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ICSECC 2019

International Conference
on Sustainable Engineering and Creative Computing

Bandung, 20 - 22 August 2019

Proceedings

New idea,
New
Innovation

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WELCOME SPEECH

The honorable,

Rector of President University,
Rector of Universitas Siliwangi,
Keynote speakers,
Invited speakers,
Dean of Faculty of Computing,
All Heads of Study Program within both Faculties of Engineering and Computing,
Ladies and Gentlemen,

On behalf of all members of the committee, I am honored and delighted to welcome you to the International Conference on Sustainable Engineering and Creative Computing (ICSECC 2019), held from 20 to 22 August 2019, at Grand Tjokro Hotel, Bandung.

We are pleased to accept 81 papers from Indonesia, South Korea, Taiwan, and Netherlands. It is also a great pleasure to welcome 4 keynote speakers and 4 invited speakers from 5 different nationalities with us in this conference, where we hope they can share their knowledge and experience. The theme of the conference is "New Idea, New Innovation" with the wish that this event can be a place to share new ideas, new innovation, but furthermore to get new insights, and to make new friendships.

The ICSECC has been intended to focus on various areas of research in Engineering and Computing. The goal of this conference is to provide opportunities for professors, academics, researchers, and students from all over the world, to come together and to learn from each other. ICSECC 2019 aims to accelerate scientific discoveries and major milestones in the current situation, challenges and innovations related to Engineering and Computing.

As the General Chair of the conference, I realized that the success of this conference depends ultimately on the many people who have worked together in planning and organizing this conference. In particular I thank all the colleagues, who were involved in review process before the conference, are involved in technical program preparation during the conference, and will be involved in publication process after the conference.

Last but not least, I would like to thank IEEE Indonesia Section and CSS/RAS Joint Chapter, for the cooperation with ICSECC. All accepted and presented papers in the conference will be published in IEEE Xplore.

I remind again all authors to be cooperative and responsive in the communication with the Publication Chair, even though the conference days are already over. All the minor and major revisions must be completed so that your papers can be fully accepted and can be published.

I hope this conference can be an inspiring experience for you. Also, I hope that you can enjoy your participation in the ICSECC 2019, in beautiful city of Bandung, Indonesia.

Best regards,
Dr.-Ing. Erwin Sitompul
ICSECC General Chair

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2019 International Conference on Sustainable Engineering and Creative Computing (ICSECC)

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The Technical Program Committee of the International Conference on Sustainable Engineering and Creative Computing (ICSECC 2019) consists of 56 members from various renown educational institutions. Each member arean be assigned not only as conference publication but also has a role in reviews and evaluates submissions.

The first deadline of paper submission will 21 June 2019. Reviewers will be chosen based on field of expertise and non-student priority. Reviewers can also be experienced members of organizing committee. Thus, we strongly believe in the review results in the paper of the International Conference on Sustainable Engineering and Creative Computing (ICSECC 2019) will be strict and thus ensure high quality presentations.

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CONFERENCE PROGRAM

International Conference on Sustainable Engineering and Creative Computing (ICSECC 2019)

Grand Tjokro Hotel, Bandung, 20-22 August 2019

Day 1: Tuesday, 20 August 2019

Time	Agenda
14:00 - 17:00	Registration

Day 2: Wednesday, 21 August 2019

Time	Agenda
07:30 - 08:15	Registration
08:15 - 08:30	Safety Induction
08:30 - 09:00	Opening Ceremony National Anthem "*Indonesia Raya*" Welcome Speech from General Chair Welcome Speech from IEEE Indonesia Welcome Speech from Rector of President University
09:00 - 10:15	Keynote Speeches *Eur. Ing. Prof. J. Scott Younger, OBE* *Prof. Poki Chen, Ph.D.*
10:15 - 10:20	Token of Appreciation
10:20 - 10:45	Photo Session with All Participants and Coffee Break
10:45 - 12:00	Keynote Speeches *Prof. Datuk Mohd. Razali bin Muhamad* *Assoc. Prof. Tohru Suwa*
12:00 - 12:05	Token of Appreciation
12:05 - 13:00	Lunch Break
13:00 - 15:00	Parallel Session 1
15:00 - 15:05	Announcement of Session Best Presenter
15:05 - 15:30	Coffee Break
15:30 - 17:00	Parallel Session 2
17:00 - 17:05	Announcement of Session Best Presenter
17:05 - 17:30	Distribution of Conference Certificates
19:00 - finish	Gala Dinner Closing Speech

Day 3: Thursday, 22 August 2019

Time	Agenda
8:00 - 14:30	Bandung City Heritage Tour (optional)

PARALLEL SESSION SCHEDULE

Parallel Session 1A

Time	Speaker
13:00 - 13:30	Invited Speaker : Indonesian Maritime Challenges as Part of Sustainability (D. Wignall)
13:30 - 13:45	The Solution of the Capacitated Vehicle Routing Problem Using Variable Neighborhood Search with Threshold (A.Imran, F.Ramadhan)
13:45 - 14:00	Design and Prototyping Automatic Fish Feeder Machine for Low Energy Consumption (N. Busaeri; N. Hiron; A. Andang)
14:00 - 14:15	Development of Automatic CAD Drawing for Tyre Mould Design (N.A.Sutisna)
14:15 - 14:30	Analysis of Risk Priorities in Medical Record Unit at the Hospital (K.Syahputri, R.Sari, I.Rizkya, I.Alona, V.D.A.Zati)
14:30 - 14:45	Machine Tonnage Optimization by Reused Scrap Material Applied for Car Propeller Shaft Guard (V.A.Pratiwi, L.Anggraini)
14:45 - 15:00	The Performance of a Three-blades Fish-ridge Turbine in an Oscillating Water Column System for Low Waves (N. Hiron; I.A.D. Giriantari; I.N.S. Kumara; L. Jasa)

Parallel Session 1B

Time	Speaker
13:00 - 13:30	Invited Speaker : Waste to Energy – A Necessary Modern Day Application (M. I. Murray)
13:30 - 13:45	ZT: An Adaptive Learning Tool for Chinese L2 Learners (S. Darmowinoto)
13:45 - 14:00	Design of Distribution Routes Using Saving Matrix Method to Minimize Transportation Cost (I. Rizkya, N. Matondang, M. Ningsih)
14:00 - 14:15	Six Sigma Method for Improvement of Crude Palm Oil (CPO) Quality (K. Siregar)
14:15 - 14:30	Design of Testing Results of Reduction and Migration of Write off Transaction Data in POTS Segment Using Integration Testing on SAP Application (R.L.S. Sianturi)
14:30 - 14:45	Prototyping of Automatic Braking System Using Fuzzy Logic (A.N.D. Dewa, O. Wahyunggoro, P. Nugroho)
14:45 - 15:00	Maintenance Strategy Optimization in Uniformity Machines (Y. Syafei, J. Runtuk, D. Ruswandi)

Parallel Session 1C

Time	Speaker
13:00 - 13:30	Invited Speaker : Interoperability of Process Control in RAMI 4.0 (E. Joelianto)
13:30 - 13:45	Value Engineering in Crude Palm Oil Industry to Minimize Cost (I.Rizkya, R.Sari, K.Syahputri, E.Sitorus, I.Siregar)
13:45 - 14:00	Preliminary Study on Tamarindus Indica Seeds Kernel as Natural Coagulant for Color Removal of Synthetic Textile Wastewater (H.Kristianto, C.Handriono, J.N.M. Soetedjo)
14:00 - 14:15	Mapping of Communal Waste Water Treatment Plant User Group in Citarum River Areas Using Geographic Information System (A.S.P.Harris, A.Kurniawati, A.F.Rizana)
14:15 - 14:30	WOTEC Technology as the Potential Renewable Energy in East Nusa Tenggara (L.O.R.N.Prakasa, H.Sholichah, T.Wikaningrum)
14:30 - 14:45	Building Industrial Symbiosis at Automotive Supply Chain (Y.Ismail)
14:45 - 15:00	Estimation Model Using Cost Driver in Aggregate Level for Mould Manufacturing (A. Maukar)

Parallel Session 1D

Time	Speaker
13:00 - 13:30	Invited Speaker : The Increase of Brain Activity in Frontal Lobe After One Hour Methadone Intake (A. Turnip)
13:30 - 13:45	Data Mining Based Privacy Attack Through Paper Traces (M. Adithia, E. Yudhistira)
13:45 - 14:00	Architecture Enterprise Design Based on Cloud Computing Using TOGAF (Y. Osadhani, D. Rizkiputra, A. Maulana, E.R. Kaburuan)
14:00 - 14:15	Big Data Forecasting Applied Nearest Neighbor Method (A.R. Lubis, M.Lubis, A.Khowarizmi)
14:15 - 14:30	Mapping and Grouping of Farm Land with Graham Scan Algorithm on Convex Hull Method (A. Wibowo, H. Santoso, A. Rachmat, R. Delima)
14:30 - 14:45	Electro-tactile Cues for a Haptic Multimedia Finger Motoric Learning System (D. Pamungkas, A. Turnip)
14:45 - 15:00	The Relation Between Internet Use and Societal Development in Indonesia (T.Setiawan, A.Suhartomo)

Parallel Session 1E

Time	Speaker
13:00 - 13:15	Development of a Simple Ultrasonic Motor Driver (T.H.Yu, T.C.Lu)
13:15 - 13:30	The Implementation of Naïve Bayes Algorithm for Classifying Tweets Containing Hate Speech with Political Motive (R.R.E. Akbar; R.N.Shofa; Supratman, M.I. Paripurna)
13:30 - 13:45	System Modelling Using Neural Networks with External Recurrence and Exponential Quadratic Cost Function (E.Sitompul)
13:45 - 14:00	Determination of Technical Characteristics in Panel Button and Control Seat Using Quality Function Deployment (K.Syahputri, I.Siregar, I.Rizkya, R.Sari)
14:00 - 14:15	The Performance of a Single-phase Shunt Hybrid Active Power Filter with FCS MPC and Hysteresis Control (A. Andang; R.S. Hartarti; I.B.G. Manuaba; I.N.S. Kumara)
14:15 - 14:30	A Two-Phase Metaheuristic Method for Solving Travelling Repairman Problem (F.Ramadhan, A.Imran)
14:30 - 14:45	Development of Synoptic Automatic Weather Station Based on Internet of Thing at the Kemayoran Meteorological Station (Sugiarto, S.K. Wijaya, M.Rosid)
14:45 - 15:00	Swarm Intelligence on Color-Embedded-Grayscale Image (Heri Prasetyo; Esti Suryani)

Parallel Session 1F

Time	Speaker
13:00 - 13:15	The Relationship Between Absorptive Capacity, Knowledge Sharing Capability, and Green Dynamic Capability: A Conceptual Model (R. Amaranti)
13:15 - 13:30	Bottleneck Reduction at the Shoes Production Line Using Theory of Constraint Approach (E. Prasetyaningsih; R. Amaranti; C. Deferinanda)
13:30 - 13:45	Stability Analysis in a Technology Transfer Model with Competing Followers (H. Husniah; N. Anggraeni; A.K. Supriatna)
13:45 - 14:00	Development of Flexible Production Scheduling by Applying Gantt Charts in Manufacturing Module Open Source ERP (Case Study CV. XYZ) (C. Nafianto; W. Puspitasari; M. Saputra)
14:00 - 14:15	Parking Service Management with Hybrid Code Technology (HCT) (N. Herlina; N. Hiron)
14:15 - 14:30	The Validation of Linear Method in Cascade Reservoir System for Prediction of Energy Production to Optimize Supply and Demand (Empung; I.N. Norken; M.I. Yekti; I.G.A.A. Putera; N. Hiron)
14:30 - 14:45	Green Campus Energy Measurement Using Three Measurement Approaches for Green Campus Concept (A Case Study at: Siliwangi University) (N. Busaeri; I.A.D. Giriantari; W.G. Ariastina)
14:45 - 15:00	Multistage Fuzzy Inference System for Solving Problems in Performance Appraisal (H.A.Azwir)

Parallel Session 2A

Time	Speaker
15:30 - 15:45	CARDUINO: An Effort Towards Commercial Autonomous Public Vehicles Based on Arduino (R.Roestam, N.Hadisukmana)
15:45 - 16:00	Voice Activity Detector for Device with Small Processor and Memory (T.W.Sen)
16:00 - 16:15	Assessing Trust Variable Impact on the Information Technology Governance Using Business-IT Alignment Models: A Model Development Study (R. Setyadi)
16:15 - 16:30	Machine Learning as a Prediction for Talent Acquisition (E.R.Kaburuan, I.Ranggadana, M.E.Johan, F.Fernandus, M.F.Rizqon, G.Wang)
16:30 - 16:45	Compressive Sampling for Robust Video Watermarking Based on BCH Code in SWT-SVD Domain (L.Novamizanti)
16:45 - 17:00	Smart Postpaid Electricity Meter Using Arduino (A.Ghofir, R.Roestam)
17:00 - 17:15	

Parallel Session 2B

Time	Speaker
15:30 - 15:45	Bidik as a Location Midwife & Clinical Search Plarform and Health Services to Meet Family Health Needs (O.Soleh, H.Ariessanti)
15:45 - 16:00	Sentiment Analysis of Social Media Users Using Naïve Bayes, Decision Tree, Random Forest Algorithm: A Case Study of Draft Law ... (K.Virra, R.Andreswari, M.Hasibuan)
16:00 - 16:15	Wood Classification Based on Fiber Texture Using Backpropagation Method (M.I.Taqyudin, B.Irawan, C.Setianingsih)
16:15 - 16:30	OBD-II Sensor Approaches for the IMU and GPS Based Apron Vehicle Positioning System (B.Suwandi, W.Pinasko, R.Roestam)
16:30 - 16:45	Flow Analysis of Payment Transactions in SAP Reduction of Data with Some Testing Method in PT XYZ (R. Nuzuli; W. Puspitasari)
16:45 - 17:00	Determination of Reactor Diameter of Wastewater Treatment for Vehicle Wash Facilities Using RA 52 Modified Zeolite Filtration Media (M.G.Harahap, H.Pradiko)
17:00 - 17:15	Batik Image Retrieval Using Maximum Run Length LBP and Sine-Cosine Optimizer (H. Prasetyo; J.W. Simatupang)

Parallel Session 2C

Time	Speaker
15:30 - 15:45	Analog Behavioral Model of Underdamped Free Oscillation of Cantilever Beams (H.Tarigan, E.Sitompul)
15:45 - 16:00	Blockchain-Enabled 5G Autonomous Vehicular Networks (S. Rahmadika)
16:00 - 16:15	Evaluation of Governance Information System Using Framework Cobit 5 in Banking Company (N.Legowo)
16:15 - 16:30	Identification of Green and Sustainable Campus Indicators in Its Implementation at President University (R. Hakiki)
16:30 - 16:45	Counting of Aedes Aegypti Eggs using Image Processing with Grid Search Parameter Optimization (S. Bandong; E. Joelianto)
16:45 - 17:00	A Blue Robotic Sensor for Tech_SAS V1 ROV Depth Controller (S. Siregar; M.I. Sani; R. Febriansyah; S.T. Parlindungan)
17:00 - 17:15	Prototype of Postpaid Electricity and Water Usage Monitoring System (M. Galina; M. Ramadhani; J.W. Simatupang)

Parallel Session 2D

Time	Speaker
15:30 - 15:45	Sound Visualization Using Typography Composition Based GIF (C. Fadillah; R.R.R.A.R. Rahayu)
15:45 - 16:00	Aesthetic Affordances of Buto's Shape and Texture Characters in Wayang Kulit Through Digital Sculpting (A. Ardiyan)
16:00 - 16:15	Designing Video Campaign Using Visual Rhetoric: Irony to Increase Awareness of Millennial in Using Social Media Wisely (T.Walewangko, R.Mulcki, N.Iskandar)
16:15 - 16:30	The Mapping of Strategic Concept Through 5C Model Theory as a Visual Communication Design Tool for Jakarta City Branding (N.D.C. Kertasari)
16:30 - 16:45	Packaging Local Identity: Redesigning the Brand and Package of 'Tenteng Malino of South Sulawesi (D. Wijaya; F. Rachel; S.Aziz)
16:45 - 17:00	The Role of Active Participation and Satisfaction Towards Community Promotion and Behavior Change for Effective Marketing Outcomes of ... (F.Zarani, I.Tarigan, A.S.Santoso)
17:00 - 17:15	Exploring the Drivers of Peer-to-Peer (P2P) Lending Mobile Application Service Quality in Indonesia (R.Ghazali, J.O.Haryanto, W.H.Utomo, A.Santoso, R.Nughara, B.Asgha)

Parallel Session 2E

Time	Speaker
15:30 - 15:45	Heart Rate Monitoring Using ECG Sensor in Android (Rosalina)
15:45 - 16:00	Stream Control Transportation Protocol (SCTP) Towards MANET Routing: Comparison of DSR and AODV (A.R.Lubis, M.Lubis, F.Lubis)
16:00 - 16:15	Detection of Potentially Students Drop Out of College in Case of Missing Value Using C4.5 (S.Mutrofin, R.V.H.Ginardi, C.Fatichah, Y.A.Sari, A.M. Khalimi, E.Kurniawan)
16:15 - 16:30	Prediction Analysis of Student Specialization Suitability Using Artificial Neural Network Algorithm (S.N.Latifah, R.Anreswari, M.Hasibuan)
16:30 - 16:45	Realistic or Iconic 3D Animation (Adaptation Study with Theory Uncanny Valley) (F.Limano)
16:45 - 17:00	Encryption Application Using Verifiable Secret Sharing Scheme (N.Hadisukmana, R.Roestam)

Parallel Session 2F

Time	Speaker
15:30 - 15:45	Reducing Wastes in Laboratory Activities Using DMAIC Method (A.Saptari, C.Monika, I.Halim)
15:45 - 16:00	The Quality Metric Design to Control Quality of Telecommunication Construction Project Using Internal Control Method (F.Nabilah, I.A.Puspita, W.Tripiawan)
16:00 - 16:15	Semi-Automatic Machine with Programmable Logic Controller in the Mendong Woven industrial (N. Hiron; F.M.S. Nursuwars; Supratman; Sutisna)
16:15 - 16:30	Design and Implementation of Internet of Things Based Remote Monitoring System at Electrical Engineering Laboratory in President University (I. Bukhori; R. Thiara; A. Suhartomo)
16:30 - 16:45	Extraction of P and T Waves from Electrocardiogram Signals with Modified Hamilton Algorithm (A. Turnip; C. Wijaya; E. Sitompul)
16:45 - 17:00	A Comparison of Continuous and Periodic Review on Inventory Components of Dump Trucks (M.Toha, D.Prastyo, A.Saptari)
17:00 - 17:15	The Performance of Microcontroller Equipment to Save Fuel Consumption for Motorcycle (F. Ariani, T. B. Sitorus, Tugiman, H. Helmi)

TABLE OF CONTENTS

TABLE OF CONTENTS

Energy Management Assessment Measurement Using Three Measurement Approaches for Green Campus Concept

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***Abstract*—This paper discusses the measurement of green campus assessments at a Siliwangi University, which has a total occupancy of 15973 people with an area of 50 Hectares The problem of the paper is how the level of the green campus from the energy aspect based on three measurement standards for the green campus. The method used in applying the measurement of energy ranking from three approaches, namely the UI Green Metric standards, the United Nations Environment Program (UNEP) and Greenship version 1.1. The measurement results show that the University of Siliwangi still has a low score according to the three standard measurements. Using the UI GreenMatric, the energy aspect score obtained was at the 7% level, then accepted a score of 5 from the maximum value of 15 on the UNEP approach, and scored 23 on the Greenship version 1.1 approach. The program of providing new renewable energy sources for the UNSIL campus is needed in achieving a green campus. In addition to that, a conservation and efficiency program to reduce greenhouse gas emissions becomes a campus priority.**

Keywords—Campus, Energy, UI GreenMatric, UNEP, Greenship.

I. INTRODUCTION

Green-Campus is an international program, where the main aim is to realize how to control educational programs on campus in dealing with and resolving environmental issues through education and research programs that innovate and implement results on an ongoing basis on campus [1]. The green campus in the formation of its strategy still refers to sustainable theory [2], [3], [4], [5], [6], which consists of the environment, social and economy [7]. The illustration is shown in Fig.1.

In Indonesia, the university has been growing rapidly, according to Nasional Tempo.co, that one university is established every two days [8]. The number of students in Indonesia has reached 6,924,511 or much larger than the population of Singapore. The total number of 20,516 departments and the largest field is engineering, reaching up to 4,634 [9].

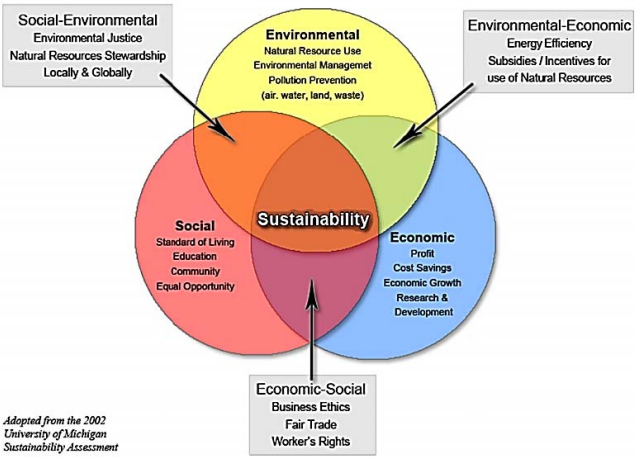

Fig. 1. The fundamental area of sustainable development [7]

The recent economic development in Indonesia demands an increase in the efficiency of energy use in universities [6]. H. Tan et al. in 2014, raised the problem that occurred in China, namely how to create a green campus in line with the growth of universities and schools in China which increases every year, while these conditions are not matched by the number of staff needed. H. Tan et al. found the fact that Green campus can be achieved by starting from the design of top-level strategies, such as the processing of departments in universities to the relevant different national ministries and the collaborative innovation among different departments in the university [6].

Fig. 2 shows the seven steps to achieving a green campus based on the green campus program manual [1]. The seven stages are the establishment of a green campus board supported by six other stages, specifically Environmental review, action plans, monitoring, and evaluation, linking to learning on campus, informing and involving green charter.

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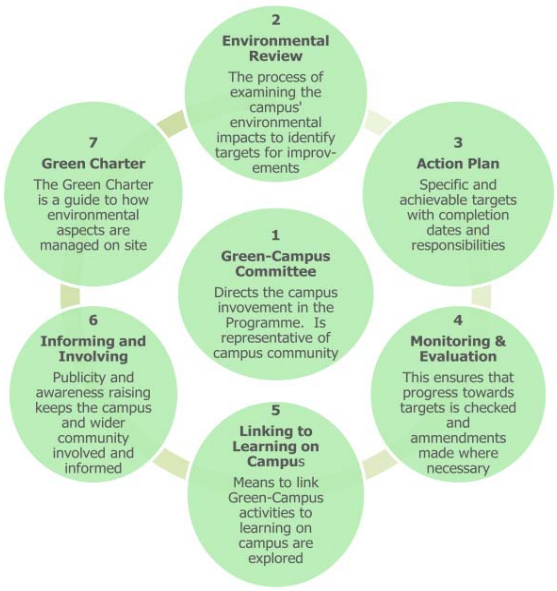

Fig. 2. Seven stages of the green campus program [1].

EA Hopkins et al. in 2016 revealed that generally, barriers in making decisions to realize a green campus include lack of attention and awareness among decision-makers, low incentives, lack of competition policy (champions), unfavorable financial policies [10]. The same condition is found in [9]. Then, E. A. Hopkins et al. found that these barriers could be addressed by reviewing student perceptions, encouraging understanding to university owners or university executives, marketing green campus development initiatives, and each policyholder must be part of the collaboration to reduce these barriers.

R. Dagiliūtė et al. in 2018 have compared the attitudes of students from universities with the green campus with students from non-green campus universities. The results show that there is no significant difference in the aspect of sustainability in general. However, even so, students want their campus to be declared a green campus.

Green campus assessment categories commonly used today are UI GreenMetric and UNEP's Greening University Toolkit, Greenship [11], [12]. Assessment based on UI GreenMetric [2] includes assessment variables including Settings and Infrastructure (SI), Energy and Climate Change (EC), Waste (WS), Water (WR), Transportation (TR), Education (ED) [13]. The assessment based on UNEP's Greening University includes assessment variables including Energy, Carbon and Climate Change, water, waste, Biodiversity and Ecosystem Services, Planning, Design and Development, Procurement, Green Office, Green Lab, Green IT, Transport [11]. In the assessment based on Greenship version 1.1 UNEP's Greening University includes assessment variables including appropriate site development, energy efficiency, and conservation, water conservation, material resources and cycles, indoor health and comfort, building environment management [14].

Previous research has discussed water security in green campus assessment standards by comparing the three assessment standards, namely UI GreenMatric, Greenship (for Existing Buildings), STARS [15]. Then the measurement model is proposed to find out energy consumption online [16].

UI GreenMatric is a green campus assessment manual [2] with assessment variables consisting of 6 components, namely Structuring and Infrastructure (SI), Energy and climate change (EC), Waste (WS), Water (WR), Transportation (TR), Education (ED). Apart from the GreenMatric UI. UNEP's Greening University Toolkit is a green campus assessment using ten assessment variables [11], [17]. These variables are (1) Energy, Carbon, and Climate Change, (2) water, (3) waste, (4) Biodiversity and Ecosystem Services, (5) Planning, Design and Development, (5) Procurement, (6) Green Office, (7) Green Office, (8) Green Lab, (9) Green IT, (10) Transport. While some researchers have found the fact of the success of the green campus program, it is also influenced by the level of awareness of leaders and university owners to students, who have an impact on the behavior that successfully manifests in the university's green campus concept [6]. Variables from Greenship Rating Tools for Existing Building Version 1.0 are Appropriate Site Development (ASD), Energy Efficiency and Conservation (EEC), Water Conservation (WAC), Material Resources and Cycle (MRC), Indoor Health and Comfort (IHC), Building Environment Management (BEM) [18].

II. METHOD

The sample of this research is collected from Siliwangi University. Where the Siliwangi University is the biggest university in *Priangan Timur* region. Priangan east is a collection of districts located in the middle of the province of West Jawa. The Siliwangi University coverage some district di west java province. Green campus analysis based on energy aspects on campus uses three measurement standards, namely UI GreenMatric, United Nations Environment Program (UNEP), Greenship Version 1.1. Parameter

A. Measurement of green campus from energy aspect based on UI GreenMetric.

Measurement of green campus from the energy aspect based on the UI Green Matric includes eight criteria, specifically energy-efficient appliances usage, smart building implementation, renewable energy usage, the ratio of total electricity usage towards campus population, the ratio of renewable energy produce towards energy usage, Element of green building implementation, greenhouse gas emission reduction program.

The energy aspect assessment of the Siliwangi University campus uses an approach of 3 types, and they are UI GreenMatric, UNEP, Greenship version 1.1. Then from three measurement standards, sub-categories are selected based on energy aspects only.

Total emissions are divided by open space area per total people on campus. Total emissions are collected from electricity usage per year and transportation in around campus per year, like bus, car, motorcycle [13].

$$OSa = \sum Ca - \sum GFa \qquad (1)$$

Where, *OSa* is open space area, *Ca* is the total campus area, *GFa* is total ground floor area of a building.

The number of occupations on campus is the sum of students, lecturers, and staff on campus [13], therefore, the total campus occupation is calculated using the following equation below:

$$\sum P = \sum Std - \sum FTstd + \sum A + \sum Stf \qquad (2)$$

Where P is total people, Std is the number of students including part-time and full-time students, and A is the total of academic staff, lecturer and administrative staff.

Electricity usage per year is determined from carbon emissions originating from electricity usage, the use of transportation in the form of buses, cars, and motor vehicles that enter and exit the campus [13]. Therefore the carbon emissions from the use of electrical energy are calculated using the following equation:

$$CO_2\ (electricity) = \frac{E \times 0.84}{1000} (\text{MT}) \qquad (3)$$

Where CO_2 (electricity) is the number of carbon emissions (CO_2) produced in Metric Tons (MT), E is energy per year (kWh/year).

Carbon emissions released from the use of campus bus vehicles are calculated using the following equation [13]:

$$CO_2\ (bus) = \frac{N_{bus} \times L \times D \times 240 \times 0.01}{100} (\text{MT}) \qquad (4)$$

Where $CO_2\ (Bus)$ is carbon emissions produced from campus buses per year (MT), N_{bus} is the Number of shuttle buses in the University, L is the total trips for shuttle bus services in km per day, D is the approximate travel distance of a vehicle each day in the campus (km). (240x0.01/100) is a constant.

Carbon emissions from the use of vehicles entering the campus are calculated using the following equation [13].

$$CO_2\ (car) = \frac{N_{car} \times 2 \times D \times 240 \times 0.02}{100} (\text{MT}) \qquad (5)$$

where $CO_2\ (car)$ (car) is carbon emissions produced from car vehicles per year (MT), N_{car} is a vehicle entering and exiting campus, D is the approximate travel distance of a vehicle per day on campus (km), (240x0.02/100) is a constant.

Carbon emissions from the use of motor vehicles entering the campus are calculated using the following equation [13]:

$$CO_2\ (motorcycle) = \frac{N_{motorcycle} \times 2 \times D \times 240 \times 0.01}{100} (\text{MT}) \qquad (6)$$

where is the amount of carbon emissions produced from motorized vehicles on campus (MT), $N_{motorcycle}$ is the number of motorcycle entering the university per year, D is the approximate travel distance of a vehicle each day on campus (km), (240x0.01/100) is a constant.

Total carbon emissions on campus per year are calculated using the following equation [13]:

$$CO_2\ (emission) = \{CO_2\ (electricity) + CO_2\ (bus) + CO_2\ (car) + CO_2\ (motorcycle)(\text{MT})\} \qquad (7)$$

where CO_2 (emission) is the total carbon produced by the campus, CO_2 (electricity) is the amount of carbon produced from the use of electricity per year according to equation (3). CO_2 (bus) is the amount of carbon produced from the use of bus vehicles on campus per year according to equation (4). CO_2 (car) is the amount of carbon produced from the use of cars per year according to equation (5). CO_2 (motorcycle) is the amount of carbon produced from the use of motorcycles per year following equation (6).

B. Measurement of green campus from the energy aspect based on UNEP

The United Nations Environment Program (UNEP) has ten categories, namely energy, carbon, and climate change, water, waste, biodiversity and ecosystem services, planning, design and development, procurement, green offices, green labs, green IT, transport. In this paper, energy subcategories are used. UNEP's energy subcategories consist of energy conservation, energy efficiency, renewable and alternative energy

Energy conservation variable has a maximum value of 45 points. Each includes employment of energy managers, energy efficiency standards for new construction and refurbishments, energy efficiency purchasing standards, staff energy conservation training, improved space utilization to avoid new construction or heating/cooling of underutilized space, thermal comfort policy, financial strategies to assign energy costs incurred - and savings achieved - to the responsible cost centers, energy/climate change awareness programs, establishment of "energy champions" network across campus buildings.

Energy efficiency variable has a maximum value of 35 points. Energy efficiency variables include detailed energy audit to identify priority areas, periodic recommissioning and building tuning to optimize energy efficiency, building retrofitting lighting, heating, ventilation and air-conditioning (HVAC) laboratory ventilation and fume hoods, installation of building management and control systems (BMCS) and sub-metering for primary building energy uses, energy use displays.

The variable renewable and alternative energy have a maximum value of 25 points, and this variable includes the purchase of certified "green power," installation of photovoltaic, wind, biomass. Systems. Installation of cogeneration and trigeneration, fuel switching, the university managed revegetation programs to offset greenhouse emissions.

C. Measurement of green campus from the energy aspect based on Greenship version 1.1

The Greenship version 1.1 consists of 8 variables, namely policy, and energy management plan, minimum building energy performance, optimized efficiency building energy performance, testing, recommissioning or retro-commissioning, system energy performance, energy monitoring, and control, operation and maintenance, on-site renewable energy. Retro-commissioning is a process to improve the efficiency of an existing building's equipment and systems.

Table I is a list of subcategories based on the measurement standards used. UNEP has fewer variables than Greenship or UI GreenMatric.

TABLE I. VARIABLE OF ENERGY SUBCATEGORY FOR VARIOUS STANDARD MEASUREMENTS

Standard	Code	Subcategory
UI GreenMetric	EC 1	Energy efficient appliances usage
	EC 2	Smart building implementation
	EC 3	Renewable energy usage
	EC 4	The ratio of total electricity usage

		towards the campus population
	EC 5	The ratio of renewable energy produce towards energy usage
	EC 6	An element of green building implementation
	EC 7	Greenhouse gas emission reduction program
	EC 8	The ratio of total carbon footprint towards the campus population
UNEP	1	Energy conservation
	2	Energy efficiency
	3	Renewable and alternative energy
Greenship Version 1.1	P1	Policy and energy management Plan
	P2	Minimum building energy performance
	EEC1	Optimized efficiency building energy performance
	EEC2	Testing, recommissioning or retrocommissioning
	EEC3	System energy performance
	EEC4	Energi monitoring & control
	EEC5	Operation and maintenance
	EEC6	On-site renewable energy

III. Result and Discussion

Based on the results of the analysis of the data available on the Siliwangi university campus, after an assessment analysis based on using the GreenMatric UI, it was found that the UNSIL campus was still not feasible to be called a green campus. 578. This result means that there are still many things that need to be fixed of the Siliwangi University campus. The lowest value is on the EC3 and EC7 variables. Improvements can be prioritized in programs providing new renewable energy sources (EC3) and Programs for greenhouse gas emission reduction (EC7). Although other variables have values, the values obtained are still below standard. Table II shows the total of measurement score according to energy subcategory of GreenMatric UI assessment standards. Fig.3 shows the graphical representation of Table II.

Table II. Tabulation of Measurement Data Based on The GreenMetric UI on The Energy Aspect

Code	Maximum Score	Measurement Score
EC 1	200	100
EC 2	300	45
EC 3	300	0
EC 4	300	170
EC 5	200	100
EC 6	300	150
EC 7	200	0
EC 8	300	12.3
Score	**2100**	**578**

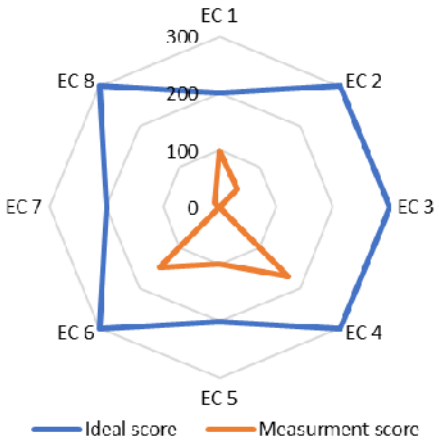

Fig.3. Energy and climate change (UI GreenMatric)

As seen from the results of the analysis using UNEP assessment standards, it is known that the UNSIL campus has a low rating of all variables. Of the total three variables, the lowest value is variable 1, namely Energy conservation with point 1 of the maximum value of 5, then the value of 2 on the energy efficiency variable is two from the maximum value of 5. The variable Renewable and alternative energy is the value at 2 from the maximum value of 5. Table III shows the total of measurement score according to energy subcategory of UNEP assessment standards.

Table III. Tabulation of Measurement Data Based On UNEP on The Energy Aspect

No.	Sub category	Value	Measurement score	Ideal score
1	Energy conservation	very poor	1	5
2	Energy efficiency	poor	2	5
3	alternative and renewable energy	poor	2	5
Total Score		**very poor**	**5**	**15**

From Fig.4. It can be concluded that immediate programs are needed to be related to campus energy conservation, campus energy efficiency, and the creation of new renewable energy sources as alternative energy.

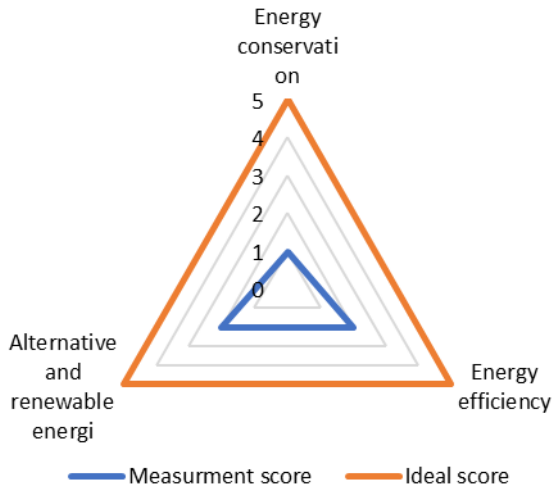

Fig.4. Energy, carbon and climate change (UNEP).

Fig.5 shows the results of measurement analysis based on Greenship version 1.1, and it was found that UNSIL can achieve the score is 23 and from a maximum score of 36. It means that UNSIL has not yet reached the category green campus. Of the seven variables in the Greenship version 1.1 assessment, the EEC6 variable scored zero, meaning that UNSIL does not have a new renewable energy source as alternative energy yet. However, based on Table IV, the EEC1 variable obtained a measurement of 14 from the maximum value of 16, meaning that UNSIL has been on the right track in carrying out Optimizing Efficiency Building Energy Performance. Meanwhile, other variables need attention to achieve better grades. Table IV shows the total of measurement score according to energy subcategory of Greenship version 1.1 assessment standards.

TABLE IV. RESULT MEASUREMENT BASED ON GREENSHIP VERSION 1.1 ON THE ENERGY ASPECT.

Code	Energy Efficiency and Conservation	Maximum score	Measurement score
EEC 1	Optimized Efficiency Building Energy Performance	16	14
EEC 2	Testing, Recommissioning or Retro-commissioning	2	1
EEC 3	System Energy Performance	12	6
EEC 4	Energy Monitoring & Control	3	2
EEC 5	Operation and Maintenance	3	3
EEC 6	On-Site Renewable Energy	5	0
EEC 7	Less Energy Emission	3	3
	Total	**36**	**23**

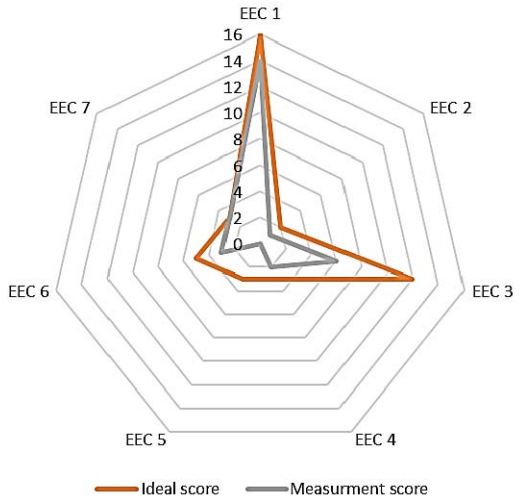

Fig.5. Energy efficiency and conservation (greenship v. 1.1)

IV. CONCLUSION

Conclusions are derived based on the results of the assessment analysis. Based on energy aspects using three assessment approaches, this research obtained several facts that become the highlight of the research. Based on UI GreenMatric, UNSIL must immediately have two main programs. The first program is the new renewable energy sources, and the second is the greenhouse for gas emission reduction program. UNSIL also needs to provide an official program to reduce greenhouse gas emissions that can be applied to building and laboratory air conditioning systems.

Based on the assessment standard with UNEP, UNSIL obtained a low score of three variables. The lowest value is variable for energy conservation. This low value means that UNSIL must immediately create an energy conservation program, energy efficiency, and provide renewable new energy as an alternative source of energy.

Based on the assessment standard with Greenship version 1.1, UNSIL soon has a new renewable energy source as alternative energy. Nevertheless, according to UNSIL, it is on the right track in realizing a green campus by carrying out Optimizing Efficiency Building Energy Performance.

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