A Comparative Analysis of AWS EKS and Azure AKS: Performance, Cost, and Environmental Efficiency for Containerised Microservices

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Introduction

Kubernetes has become the dominant platform for orchestrating containerised microservices, enabling scalable, resilient, and portable cloud-native applications. To reduce the operational complexity associated with running Kubernetes in production, cloud providers offer managed Kubernetes services that abstract control-plane management, automate maintenance tasks, and integrate closely with cloud-native infrastructure.

Among these services, AWS Service (EKS) and Azure Kubernetes Service (AKS) are two of the most widely adopted platforms. Although both expose the same upstream Kubernetes API, they differ in underlying infrastructure design, resource management strategies, pricing models, and optimisation mechanisms. These differences can influence application performance, operational cost, and environmental efficiency.

As organisations increasingly deploy microservices at scale and face growing pressure to optimise cost and reduce carbon emissions, understanding how managed Kubernetes platforms behave under realistic workloads is critical. This research provides an empirical comparison of EKS and AKS, examining their performance, cost efficiency, and environmental impact to support evidence-based platform selection for cloud-native applications.

Objective

The objective of this research is to compare AWS EKS and Azure AKS across performance, cost, and environmental impact using controlled microservice workloads, in order to support evidence-based cloud platform selection..

Research Question

Which managed Kubernetes platform—Amazon EKS or Azure AKS—provides the more effective environment for hosting containerised microservices when evaluated across performance, cost efficiency, and environmental impact?

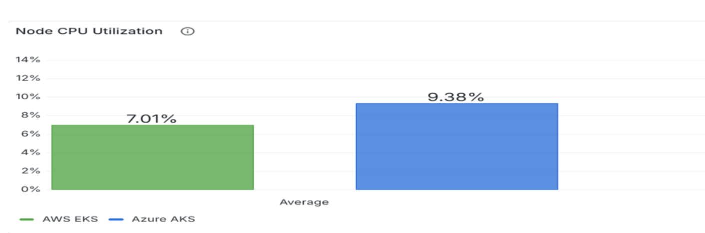
Methodology

- Three .NET microservice workloads: compute, transactional, I/O
- Identical single-node EKS and AKS clusters
- Standardised deployment, configuration, and load conditions
- k6 load testing; Prometheus/Grafana for resource metrics
- Kepler for power + CO2 estimation
- Cloud pricing used for cost-per-request analysis
- Repeated trials for statistical validity

Results

Latency (P95)

Pod CPU

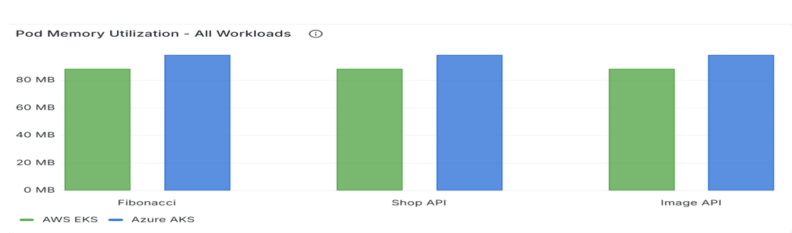


Node CPU

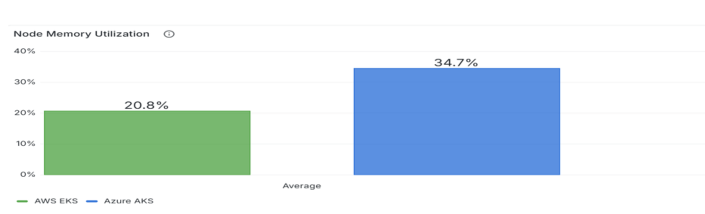
Metric (average across Fibonacci, Shop, Image)	AWS EKS	Azure AKS	Relative difference
Power draw	389.41 W	389.88 W	~Equal (+0.1% AKS)
CO_2 emissions	185.68 g/h	185.86 g/h	~Equal (+0.1% AKS)

Power & CO_2

Throughput



Pod Memory



Node Memory

AVERAGE COST RESULTS

Platform	Compute (€ / hour)	Control Plane (€ / hour)	Total (€ / hour)	Total (€ / month)	Total (€ / year)
AWS EKS	€ 0.20	€ 0.10	€ 0.29	€212.72 / month	€2,552.66 / year
Azure AKS	€ 0.22	€ 0.00	€ 0.22	€158.78 / month	€1,904.70 / year

Cost

Conclusions and Future Work

AWS EKS demonstrates superior performance, scalability, and energy efficiency across the evaluated microservice workloads, making it well suited for production environments that require high throughput, low latency, and stable execution. Azure AKS remains a viable option for lightweight or cost-sensitive deployments due to its lower entry-level infrastructure costs, but its efficiency and stability diminish as workload intensity increases. These findings highlight that managed Kubernetes platform selection must be workload-aware, requiring performance, sustainability, and cost to be considered together rather than in isolation. Overall, the results answer the research question by showing that AWS EKS provides the more effective managed Kubernetes platform for production microservices demanding performance, reliability, and sustainable resource utilisation.

Future work will extend this study by expanding the platform comparison beyond AWS EKS and Azure AKS to include additional managed Kubernetes services and by evaluating identical workloads across multiple geographic regions. The environmental analysis can be enhanced by applying energy instrumentation consistently across all workload types and integrating region-specific carbon intensity data to improve emissions accuracy. Further research should also investigate more complex microservice architectures and analyse the transactional instability observed on Azure AKS through targeted resilience and failure-scenario testing, enabling a deeper understanding of platform behaviour under realistic production conditions.

QR Code for Recording