto, S Rahayu. "Beneficial Health Effect of Aquarobics (Role of Adiponectin on Women with Obesity)", IOP Conference Series:	<1%

	Materials Science and Engineering, 2017 Publication	
12	sinta3.ristekdikti.go.id Internet Source	<1%
13	www.researchgate.net Internet Source	<1%
14	repository.unair.ac.id Internet Source	<1%
15	mafiadoc.com Internet Source	<1%
16	msceis.conference.upi.edu Internet Source	<1%
17	Teguh Prihanto. "Green campus management based on conservation program in Universitas Negeri Semarang", AIP Publishing, 2018 Publication	<1%
18	Teguh Prihanto. "Green connector design for conservation campus", AIP Publishing, 2017 Publication	<1%
19	Submitted to Universitas 17 Agustus 1945 Semarang Student Paper	<1%

Exclude quotes	Off	Exclude matches	Off

Exclude bibliography On