Energy-Efficient Cloud Computing using Power Optimisation

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***Abstract*—Cloud computing is ahighly sought trend in the current time which involves the usages of resources on demand, virtualization, and many more computational demands. With the exorbitant demand of users of cloud and increasing complexity of problems, many resources are required to maintain the cloud. To adhere to the increasing requests we need ahuge amount of natural, financial and technical resources such as land, money, datacenters, etc. Maintaining huge data over cloud needs deployment of a huge number of datacenters which absorbs electricity which in turn produce ahuge amount of heat. This heat produced will be contributing to the poisonousgasses such as carbon-di-oxide by use of coolant at data center and servers [1]. Without properly optimized management of the cloud computing is not a worth practice because it will add to the expenditures of the organization. Proper resource management should be done in anoptimized manner such that all entities get sufficient resources for their computation. For properly optimized management resource management, there is needed to imbibe green cloud computing principles. Green cloud computing provides provisions to make cloud energy and cost efficient. This paper provides methods and techniques to make energy efficient cloud using Green Cloud computing principles.**

***Keywords*—**Cloud computing, Green Cloud Computing, Scheduling, Workload balancing, Green cloud computing simulator.

I. INTRODUCTION

Cloud computing is a procedure for making omnipresent, helpful, on-request arranges access to thesame type of configurable figuring assets (e.g., systems, servers,etc.) that can be quickly provisioned and discharged with insignificant administration exertion or specialist cooperation[1].Various characteristics of thecloudareOn-demandservice, large network access, resourceallotment, elasticity, etc. The various layers of cloud consistIAAS, SAASand PAAS. Cloud computing has four articulation model namely public, private, hybrid and community cloud for which proper resource management should be done. The resource management in cloud computing means optimized theuse of heterogeneous and location based shared resource for the client request. Theoptimized use of cloud holds a great importance as the number of cloud users and resources increases by manifold due to increase in computer resources and client request. This leads to more servers and more development data centers and other physical entities. This will increase the cost as well as it will affect the environment by theemission of heat and high usage of electricity which in turns require coolants. So there is aneed for green cloud computing to give resources to the cloud entities according to their need and maintain proper statistics of their usage. Proper scheduling and workload balancing of the resources should be done to make an efficient and optimized cloud [3]. Green cloud computing focuses mainly on theusage of its resources such as data center and servers. Green cloud computing can be achieved by algorithmic efficiency, virtualization, dynamic resource allocation and power management. Green cloud computing model is shown in thefigure.

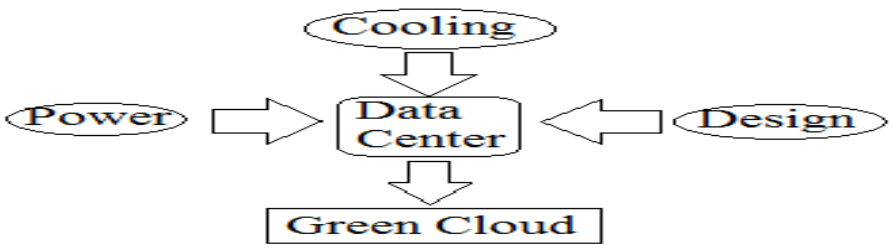


Figure 1:Green cloud computing model

Green cloud computing simulator is used for simulation of the CPU resources, energy consumed and the various statistical data to analyze and optimize the cloud. This simulator gives the proper graph based on the resources used and optimized use of resources.

II. METHODOLOGY FOR GREEN COMPUTING

Essentially four methodologies have been gone for to make Cloud computing situations more efficient and green. These methodologies have been gone for in the server farms under trial conditions. The handy utilizations of these strategies are still under review and techniques are:-

• **Dynamic Voltage Frequency scaling method (DVFS):-** Each electronic hardware will have a working clock related with it. The working recurrence of this clock is balanced so that the supply voltage is controlled. Consequently, this technique intensely relies on upon the equipment and is not controllable as indicated by the fluctuating needs. The power investment funds are additionally low contrasted with different methodologies. The control reserve funds to cost caused proportion is additionally low.Although DVFS is a hardware intensive task as compared to algorithmic or resource allotment task and so it is less preferred over main green computing techniques [6].

• **Resource allotment with dynamism and virtual machine relocation procedures: -** In a cloud computing condition, each physical machine has various virtual machines whereupon the applications are run [6]. These virtual machines can be exchanged over the hosts as indicated by the shifting needs and accessible assets. The VM relocation technique concentrates on moving VMs such that the watt increment is minimum. The most efficient hubs are chosen and the VMs are exchanged crosswise over to them. The vitality effective methodologies for green processing determined in concentrated on VMS assignment and relocations. Be that as it may, movement and booking of virtual machines likewise acquire some price which may not be disregarded.

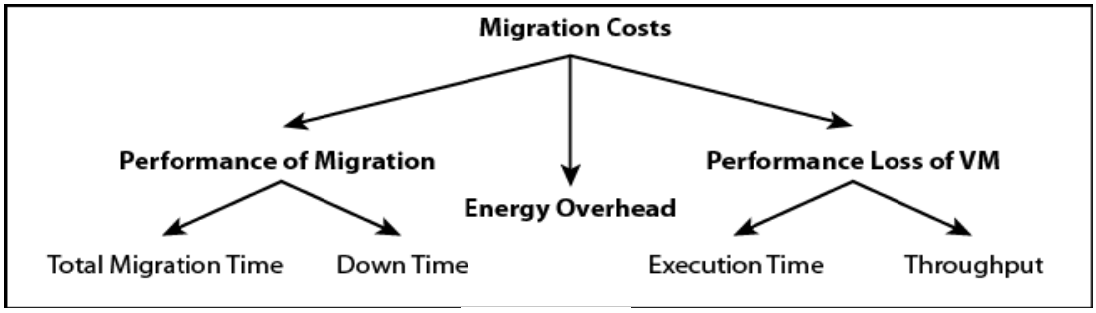


Figure 2

VM designation and movement can shift the vitality proficiency of the cloud networks however in the event that the systems are not used properly; it can prompt high vitality utilization and thusly high poisonous gases. The writers in [5], had proposed a VM arrangement algorithmic approach for ameliorating the power utilization and gas outflow.

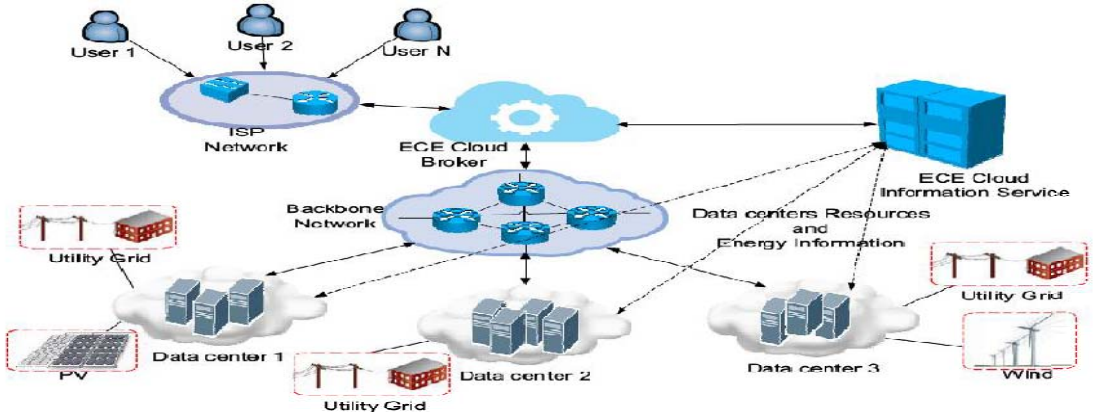


Figure 3

• **Virtualization**: - It helps in reducing the workload and working expense by essentially running various working frameworks together on a common framework [7].

• **Algorithmic methodologies**: - It has been tentatively confirmed that a perfect server devours around 70% of the power used by a completely used server. Another element like theshutdown of underutilized machines and movements of workloads from the machines that are working underneath a particular limit were likewise

utilized. The algorithm was fit for playing out the booking of VMs in non-unified, different type of data centers [6].

III. POWER CONSUMPTION IN CLOUD COMPUTING

The power utilization of servers can be precisely portrayed by a direct connection between the power utilization

$$P(u) = Pmax\ (0.7+ 0.3\ u) \qquad (1)$$

and CPU usage, as appeared in [3]

Where Pmax is 250 W for current figuring server and 'u' is the CPU usage and the reviews say that a normal power devoured by a sit without moving server is 70% of theenergyexpanded.So the aggregate vitality devoured (E) as appeared in (2)

$$E = \int t\ P\ (u\ (t))\ dt \qquad (2)$$

Here the total CPU utilization power is calculated as well as its energy consumed.

The writers in [5] worked on the vitality utilization in the migration procedure for different sorts of workloads by doing test contemplate in which it was found that migration can bring about an expansion in power use by around 10 percent. Likewise in a few applications, the power utilization can be diminished by reducing the length of relocation.i.e.: 1.1 Times Power or 110W Power as compared to 100W. So we have to reduce the Power/energy to its minimum value by differentiating it with respect to time and finding its Minima. **dE/dt<0=Pmin**(For min value-efficient).

IV. THE SOLUTIONFOR EFFICIENT CLOUD

Hybrid VM Selection policy Algorithm [4]:-

1. Analyse Vms on the host.
2. Find if the Vm on the host are migratable. If there are no migratable Vms return null.
3. Set first Vm CPU utilization and ram equal to minimum.
3. Find the CPU utilization and memory utilization of the Vm on the host.
If (CPU utilization >= minimum)
Compare CPU utilization and memory utilization with the previously stored Vm
If (CPU utilization of selected Vm< stored Vm) and (ram utilization of selected Vm< stored Vm)
Select Vm for migration.
4. Repeat step 3 till all Vms is analysed.

Low Utilization Host Policy Algorithm [4]:-

After choosing the Virtual machines to be relocated next procedure is to choose the host on which it can be relocated.

As indicated by our examination it is better thought to move VMs on the hosts that have low CPU use in light of the fact that in the event that we will relocate VMs over a host that has high CPU use there are chances that we may overburden the host and host may crash. Relocating VMs over low usage host will lessen the probability of host over-burdening.

1. Get the list of host to which Vm can be migrated.
2. Find the total utilization of the host.
3. If it is the first host in the list, store its utilization information, this information will be used as reference to compare with other hosts.
4. Compare the utilization of the hosts with the previous host; if the utilization of host is less than previously stored utilization info replace the utilization information.
5. Compare utilization of each host. In the end we will have host with lowest utilization.
6. Return host, this host will be selected for VM migration.

V. GREEN CLOUD SIMULATOR

Green Cloud Simulator is an arranged test system for measuring of theworkload in cloud computing. It imprints the different entities of cloud, for example, servers, switches, etc. for conveyance and their viability [4]. It can be favorable in advancing explanations for looking over and allocation of different stores, recording assignments for a number of customers, building up the guidelines required for conveyance and furthermore picking up comes about for system switches. The centers upgrading may be executed utilizing this device.

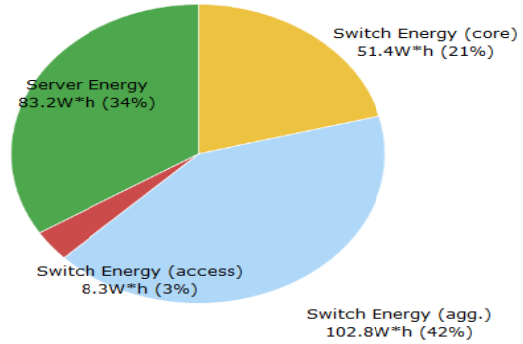
Taking into account the original values set **for three tier high speed**
Number of Rack Hosts – 3
Access Switches – 256
Aggregation Network – expr (2* top Ncore)
Core Switches – 2
No of servers-36

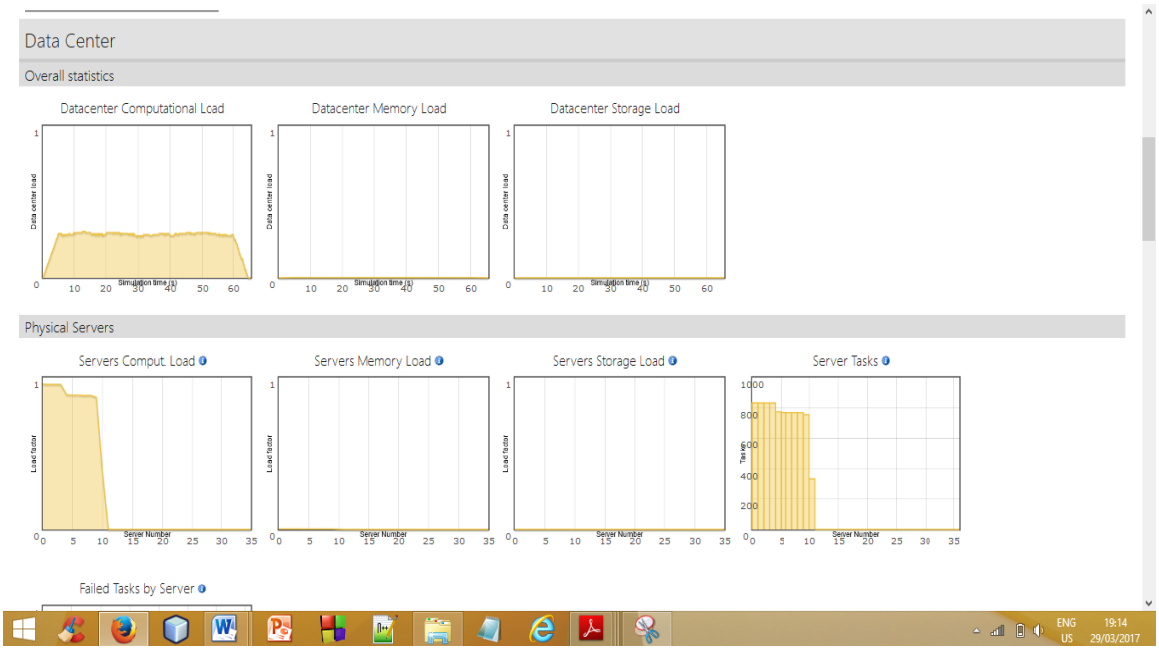
No of users: 1

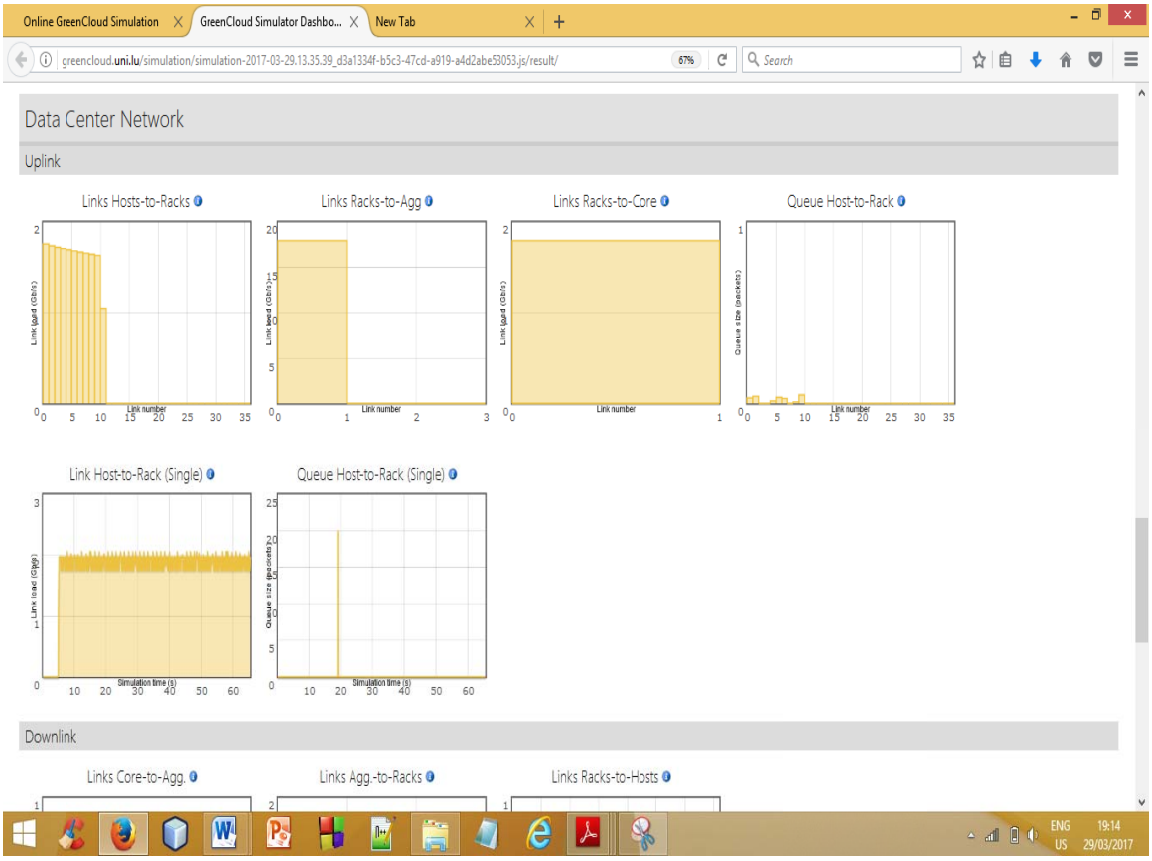
Energy efficiency: 306.2 W*h

Figures of Experiment 1 with cloud user: 1

Switches (core):	1
Switches (agg.):	2
Switches (access):	3
Servers:	36
Users:	1
Power Mgmt. (servers):	No
Power Mgmt. (switches):	No
task.mips:	300000
task.memory:	1000000
task.storage:	300000
task.size:	8500
task.outputsize:	250000
Average Load/Server:	0.3
Datacenter Load:	26.4
Total Tasks:	8264
Average Tasks/Server:	229.6
Tasks Rejected by DC:	0
Tasks Failed by Servers:	0
Total Energy:	245.7 W*h
Switch Energy (core):	51.4 W*h
Switch Energy (agg.):	102.8 W*h
Switch Energy (access):	8.3 W*h
Server Energy:	83.2 W*h



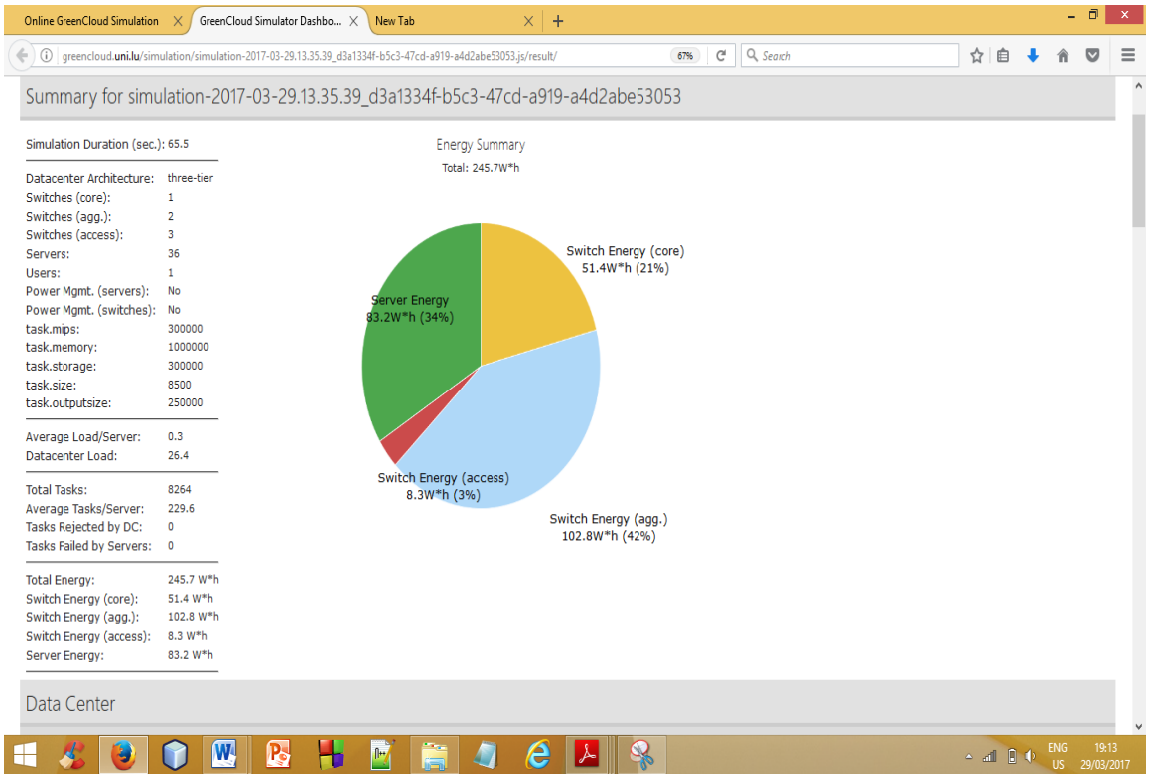




No of users: 2

Energy efficiency: 447.5 W*h

Figures of Experiment 2 with cloud user: 2



According to the experiment done using cloud simulator when we doubledthe quantity of cloud clients to the 98percent so in like manner the power consumed ought to likewise be multiplied that will be expanded 98 percent just however rather it is quite recently expanded 43 percent. We can check through qualities too when cloud workers- 1 the power was 316.2 Watt-hour and when we multiplied the cloud workers- 2 the power consumed came up to 477.5 Watt-hour.

VI. CONCLUSION

A useful and proficient usage of figuring assets in thecloud can help in accomplishing Green Cloud Computing. In this paper, we have talked about variousexperiments proposed in past research works in this field. The cloud efficiency can help in thebetter use of assets in Clouds. VM scheduling relocation is vital however the cost and power usage of relocation procedures came to likewise be taken in assessing framework execution.The use of simulation tool shows how green cloud can be achieved efficiently by observing the components like servers, users, switches, etc.

VII. FUTURE SCOPE

Later on work, there can be afurther review on energy saving methods for live VM relocation arrangement with such advancement forms that whatever number physical has as would be prudent are closed down. Through this, we can diminish the energy consumption in near future. As future work, we can examine a few Cloud situations and propose new enhancement approaches which will limit the CO2 emanations, we will coordinate energy cost rate into our new models in varying ecological effect and to limit the energy cost. With advancement in cloud computing the various new methods and techniques would be invented which will contribute to the efficiency and eco-friendly nature of cloud computing.Future Research work incorporates better other option to information focus energy proficient mindful booking calculation in Green Cloud Simulator in order to lessen more energy utilization and therefore lessening heat with expanding the cloud clients or, then again reproduction time.

VIII.LITERATURE SURVEY

YEAR	Methodology/Objectives	Issues
2016	A Survey Of Computing Strategies For Green Cloud	Innovations in green cloud computing practices.
2015	Towards Green Cloud Computing: Demand Allocation and Pricing Policies for Cloud Service Brokerage	More optimized allocation policies and brokering facilities.
2016	Perception of Energy Efficiency in Green Cloud Simulator	Use of tools to implement the efficient cloud.
2015	Use of awareness cloud computing	Advanced awareness of the user characteristics.
2015	Optimization of Energy Efficiency for SLA manager.	Giving the services based on the requirements and maintaining the SLAs.
2011	Profiling vitality utilization of VMs for green distributed computing	Analysis of usage and energy consumption with proper tools.
2012	Green Cloud Computing techniques	Use of less physical resources and efficient cloud.
2014	Vitality Approaches for Green Cloud Figuring	Making advanced procedures and techniques for green cloud computing.
2015	Vitality Efficient Hybrid Policy in Green Distributed computing	Making policies and regulations in the cloud to ensure green cloud computing principles.
2015	Green IT Territories of Cloud Computing Environment for management	New branches of green cloud computing to be developed based on the increasing need and demand forcloud.

IX. REFERENCES

[1] Rubyga, G., and Ponsy RK SathiaBhama. "A survey of computing strategies for thegreen cloud." Science Technology Engineering and Management (ICONSTEM), Second International Conference on. IEEE, 2016.

[2] Qiu, Chenxi, Haiying Shen, and Liuhua Chen. "Towards green cloud computing: Demand allocation and pricing policies for cloud service brokerage." Big Data (Big Data), 2015 IEEE International Conference on. IEEE, 2015.

[3] Kushwaha, Anup Singh, Bashir Alam, and Gaganjot Kaur. "Observation of energy efficiency in Green cloud simulator." Cloud System and Big Data Engineering (Confluence), 2016 6th International Conference. IEEE, 2016.

[4] Farahnakian, Fahimeh, et al. "Utilization prediction aware VM consolidation approach for green cloud computing." Cloud Computing (CLOUD), 2015 IEEE 8th International Conference on. IEEE, 2015.

[5] Anan, Muhammad, and Nidal Nasser. "SLA-Based Optimization of Energy Efficiency for Green Cloud Computing." Global Communications Conference (GLOBECOM), 2015 IEEE. IEEE, 2015.

[6] Chen, Qingwen, et al. "Profiling energy consumption of VMs for green cloud computing." Dependable, Autonomic and Secure Computing (DASC), 2011 IEEE Ninth International Conference on. IEEE, 2011.

[7] Gayathri, B. "Green cloud computing." Sustainable Energy and Intelligent Systems (SEISCON 2012), IET Chennai 3rd International on. IET, 2012.

[8] Wadhwa, Bharti, and Amandeep Verma. "Energy saving approaches for green cloud computing: a review." Engineering and Computational Sciences (RAECS), 2014 Recent Advances in. IEEE, 2014.

[9] Goyal, Yashi, Meenakshi S. Arya, and Sunil Nagpal. "Energy efficient hybrid policy in green cloud computing." Green Computing and Internet of Things (ICGCIoT), 2015 International Conference on. IEEE, 2015.

[10] Patel, Yashwant Singh, NeeteshMehrotra, and Swapnil Soner. "Green cloud computing: A review on Green IT areas for cloud computing environment." Futuristic Trends in Computational Analysis and Knowledge Management (ABLAZE), 2015 International Conference on. IEEE, 2015.