**Optimizing Costs through a Synergistic Approach of Various Methods.**

* [Reserved Instance (RI)](#RI)
* [Right sizing VMs](#rightsize)
* [Saving plan for Compute](#savingplan)
* [Azure backup for Non-Prod VMs](#azurebackup) should be on LRS backup configuration, not GRS. GRS can be applied for Prod to ensure DR.
* [Reserve capacity for managed disks](#reservedisk)
* [Second SQL instance in a VM and consolidation](#secondSQLinstance)
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**Azure Advisor** provides information on the first three cost optimization methods (Reserved Instance (RI), Saving plan and Right sizing). Azure advisor is a tool that helps to analyze your resource configuration and usage telemetry and then recommends solutions that can help you improve the cost effectiveness, performance, reliability and security of your Azure Resources.

With Azure Advisor we can identify unused VMs and receive recommendations about Azure reserved instance purchases. In our environment, Azure advisor suggests a **61% percent saving (totaling $53K)** using a combination of the three methods.

**Azure reservation (RI)**

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| **Description** | **Method of Calculation** | **Amortized Monthly (Yes/No)** | **Example** |
| Purchase of virtual machine at a discounted price of 32% to 70%. Swapping from PAYG to a committed 1–3-year RI plan can be initiated by FinOps (finance dept.). | **Savings** = (PAYG cost of a SKU per month – RI cost of a SKU per month) \* Quantity | Yes | Purchase of Virtual Machine “Standard\_F16s\_v2” of quantity of 4 in East US region  On demand cost of standard\_F16s\_v2 = $1343.20 per month/resource  RI Cost of standard\_F16s\_v2 = $724.20 per month/resource  Total savings per month for quantities purchased = On-demand cost - RI cost x quantities purchased  **Total monthly savings: ($1,343.20 - $724.20) \* 4 = $2,476/month** |

**Rightsizing VMs**

Rightsizing VMs is a cost optimizing technique in which the underutilized VMS are picked from the Azure Advisor and are resized to lower SKU. VMs that are not used consistently are recommended to shut down. The VMs which consume less than 5% of CPU utilization in the past 7 days are classified as “Underutilized” by the Advisor.

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| Rightsizing (SKU upgrade, AHB, ASB Optimization, etc.) | This includes VM SKU upgrade/downgrade, AHB, ASB Optimization, etc. | **Savings** = (Daily cost of current VM (RI & On demand) – Daily cost of newly upgraded VM) \* # of days in a month effective implementation date | Amortized monthly | Example  If a SKU standard\_DS3\_v2 is upgraded to standard\_DS4\_v2,  Daily cost of current VM = $ 100  Daily cost of newly upgraded VM = $80  **Total monthly savings = ($100-$80) \* 30 days (Avg days per Month) = $600 monthly** |

**Azure Saving Plan**

The [Azure Savings Plan](https://learn.microsoft.com/en-us/azure/cost-management-billing/savings-plan/savings-plan-compute-overview) for compute offers a versatile pricing structure, delivering savings of up to 65% compared to pay-as-you-go rates. By committing to a fixed hourly expenditure on compute services for either one or three years, you can unlock discounts on the resources you utilize, extending up to the hourly commitment amount. This commitment to a savings plan provides a cost-effective solution for optimizing your compute expenses.

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| Azure Savings Plan | Committing to fixed hourly spend for compute services | Savings = (Daily cost of pay-as-you-go - Daily cost with Azure Savings Plan) \* # of days in a month from effective implementation date | Amortized monthly | Example  If committing to a savings plan results in a $200 daily cost reduction, monthly savings = $200 \* 30 days = $6,000 |

**Azure Backup Configuration under Recovery Service Vault**

The Azure Backup service is a simple, secure, and cost-effective solution to backup SQL databases, file shares, managed disks, VMs etc. and recover them from the Microsoft Azure cloud.

The cost of backups varies based on the chosen location configuration. Backup configurations include Local Redundant Storage (LRS), Geo-Redundant Storage (GRS), and Zonal Redundant Storage (ZRS). LRS maintains three copies of data within a region, while GRS duplicates three copies in both primary and secondary locations, resulting in doubled costs.

To optimize costs, we propose adjusting our backup configuration. **For non-production servers, transitioning from Geo-Redundant Storage (GRS) to Local Redundant Storage (LRS) can significantly reduce expenses**. Meanwhile, maintaining GRS for production servers ensures robust backup solutions while cutting vault costs in half, currently identified as a top expense in our Azure usage.

**Reserve capacity for managed disks (specially for prod subscription)**

Storage costs can be optimized using [reserved capacity](https://learn.microsoft.com/en-us/azure/virtual-machines/disks-reserved-capacity). When paired with Azure Reserved Virtual Machine Instances, you can reduce overall expenses. The reservation discount is automatically applied to matching disks within the selected scope, eliminating the need to assign reservations to managed disks. Discounts are applied hourly based on disk usage, but unused capacity doesn't carry over. Note that Azure Disk Storage reservation discounts exclude unmanaged disks, ultra disks, and page blob consumption. **Currently, Azure Disk Storage reservations are available only for selected Azure *Premium SSD* SKUs.**

Disk reservation is recommended with VM reservations to maximize saving benefit. There are limitations to this (e.g. reservations are only for Premium SSD SKUs). The steps for purchase are in the hyperlinked website.

**Second SQL instance in a VM and/or Consolidation**

1. Consolidating small databases in a single instance
2. Installing 2nd SQL Server instance on existing VMs (instead of having a separate VM for servers with small to medium databases).

**Deallocation**

Shutting off VMs when they are not needed.

**Managed instance for Test environment**

Azure SQL Managed Instance is a comprehensive platform-as-a-service (PaaS) offering within Microsoft Azure, providing near-complete compatibility with on-premises SQL Server. MI saves time and costs related to maintenance, backups, high-availability, or data center operations. This solution facilitates a seamless migration of databases with minimal modifications, aligning perfectly with our modernization goals.

In light of the limitations, we currently face in our Dev environment, particularly with regards to Distributed Transaction Coordinator (DTC), our initial migration option to PaaS would be the Test environment.

According to Microsoft, Azure SQL Managed Instance offers these attractive features:

* Broad SQL Server compatibility on a fully managed service requires minimal code changes.
* Use the tools and experience you already have with SQL Server
* Secure data with layers of protection and intelligent threat detection
* Native virtual network support functionality

**Key Considerations:**

1. **Cost Optimization through Automation:**

Azure SQL MI offers an auto-pause feature and allows scheduling auto-stop actions through the portal. Leveraging this functionality in non-production environments automates the pausing and resuming of the managed instance during idle periods. This approach effectively minimizes costs, as resources are only active when needed, aligning with our commitment to cost-conscious practices.

1. **Dev-Test Free Subscriptions:**

Azure MI provides both hybrid (AHUB) and free licensing benefits. The hybrid option leverages our existing SQL licenses, resulting in substantial cost savings. Furthermore, opting for the developer edition eliminates licensing costs entirely in non-production environments, further reducing the overall operational expenditure associated with running the managed instance.

1. **Reserved Capacity for Cost Efficiency:**

Acquiring reserved capacity for managed instances allows us to benefit from reduced rates compared to pay-as-you-go pricing. This approach not only provides cost predictability but also demonstrates a commitment to long-term planning and efficiency in resource utilization.

By adopting Azure SQL Managed Instance, we lay the foundation for a more scalable, cost-effective, and modernized infrastructure.

1. **Free Readable Secondary Replica:**

The inclusion of a free readable replica is a significant benefit in the future for our production environments. This feature enhances scalability, availability, and fault tolerance without incurring additional costs, contributing to a more robust and reliable architecture.