4TH ANNUAL 2019

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ICESTI 2019 will provide a forum for accessing to the most up-to-date and authoritative knowledge from both industrial and academic worlds, sharing best practice in the field of Electrical Systems, Technology and Information towards sustainable development.
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24-27 October 2019

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- e-Health, Smart Learning, Intelligent Processing
- Computer Vision Applications
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Internet of Things (IoT)
- ICT Architecture for IoT
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- Mobile Computing & Applications
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- Mechatronics and Robotics
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- Electrical Machines, Power Electronics and Drives
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Graduate School of Environment and Energy Engineering
Waseda University, Japan

Prof. Dr. Ir. Mauridhi Hery Purnomo, M.Eng
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Department of Mechanical Engineering, Energy Management and Transport
University of Genoa, Italy

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	International	Local	International	Local
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Important Dates

Extended abstract submission	30 May 2019
Notification of abstract acceptance	10 June 2019
Full paper submission	25 June 2019
Notification of acceptance	30 June 2019
Final paper submission and registration	15 July 2019

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Preface 4th ICESTI 2019

This proceeding includes the original, peer-reviewed research papers from the 4th International Conference on Electrical Systems, Technology and Information (ICESTI 2019), held during 24-27 October 2019, at Bintang Bali Resort Hotel, Kuta, Bali, Indonesia.

The primary objective of this proceeding is to provide references for dissemination and discussion of the topics that have been presented in the conference. This volume is unique in that it includes work related to Electrical Engineering, Technology and Information towards their sustainable development. Engineers, researchers as well as lecturers from universities and professionals from industry and government will gain valuable insights into interdisciplinary solutions in the field of Electrical Systems, Technology and Information, and its applications.

It explores emerging technologies and their application in a broad range of engineering disciplines, including communication technologies, smart grids, and renewable energy. It examines hybrid intelligent and knowledge-based control, embedded systems, and machine learning. It also presents emerging research and recent application in green energy system and storage. It discusses the role of electrical engineering in biomedical, industrial and mechanical systems, as well as multimedia systems and applications, computer vision and image and signal processing.

In the conference there were three invited papers, entitled: “Power System Planning for Energy Transition”, “CAE Based Method for Designing Compliant Mechanism”, “The Role of Deep Learning in Computational of Power System Operation”, and “Reliability and Real Time in Industrial IoT”, and one invited speaker with the topic of “Grid Integration of Renewable Energy Technical Challenge to Technological Solution”.

This conference was also attending by special guests from e-Asia Joint Research Project, a research collaboration among four countries, Institut Teknologi Nasional Malang supported by RISTEKDIKTI, Waseda University supported by Japan Science and Technology Agency, Mindanau State University-Iligan Institute of Technology supported by DOST, The Philippines, and NECTEC research center supported by Nasdac Thailand. This collaborative research focuss on Energy Infrastructure in e-Asia Countries.

The Proceedings of the 4th ICESTI 2019 consists of 27 selected articles, amount 24 of them were the results of joint research by Indonesian and overseas scholars. In the collaboration research, 32 institutions were involved 18 of which were from abroad Indonesia. The overseas institutions are from Australia, Estonia, Germany, India, Japan, Latvia, Lithuania, Malaysia, the Netherlands, Palestine, Philippines, Republic of China, Singapore, Sweden, & United Kingdom. Editing procedures were held by scholars from four countries (Estonia, Georgia, India, Indonesia)

In addition, we are really thankful for the contributions and for the valuable time spent in the review process by our Advisory Boards, Committee Members and Reviewers. Also, we appreciate our collaboration partners (Petra Christian University, Surabaya; University of Ciputra, Surabaya), and also to our keynote and invited speakers from Graduate School

of Environment and Energy Engineering, Waseda University, Japan; Department of Mechanical Engineering, Energy, Management, and Transport University of Genoa, Italy, Department of Electrical Engineering, Kumoh National Institute of Technology, South Korea, Department of Electrical Engineering, Sepuluh Nopember Institute of Technology, Surabaya, and School of Information Technology and Electrical Engineering, The University of Queensland, respectively. And also thanked to Department of Electrical Engineering, National Institute of Technology, Malang, Indonesia, Bintang Bali Resort Hotel, Kuta, Bali, E3S Web of Conferences, and "*Rumah Paper Kita*" as editing and proofreading services.

On behalf of the Organizing Committee

Abraham Lomi
General Chairman

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Right: Prof. Giovanni Berselli, Ph.D.

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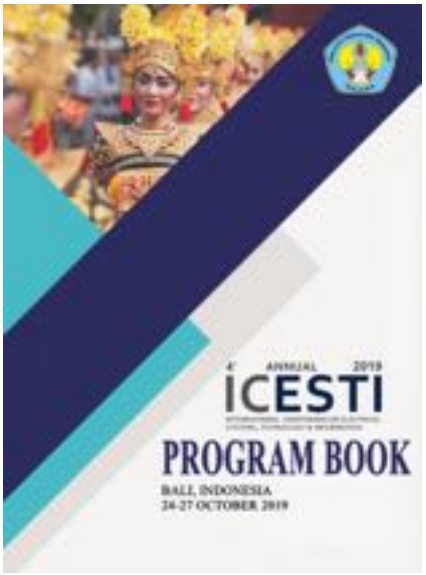

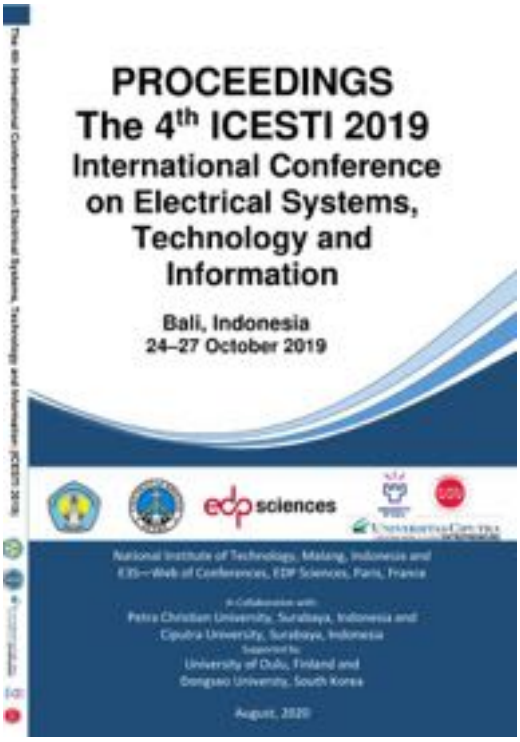

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Title: The 4th International Conference on Electrical Systems, Technology and Information (ICESTI 2019).
Date: 24-27 October 2019
Place: Bintang Bali Resort Hotel, Kuta, Bali, Indonesia.
Website: http://www.icesti.org/

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Design and Construction of Single Phase Radial Flux Permanent Magnet Generators for Pico hydro Scale Power Plants Using Propeller Turbines in Water Pipes 00006

Eko Yohanes Setyawan, Yusuf Ismail Nakhoda, Awan Uji Krismanto, Lalu Mustiadi, Erkata Yandri and Juris Burlakovs

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Conceptualizing Indonesia's ICT-based Energy Security Tracking System with Detailed Indicators from Smart City Extension 00007

Erkata Yandri, Roy Hendroko Setyobudi, Herry Susanto, Kamaruddin Abdullah, Yogo Adhi Nugroho, Sariyo Kridо Wahono, Feri Wijayanto and Yanuar Nurdiansyah

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Friskila Enggar Pamudyaningrum, Hestiasari Rante, Muhammad Agus Zainuddin and Michael Lund

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Life Cycle Impact Assessment on Electricity Production from Biomass Power Plant System Through Life Cycle Assessment (LCA) Method using Biomass from Palm Oil Mill in Indonesia 00018

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Energy Efficiency of Eco-Friendly Home: Users' Perception 00019

Maranatha Wijayaningtyas, Sutanto Hidayat, Togi Halomoan Nainggolan, Fourry Handoko, Kukuh Lukiyanto and Azizah Ismail

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Energy Efficiency of Eco-Friendly Home: Users' Perception

Maranatha Wijayaningtyas[1,*], *Sutanto* Hidayat[1], *Togi* Halomoan Nainggolan[1], *Fourry* Handoko[2], *Kukuh* Lukiyanto[3] and *Azizah* Ismail[4]

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Abstract. As the population in Indonesia grow, the use of energy in eco-friendly residences increases. Concerning this issue, the Green Building Council Indonesia provides standard criteria for greenhouses. Nevertheless, eco-friendly homes' users are still not familiar with the application of these criteria. Therefore, this research aims to investigate the users' perception of eco-friendly homes' energy efficiency. The study was conducted in Surabaya and Malang, using a cross-sectional survey method by distributing questionnaires; 200 respondents participated in the study. After the descriptive analysis, it was revealed that most of the respondents had the same perception regarding the importance of energy efficiency in their homes. According to the results, the criteria of water conservation, under the sub-criteria of using fittings for water-saving, shows the highest mean value; so, it can be concluded that the respondents prioritize the household water use efficiency more than other types of energy.

Keywords: Eco-friendly residence, greenship, household perception, water conservation, water efficiency.

1 Introduction

Indonesia is the fourth most populous country in the world and thus includes it as one of the suitable property locations. On top of that, it is the country with the largest economic growth rate in Southeast Asia [1]. Today, more than 50 % of 240 × 10^6 Indonesians reside in urban areas. In 2025, it is estimated that 68 % of the population will live in this area. Thus, housing is essential to meet the need of the growing population [2]. However, residential development in urban areas entails the concept of environmental degradation and brings fundamental changes in respect for the environment [3]. Due to its limited carrying capacity, an eco-friendly home needs to heed the needs of people and provides

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environmental, social, and economic benefits, as well as protects the earth and mankind [4]. An eco-friendly home is a part of the sustainable development and green buildings which focuses on preventing the house resources from polluting the environment and emphasizes on energy-saving features [5, 6].

Based on data obtained from the Ministry of Energy and Mineral Resources of the Republic of Indonesia [7], the housing sector, especially the use of electricity, contributes more than 30 % of the national energy consumption. Electricity is mostly used in urban area residences. Inevitably, this will trigger excessive use of energy, even though the effort to control the use of energy depends on the individual. Thereby, the community should possess the understanding, behavior, and motivation to use energy efficiently in pursuance of a sustainable environment [8]. Community understanding is inseparable from their social activities. Social interaction of each individual within the community generally occurs in their neighborhood. Through interaction, knowledge can be directly transferred and understood. However, each family's perception of energy efficiency will certainly be different.

The living environment might influence each individual's understanding of energy saving. Generally, energy use can be divided into contextual and psychological (behavior) categories [9]. The contextual category involves local climate, energy marketing, and attributes in buildings, including the physical and system of energy use [10]. The second category focuses on the consequences of building attributes and user characteristics [11]. Related to this matter, user satisfaction in eco-friendly homes is influenced by energy efficiency.

Green Building Council Indonesia (GBCI) is an institution that focuses on the application of the green building concept as a solution for sustainable development issues. The agency has created a system of criteria called the 'Greenship' as a standard to determine a residence's environmental friendliness. The criteria system is still new to the people of Indonesia, so it is necessary to investigate their perceptions of the criteria for environmentally friendly homes concerning energy efficiency.

2 Energy efficiency and user behaviour

'Energy efficiency' is a generic term. In other words, it denotes the efficient consumption of energy. It refers to low energy consumption and simultaneously produces the same or better total consumption value [12]. Some views state that energy efficiency means "energy conservation" as it refers to the same meaning. Energy conservation refers to low energy consumption along with low energy production [11]. The use of the term "energy consumption" reflects the total energy consumed. There is a close relationship between the terms; thus, their focus is interrelated in "energy consumption towards efficient use." There are eight [9] main concepts in constructing an energy-efficient building: wind break; plants and water; indoor/outdoor rooms; earth sheltering; solar walls and windows; material thermal-envelope; sun shading; and natural ventilation.

Reducing energy consumption in buildings relies on users' awareness. Several studies have explored how users' behavior may affect energy consumption in buildings. For instance, Fabi, Spigliantini and Corgnati [13] and Soares et al. [14] evaluated how different behavior patterns affect the quality of indoor climate and energy consumption. In the first study, occupants' behavior (opening and closing the house's windows) has something to do with the building control systems; in the second study, a probabilistic approach was proposed and applied to realistically simulate occupants' behavior.

3 Green building rate systems

A green residential is a wise choice of home in terms of land use, efficient and effective use of energy and water, considering the material conservation of natural resources, as well as health and safetyof the occupants. The treatment and safety of green residential are also essential since the sustainability of eco-friendly home must be accompanied by the eco-friendly behavior of its occupants. Understanding the concept of green residential should be prioritized to avoid a misconceptionstating that environmentally friendly homes require high maintenance costs or that they just have a lot of green lands [15].

An establishment can be characterized as a green building if it passes the evaluation process and acquires the green building certification. A rating system is used in the evaluation of the benchmark assessment. At present, the Green Building Council of Indonesia has developed a rating tool called the'Greenship'. This system is expected to help the green residential development elements (consumers, industry, and government) to reduce the negative impacts on the environment. By this virtue, the vision and goals of housing and settlement development in Indonesia are stipulated in the Law of Housing and Settlement Area Act No. 1, year 2011. The law states that the advancement and development of housing and habitation should be pursued as a single entity to implement the spatial function with the physical, life and social economics of culture whichcan guarantee the environment conservation and restore the quality of Indonesian people life.

In drafting the Greenship, GBCI attempted to address the local context, such as reusing water after ablution (technically, the water is still very clean). They also consider the tropical climate regarding health and comfort of rooms in the building, as well as the effect of the climate on the energy required for heating, cooling and air-conditioning (HVAC). In manufacturing, the Greenship as an assessment tool requires a reference and support from the government. Therefore, it uses the assessment criteria based on the local standards, videlicet Act, Presidential Decree, Presidential Instruction, Minister Regulation, Local Government (Province) Decree, and the Indonesian National Standard. The following regulations are the references in making the Greenship:

i. Minister Regulation of Public Works No. 30/PRT/M/2006 on Technical Guidelines and Accessibility Facilities in Buildings and Environment.
ii. Minister Regulation of Public Works No. 5/PRT/M/2008 regarding *ruang terbuka hijau* (green open space).
iii. Law of the Republic of Indonesia No. 28 of 2002 on Buildings.
iv. Law No. 26 of 2007 on Spatial Planning.
v. Law No. 32 of 2009 on the Protection and Environmental Management.
vi. DNA (Designated National Authority) Decree in the B-277/Dep.III /LH/01/2009
vii. Decree No. 112 of 2003 on the Gross Domestic Water Quality Standard.
viii. Minister Regulation of Public Works No. 2 /PRT/M/2006 on Guidelines for Technical Requirements for Building Structure.
ix. Minister of Health Decree No. 1405/Menkes/SK/XI/2002
x. Law No. 18 of 2008

Accordingly, the Greenship consists of six main criteria: (i) Appropriate Site Development (ASD); (ii) Energy Efficiency and Conservation (EEC); (iii) Water Conservation (WC); (iv) Material Resources and Cycles (MRC); (v) Indoor Health and Comfort (IHC); (vi) Building Environment Management (BEM) along with the sub-criteria [15].

4 Methodology

The research subjectswerethe environmentally friendly home occupants (and/or users) from several housing zones in Malang and Surabaya, East Java, Indonesia. This domain (environmentally friendly home) was selected based on its potential role in energy efficiency practices; it is estimated that the occupants significantly practice energy efficiency.

This research employs post-positivism paradigm as it determines the effects or outcomes needed to be identified. This paradigm also intends to make the ideas into small and discrete sets of tests, for example, variables consisting of hypotheses and research questions. Therefore, the most important point of post-positivism starts with a theory that needs to be tested or verified and refined to understand the world [16]. Furthermore, the quantitative research approach used in this study has been proven empirically by many researchers in studies of green consumer behavior [14–18]. In general, this research is designed to discover the users or occupants' perception of environmentally friendly homes on energy efficiency.

The data were collected using a survey method which was self-administered and cross-sectionally conducted through questionnaire distribution. The advantage of this method is that it can provide a higher response rate than questionnaires distributed by mail, telephone, and electronics [17–19]. The second advantage is that respondents can be directly asked about things that are still not clear after the researchers read their responses. The third advantage is that this technique is very flexible for obtaining data. In regard to data sampling, more than 200 respondents were involved in this research.

Data analysis is highly essential in a study as it will provide answers to research problems and objectives. This research employs a descriptive analysis method. The research instruments based on the Greenship criteria related to energy efficiency, water conservation, and indoor comfort are presented in Table 1. The data measurements used a Likert scale. The guidelines for all variables measurement indicate the usage of a five point Likert scale allowing the respondents to select their level of importance with a statement. The categories available for each answer are as follows: very important (5-point score); important (4-point score); moderately important (3-point score); less important (2-point score); un-important (1-point score).

Table 1. List of greenship criteria for green home [15].

Code	Objective	Criteria
ENERGY EFFICIENCY & CONSERVATION (EEC)		
EEC 1	Electric Sub-metering	Providing sub-metering for lamps
		Providing sub-metering for airconditioner(s)
		Providing sub-metering for electric sockets
EEC 2	Artificial Lighting	Knowing the average usage of lamps calculated by W m^{-2}
		Using automatic features such as motion sensor, timer, and light sensor in at least one room
EEC 3	Air Conditioning	Using airconditioner(s)for 50 % of the total area at most
		Understanding the COP (coefficient of performance) of the airconditioner(s)
EEC 4	Thermal Reduction	Using thermal absorbing material for the roof

Table 1. continue to the next page

Table 1. (Continued).

Code	Objective	Criteria
		Using thermal absorbing material for glasses and skylights
EEC 5	Renewable Energy Sources	Using a solar water heater that does not consume electrical energy
		Providing an alternative power plant
WATER CONSERVATION		
WAC 1	Water-saving fitting	Using fitting for water-saving
WAC 2	Rainfall Utilization	Providing rainwater tanks with a minimum capacity of 200 L
		Providing rainwater tanks with a minimum capacity of 500 L
		Providing 1A and using it for flushing the toilet
WAC 3	Water-saving irrigation	Not using main water sources to water the plants
		Having a strategy of water-saving to water the plants
INDOOR HEALTH AND COMFORT (IHC)		
IHC 1	Indoor air Circulation	Providing naturalventilation
		Providing circulation for a minimum 5 % to 10 % of the total area
		Covering 50 % total area with cross ventilation
		Covering 75 % total area with cross ventilation
		Covering 100 % total area with cross ventilation
		Providing unnatural ventilation
		Putting on the exhaust fan in bathrooms
		Putting on the exhaust fan in the kitchen
IHC 2	Minimization of Polutant Sources	Using low VOC (volatile organic compounds) wall-paint
		Using low VOC sealant and adhesive
IHC 3	Maximize Natural Lighting	Making sure that the sunlight can illuminate a family room area as much as 200 lux in 50 % of the room
		Making sure that sunlight can illuminate a bedroom area as much as 200 lux in 50 % of the room

5 Results and discussion

Tests were conducted to verify the reliability and validity of the instruments. Total of 250 questionnaires were distributed, and 200 responses were obtained; not withstanding, the number of respondents meets the minimum requirement. Statistical measurement was conducted to test the reliability and validity of the instrument. Pearson correlation and Cronbach's alpha coefficient were applied and are presented in Table 2. This approach was employed to ensure that the measurement instrument worked well. For all items, the Cronbach's alpha coefficient values were greater than the acceptable value of 0.6, indicating that the items assigned to the constructs were reliable.

Table 2. Validity, Reliability, and Mean

Variable	Item	Pearson Correlation		Reliability Cronbach Alpha	Mean	Av. Mean
		r	Status			
Energy Efficiency and Conservation (EEC)	EEC1	0.530**	Valid	0.886	3.73	3.80
	EEC2	0.771**	Valid		3.67	
	EEC3	0.664**	Valid		3.74	
	EEC4	0.758**	Valid		3.74	
	EEC5	0.680**	Valid		3.78	
	EEC6	0.676**	Valid		3.79	
	EEC7	0.737**	Valid		3.55	
	EEC8	0.700**	Valid		3.86	
	EEC9	0.637**	Valid		3.95	
	EEC10	0.707**	Valid		3.99	
	EEC11	0.682**	Valid		4.00	
Water Conservation (WC)	WC1	0.848**	Valid	0.900	4.11	4.00
	WC2	0.848**	Valid		3.92	
	WC3	0.871**	Valid		3.94	
	WC4	0.848**	Valid		4.01	
	WC5	0.818**	Valid		4.04	
Indoor Health and Comfort (IHC)	IHC1	0.696**	Valid	0.846	3.97	3.89
	IHC 2	0.759**	Valid		3.92	
	IHC 3	0.714**	Valid		3.84	
	IHC 4	0.807**	Valid		3.72	
	IHC 5	0.779**	Valid		3.96	
	IHC 6	0.766**	Valid		3.92	

Based on the data shown in Table 2, EEC 11 indicated the highest mean value; the criteria address renewable energy sources with the sub-criteria of alternative power supply plant. The Water Conservation (WC) criteria indicate that WC 1 has the highest mean value, asserting that using fitting for water-saving is highly important. As for the Indoor Health and Comfort (IHC) criteria, the highest mean value at IHC1 is the Indoor Air circulation sub-criteria; it shows that it is important to have natural ventilation in an environmentally friendly home. The highest mean value of all sub-criteria in environmentally friendly homes is in the water conservation criteria.

In sequence, the users' perception of environmentally friendly homes' energy efficiency is the importance of water conservation, indoor health and comfort, and energy efficiency conservation. In Indonesia, the importance of saving water in homes has become a national issue and jargon in saving energy and electricity. Nevertheless, according to the results of the analysis, the health and comfort of the residents are also essential in the sake of energy efficiency. By providing a lot of windows or ventilation, it can naturally reduce the use of air ventilators (exhaust fan), and thus reduce the use of electrical energy as well.

6 Conclusion

The main objective of this paper is to study the users' perception of energy efficiency in eco-friendly homes. This study discovered that items adopted to measure all energy efficiency criteria from the Greenship provided a good reliability value; the mean values

indicate that all criteria are essential. These findings clarified that users' perception of eco-friendly home increases along with energy consumption efficiency. The findings support recommendations on the need to consider users' factors in measuring energy efficiency in the building. This study also revealed that users already perceive that energy efficiency is highly important. Therefore, the simultaneous application of the Greenship criteria for housing is needed to achieve sustainable development goals in Indonesia.

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