How to create a .NET8 CRUD WebAPI Azure CosmosDB for PostgreSQL MicroService

The source code for this example can be found in this github repo: https://github.com/luiscoco/MicroServices_dotNET8_CRUD_WebAPI-AzureCosmosDB-for-PostgreSQL

0. Prerequisites

- Install Visual Studio 2022 Community Edition
- Install .NET SDK 8.0.1
- Install Entity Framework Core tools reference - .NET Core CLI: https://learn.microsoft.com/en-us/ef/core/cli/dotnet

dotnet ef can be installed as either a global or local tool. Most developers prefer installing dotnet ef as a global tool using the following command:

```
dotnet tool install --global dotnet-ef
```

Update the tool using the following command:

```
dotnet tool update --global dotnet-ef
```

Before you can use the tools on a specific project, you'll need to add this package to your application

```
dotnet add package Microsoft.EntityFrameworkCore.Design
```

Run the following commands to verify that EF Core CLI tools are correctly installed:

```
dotnet ef
```

1. Create .NET8 CRUD WebAPI for PostgreSQL

Step 1: Create a New .NET Web API Project. Open a command line interface (CLI).

Run the following command to create a new Web API project:

```
dotnet new webapi -n BookApiProject
```

Navigate into your project directory:

```
cd BookApiProject
```

Step 2: Add Required Packages. Add the necessary NuGet packages:

```
dotnet add package Microsoft.EntityFrameworkCore
dotnet add package Npgsql.EntityFrameworkCore.PostgreSQL
dotnet add package Swashbuckle.AspNetCore
```

Step 3: Input the Program.cs source code:

```
using Microsoft.AspNetCore.Mvc;
using Microsoft.EntityFrameworkCore;
using Microsoft.OpenApi.Models;
using Swashbuckle.AspNetCore.Swagger;
```

```
var builder = WebApplication.CreateBuilder(args);

// Configure your DbContext
var connectionString = builder.Configuration.GetConnectionString("MyPostgresDb");
builder.Services.AddDbContext<BookDbContext>(options =>
    options.UseNpgsql(connectionString));

// Add services to the container.
builder.Services.AddControllers();
builder.Services.AddEndpointsApiExplorer();

// Add Swagger support
builder.Services.AddSwaggerGen(c =>
{
    c.SwaggerDoc("v1", new OpenApiInfo { Title = "Book API", Version = "v1" });
});

var app = builder.Build();

// Initialize the database
using (var scope = app.Services.CreateScope())
{
    var services = scope.ServiceProvider;
    var dbContext = services.GetRequiredService<BookDbContext>();
    dbContext.Database.Migrate(); // This applies pending migrations or creates the database if it doesn't exist
}

// Configure Swagger middleware
if (app.Environment.IsDevelopment())
{
    app.UseSwagger();
    app.UseSwaggerUI(c => c.SwaggerEndpoint("/swagger/v1/swagger.json", "Book API v1"));
}

// Map CRUD operations for Books
app.MapGet("/books", async (BookDbContext db) => await db.Books.ToListAsync());
app.MapGet("/books/{id}", async (int id, BookDbContext db) => await db.Books.FindAsync(id) is Book book ? Results.Ok(book) : Resu
app.MapPost("/books", async (Book book, BookDbContext db) =>
{
    db.Books.Add(book);
    await db.SaveChangesAsync();

    return Results.Created($"/books/{book.BookId}", book);
});
app.MapPut("/books/{id}", async (int id, Book inputBook, BookDbContext db) =>
{
    var book = await db.Books.FindAsync(id);

    if (book == null) return Results.NotFound();

    book.BookName = inputBook.BookName;

    await db.SaveChangesAsync();
    return Results.NoContent();
});
app.MapDelete("/books/{id}", async (int id, BookDbContext db) =>
{
    var book = await db.Books.FindAsync(id);

    if (book == null) return Results.NotFound();

    db.Books.Remove(book);
    await db.SaveChangesAsync();
    return Results.NoContent();
});

app.Run();

// Define your DbContext and Book entity
public class BookDbContext : DbContext
{
    public BookDbContext(DbContextOptions<BookDbContext> options)
        : base(options) { }
    public DbSet<Book> Books { get; set; }
}

public class Book
{
    public int BookId { get; set; }
    public string BookName { get; set; }
}
```

Step 4: Modify **appsettings.json** and set your database connection string

```
{
  "Logging": {
    "LogLevel": {
      "Default": "Information",
      "Microsoft.AspNetCore": "Warning"
    }
  },
  "AllowedHosts": "*",
  "ConnectionStrings": {
    "MyPostgresDb": "Server=c-mypostgresql.znj364bc3mdfyx.postgres.cosmos.azure.com;Database=citus;Port=5432;User Id=citus;Passwo
  }
}
```

Step 5: Run Migrations (if using Code First). Run the following command to add a migration:

```
dotnet ef migrations add InitialCreate
```

Apply the migration to your database:

```
dotnet ef database update
```

Step 6: Run Your Application

```
dotnet run
```

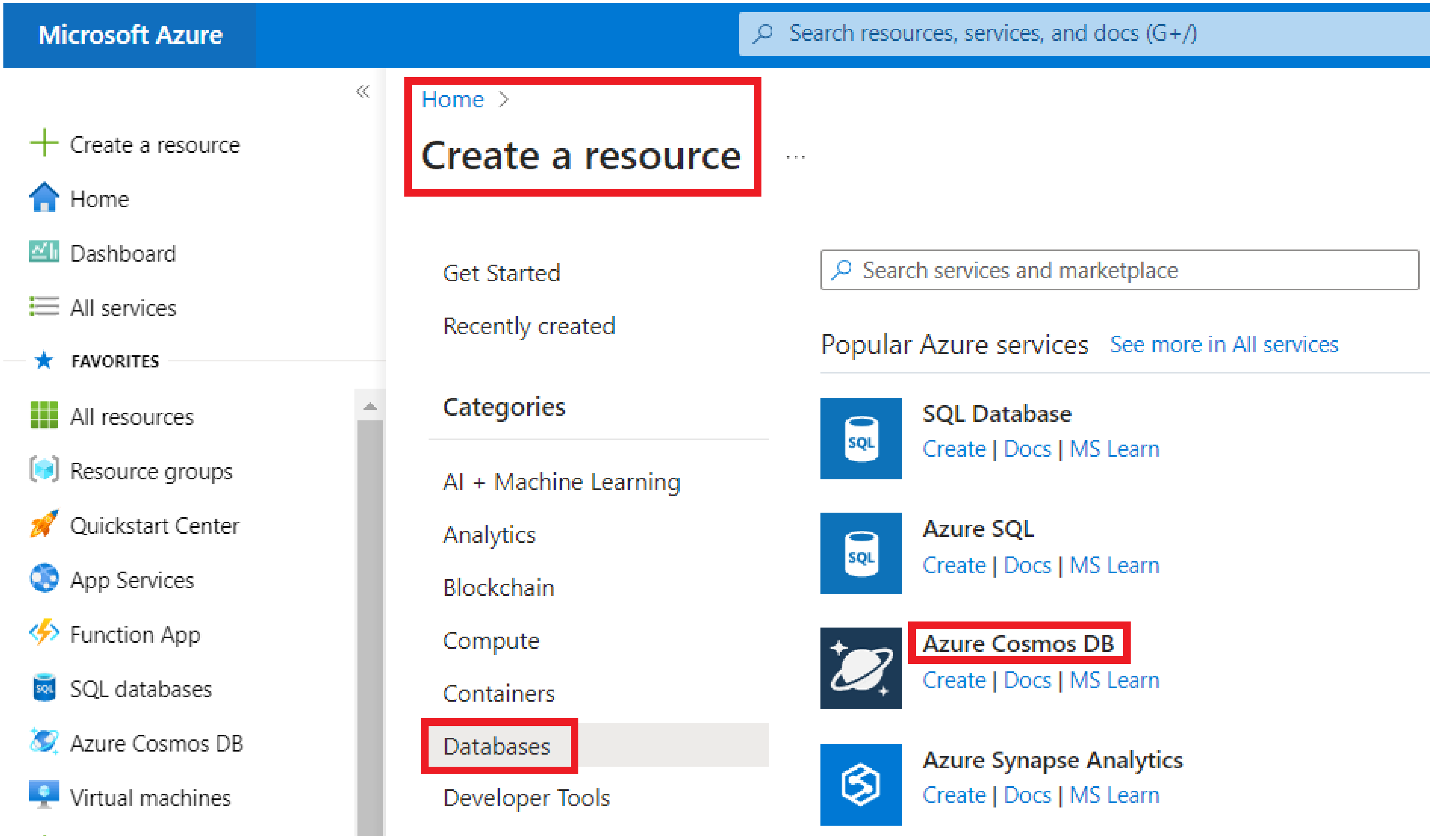
Access the Swagger UI by going to http://localhost:5000/swagger in your web browser.

2. Create Azure CosmosDB for PostgreSQL with Azure Portal

Sign in to Azure Portal:

Go to Azure Portal and sign in with your Azure account.

Create a New Resource:



Click on "**Create a resource**" in the top left corner of the dashboard.

image

Search for Azure Cosmos DB:

In the "New" window, search for "**Azure Cosmos DB**" and select it from the results.

Create Azure Cosmos DB Account:

Click the "**Create**" button to start configuring your Azure Cosmos DB account.

image

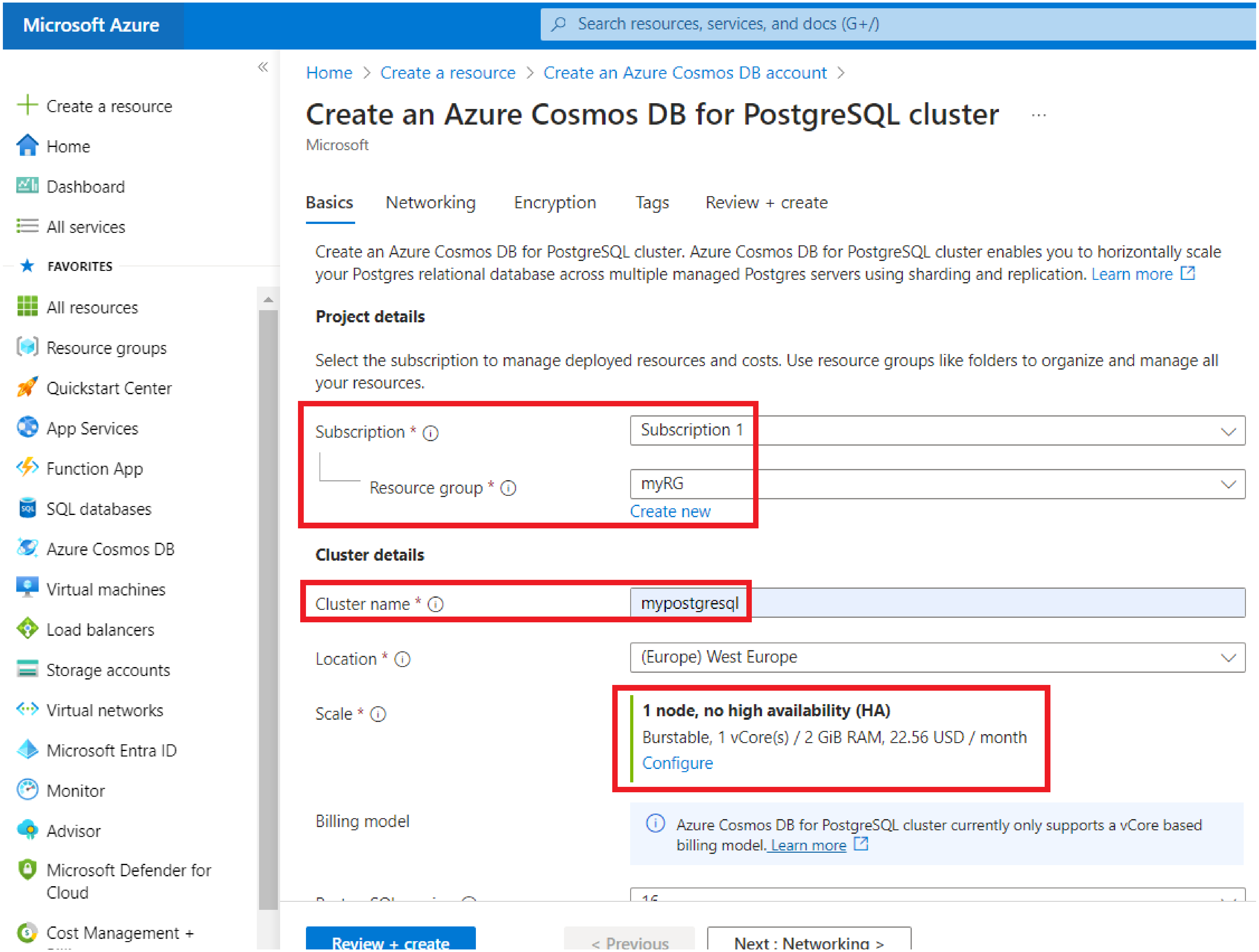
Select the appropriate subscription and resource group (or create a new resource group).

Enter an account name.

Choose the API as "**Azure Cosmos DB for PostgreSQL**".

image

Input the new PostgreSQL values



Create an Azure Cosmos DB for PostgreSQL cluster

Microsoft

Create an Azure Cosmos DB for PostgreSQL cluster. Azure Cosmos DB for PostgreSQL cluster enables you to horizontally scale your Postgres relational database across multiple managed Postgres servers using sharding and replication. Learn more

Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription * : Subscription 1

Resource group * : myRG

Create new

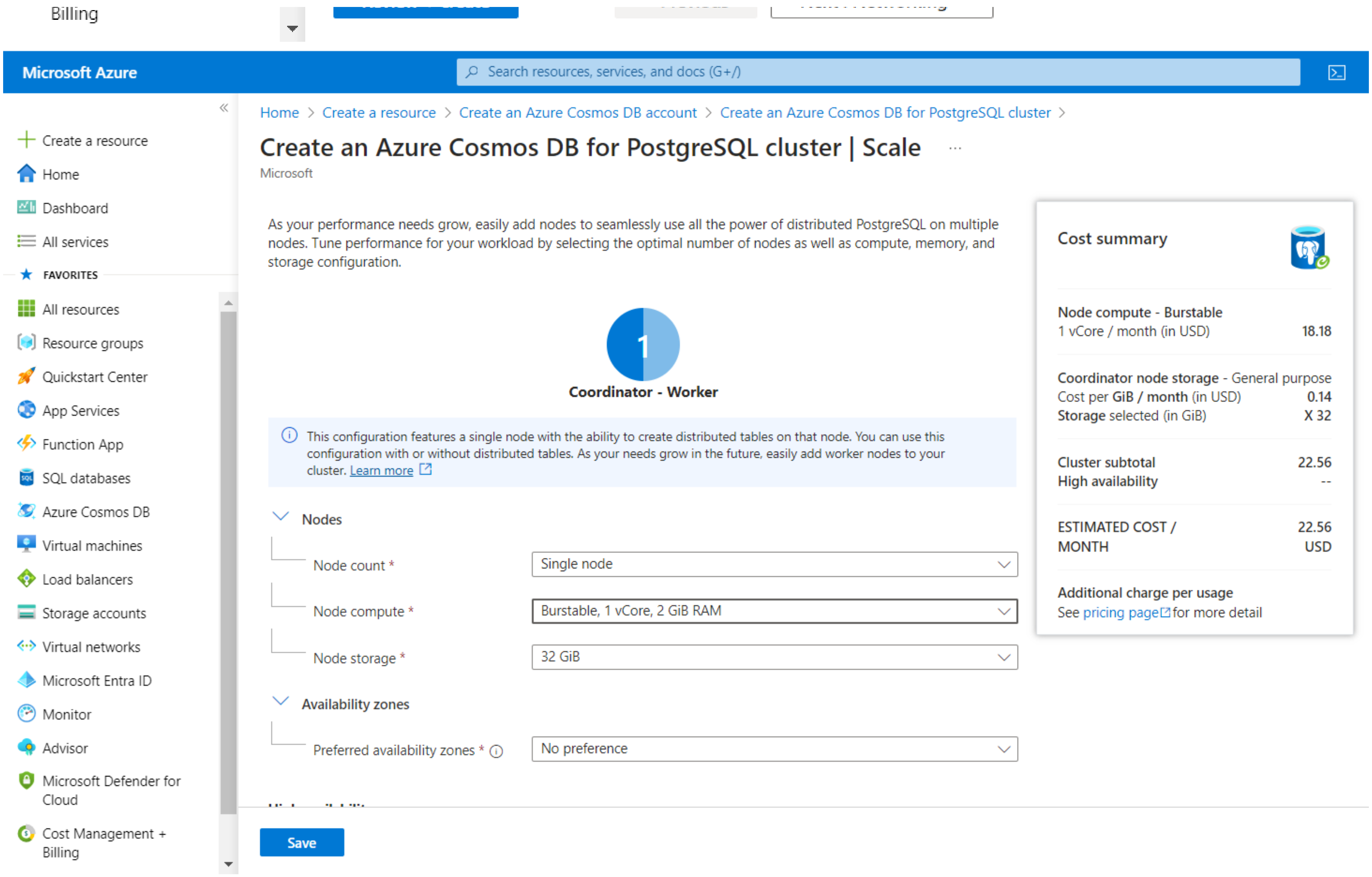
Cluster details

Cluster name * : mypostgresql

Location * : (Europe) West Europe

Scale * : **1 node, no high availability (HA)** Burstable, 1 vCore(s) / 2 GiB RAM, 22.56 USD / month Configure

Billing model: Azure Cosmos DB for PostgreSQL cluster currently only supports a vCore based billing model. Learn more



Create an Azure Cosmos DB for PostgreSQL cluster | Scale

Microsoft

As your performance needs grow, easily add nodes to seamlessly use all the power of distributed PostgreSQL on multiple nodes. Tune performance for your workload by selecting the optimal number of nodes as well as compute, memory, and storage configuration.

This configuration features a single node with the ability to create distributed tables on that node. You can use this configuration with or without distributed tables. As your needs grow in the future, easily add worker nodes to your cluster. Learn more

Nodes

Node count *	Single node
Node compute *	Burstable, 1 vCore, 2 GiB RAM
Node storage *	32 GiB

Availability zones

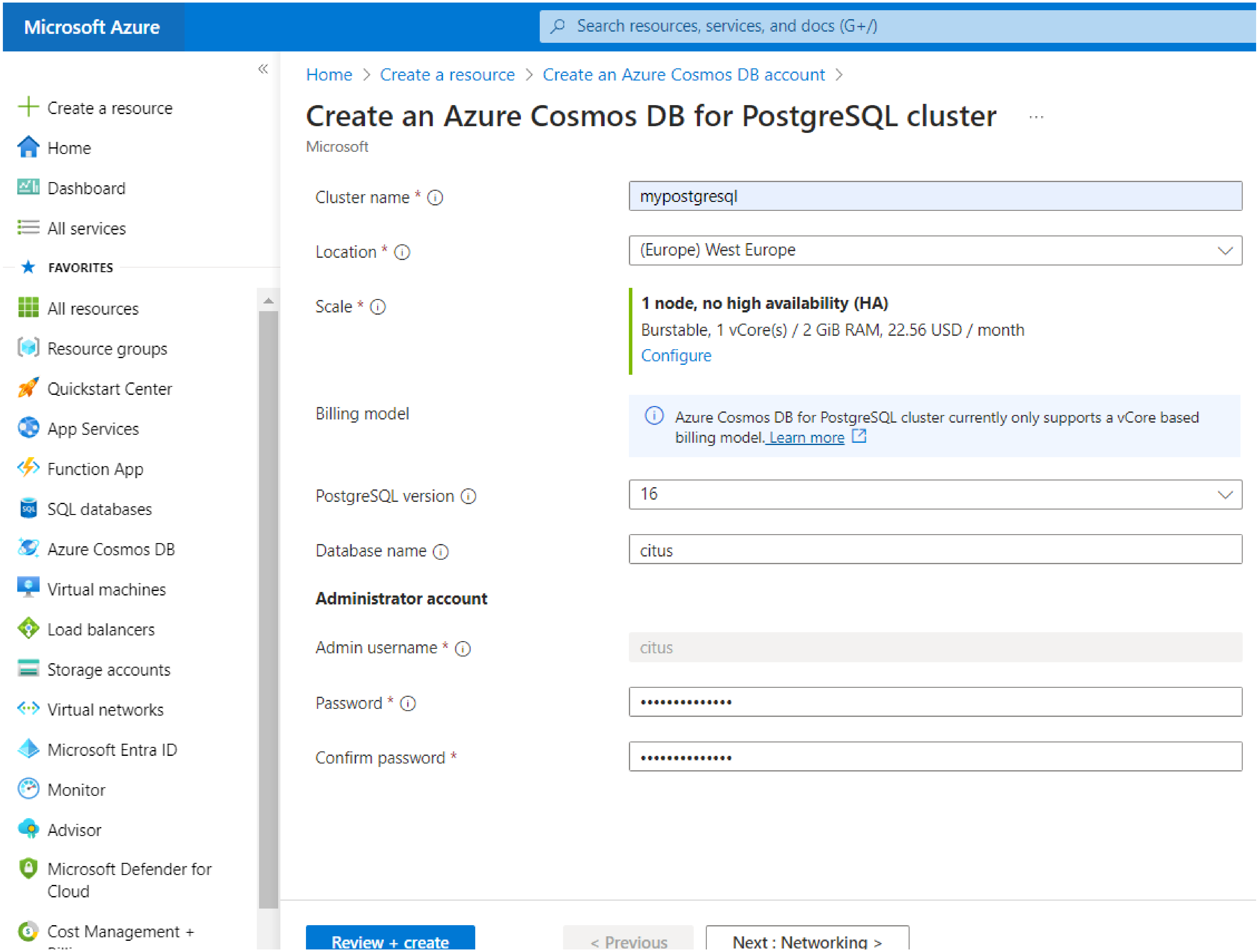
Preferred availability zones *	No preference

Cost summary

Node compute - Burstable	
1 vCore / month (in USD)	18.18
Coordinator node storage - General purpose	
Cost per GiB / month (in USD)	0.14
Storage selected (in GiB)	X 32
Cluster subtotal	22.56
High availability	--
ESTIMATED COST / MONTH	22.56 USD

Additional charge per usage

See pricing page for more detail



Create an Azure Cosmos DB for PostgreSQL cluster

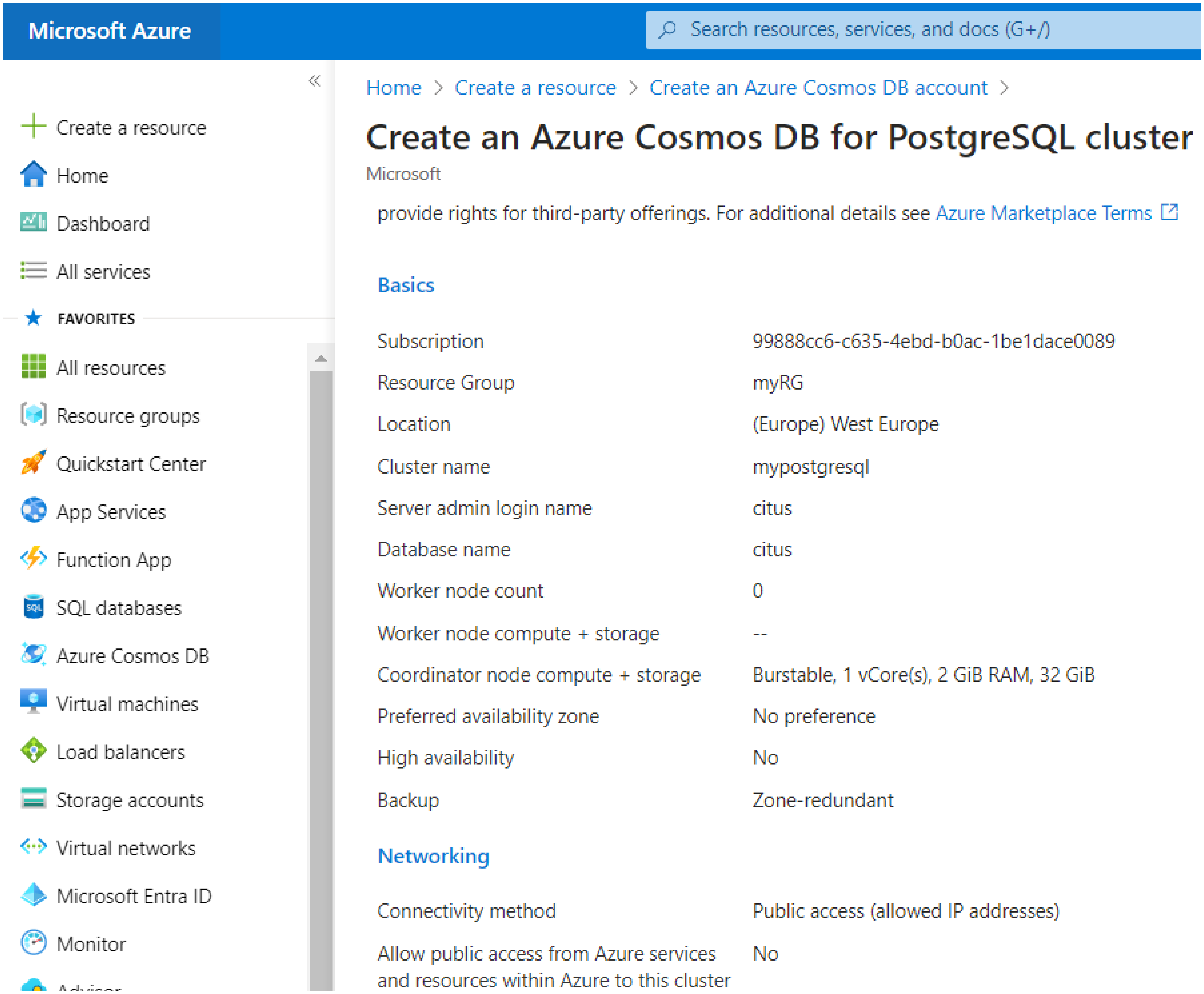
Microsoft

Cluster name *	mypostgresql
Location *	(Europe) West Europe
Scale *	**1 node, no high availability (HA)** Burstable, 1 vCore(s) / 2 GiB RAM, 22.56 USD / month Configure
Billing model	Azure Cosmos DB for PostgreSQL cluster currently only supports a vCore based billing model. Learn more
PostgreSQL version	16
Database name	citus

Administrator account

Admin username *	citus
Password *	••••••••••••••
Confirm password *	••••••••••••••

Review and create the account.



Create an Azure Cosmos DB for PostgreSQL cluster

Microsoft

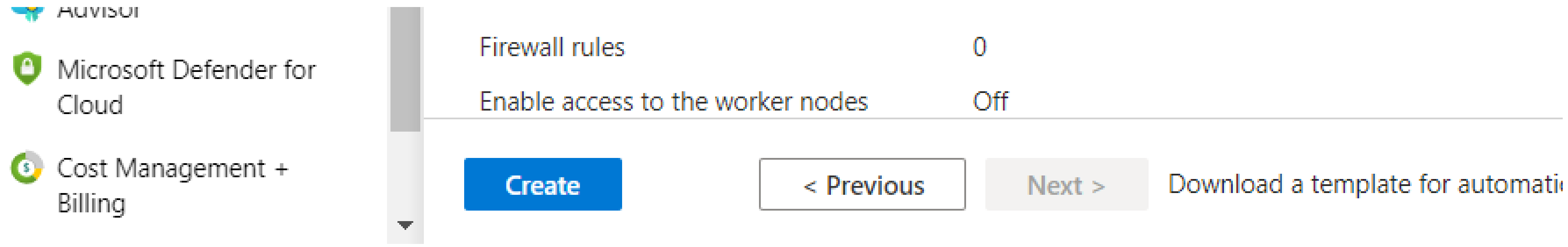
provide rights for third-party offerings. For additional details see Azure Marketplace Terms

Basics

Subscription	99888cc6-c635-4ebd-b0ac-1be1dace0089
Resource Group	myRG
Location	(Europe) West Europe
Cluster name	mypostgresql
Server admin login name	citus
Database name	citus
Worker node count	0
Worker node compute + storage	--
Coordinator node compute + storage	Burstable, 1 vCore(s), 2 GiB RAM, 32 GiB
Preferred availability zone	No preference
High availability	No
Backup	Zone-redundant

Networking

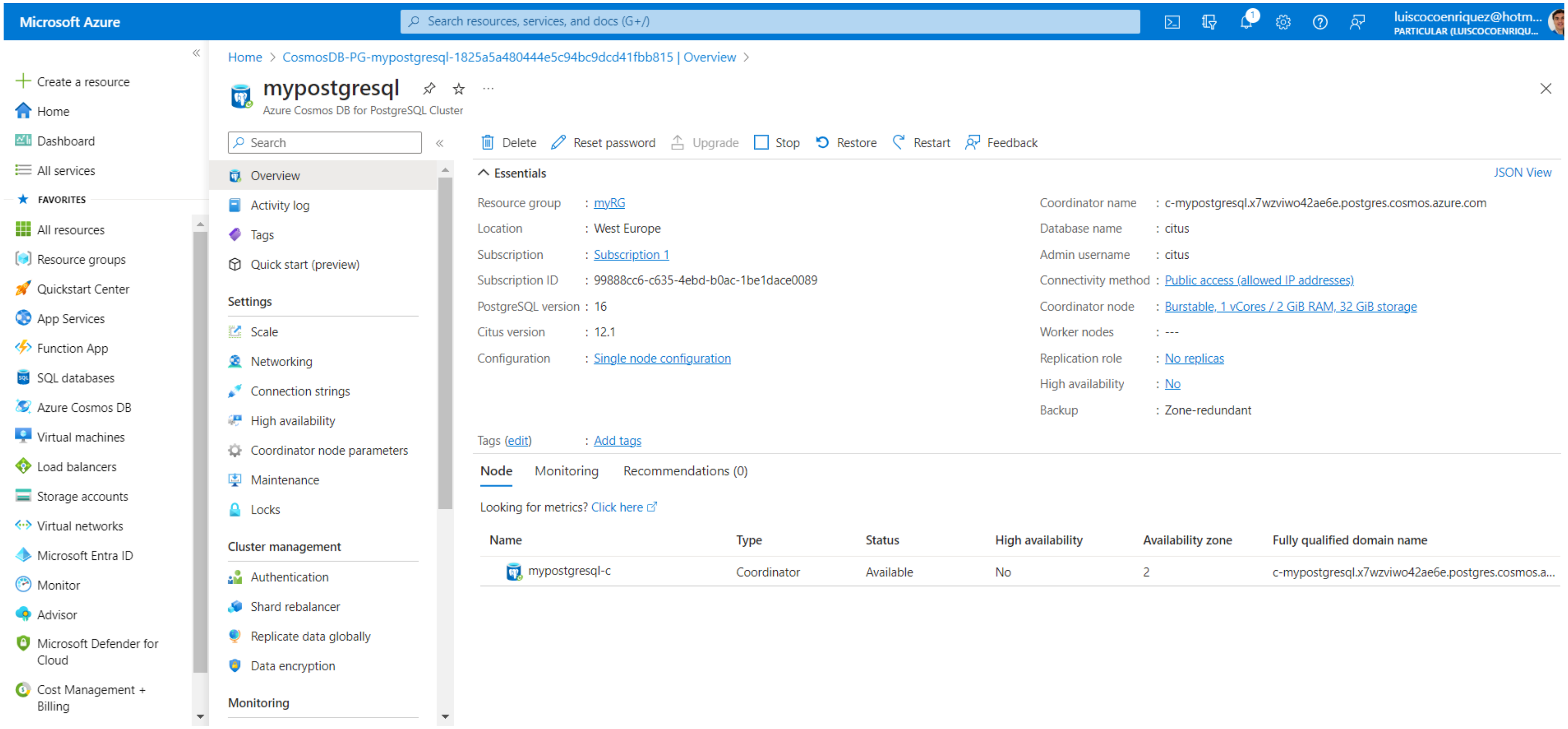
Connectivity method	Public access (allowed IP addresses)
Allow public access from Azure services and resources within Azure to this cluster	No


Advisor
Microsoft Defender for Cloud
Cost Management + Billing
Create
< Previous
Next >
Download a template for automati

Firewall rules 0

Enable access to the worker nodes Off

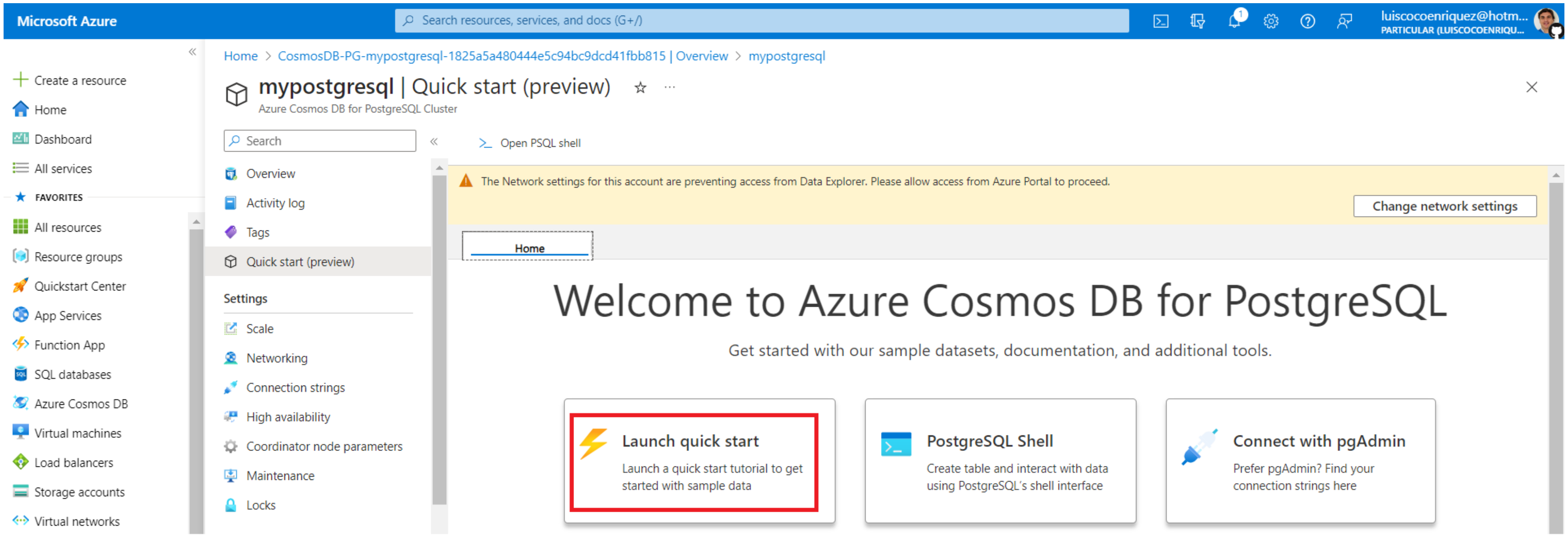
Once your account is created, go to it in the Azure portal.



Resource group	myRG	Coordinator name	c-mypostgresql.x7wzviwo42ae6e.postgres.cosmos.azure.com
Location	West Europe	Database name	citus
Subscription	Subscription 1	Admin username	citus
Subscription ID	99888cc6-c635-4ebd-b0ac-1be1dace0089	Connectivity method	Public access (allowed IP addresses)
PostgreSQL version	16	Coordinator node	Burstable, 1 vCores / 2 GiB RAM, 32 GiB storage
Citus version	12.1	Worker nodes	---
Configuration	Single node configuration	Replication role	No replicas
		High availability	No
		Backup	Zone-redundant
Tags (edit)	Add tags		

Name	Type	Status	High availability	Availability zone	Fully qualified domain name
mypostgresql-c	Coordinator	Available	No	2	c-mypostgresql.x7wzviwo42ae6e.postgres.cosmos.a...

Under "**Quick start (preview)**" create a new database and a container within that database.



The Network settings for this account are preventing access from Data Explorer. Please allow access from Azure Portal to proceed.

Welcome to Azure Cosmos DB for PostgreSQL

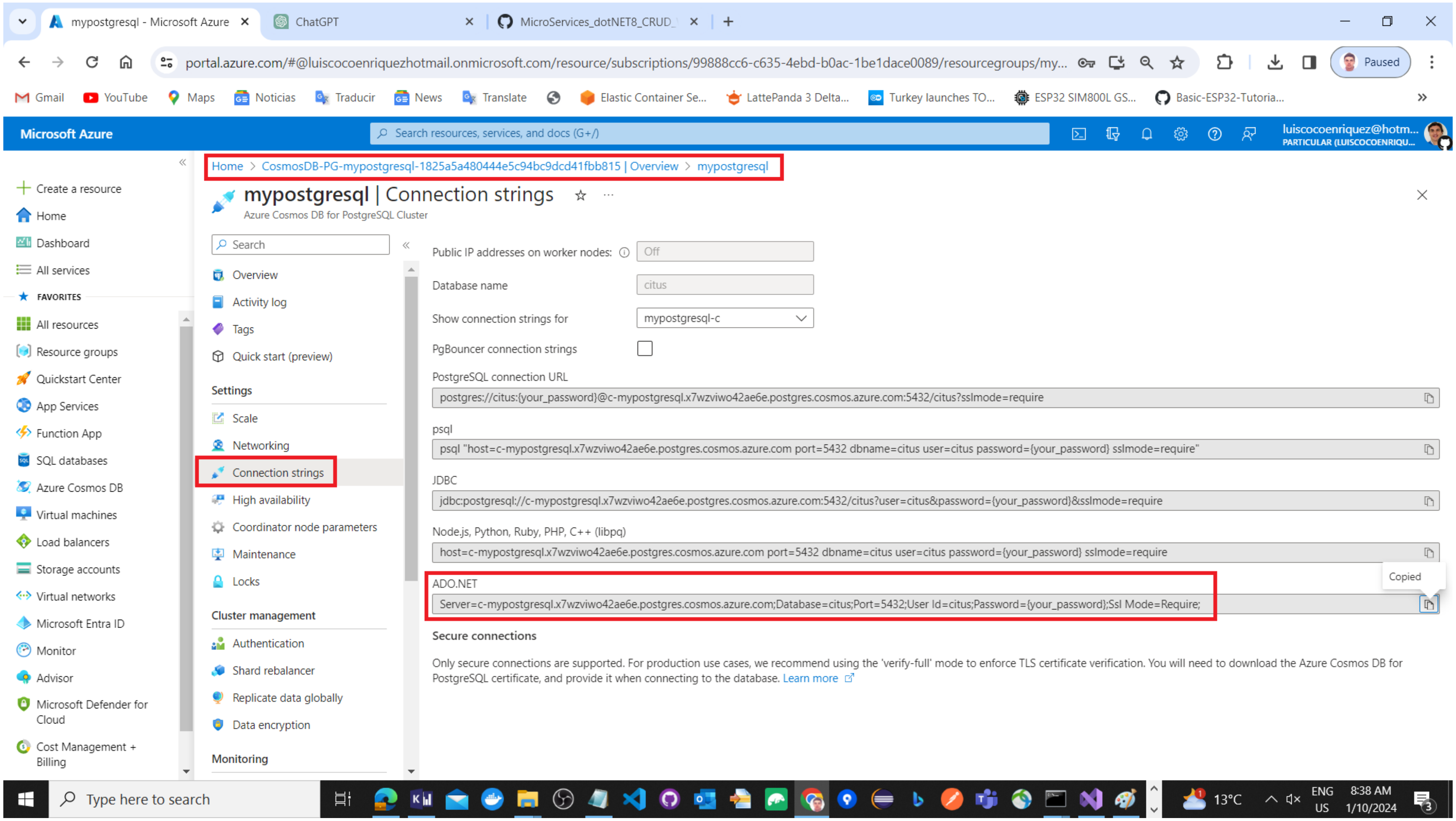
Get started with our sample datasets, documentation, and additional tools.

Launch quick start: Launch a quick start tutorial to get started with sample data

PostgreSQL Shell: Create table and interact with data using PostgreSQL's shell interface

Connect with pgAdmin: Prefer pgAdmin? Find your connection strings here

3. Copy the Connection String in appsettings.json file



Home > CosmosDB-PG-mypostgresql-1825a5a480444e5c94bc9dcd41fbb815 | Overview > mypostgresql

mypostgresql | Connection strings

Azure Cosmos DB for PostgreSQL Cluster

Public IP addresses on worker nodes: Off

Database name: citus

Show connection strings for: mypostgresql-c

PgBouncer connection strings: ☐

PostgreSQL connection URL

```
postgres://citus:{your_password}@c-mypostgresql.x7wzviwo42ae6e.postgres.cosmos.azure.com:5432/citus?sslmode=require
```

psql

```
psql "host=c-mypostgresql.x7wzviwo42ae6e.postgres.cosmos.azure.com port=5432 dbname=citus user=citus password={your_password} sslmode=require"
```

JDBC

```
jdbc:postgresql://c-mypostgresql.x7wzviwo42ae6e.postgres.cosmos.azure.com:5432/citus?user=citus&password={your_password}&sslmode=require
```

Node.js, Python, Ruby, PHP, C++ (libpq)

```
host=c-mypostgresql.x7wzviwo42ae6e.postgres.cosmos.azure.com port=5432 dbname=citus user=citus password={your_password} sslmode=require
```

ADO.NET

```
Server=c-mypostgresql.x7wzviwo42ae6e.postgres.cosmos.azure.com;Database=citus;Port=5432;User Id=citus;Password={your_password};Ssl Mode=Require;
```

Copied

Secure connections

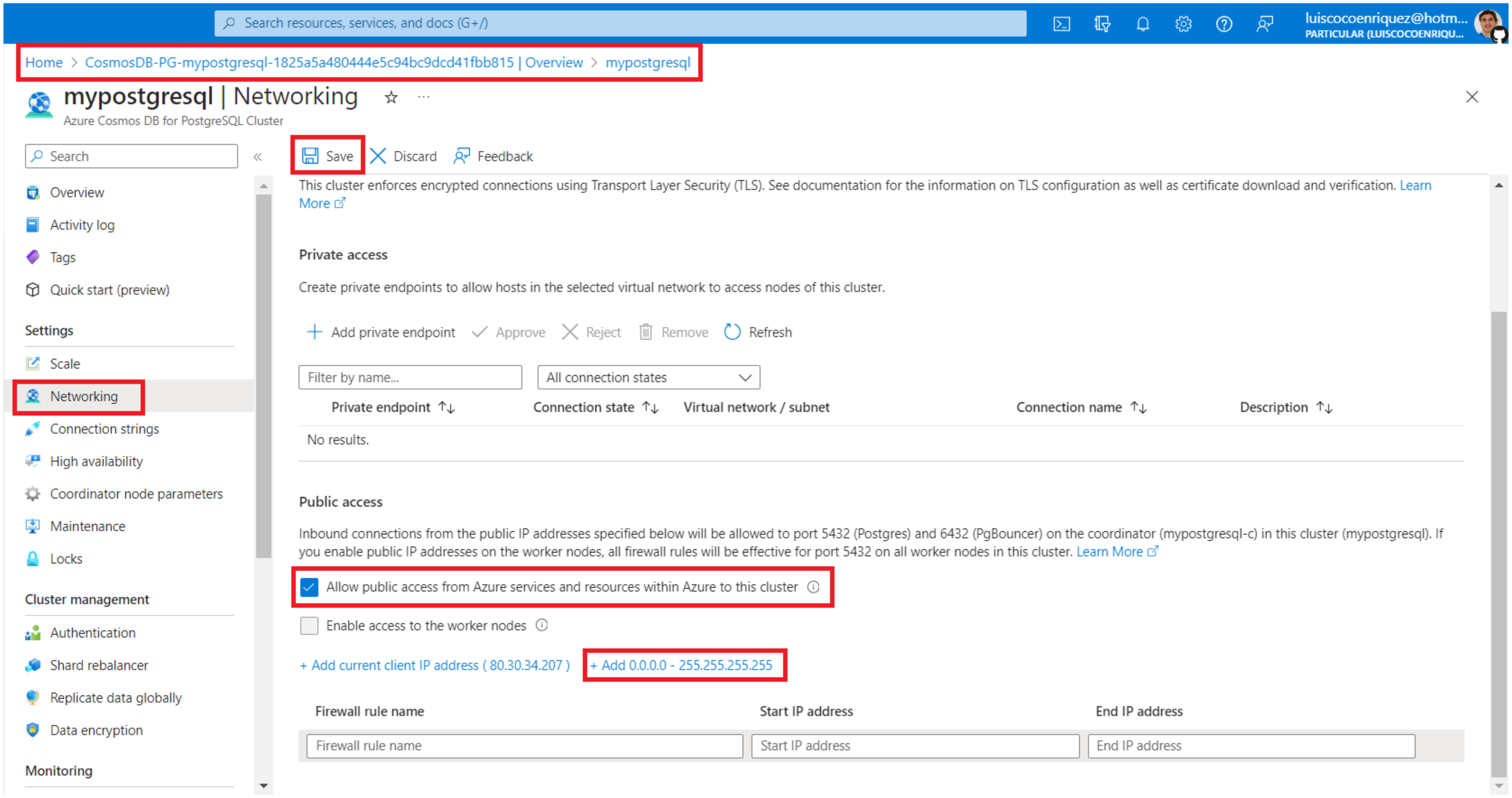
Only secure connections are supported. For production use cases, we recommend using the 'verify-full' mode to enforce TLS certificate verification. You will need to download the Azure Cosmos DB for PostgreSQL certificate, and provide it when connecting to the database. Learn more

IMPORTANT NOTE: Do not forget to input your PASSWORD (Password=Luiscoco123456) in the connection string, by default is not set.

appsettings.json

```
{
  "Logging": {
    "LogLevel": {
      "Default": "Information",
      "Microsoft.AspNetCore": "Warning"
    }
  },
  "AllowedHosts": "*",
  "ConnectionStrings": {
    "MyPostgresDb": "Server=c-mypostgresql.x7wzviwo42ae6e.postgres.cosmos.azure.com;Database=citus;Port=5432;User Id=citus;Passwo
  }
}
```

4. Add the FireWall rules



Home > CosmosDB-PG-mypostgresql-1825a5a480444e5c94bc9dcd41fbb815 | Overview > mypostgresql

mypostgresql | Networking

Azure Cosmos DB for PostgreSQL Cluster

This cluster enforces encrypted connections using Transport Layer Security (TLS). See documentation for the information on TLS configuration as well as certificate download and verification. Learn More

Private access

Create private endpoints to allow hosts in the selected virtual network to access nodes of this cluster.

Private endpoint	Connection state	Virtual network / subnet	Connection name	Description
No results.				

Public access

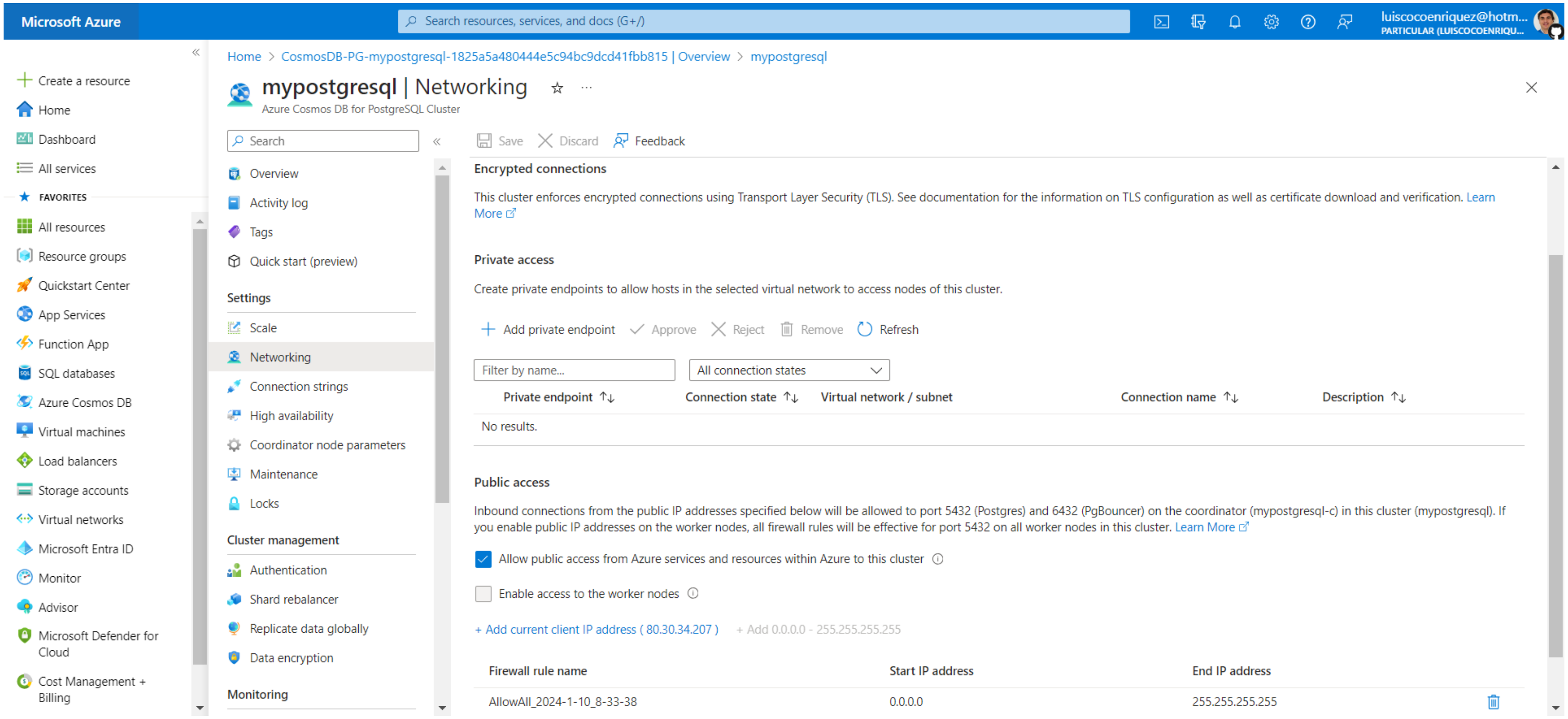
Inbound connections from the public IP addresses specified below will be allowed to port 5432 (Postgres) and 6432 (PgBouncer) on the coordinator (mypostgresql-c) in this cluster (mypostgresql). If you enable public IP addresses on the worker nodes, all firewall rules will be effective for port 5432 on all worker nodes in this cluster. Learn More

[✓] Allow public access from Azure services and resources within Azure to this cluster

[ ] Enable access to the worker nodes

+ Add current client IP address (80.30.34.207)   + Add 0.0.0.0 - 255.255.255.255

Firewall rule name	Start IP address	End IP address
Firewall rule name	Start IP address	End IP address



Encrypted connections

This cluster enforces encrypted connections using Transport Layer Security (TLS). See documentation for the information on TLS configuration as well as certificate download and verification. Learn More

Private access

Create private endpoints to allow hosts in the selected virtual network to access nodes of this cluster.

Private endpoint	Connection state	Virtual network / subnet	Connection name	Description
No results.				

Public access

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- [✓] Allow public access from Azure services and resources within Azure to this cluster
- [ ] Enable access to the worker nodes

+ Add current client IP address (80.30.34.207) + Add 0.0.0.0 - 255.255.255.255

Firewall rule name	Start IP address	End IP address
AllowAll_2024-1-10_8-33-38	0.0.0.0	255.255.255.255

5. Create Azure CosmosDB for PostgreSQL with Azure CLI

Ensure you have the Azure CLI installed and you're logged in. If not, you can download it from the Azure CLI website and log in using az login.

Create a Resource Group (if you don't already have one):

```
az group create --name YourResourceGroupName --location eastus
```

Create an Azure Cosmos DB Account:

```
az cosmosdb create --name YourCosmosDBAccountName --resource-group YourResourceGroupName --capabilities EnablePostgreSQL
```

Create a Database and Container:

Currently, creating databases and containers specifically for Azure Cosmos DB for PostgreSQL through the Azure CLI might not be supported directly.

You might need to use the Azure Portal or Cosmos DB SDK for this step.

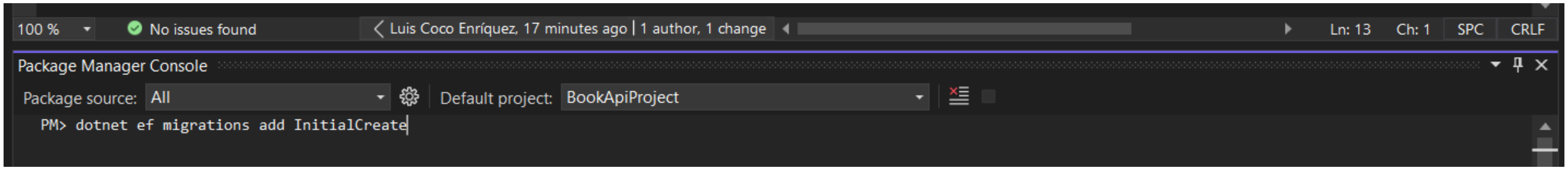
After setting up your Azure Cosmos DB for PostgreSQL, you'll need to retrieve the connection string to use in your .NET application.

You can find this in the Azure Portal under your Cosmos DB account's "Connection String" section.

6. Migrate the database

Run this command for creating the initial migration

```
dotnet ef migrations add InitialCreate
```



Package source: All
Default project: BookApiProject

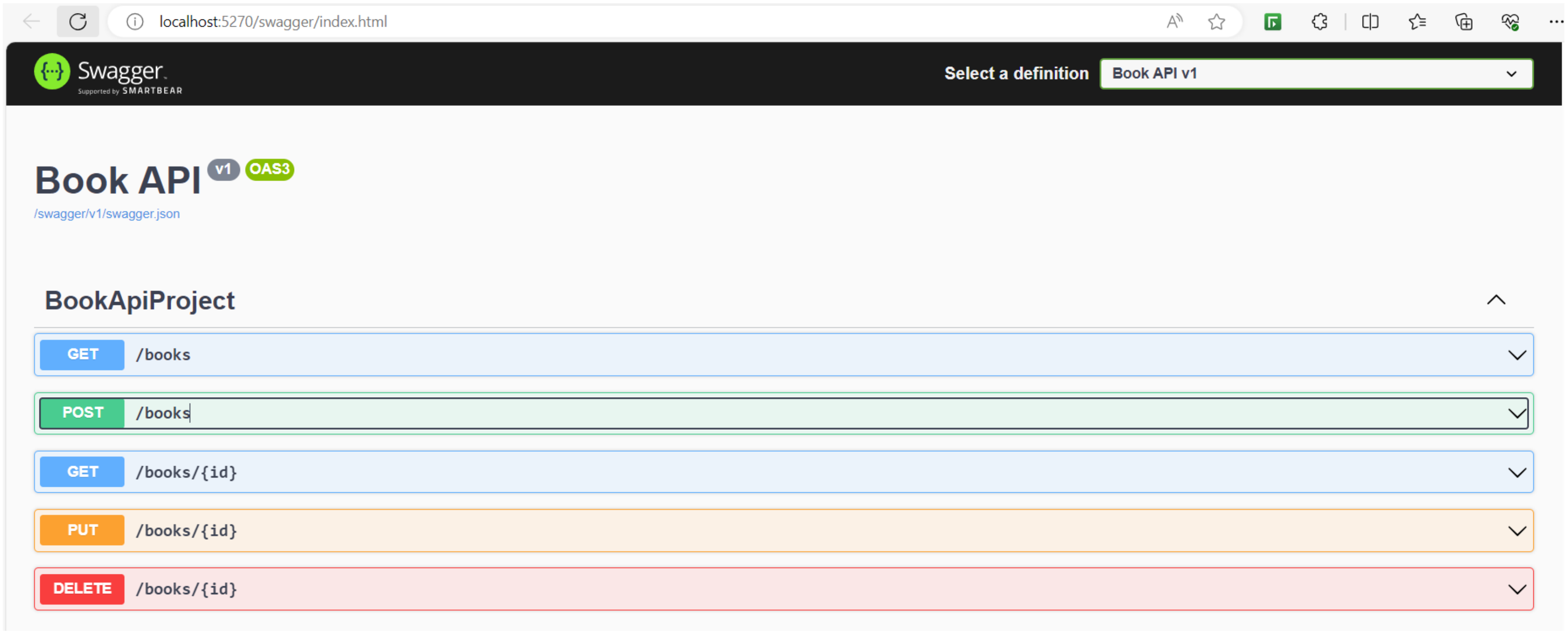
```
PM> dotnet ef migrations add InitialCreate
```

Or this command for updating the migartion

```
dotnet ef database update InitialCreate
```

7. Verify your application

http://localhost:5270/swagger/index.html



Book API v1 OAS3

/swagger/v1/swagger.json

BookApiProject

GET /books

POST /books

GET /books/{id}

PUT /books/{id}

DELETE /books/{id}