Available online at www.sciencedirect.com
ScienceDirect
Energy Procedia 65 (2015) 48 – 57
Energy Procedia

Conference and Exhibition Indonesia - New, Renewable Energy and Energy Conservation (The 3rd Indo-EBTKE ConEx 2014)

Determining Optimal Schedule and Load Capacity in the Utilization of Solar and Wind Energy in the Microgrid Scheme: A Case Study

Dhanis Woro Fittrin[a]*

[a]*Electrical Engineering, Universitas Gadjah Mada, Jl. Grafika No. 2,Yogyakarta 55281, Indonesia*

Abstract

Solar and wind energy are the kinds of renewable energy that can handle increasing of load demand, scarcity of fossil fuel and greenhouse gasses effect. The main problem of solar and wind energy utilization is the higher cost of electricity production. The pupose of this research was to determine optimal schedule and load capacity in the utilization of solar and wind energy capacity. The results showed that the utilization is economist to fulfill daily load. Then, the utilization in the different load capacities give an information that solar and wind energy in the location have the capability to fulfill load demand more than 1 000 kWh · day^{-1} 100 kWp.

Peer-review under responsibility of the Scientific Committee of EBTKE ConEx 2014

Keywords: Optimal load capacity; optimal schedule; microgrid; solar energy; wind energy.

Nomenclature

RE	renewable energy	**AC**	alternating current
DG	distributed generation	**DC**	direct current
COEP	cost of electricity production	**HOMER**	Hybrid Optimization Model for Electric Renewable
COEG	cost of electricity generation	**NREL**	National Renewable Energy Laboratory
DER	distributed energy resource	**NASA**	National Aeronautics and Space Administration

* Corresponding author. Tel.: +62 856 4364 7525
E-mail address: dhaneesywara@gmail.com.

Peer-review under responsibility of the Scientific Committee of EBTKE ConEx 2014
doi:10.1016/j.egypro.2015.01.030

$	USD	**HDKR**	Hay, Davies, Klucher and Reindl

1. Introduction

Solar and wind energy one of renewable energy that claimed have capability to handle increasing of load demand, scarcity of fossil fuel and greenhouse gasses effect [1]. Referring to Government Planning No. 5 year 2006 and The Electricity Development Planning year 2008, the development medium voltage network 20 kV to fulfill increasing load demand have done by building isolated power system [2,3]. In the implementation, solar and wind energy can be utilized modularly with adding energy storage such as battery to damp the intermittent characteristic [4].

Microgrid scheme was the proposed by R.H. Lasseter from University of Wisconsin-Madison. It proofed to handle weaknesses of previous electricity scheme [5], namely conventional power system and DG [6]; the weaknesses are complexity of control system in the high penetration of RE in the electrical bulk system and high COEP and COEG [7]. It was caused by its microgrid scheme's flexibility to form isolated mode and connected to grid mode. Microgrid consisted of DERs such as photovoltaic generator and wind turbine generator, energy storage facility, energy transformation facility, monitoring and protection facility and load [6]. With the more energy resources, microgrid can support the reliability and lower cost [8]. Furthermore, the availability of battery in the configuration, the intermittent characteristic of solar radiant and wind velocity can be damped, namely especially in the renewable fraction more than 10 % [4]. The availability of energy transformation facility such as inverter and converter in the microgrid configuration cause different from power coming from solar and wind energy, namely AC and DC can be used together to fulfill load demand, both are AC and DC [9]. Monitoring facility was purpose to management energy and energy conservation by interactively between customer and supplier of energy electricity. Protection facilities have the capability to clearing any faults in the electrical power system [10].

Previous researches have discussion about microgrid configuration. Recent study [11], proofed that PV-Battery more economist to fulfill load demand in the village area than diesel and Wind turbine-Battery. Recent study also elucidated related study to determine optimal microgrid configuration [12]. The result showed that renewable fraction increasement align to the cost of electricity production. The result showed that potency of RE in there has the capability to fulfill load demand but not economist. On the other hand, microgrid with the integration grid around 27 % was more economists to be implemented. In the reality, planning to reduce carbon emission succeed with the utilization penalty given [14]. The reference [15] stated that optimization of solar energy, wind energy and conventional energy have done based on economic and realibility parameter. Due to obtain opimal design of microgrid software Retscreen was used [16]. Regarding to literature study from all related references, optimization in microgrid configuration only focused on technical, economical and environmental parameters. More research related to effective load capacity and optimal schedule in the utilization of solar and wind energy in the location of case study was needed.

2. Material and method

Software HOMER from NREL was used to simulate utilization of solar and wind energy through forming microgrid PV-Battery and Wind turbine-Battery to fulfill load demand in the daylight time (06.00 to 18.00 AM), night time (18.00 PM to 06.00 PM) and daily time. These experiments were conducted to obtain an optimal schedule in the utilization of solar and wind energy. Optimal load capacity of these utilizations was obtain by distributed total load into 1 to 10 submicrogrids such as illustrated in the Table 1 until Table 3 as follow.

Solar radiant intensity and wind velocity profile was depending on the astronomies location, namely 7º53' in north latitude and 110º20' in east longitude. Solar radiant intensity and wind velocity profile can be downloaded from NASA [17]. Fig. 1 and Fig. 2 show solar radiant intensity and wind velocity profile in the section C, section G and section N. Based on these figures, solar radiant intensity in these regions was 4.8 $kWh \cdot m^{-2} \cdot day^{-1}$ and the average profile of wind velocity was 4.21 $m^2 \cdot s^{-1}$. The clearness index indicated that not all solar energy potency can be converted to be electrical energy.

Table 1. Load capacity in every distributed load to fulfill load demand in the daylight

Level of load capacity	Section C	Section G	Section N
1	318 kWh · day^{-1} 62 kWp	662 kWh · day^{-1} 130 kWp	172 kWh · day^{-1} 34 kWp
2	159 kWh · day^{-1} 31 kWp	331 kWh · day^{-1} 65 kWp	86 kWh · day^{-1} 17 kWp
3	106 kWh · day^{-1} 21 kWp	221 kWh · day^{-1} 43 kWp	57 kWh · day^{-1} 11 kWp
4	79 kWh · day^{-1} 16 kWp	165 kWh · day^{-1} 32 kWp	43 kWh · day^{-1} 8.4 kWp
5	64 kWh · day^{-1} 12 kWp	132 kWh · day^{-1} 26 kWp	34 kWh · day^{-1} 6.7 kWp
6	53 kWh · day^{-1} 10 kWp	110 kWh · day^{-1} 22 kWp	29 kWh · day^{-1} 5.6 kWp
7	45 kWh · day^{-1} 8.9 kWp	95 kWh · day^{-1} 19 kWp	25 kWh · day^{-1} 4.8 kWp
8	40 kWh · day^{-1} 7.8 kWp	83 kWh · day^{-1} 16 kWp	22 kWh · day^{-1} 4.2 kWp
9	35 kWh · day^{-1} 6.9 kWp	74 kWh · day^{-1} 14 kWp	19 kWh · day^{-1} 3.7 kWp
10	32 kWh · day^{-1} 6.2 kWp	66 kWh · day^{-1} 13 kWp	17 kWh · day^{-1} 3.4 kWp

Table 2. Load capacity in every distributed load to fulfill load demand in the night

Level of load capacity	Section C	Section G	Section N
1	276 kWh · day^{-1} 46 kWp	574 kWh · day^{-1} 95 kWp	149 kWh · day^{-1} 25 kWp
2	138 kWh · day^{-1} 23 kWp	287 kWh · day^{-1} 47 kWp	75 kWh · day^{-1} 12 kWp
3	92 kWh · day^{-1} 15 kWp	191 kWh · day^{-1} 32 kWp	50 kWh · day^{-1} 8.2 kWp
4	69 kWh · day^{-1} 11 kWp	144 kWh · day^{-1} 24 kWp	37 kWh · day^{-1} 6.2 kWp
5	55 kWh · day^{-1} 9.1 kWp	115 kWh · day^{-1} 19 kWp	30 kWh · day^{-1} 4.9 kWp
6	46 kWh · day^{-1} 7.6 kWp	96 kWh · day^{-1} 16 kWp	25 kWh · day^{-1} 4.1 kWp
7	39 kWh · day^{-1} 6.5 kWp	82 kWh · day^{-1} 14 kWp	21 kWh · day^{-1} 3.5 kWp
8	35 kWh · day^{-1} 5.7 kWp	72 kWh · day^{-1} 12 kWp	19 kWh · day^{-1} 3.1 kWp
9	31 kWh · day^{-1} 5 kWp	64 kWh · day^{-1} 11 kWp	17 kWh · day^{-1} 2.7 kWp
10	28 kWh · day^{-1} 4.6 kWp	57 kWh · day^{-1} 9.5 kWp	15 kWh · day^{-1} 2.5 kWp

Table 3. Load capacity in every distributed load to fulfill load demand in the full day

Level of load capacity	Section C	Section G	Section N
1	594 kWh · day^{-1} 62 kWp	1 236 kWh · day^{-1} 130 kWp	322 kWh · day^{-1} 34 kWp
2	297 kWh · day^{-1} 31 kWp	618 kWh · day^{-1} 65 kWp	161 kWh · day^{-1} 17 kWp
3	198 kWh · day^{-1} 21 kWp	412 kWh · day^{-1} 43 kWp	107 kWh · day^{-1} 11 kWp
4	148 kWh · day^{-1} 16 kWp	309 kWh · day^{-1} 32 kWp	80 kWh · day^{-1} 8.4 kWp
5	119 kWh · day^{-1} 12 kWp	247 kWh · day^{-1} 26 kWp	64 kWh · day^{-1} 6.7 kWp
6	99 kWh · day^{-1} 10 kWp	206 kWh · day^{-1} 22 kWp	54 kWh · day^{-1} 5.6 kWp
7	85 kWh · day^{-1} 8.9 kWp	177 kWh · day^{-1} 19 kWp	46 kWh · day^{-1} 4.8 kWp
8	74 kWh · day^{-1} 7.8 kWp	155 kWh · day^{-1} 16 kWp	40 kWh · day^{-1} 4.2 kWp
9	66 kWh · day^{-1} 6.9 kWp	137 kWh · day^{-1} 14 kWp	36 kWh · day^{-1} 3.7 kWp
10	59 kWh · day^{-1} 6.2 kWp	124 kWh · day^{-1} 13 kWp	32 kWh · day^{-1} 3.4 kWp

Extraction of solar radiant intensity to be electrical energy was based on photo-electric effect [18]. Furthermore, direct current can be produced by the existing internal resistance in the module construction and the mathematical expression was given in the [19]. Software HOMER was used HDKR model to get solar radiant model which was falling in the surface of solar panel [15]. On the other hand, wind energy was extracted by multiplication of Weibull distribution function and power curve of wind turbine [20]. Software HOMER was used linear interpolation to get power output coming from wind turbine generator [15].

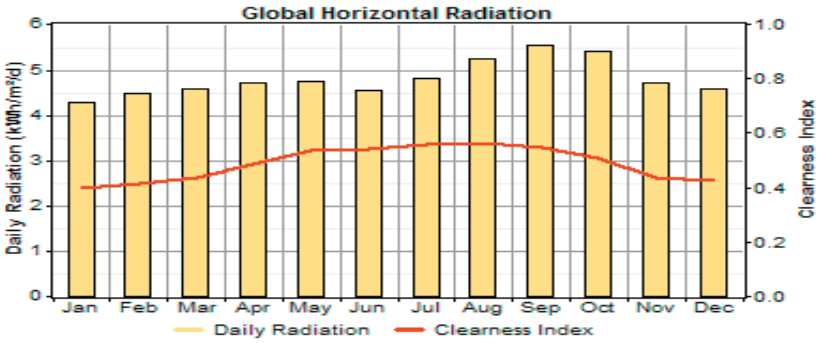


Fig. 1 Profile of solar radiant intensity in the section C, section G and section N

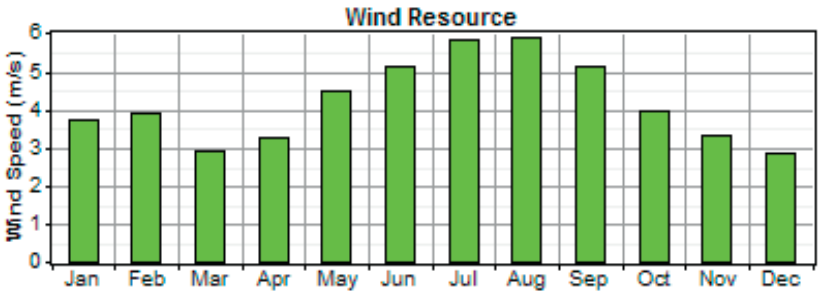


Fig. 2 Profile of wind velocity in the section C, section G and section N.

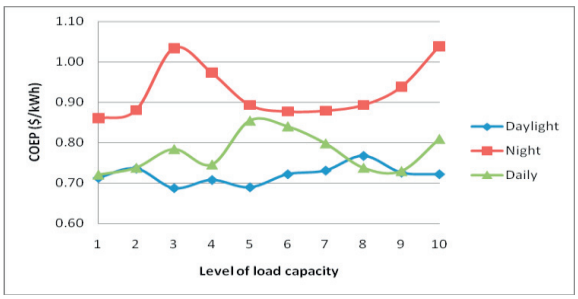
Then, specification of wind turbine, solar panel, battery and converter in this research are suitable in the reference [21] while the real interest rate was difference between discount rate and inflation rate. In this simulation, its was 0.20 %, namely the difference between inflation rate and discount rate in Indonesia [22,23].

3. Result and discussion

3.1. Determining optimal schedule in the utilization of solar and wind energy

Fig. 3, Fig. 4 and Fig. 5 elucidated comparison cost of electricity production in the utilization of solar energy in the section C, section G and section N. Three different locations illustrate different load capacities such as mentioned in the Table 1, Table 2 and Table 3. Based on these figures, utilization of solar energy to fulfill load demand in the daylight, night and daily produces different profile of COEP in each section.

a)



b)

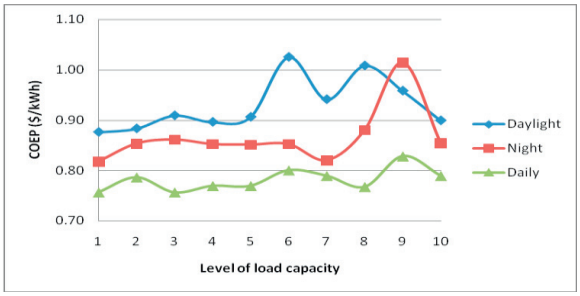


Fig. 3 a) Comparison of COEP in the utilization of solar energy to in the section C;
b) Comparison of COEP in the utilization of wind energy in the section C.

In the Fig. 3a, the highest COEP was occur when solar energy wass used to fulfill load demand in the night and the lowest COEP was occur when solar energy to fulfill load demand in the daylight time. The condition was caused by the process of energy transformation. Transformation of electrical energy utilization to the load, namely load with consumed AC consists of two processes, i.e., transformation DC to AC and AC to DC. But, the percentage of these processes was different. Solar panels receive solar radiant intensity and convert them to be electrical energy in the daylight. At the same time, solar panels transform electrical energy to the load. Utilization of solar energy in that time was more efficient than utilization in the other time due to solar panels can produce electrical energy in the full time, i.e., 09.00 to 15.00 AM. In this fact, capacity of battery as energy storage can be minimized because electrical energy which was produced n that time was consumed in same time. On the other time, the power which was produce every time with solar panels was not due to these intermittent characteristics. Stabilization of produced power was using battery battery recently. Furthermore, in the utilization of solar energy to serve load demand in the night time, electrical energy which was produced by solar panels in the daylight cannot consumed in the same time. As a consequence, there was high capacity of battery so it was caused high cost of electricity production. Then, the phenomenon in the utilization of solar energy to serve load demand for daily load was merger these energy transformation. The basic physical process of energy transformation like that was happened in the section G (Fig. 2a) and section N (Fig. 3a). The different transformation process was caused by the availability of solar radiant, namely available only a part of daylight.

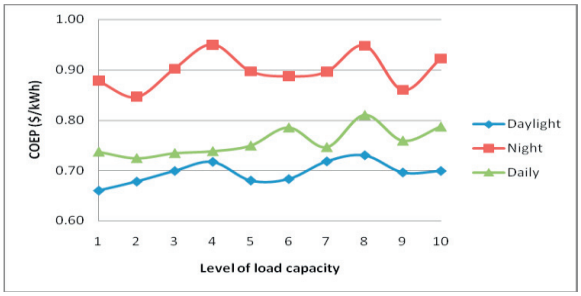
The different process in the conversion of wind energy was illustrated in Fig. 1b, Fig. 2b and Fig. 3b. Based on these figures, the highest cost of electricity production was happened in the utilization of wind energy to fulfill load demand in the daylight and the lowest cost was happened in the daily time. The high cost in the utilization in the daylight because the high intermittent in there and the low cost in the utilization of wind energy to serve load demand in the daily time because the high potency of wind energy to supply electrical energy than solar energy. Different from solar energy conversion, though power produces from wind energy has the same form with load demand but it cannot supply them directly. It was caused by the intermittent characteristic. The high willingness of cost of electricity production in the utilization of wind energy than solar energy was caused by its intermittent characteristic. Furthermore, as an increasing its characteristic cause the high capacity of battery needed so the cost was increasing. Different from solar radiant, wind velocity profile in the daily did not depending on the time utilization.

Then, efficiency in the utilization of solar and wind energy were depending on the suitability between RERs in microgrid and load demand profile. As a decreasing them, the excess electricity was increasing. Excess electricity was exhausted to the environment as a thermal energy but it causes high COEP.

Referring to solar energy utilization, lowest cost of electricity was existed at daylight time but with considering the load served, the utilization of solar energy to fulfill daily load more efficient. The utilization of wind energy was clearly efficient to fulfill daily load. In the utilization of solar energy in the section C, cost of electricity production in there was USD 0.71 · $(kWh)^{-1}$, section G USD 0.69 · $(kWh)^{-1}$ and section N USD 0.79 · $(kWh)^{-1}$. The utilization of wind energy in the section C was having cost USD 0.77 · $(kWh)^{-1}$; section G USD 0.75 · $(kWh)^{-1}$ and section N USD 0.73 · $(kWh)^{-1}$. Comparing to the utilization of solar and wind energy to serve daily load, the utilization of wind energy was lower cost than solar energy. The differences between two kinds was 0.65 % in the section C, 0.18

% in section G and 1.88% in section N. The difference explained that potency of solar and wind energy has the same contribution to serve load demand with the same COEP. Finally, it was better that solar and wind energy were used together through forming microgrid PV-Wind turbine-Battery such as in illustrated in Fig. 6. In the section C, the cost of electricity production for PV-Wind turbine-Battery was USD 0.63 · $(kWh)^{-1}$, section G USD 0.63 · $(kWh)^{-1}$ and section N USD 0.65 · $(kWh)^{-1}$.

a)



b)

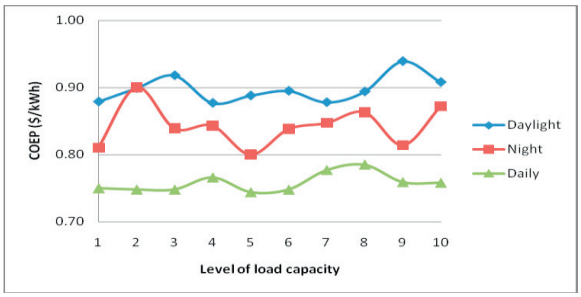
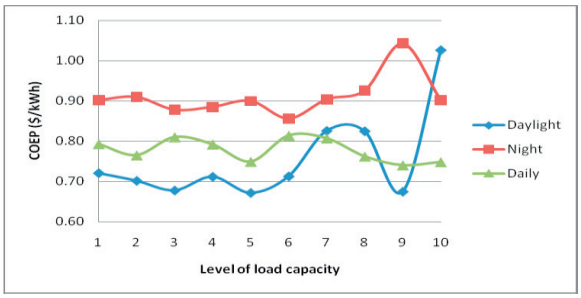


Fig. 4 a) Comparison of COEP in the utilization of solar energy in the section G;
b) Comparison of COEP in the utilization of wind energy in the section G.

a)



b)

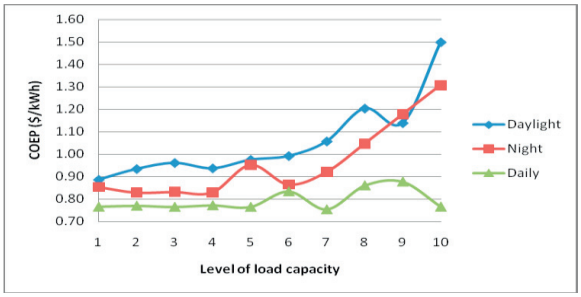


Fig. 5 a) Comparison of COEP in the utilization of solar energy in the section N;
b) Comparison of COEP in the utilization of wind energy in the section N.

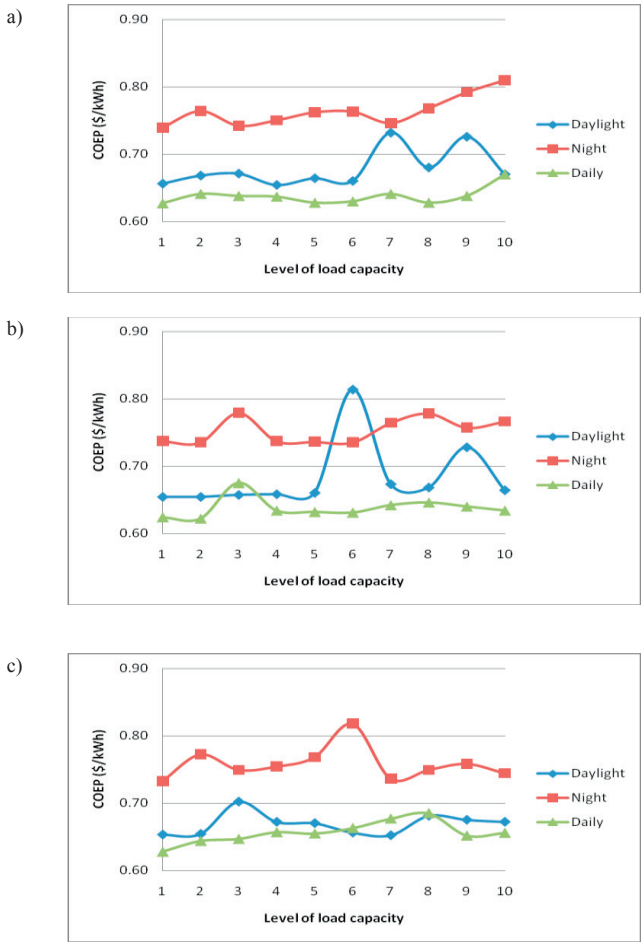


Fig. 6 a) Comparison of COEP in PV-Wind turbine-Battery in section C; b) Comparison of COEP in PV-Wind turbine-Battery in section G; c) Comparison of COEP in PV-Wind turbine-Battery in section N.

3.2. Determining optimal load capacity in the utilization of solar and wind energy

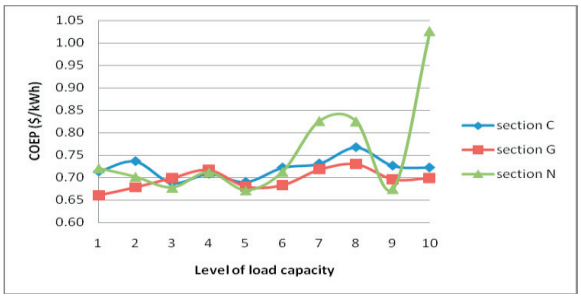
Mentioned previously that the COEP in the utilization of solar and wind energy was depending on the conformity between RERs and load profile. The high conformity was causing lower cost of electricity production and the other. Furthermore, research to obtain optimal load capacity must be considered time utilization due to solar radiant.

Fig. 7 elucidated that load capacity was decreasing in COEP relatively high. It was explained that small load demand in the microgrid did not guarantee the low cost. With the polynomial regression analysis in order 2nd, profile of electricity production cost in there was being analyzed.

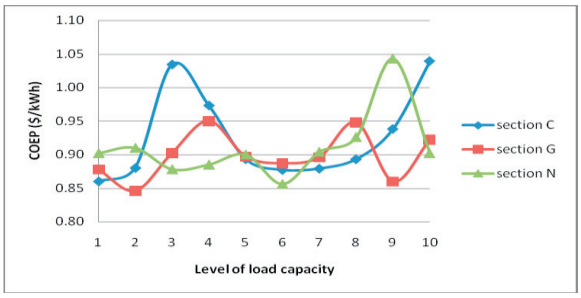
In the utilization of solar energy to serve load demand in the daylight time, lowest COEP in the section C was in 2nd level of load capacity (159 kWh · day^{-1} 31 kWp), section G 7th level (95 kWh · day^{-1} 19 kWp) and section N 4th (43 kWh · day^{-1} 8.4 kWp). Then, with the same analysis method for these utilizations in the night time, section C was in the 4th level of load capacity (69 kWh · day^{-1} 11 kWp), section G 7th (82 kWh · day^{-1} 14 kWp) and section N 4th (37 kWh · day^{-1} 6.2 kWp). Furthermore, in the utilization of solar energy in the daily time, the lowest COEP in the section C was in the 6th level of load capacity (99 kWh · day^{-1} 10 kWp), section G 1st (1 236 kWh · day^{-1} 130 kWp) and section N 4th (80 kWh · day^{-1} 8.4 kWp).

Such as in the section 3.1 in the above, the optimal schedule in the utilization of solar energy, namely schedule which was caused the low COEP, the efficient load capacity in the utilization of them was in the supplying load demand in the full day. Then, the lowest cost in there was happened in the utilization of solar energy to fulfill 1 236 kWh.day^{-1} 130 kWp. It was good information for government that we have a big potency to utilize solar energy to fulfill electrical energy demand. It was clarified in these figures that as decreasing load capacity cause increasing of COEP.

a)



b)



c)

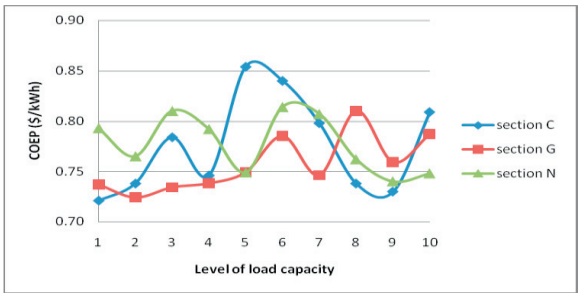


Fig. 7 a) Comparison of COEP in the utilization of solar energy in the daylight; b) Comparison of COEP in the utilization of solar energy in the night; c) Comparison of COEP in the utilization of solar energy in the full day.

The same fact also happened in the utilization of wind energy such as in the Fig. 8. As an increasing of load capacity level, the cost of electricity production in there was increasing too. With the same method in the determining optimal capacity for utilizing solar energy, the lowest cost in the utilization of wind energy to serve load demand in the daylight time in section C was in the 7th level of load capacity (45 kWh • day-1 8.9 kWp), section G 4th (165 kWh • day-1 32 kWp) and section N 3rd (57 kWh • day-1 11 kWp). Then, utilization of wind energy for serving load demand in the night in section C was 1st (276 kWh • day-1 46 kWp), section G 5th (115 kWh • day-1 19 kWp) and section N 3rd (50 kWh • day-1 8.2 kWp). Finally, in the utilization of wind energy for full day in the section C was 1st (594 kWh • day-1 62 kWp), section G 1st (1,236 kWh • day-1 130 kWp) and N 1st (322 kWh • day-1 34 kWp). Furthermore, wind energy in these sections was suitable to fulfill load capacity 1 236 kWh • day-1 130 kWp.

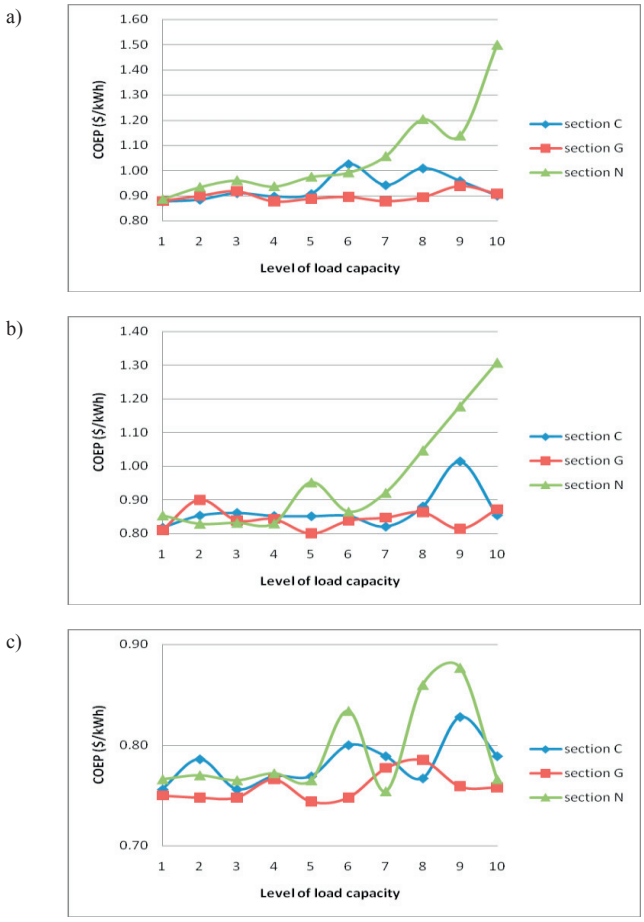


Fig. 8 a) Comparison of COEP in the utilization of wind energy in the daylight; b) Comparison of COEP in the utilization of wind energy in the night; c) Comparison of COEP in the utilization of wind energy in the full day.

Solar and wind energy were the kinds of RE whose intermittent characteristic. Different from the other sources such as fuel cell and biomass or biogas, the characteristic was harder to control. The economically of the utilization in there was depending on the capacity of source, namely solar radiant intensity and wind velocity, utilization schedule and load profile. As an increasing of capacity source, the capability to handle high load demand was increasing and the opposite. In the fact, utilization of these sources whose have small capacity to fulfill high load demand made utilization does not effective with remember that economic factor was the first priority to choose the kind of RE. Then, the availability of solar radiant intensity and wind velocity was being affected by time of utilization. So, the utilization of them when the sources did not exist on the time of utilization would make high cost to consumed energy storage. Furthermore, profile of load demand was being affected economically utilization of solar and wind energy. The high conformity between load profile and profile of RERs made the cost to be low.

4. Conclusion

Regarding to this research experiment, low load capacity in the utilization of solar and wind energy in the area whose solar radiant intensity 4.8 kWh · m^{-2} · day^{-1} and average of wind velocity 4.21 m · s^{-1} did not guarantee the lower cost of electricity production. Trough simulations, efficient utilization of solar and wind energy was happened if these resources are used to fulfill daily load demand. Furthermore, the analysis to determine optimal load capacity in these utilizations, load capacity that can be overcome through resources 1 236 kWh · day^{-1} 130 kWp.

The schedule and time utilization can be used in the utilization of solar and wind energy in Indonesia because almost region in there have the same potencies. On the other hand, case study with many load capacities was needed. Then, the economically of solar and wind energy was beind independing on the cost of electricity production only. Finally, determining optimal schedule and optimal load capacity have considered penalty given, certificate of carbon trade, area installation, unemployment reduction and sustainability.

References

[1] Tan WS, Hasan MY, Majid S, Rahman HA. Optimal distributed renewable generation planning: A review of different approaches. Renewable and Sustainable Energy Reviews vol. 18; 2013, p. 626-645.

[2] Sukarna D. Opportunity and challenge in the development of new and renewable rnergy. Yogyakarta, September 21, 2011.

[3] DIY (Daerah Istimewa Yogyakarta). Rencana umum ketenagalistrikan daerah Propinsi Daerah Istmewa Yogyakarta tahun anggaran 2008 [Structural planning of electricity development review for Yogyakarta Special Region Province in budgeting year 2008] Dinas Perindustrian, Perdagangan dan Koperasi Bidang Pertambangan dan Energi Pemerintah Propinsi Daerah Istimewa Yogyakarta, Yogyakarta. Laporan Akhir; 2008 [Bahasa Indonesia].

[4] Solanki A, Montoya LF, Fu Q, et al. Managing intermittent renewables in a microgrid. IEEE; 2011, p. 1-6.

[5] Zhang L, Gari N, Hmurcik LV. Energy management in a microgrid with distributed energy resources. Energy Conversion and Management vol. 78; 2014, p. 297-305.

[6] Erdinc O, Uzunoglu M. Optimum design of hybrid renewable energy system: Overview of different approaches. Renewable and Sustainable Energy Reviews vol. 16; 2012, p. 1412-1425.

[7] Hongen T, Bo W, Dichen L, Suxuan G. Analysis of distributed generation system based on micro-grid and its impaction on voltage distribution. IEEE; 2011.

[8] Tan X, Li Q, Wang H. Advances and trends of energy storage technology in microgrid. Electrical Power and Energy Systems, vol. 44; 2013. p. 2013.

[9] Chermak C. The environmental impacts of wind integration and comparison to conventional energy sources: A life cycle analysis of wind generation transmission in Texas. Thesis, Southern Methodist university; 2009.

[10] Ayyub BM, Amin M. Handbook of energy efficiency and renewable e nergy. CRC Press, United States of America; 2007.

[11] Thiam DR. Renewable decentralized in developing countries: Appraisal from microgrids project in Senegal. Renewable Energy, vol. 35; 2010. p. 1615-1623.

[12] Bekele G, Palm B. Feasibility study for a standalone solar-wind based hybrid energy system for application in Ethiopia. Applied Energy, vol. 87; 2010. p. 487-495.

[13] Dalton GJ, Lockington, Baldock, TE. Feasibility analysis of renewable energy supply options for a grid-connected large hotel. Renewable Energy, vol. 34; 2009. p. 955-964.

[14] Su W, Yuan Z, Chow MY. Microgrid planning and operation: Solar energy and wind energy. IEEE; 2010. p. 1-7.

[15] Liu S, Wu Z, Dou X, et al. Optimal configuration of hybrid solar-wind distributed generation capacity in a grid-connected microgrid. IEEE PES Innovative Smart Grid Technologies; 2013. p. 1-6.

[16] G Mendes, C Ioakimdis, P Ferrao. On the planning and analysis of integrated community energy systems: A review and survey of available tools. Renewable and Sustainable Energy Reviews, vol. 15; 2011. p. 4836-4854.

[17] Dimakis AA, Biberacher B, Dominguez J, et al. Methods and tools to evaluate the availability of renewable energy sources. Renewable and Sustainable Energy Reviews, vol. 15; 2011. p. 1182-1200.

[18] Ali MS. Photovoltaic systems modeling and analysis. [Thesis] Kind Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia; 2010.

[19] Jianye L, Jia L. Model and control of a DC microgrid made up by solar and wind. International Conference on Computer Science and Electronics Engineering; 2012. p. 437-441.

[20] Nor KM, Shaaban M, Rahman HA. Feasibility assessment of wind energy resources in Malaysia based on NWP models. Renewable Energy, vol. 62; 2014. p. 147-154.

[21] Mondal MAH, Islam AKMS. Techno-economic feasibility of grid connected solar PV system in Bangladesh. 1st International Conference on the Developments in Renewable Energy Technology (ICDRET), IEEE; 2009. p. 1-4.

[22] BI (Bank Indonesia). Indonesia Interest Rate [Laju Pembungaan di Indonesia]. [internet] Accessed Nov. 3, 2013, from http://www.tradingeconomics.com/indonesia/interest-rate [Bahasa Indonesia].

[23] BI (Bank Indonesia). Indonesia Interest Rate [Laju Pembungaan di Indonesia]. [internet] Accessed Nov. 3, 2013, from http://www.tradingeconomics.com/indonesia/interest-rate [Bahasa Indonesia].