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A systematic review on the various approaches used for achieving Energy consumption in Cloud

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Abstract:
Cloud computing is an infrastructure for performing the organization and web application is cost effective way. The implementation of cloud computing has gained attention of computing as an advantage and enhances applications from consumer, business and scientific domains. Though, this operation faces huge energy consumption, carbon dioxide emission and related cost concerns. With energy consumption becoming the major problem for the maintenance and operation of cloud data centres, the cloud computing providers are becoming profoundly concerned. Greater consumption of energy not only translates to greater cost of operation but also badly influences the surroundings. The cloud design is such that it must be power efficient. Data centres are becoming essential infrastructure for assisting the provided services by cloud computing. They consume huge amount of energy reporting for 3 percent of electrical energy consumption globally. The impact of this is that the providers of cloud faces greater costs of operation which leads to data centre's infrastructure increased usage. The main aim of this study is to develop the utilization of computing resources and reduce the consumption of energy under independent quality of service constraints of workload. This study presents the survey of various techniques used for consumption of energy in cloud computing.

Keywords: *Cloud Computing, Energy Consumption, Task Scheduling, CPU Utilization, DVFS*

I. INTRODUCTION

Cloud computing provides new models of computing where resources namely computing power, online applications, network infrastructure and storage can be shared as services through online. The familiar model of utility computing acquired by several providers of cloud computing is inspiring characteristics for consumers whose request on virtual resources differ with time. The vast scale importance of social networking, online banking, electronic commerce, information processing, electronic government and others result in workloads of vast scale and huge range (Uchechukwu et al, 2014). Save and Varshapriya (2015) has mentioned thatinformation processing and computing capability of many private and public firms ranging from housing to manufacture and banking to transportation have been raised speedily. Such a vivid and wide increase in the resources of computing needs an efficient and scalable IT infrastructure involving electrical grids, servers, network bandwidth, physical infrastructure, huge capital expenditure, operational cost and personnel. Rakshith and Sreenivas (2015) has stated that the cloud data

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centres are the strength of nowadays demanding information technology infrastructure there is an essential requirement to develop its effectiveness. The services of cloud computing are gaining familiarity nowadays and it is expected that the organizations will migrate from building and owing their own systems to rent the services of cloud computing because the services of cloud computing are simple to use and can decrease both the environmental loads and business costs (Kaur and Kaur, 2015; Dabbagh et al, 2015). The environment of cloud computing needs huge number of ICT equipment such as servers, storage devices, client terminals and communication network devices. The widespread use of the services of cloud computing will highly contribute to rapid raise on the power consumption of information and communication technology (Kuribyashi, 2013; Djemame et al, 2014). Backialakshmi and Hemavathi (2015) has mentioned that the consumption of energy is determined only by the efficiency of hardware but it is also relied on the resource management systemarranged on infrastructure and the running efficiency of application in the system. The energy efficiency influences end users in resource usage costs terms which are decided by the TCO experienced by the providerof resource (Aulakh, 2014). The results of greater consumption of power not only enhanced the bills of electricity but also in additional needs to power delivery infrastructure and cooling system that is uninterruptible power supplies, PDU (power distribution units) and so on (Hammadi and Mhamdi, 2014). With the development of the computer components density the cooling issue becomes essential as huge heat amount has to be degenerate for square meter. It is essential to estimate the power consumed by entire network devices accurately (Pagare and Koli, 2014). Li et al (2017) has stated that it is essential to evaluate the consumption of power much accurately if the carbon dioxide emission must be evaluated from every network user's power consumption. However, it is not realistic to predict the carbon footprint for every packet in a similar way that the transportation system predicts a carbon footprint for every package. It is essential to regard an easier way of evaluating the power consumed by an individual network (Zakarya and Gillam, 2017; Rong et al, 2016).Moreover, it is anticipated that the power percentage produced by renewable power such as wind power and photovoltaic power generation will continue to increase. Since the power generated by natural ways differs over time the storage of electric power requires to be established to stabilize the supply of power (Mohammed and Tapus, 2017). This denotes that it is essential to consider cases where information and communication technology equipment performs under the situation that the total supply of power feasible is limited. Therefore, it is needed to take the limitation of feasible supply of power into consideration (Tian et al, 2018). Mevada (2017) has suggested an enhanced energy efficient virtual machine placement which applies virtual machines such that the overload of hosts and status of underload is resolves and manage SLA between cloud provider and user. They presented their algorithm to decrease the consumption and accomplish better balancing of load (Nakku et al, 2014). Kumar (2016) has proposed first last algorithm which establishes the energy consumption balance and performance through decreasing migration. Moreover, the complexity of time is also reduced. Li (2013) has suggested an off line method to migrate a virtual machine to much applicable PM and capacity of PM is not adequate and another virtual machine must be selected to migrate from it to free certain space for the needed virtual machine. The outputs reveal that it is much effective. Dhari and Arif (2017) has suggested a load balancing scheme among several virtual machines based on certain threshold. The outputs acquired are compared with other approaches and assured that it is best.

Phi (2017) has proposed a method for enhancing both response and processing time with load balancing. Thus, theconsumption of energy is examined by the physical resources efficiency and also determined by system of managing the resource organized in infrastructure and applications efficiency running in systems. Singh et al (2017) has stated that the main issue faced by providers of cloud service is balancing between reducing the usage of energy and distributed performance. Present trend expected that consumption of the energy would, maximize, at the time, cost of the power can effortlessly overtake cost of hardware by a high margin (Xu et al, 2014). It can be inferred that minimizing the energy and power consumption was major goal in the present cloud computing systems.

II. Literature Review

2.1 Energy Consumption Techniques in Cloud Computing:

Rahman et al (2016) has stated that data centre is a set of linked servers utilized by a firm for storage and remote processing. Data centre provides flexible platform to customers by hiding the dependency of platform. User has no requirement of any special hardware all the user required is the thin client. To perform the request of user efficiently data centre have 1000s or 100s of servers which must be handled intelligently. Energy consumption is one of the largest problems faced by Data centre. The energy consumption can be reduced by effective resourcesuse of data centre. Constructing energy effective data centre is not only advantageous for service provider of cloud but also environment friendly. Several energy consumption techniques in cloud computing are discussed below:

2.1.1 DVFS:

Wu et al (2014) proposes an algorithm ofscheduling for the data centre of cloud with a DVFS technique. The scheduling algorithm can effectively enhance the use of resource hence it can reduce the energy consumption for performing jobs. This study also offers a green efficient algorithm of scheduling using the DVFS technique for data centres of cloud computing. Arroba et al (2015) proposes 2 techniques namely a policy of DVFS that considers trade-off between degradation of performance and consumption of energy and analgorithm of novel consolidation that is frequency aware which is essential when allotting a workload of cloud to manage service quality. The results of the study involves the awareness of Dynamic Voltage Frequency Scaling in management of workload which offers considerable savings of energy for conditions under dynamic conditions of workload. Similarly Kaur and Walia (2016) research study proposes a technique that would reduce the servers consumption of energy in cloud data centre by increasing the DVFS algorithm performance using various power models. The model of low power blade with Dynamic Voltage Frequency Scaling has provided a good output that consumption of energy is reduced with similar design of data centre architecture which in turn will support in decreasing the emission of carbon by upholding the overall performance of system (Kumar et al, 2018; Mishra et al, 2019). The below table shows the reviews of DVFS technique for energy consumption in cloud computing:

Table 2.1: Reviews of DVFS Technique for Energy Consumption in Cloud Computing
Source: Author

S.No.	Author	Year	Technique used	Tools used	Advantages of the Technique
1	Wu et al	2014	DVFS technique	-	Reduce the energy consumption of distributed systems

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2	Sahoo and Das	2016	Green Energy Efficient Algorithm using Dynamic Voltage Frequency Scaling technique	Cloud Structure	Makes use of Laxity Analyzer for executing every job individually and successfully so that virtual machines are chosen according to Service Level Agreement level provided by user
3	Arroba et al	2015	DVFS and Frequency Aware Consolidation Algorithm	Cloud-Sim	DVFS reduces the underused resources consumption dynamically and FAC algorithm decreases the data centre consumption of energy while handling its quality of service
4	Kaur and Walia	2016	DVFS Algorithm	C++ and TCL (Tool Command Language)	Decreases the energy consumption of servers in cloud data centre by increasing the DVFS algorithm performance
5	Kumar et al	2018	DVFS Algorithm	Cloud-Sim	Decreases the energy consumption
6	Mishra et al	2019	Dynamic Voltage Frequency Scaling	Cloud-Sim	Resolves the trade off between Optimize the consumption of energy and make-span of system

2.1.2 CPU Utilization:

Ali (2014) proposed a predictor based on neurowith an algorithm of prediction to evaluate the needed active servers simulating the objectives of green networking. Such predictor inputs are servers CPU utilization in data centre and the differences of incoming requests with several difference of users. The green networking objectives are referred to handle the Power Management Criteria which assures that entire utilization of Central Processing Unit must be larger than 30 percent. Hsu et al (2014) study presents an Energy Aware Task Consolidation technique that reduces the consumption of energy. Energy Aware Task Consolidation accomplishes this by limiting the use of CPU below a particular peak threshold. Amongst virtual clusters energy Aware Task Scheduling performs this by consolidating works. To estimate the ETC performance it was compared with MaxUtil a greedy algorithm that aims to expand the cloud computingresources (Madhu et al, 2016; Choi et al, 2016). Urul (2018) presents a dynamic VM migration and allocation approach using CPU utilization prediction to increase the efficiency of energy while handling approved QOS levels in cloud data centres. The proposed approach known as LRAPS evaluates small term utilization of Central Processing Unit of hosts based on their utilization history. This estimation is used to predict under loaded and overloaded hosts as part of their live process of migration (Pattnayak and Pal, n.d.). The below table shows the reviews of CPU utilization for energy consumption in cloud computing:

Table 2.2: Reviews of CPU utilization for Energy Consumption in Cloud Computing
Source: Author

S.No.	Author	Year	Technique used	Tools used	Advantages of the Technique
1	Ali et al	2014	Green	OPNET14.5	Manages CPU utilization greater than

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			Networking Techniques		30 percent
2	Hsu et al	2014	Energy Aware Task Consolidation and MaxUtil greedy algorithm	-	Reduce the consumption of power in a cloud system with growth over MaxUtil algorithm
3	Choi et al	2016	Task classification-based energy aware consolidation algorithm	Cloud traces	Reduces energy without incurring predefined violations of Service Level Agreement
4	Madhu et al	2016	Task Consolidation technique	Cloud-Sim	Allocates numerous tasks to single VM relying on its capability of processing estimated in Million Instructions Per Second
5	Urul et al	2018	Local Regression Automated Parameter Selection	Cloud-Sim	Finds dynamic value of span which makes CPU prediction good so that the decisions of sound migration can be made
6	Pattnayak and Pal	n.d.	Task Consolidation Using Minimization of Idle Virtual Machine Algorithm	Cloud-Sim	Reduces the idle resources number by allocating a task at an instance to virtual machine which is idle presently

2.1.3 Resource allocation:

Mohamed et al (2014) has stated that the solutions of energy efficiency aim at reducing huge servers and the disks are required to progress them rapidly within the needed period of time so the energy is consumed by an average of 40 percent over formerly established techniques. Thephysical machines number can be decreased using virtualization by virtual machine consolidation on to shared servers in data centres and motivate them to travel according to the policy of migration. This study presents selection policies and VM migration to enhance the performance of energy efficiency of cloud computing (Ahmad et al, 2015). Bermejo et al (2016) have proposed methods which move through the location design for data centres combining with methods for appropriate resource management considering the systems energy consumption. This study presents a method of resource allocation that extends the efficiency of system. This method is based on taking decisions at two stages namely the overall system and physical machine stage. Each stage ensures its own proper performance (Patel et al, 2017). Loganathan et al (2017) proposed a

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technique of job scheduling to allocate a job to a virtual machine of the already existing active hosts by regarding job pre-emption and classification. Thus, reducing the host number utilized in allocation intern decreases the energy consumptionin cloud data centre. This study proposed job scheduling algorithm classifying the work into 3 various kinds and allocation based on premption policy with the former feasible time of resource which is attached to host (Arulmozhiselvan and Senthamarai, 2016). The below table shows the reviews of resource allocation technique for energy consumption in cloudcomputing.

Table 2.3: Reviews of Resource Allocation Technique for Energy Consumption in Cloud Computing
Source: Author

S.No.	Author	Year	Technique used	Tools used	Advantages of the Technique
1	Mohamed et al	2014	Virtualization Machine Migration	Cloud Sim	Maximize energy efficiency of resource
2	Ahmad et al	2015	Virtualization Migration scheme	-	Improves the network and application performance
3	Bermejo et al	2016	Resource allocation technique based on open loop control system	Cloud-Sim	Minimize the energy consumption and expand the system performance
4	Patel et al	2017	Dynamic Allocation of Virtual Machines	Cloud-Structure	Resource allocation dynamically for task within deadline
5	Loganathan et al	2017	Energy Aware Virtual Machine Available Time scheduling algorithm	Cloud-Sim	Minimizes the consumption of energy and maximizes the resource use
6	Arulmozhiselvan et al	2016	Energy Aware Live Virtual Migration technique	-	Reduce the consumption of energy

2.1.4 Workload Consolidation:

Sridharshini and Sivagami (2015) proposed algorithms to plan virtual machine set to physical machines set using the technique of workload aware consolidation in a cloud centre of data. The main purpose of the algorithms was to reduce the energy consumption by regarding the fact that heterogenous workloads have varied features of resource consumption. In order to compare with various algorithms of measurement of scheduling such as imbalance value of use, average use of resources of cloud data centre are evolved (Wang and Tianfield, 2017). Pahlevan et al (2018) presents an exact modelling of energy characterization for new server architecture based on the technique of FD-SOI process for

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computing near threshold. Then the already existing energy versus the performance of trade-off is explored when virtualized applications with varied memory footprint and CPU utilization features are carried out. Derdus et al (2019) paper examines the link between various virtual machine types of workload and servers energy consumption in a multi-tenant data centres. The experiments were organized using well familiar input/output memory, CPU and intensive network benchmark of workload acquired from PTS (Phoronix Test Suite). The outputs reveal that there is a noticeable variation in the energy consumed amount when virtual machine perform workloads which dominate different physical resources of server. The below table shows the reviews of workload consolidation technique for energy consumption in cloud computing:

Table 2.4: Reviews of Workload Consolidation Technique for Energy Consumption in Cloud Computing
Source: Author

S.No.	Author	Year	Technique used	Tools used	Advantages of the Technique
1	Sridharshini and Sivagami	2015	Energy Aware Scheduling Algorithm and Energy Aware Live Migration Algorithm	-	Use the resources effectively and provides promising capability of energy saving
2	Wang and Tianfield	2017	Energy Aware DVMC (Dynamic Virtual Machine Consolidation)	Cloud-Sim	Reduces the consumption of energy without compromising the SLA.
3	Pahlevan et al	2018	Energy Proportionality Aware Dynamic Allocation	X86, ARM based Cavium ThunderX and NTC Servers	Improves the next generation NTC servers energy proportionality while assuring their quality of service needs
4	Derdus et al	2019	Virtual Machine Consolidation based on workload	Phoronix Test Suite	Reduces the consumption of energy and accomplish acceptable levels of performance if an optimum mix of workload is met
5	Mosa and Sakalleriou	2017	Parameter Based Virtual Machine Consolidation	Cloud-Sim	Provides flexibility to cloud provider to handle the trade off between other needs and utilization
6	Akhter et al	2018	Dynamic Virtual Machine Consolidation and Optimal Online Deterministic Algorithms	Cloud-Sim	Reduce energy consumption in cloud surroundings

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2.1.5 Task Scheduling:

Dhanalakshmi and Basu (2014) proposed a technique to accomplish the major aims of reducing the consumption of energy as well as reducing the tasks make-span. The technique accomplishes the objectives using the placement algorithm of virtual machine to decrease the energy consumption and changed version of Max-Min algorithm to reduce the make-span. Jena (2016) research proposes TSCSA (task scheduling using Clonal Selection Algorithm) to optimize the time of processing and energy. The output results of this research were compared to already existing algorithms of scheduling and predicted that the proposed Task Scheduling using Clonal Selection Algorithm which offers optimal balance outputs for numerous objectives (Thakur, 2014; Zhang et al, 2018). Atiewi et al (2016) study presents a different methods reviews of energy efficient task scheduling in a cloud surrounding. A brief summary of different parameters of scheduling is also presented. This study determines the best consumption percentage of energy by using DNS and DVFS (Ismail and Materwala, 2018). Alla et al (2019) proposes an effective EATSD (Energy Aware Task Scheduling with Deadline) controlled in CC. The major aim of the proposed technique is to decrease the cloud sources consumption of energy regarding varied priorities of users and optimize the make span under constraints of deadline (Alahmadi et al, 2015).The below table shows the reviews of task scheduling technique for energy consumption in cloud computing:

Table 2.5: Reviews of Task Scheduling Technique for Energy Consumption in Cloud Computing
Source: Author

S.No.	Author	Year	Technique used	Tools used	Advantages of the Technique
1	Dhanalakshmi and Basu	2014	Modified Max-Min algorithm and Virtual Machine placement algorithm	Cloud-Sim	Reduce the consumption of energy, reduce the make span and response time
2	Thakur	2014	Task scheduling algorithm	Cloud-Sim	Improve the resource use and redeem the energy consumption in data centres
3	Jena	2016	Task Scheduling using Clonal Selection Algorithm	Cloud-Sim	Optimize the processing time and energy
4	Zhang et al	2018	Energy and Deadline Aware with Non-Migration Scheduling	Cloud trace	Accomplishes efficiency of energy without establishing virtual machine overhead of migration and without compromising deadline assurance
5	Atiewi et al	2016	Energy efficiency task scheduling algorithms	Cloud traces	Determines the best consumption percentage of energy by using DNS and DVF
6	Ismail and Materwala	2018	Energy Aware Task Scheduling	Cloud	Reduces the energy consumption in cloud computing

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			algorithm on Cloud Virtual Machines		
7	Alla et al	2019	Energy Aware Task Scheduling with Deadline (EATSD)	Cloud-Sim	Accomplish better performance by reducing the consumption of energy, make-span and develops resource use while meeting the constraints of deadline
8	Alahmadi et al	2015	Energy Aware Task Scheduling-FFD	Cloud Report	Accomplishes good efficiency of energy without sacrificing system quality of service

2.1. 6 Virtual Machine Scheduling:

Parmar and Pandya (2015) proposed an Energy Optimized Scheduling Scheme for cloud environment where the customer needs a service, PaaS where every customer had its own virtual machine. This scheme PEOSS handles the virtual machines as per the time and date. Priority Based Energy Optimized Scheduling Scheme offers auto scheduler which handles virtual machines automatically by Power Off and Power ON, Unpause, Clone and Pause as per the request of customer. Mhedheb and Streit (2016) proposed a novel virtual machine scheduling algorithm implementation and design. This process resolves both temperature awareness and load balancing with a major aim of decreasing the energy consumption in a data centre. This schedule technique choses a physical machine to host a VM based on user needs, hosts temperature and hosts load while handling the service quality (Li et al, 2018). Pathak (2018) study main aim is to generate an energy aware data centre of cloud by means of consolidation of host and energy aware VM migration under various workload features. This study proposes a novel power virtual machine allocation policy migration algorithm namely MODA (Multi-Dimensional Overload Detection Algorithm) to offer an energy efficient data centre of cloud (Qui et al, 2019; Soltanshahi et al, 2019).The below table shows the reviews of virtual machine scheduling technique for energy consumption in cloud computing:

Table 2.6: Reviews of Virtual Machine Scheduling Technique for Energy Consumption in Cloud Computing

Source: Author

S.No.	Author	Year	Technique used	Tools used	Advantages of the Technique
1	Parmar and Pandya	2015	Priority Based Energy Optimized Scheduling Scheme	VMware workstation	Advantageous for service providers who offers platform as a service
2	Mhedheb and Streit	2016	Virtual Machine Scheduling Algorithm	Cloud-Sim	Reduces the consumption of energy of data centre because of its thermal aware technique and assistance of virtual machine migration techniques
3	Li et al	2018	GRANITE- a holistic virtual machine	Cloud-Sim	Reducing energy consumption of total data centre

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			scheduling algorithm		
4	Pathak et al	2018	Power Virtual Machine Allocation Policy Migration Algorithm namely MODA (Multi-Dimensional Overload Detection Algorithm)	Cloud-Sim	Reduce the energy by detection and mitigation of hotspot
5	Qiu et al	2019	Energy efficiency and proportionality Aware VM Scheduling EASE algorithm	Cloud trace	Achieves savings of power consumption for memory intensive workloads and computing
6	Soltanshahi et al	2019	Krill Herd Algorithm	Cloud-Sim	Allocates VM to physical hosts in data centres of cloud

2.1.7 Load Balancing:

Shree and Badal (2016) examined different energy efficient load balancing applications of VM performing on cloud[76-81]. This study has proposed an algorithm where the scheduler spreads load to VM having temperature aware scheduling of resource which is distant from its critical temperature and also reduced consumption of power. The main aim of the study is to decrease the temperature of nodes of computing and to spread the workload in an effective way regarding thermal balance and power of the system (Mehta et al, 2016). Anjum and Patil (2017) proposed application scaling operation structure and energy aware load balancing algorithm for ecosystem of cloud. The major aim of this study is an optimal regime of energy of operation and trying to extend the number of servers that are performing in this regime. lightly loaded and idle severs are changed to one of the sleep states to save energy. To balance the load the servers are being added and avoid the condition of overload or deadlock by deploying the methodologiesof scaling (Bose and Kumar, 2015; Thorat and Sonkar, 2015). Gao and Yu (2017) proposed an energy efficient algorithm of load balancing which takes benefit of both virtual machine consolidation and DVFS to decrease the consumed energy by infrastructures of cloud. The experimental outputs of the study show that in cloud computing compared to a RR algorithm for load balancing where the proposed algorithm can accomplish up to 35 percent saving of energy in heterogeneous data centre of cloud.The below table shows the reviews of load balancing scheduling technique for energy consumption in cloud computing**:**

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Table 2.7: Reviews of Load Balancing Technique for Energy Consumption in Cloud Computing
Source: Author

S.No.	Author	Year	Technique used	Tools Used	Advantages of the Technique
1	Mehta et al	2016	Thermal and power aware virtual machine scheduling	Cloud Simulator	Reduction in energy usage
2	Shree and Badal	2016	Thermal and Power Based Scheduling	Cloud Simulator	Reduce the computing nodes temperature and to spread the workload in an effective way regarding power and thermal balance of system
3	Bose and Kumar	2015	Energy aware load balancing techniques	Cloud Traces	Allocate resources to virtual machine requests for reducing the consumption of energy
4	Thorat and Sonkar	2016	Energy aware load balancing techniques	Cloud Traces	Allocate resources to virtual machine requests for reducing the consumption of energy
5	Anjum and Patil	2017	Energy Aware application scaling and load balancing operation model for cloud eco system	Visual Studio 2012	Reduces the time of response, maximize the throughput and increases the resilience of system to faults hindering the system overloading
6	Gao and Yu	2017	DVFS and Round Robin Algorithm	Cloud Infrastructure	Reduce consumed energy by infrastructures of cloud

2.1.8 Power and Thermal Aware Scheduling:

Wang et al (2015) proposes a thermal and power aware VM allocation methods for data centres of cloud. The main aim of the proposed approach is to decrease the overall energy consumption andmigration numbers of virtual machine while avoiding violations of SLA in data centres of cloud. The outputs of simulation reveal that the proposed method of allocation brings essential advantages in terms of performance indices and energy savings (Cui et al, 2015). Ilager (2019) proposes an ETAS (Energy and Thermal Aware Scheduling) algorithm that combines virtual machines dynamically to reduce the overall energy consumption while proactively hindering hot spots. Energy and Thermal Aware Scheduling is framed to resolve the trade-off between cost savings and time and it can be tuned based on the needs. This study carries out wideresearches using real world traces of cloud with thermal and power models. Balouch and Bejarzahi (2019) paper proposes thermal aware VM placement and workload for data centres of cloud. The main purpose of this study is to ameliorate through scheduling the data centre energy efficiency. The proposed scheduling method integrates the thermal and power aware scheduling methods which decrease the consumption of energy of a given centre of data because of its thermal aware technique and the assistance of virtual machine

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migration methods.The below table shows the reviews of power and thermal aware scheduling technique for energy consumption in cloud computing**:**

Table 2.8: Reviews of Power and Thermal Aware Scheduling Technique for Energy Consumption in Cloud Computing
Source: Author

S.No.	Author	Year	Technique used	Tools Used	Advantages of the Technique
1	Chaudhary et al	2015	Thermal aware Scheduling	Cloud-Sim	Saves the cooling and computing energy and ensures life of equipment safety and reliability
2	Wang et al	2015	Power and Thermal Aware Virtual Machine Allocation Method	Cloud-Sim	Reduce the consumption of energy and number of migration essentially while avoiding service level agreement violations in data centres of cloud
3	Cui et al	2015	Decentralized Thermal Aware Scheduling Algorithms	Cloud-Sim	Improves scalability and reduce temperature compared to state of art thermal aware scheduling algorithms
4	Ilager et al	2019	Energy and Thermal Aware Scheduling	Cloud-Sim	Handle the time of computation and solution quality and avoid hot spots with the rise in consumption of energy
5	Balouch and Bejarzahi	2019	Thermal aware workload and Virtual Machine placement	Cloud-Sim	Reduces the consumption of energy of a given centre of data because of its support of virtual machine migration methods and thermal aware strategy
6	Li et al	2019	Thermal Aware Hybrid Workload Management	Cloud-Sim	Reduce the brown energy consumption while expanding the green energy utilization

III. Findings and Conclusion of the Research

In present years several researches have been undertaken in the cloud computing field. An essential paradigm in the IT sector is Cloud computing. All the physical resources are available in Data centre and the machine consumes power and discharges heat which impacts the conditions of environment.The economic effect of consumption of energy is of huge concern for several firms. The cloud computing firms use large data centres which consists of virtual machines that are placed worldwide and needs huge amount of energy cost to manage. The demand for the energy consumption is developing every day in

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information technology companies. The rise in consumption of energy is the most essential issue globally. The development and growth of complexintensive applications of data have spreadlarge amount of data centres creation that has developed the demand of energy. The cloud computing firms faces barriers towards the economic effect in terms of energy cost. This study used different techniques to rise the energy consumption and reduce the waste energy in cloud computing. The choice of good techniques helps the cloud servers to save the energy cost and manages a good service quality for worldwide users. The originality of the study offers a chance to examine which technique is good. In future this study can be developed and better techniques and ways are proposed to save energy for Internet of Things, Big Data and Gaming Data centres. This can be helpful in energy optimization and improvement by undertaking failure analysis in cloud surroundings. The cloud computing resolves the global warming issue by offering eco-friendly surroundings. Thus it can be concluded that cloud computing is used to decrease the consumption of energy by physical resources in data centre and saves energy and also enhances the system performance.

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