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# AWS Database Migration Services

Workshop: Oracle to PostgreSQL Migration

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## 1 Introduction

### 1.1 Objective

In this lab, you will be performing a migration from Oracle to PostgreSQL using the AWS Schema Conversion Tool (AWS SCT) and the AWS Databases Migration Service (AWS DMS).

#### 1.1.1 Lab Setup

- Create EC2 Key Pair
- Launch AWS CloudFormation Stack
- Access Amazon AppStream 2.0 Tools
- OPTIONAL: download the JDBC drivers locally
- OPTIONAL: install the AWS Schema Conversion Tool locally
- OPTIONAL: install database management tools locally

#### 1.1.2 Lab Steps

- Create AWS Database Migration Instances
- Connect to your environment
- Setup AWS Schema Conversion Tool
- Convert the Oracle schema to PostgreSQL
- Create Source Endpoint in AWS DMS
- Create Target Endpoint in AWS DMS
- Create a Migration Task in AWS DMS
- Start the migration
- Generate transactions on Oracle and see the data being migrated to PostgreSQL - CDC

#### 1.1.3 Lab Teardown

- Delete AWS CloudFormation Stack
- Delete EC2 Key Pair

## 1.2 About AWS Database Migration Service (AWS DMS)

The AWS Database Migration Service helps you migrate databases to AWS quickly and securely. The source database remains fully operational during the migration, minimizing downtime to applications that rely on the database. The AWS Database Migration Service can migrate your data to and from most widely used commercial and open-source databases.

The service supports homogenous migrations such as Oracle to Oracle, as well as heterogeneous migrations between different database platforms, such as Oracle to Amazon Aurora or Microsoft SQL Server to MySQL. It also allows you to stream data to Amazon Redshift, Amazon DynamoDB, and Amazon S3 from any of the supported sources including Amazon Aurora, PostgreSQL, MySQL, MariaDB, Oracle, SAP ASE, SQL Server and MongoDB, enabling consolidation and easy analysis of data in the petabyte-scale data warehouse. AWS Database Migration Service can also be used for continuous data replication with high-availability.

To find out more about AWS DMS, see the product page at <https://aws.amazon.com/dms/>

### 1.3 About the AWS Schema Conversion Tool (AWS SCT)

The AWS Schema Conversion Tool makes heterogeneous database migrations predictable by automatically converting the source database schema and a majority of the database code objects, including views, stored procedures, and functions, to a format compatible with the target database. Any objects that cannot be automatically converted are clearly marked so that they can be manually converted to complete the migration. SCT can also scan your application source code for embedded SQL statements and convert them as part of a database schema conversion project. During this process, SCT performs cloud native code optimization by converting legacy Oracle and SQL Server functions to their equivalent AWS service thus helping you modernize the applications at the same time of database migration. Once schema conversion is complete, SCT can help migrate data from a range of data warehouses to Amazon Redshift using built-in data migration agents.

Your source database can be on-premises, or in Amazon RDS or EC2 and the target database can be in either Amazon RDS or EC2. The AWS Schema Conversion Tool supports the following conversions:

Source Database	Target Database on Amazon RDS
Oracle Database	Amazon Aurora, MySQL, PostgreSQL, MariaDB
Oracle Data Warehouse	Amazon Redshift
Microsoft SQL Server	Amazon Aurora, Amazon Redshift, MySQL, PostgreSQL, MariaDB
Teradata	Amazon Redshift
IBM Netezza	Amazon Redshift
Greenplum	Amazon Redshift
HPE Vertica	Amazon Redshift
MySQL and MariaDB	PostgreSQL
PostgreSQL	Amazon Aurora, MySQL, MariaDB
Amazon Aurora	PostgreSQL

Figure 1: AWS Schema Conversion Tool: Supported Platforms

## 2 Lab Setup

### 2.1 Setup EC2 Key Pair

In this step, you will generate an EC2 key pair for use in the Database Migration Workshop labs.

Make sure you have selected the **Asia Pacific (Tokyo)** region by visiting the following link:

<http://amzn.to/aws-tokyo-keypairs> (=> <https://ap-northeast-1.console.aws.amazon.com/ec2/v2/home?region=ap-northeast-1#KeyPairs:sort=keyName>)

If no EC2 key pairs have been created in this region yet, you will see the following screen:

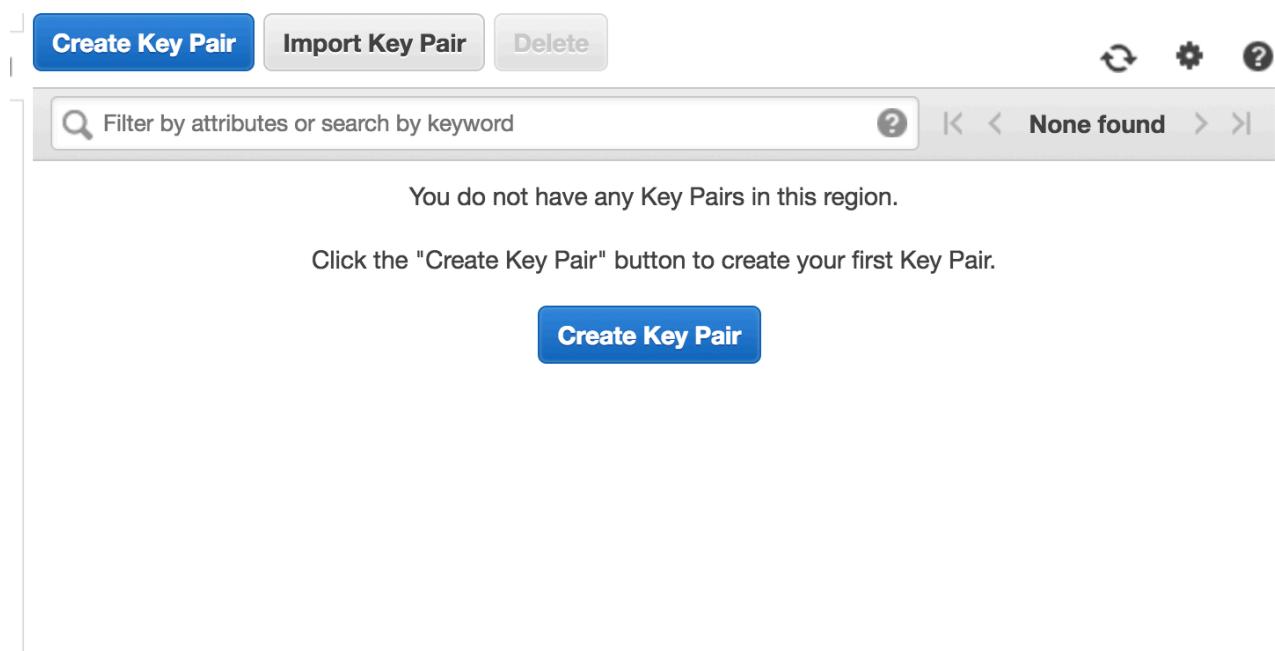


Figure 2: Key Pairs: List All Keys

*For this workshop, we recommend the creation of a new EC2 key pair to be used associated with workshop resources. We will later delete this key pair along with the workshop resources.*

You should click the **Create Key Pair** button and enter **workshop** as the name for the new key pair as shown below, clicking the **Create** button to complete the creation of the new key pair.

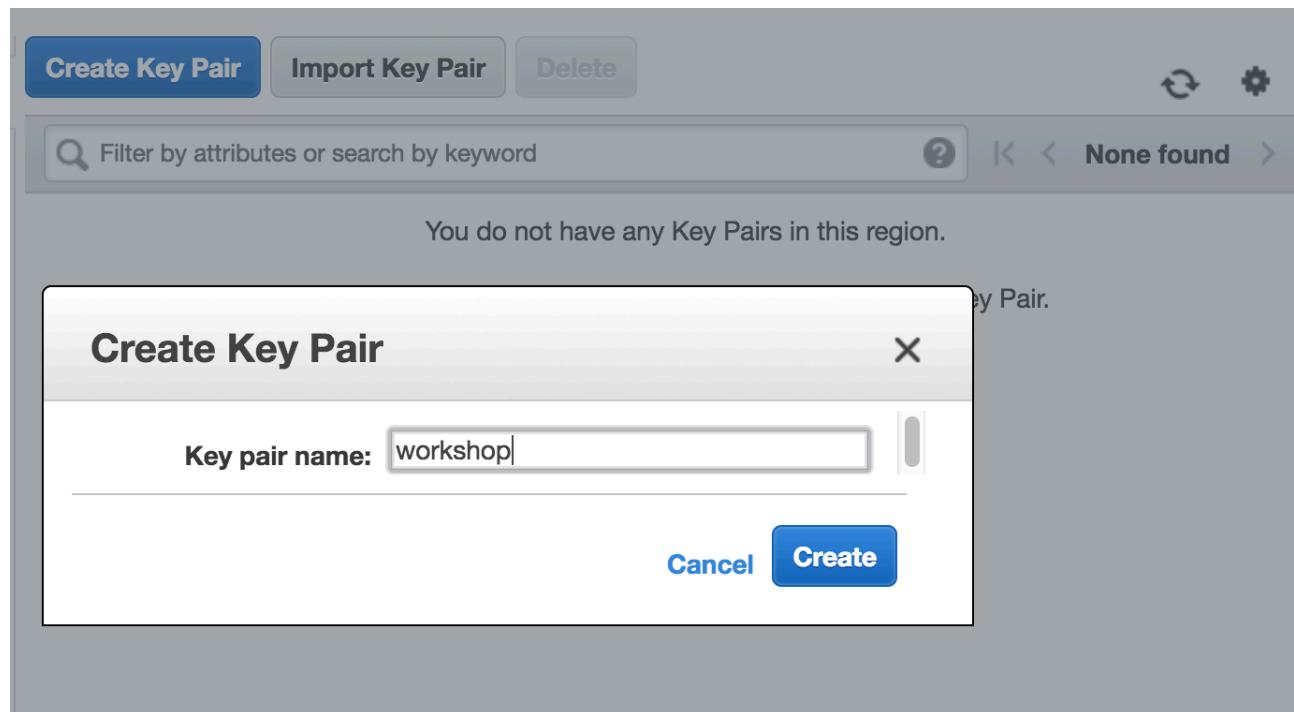


Figure 3: Key Pair: Create Dialog

You should now see a new EC2 key pair labeled **workshop**:

		Create Key Pair	Import Key Pair	Delete	Refresh	Settings	Help
		Filter by attributes or search by keyword		None found			
		Key pair name	Fingerprint				
<input checked="" type="checkbox"/>	workshop		cc:e3:5d:70:b2:47:56:ae:17:a0:44:5d:c6:30:d3:ce:cb:02:6a:a3				

Figure 4: Key Pair: Created

The private key for this EC2 key pair will have automatically downloaded to your browser's default directory, and this file will be called **workshop.pem**.

## 2.2 Setup AWS CloudFormation Stack

In this step, you will launch a AWS CloudFormation template that will setup the following resources needed for this lab:

- Source Database: Amazon RDS Oracle (this database will be pre-populated with sample database installed from <https://github.com/awslabs/aws-database-migration-samples>)
- Target Database: Amazon RDS PostgreSQL

**CAUTION: The resources that you will be spinning up will continue to run until the CloudFormation stack is deleted or the individual resources are shutdown -- the steps for teardown are located in this document at [Teardown: AWS Cloudformation Stack](#)**

To launch this template, use the following link:

<http://amzn.to/aws-dms-workshop-lab-1> (=> <https://ap-northeast-1.console.aws.amazon.com/cloudformation/home?region=ap-northeast-1#/stacks/new?stackName=workshop&templateURL=https://s3-ap-northeast-1.amazonaws.com/aws-dms-workshop/workshop-lab-1.yaml>)

### 2.2.1 AWS CloudFormation Stack Selection

You should now see the following:

#### Create stack

Select Template      [Select Template](#)

Specify Details      [Design a template](#)      Use AWS CloudFormation Designer to create or modify an existing template. [Learn more.](#)

Options      [Design template](#)

Review

**Choose a template**      A template is a JSON/YAML-formatted text file that describes your stack's resources and their properties. [Learn more.](#)

Select a sample template  
 Upload a template to Amazon S3  
 Specify an Amazon S3 template URL  
<https://s3-ap-northeast-1.amazonaws.com/aws-dms-works/> [View/Edit template in Designer](#)

[Cancel](#) [Next](#)

Figure 5: AWS CloudFormation Stack Selection: Template

**The default settings are recommended, and no changes are required to this page. Click the Next button on the bottom of the page to continue.**

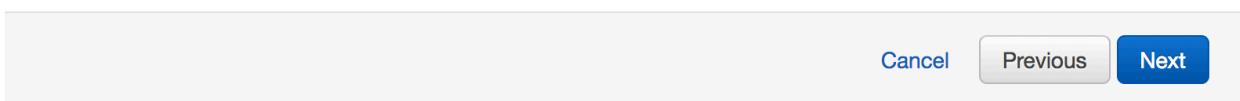


Figure 6: AWS CloudFormation Stack Selection: Confirmation

## 2.2.2 AWS CloudFormation Stack Settings

This page displays the settings and parameters for the CloudFormation stack. **The default settings are recommended, and no changes are required to this page.**

### Create stack

Select Template      **Specify Details**

Options      Review

**Specify Details**

Specify a stack name and parameter values. You can use or change the default parameter values, which are defined in the AWS CloudFormation template. [Learn more](#).

Stack name

**Parameters**

**Key Pair**

KeyName  Name of an existing EC2 KeyPair to enable SSH access to the instance

**Source Oracle Database Configuration**

OracleDBName  Enter Oracle Database name

OracleDBPassword  Enter password for the oracle admin user: dbmaster

OracleDBStorage  Enter storage for Oracle DB in GB

OracleInstanceType  Oracle DB instance type

**Target PostgreSQL Database Configuration**

PostgresDBName  Enter PostgreSQL Database name

PostgresDBUsername  Enter database Admin username for RDS PostgreSQL

PostgresDBPassword  Enter password for RDS PostgreSQL Admin user

PostgresInstanceType  RDS PostgreSQL DB instance type

PostgresDBStorage  Enter storage for PostgreSQL DB in GB

**Next**

Figure 7: AWS CloudFormation: Settings Overview

## Specify Details

---

Specify a stack name and parameter values. You can use or change the default parameter values, which are defined in the AWS CloudFormation template. [Learn more.](#)

Stack name

Figure 8: AWS CloudFormation: Stack Name

## Parameters

---

### Key Pair

---

KeyName  ▼  
Name of an existing EC2 KeyPair to enable SSH access to the instance

Figure 9: AWS CloudFormation: Key Pair

## Parameters

---

### Source Oracle Database Configuration

---

OracleDBName	<input type="text" value="ORCL"/>	Enter Oracle Database name
OracleDBPassword	<input type="password" value="....."/>	Enter password for the oracle admin user: dbmaster
OracleDBStorage	<input type="text" value="100"/>	Enter storage for Oracle DB in GB
OracleInstanceType	<input type="text" value="db.t2.medium"/> <span style="border: 1px solid #ccc; padding: 2px;">▼</span>	Oracle DB instance type

Figure 10: AWS CloudFormation: Oracle

### Target PostgreSQL Database Configuration

<b>PostgresDBName</b>	postgres	Enter PostgreSQL Database name
<b>PostgresDBUsername</b>	postadmin	Enter database Admin username for RDS PostgreSQL
<b>PostgresDBPassword</b>	.....	Enter password for RDS PostgreSQL Admin user
<b>PostgresInstanceType</b>	db.t2.medium	RDS PostgreSQL DB instance type
<b>PostgresDBStorage</b>	100	Enter storage for PostgreSQL DB in GB

Figure 11: AWS CloudFormation: Postgres

Once you have confirmed the settings, click the **Next** button on the bottom of the page to continue.

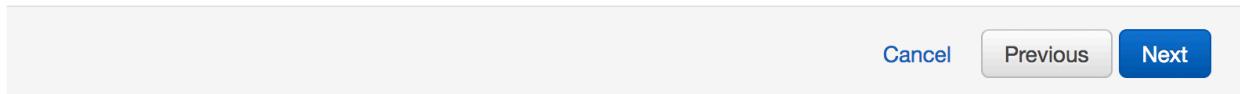


Figure 12: AWS CloudFormation Stack Parameters: Confirmation

#### 2.2.3 AWS CloudFormation Stack Options

You will now see the Options for this CloudFormation template. **The default settings are recommended, and no changes are required to this page.**

## Create stack

Select Template  
Specify Details  
**Options**  
Review

### Options

#### Tags

You can specify tags (key-value pairs) for resources in your stack. You can add up to 50 unique key-value pairs for each stack. [Learn more.](#)

	Key (127 characters maximum)	Value (255 characters maximum)	
1	<input type="text"/>	<input type="text"/>	<a href="#">+</a>

#### Permissions

You can choose an IAM role that CloudFormation uses to create, modify, or delete resources in the stack. If you don't choose a role, CloudFormation uses the permissions defined in your account. [Learn more.](#)

IAM Role [Choose a role \(optional\)](#)  
Enter role arn

#### ► Advanced

You can set additional options for your stack, like notification options and a stack policy. [Learn more.](#)

[Cancel](#) [Previous](#) **Next**

Figure 13: AWS CloudFormation Stack Options: All

Click the **Next** button on the bottom of the page to continue.

[Cancel](#) [Previous](#) **Next**

Figure 14: AWS CloudFormation Stack Options: Confirmation

### 2.2.4 AWS CloudFormation Stack Review

#### Create stack

Select Template  
Specify Details  
**Options**  
Review

#### Options

##### Tags

You can specify tags (key-value pairs) for resources in your stack. You can add up to 50 unique key-value pairs for each stack. [Learn more.](#)

	Key (127 characters maximum)	Value (255 characters maximum)	
1	<input type="text"/>	<input type="text"/>	<a href="#">+</a>

##### Permissions

You can choose an IAM role that CloudFormation uses to create, modify, or delete resources in the stack. If you don't choose a role, CloudFormation uses the permissions defined in your account. [Learn more.](#)

IAM Role [Choose a role \(optional\)](#)

Enter role arn

##### Advanced

You can set additional options for your stack, like notification options and a stack policy. [Learn more.](#)

[Cancel](#) [Previous](#) **Next**

Figure 15: AWS CloudFormation Stack: Review

Click the **Create** button on the bottom of the page to continue.

[Cancel](#) [Previous](#) **Create**

Figure 16: AWS CloudFormation Stack Review: Creation

All AWS resources associated with this workshop lab will now be created immediately, and billing will proceed until this CloudFormation stack is deleted or those resources are individually stopped/terminated -- the steps for teardown are located in this document at [Teardown: AWS Cloudformation Stack](#)

### 2.2.5 AWS CloudFormation Stack: List Stacks

You should now see a list of any existing CloudFormation templates for this region in your account, and the new CloudFormation stack called **workshop** should now appear in your console.

Stack Name				Created Time	Status	Description
<input checked="" type="checkbox"/> workshop				2017-10-22 12:12:32 UTC+0800	CREATE_COMPLETE	This CloudFormation te...

Figure 17: AWS CloudFormation Stack: List Stacks

If the stack does not immediately appear, you may need to click the **Refresh** button above the list panel.

## 2.2.6 AWS CloudFormation Stack: Outputs

When the stack and its underlying resource creations are completed, the status will be displayed as **CREATE\_COMPLETE**. Once this has occurred, we can gather Outputs from the CloudFormation stack.

Key	Value	Description	Export Name
OracleJDBCConnectionString	jdbc:oracle:thin:@wo1mo68832b8er8.cnlavnyl m1rz.ap-northeast-1.rds.amazonaws.com:152 1:ORCL	JDBC connection string for Oracle database	
Regionname	ap-northeast-1		
PostgresJDBCConnectionString	jdbc:postgresql://wpofi3ugd73u6p.cnlavnylm1 rz.ap-northeast-1.rds.amazonaws.com:5432/p ostgres	JDBC connection string for PostgreSQL dat...	
StackName	workshop		

Figure 18: AWS CloudFormation Stack: Outputs

## 2.3 Setup JDBC Drivers

If you have chosen to locally install the AWS Schema Conversion Tool and your preferred database management tool, you will also need to download the database-specific JDBC drivers to connect to the database resources in this workshop. These JDBC drivers can be found at the following links:

- <http://bit.ly/postgres-jdbc>
- <http://bit.ly/oracle-jdbc>

*The Oracle JDBC requires that you accept the associated license agreement before downloading -- the actual file required from the linked page is called **ojdbc7.jar***

You will need to download both drivers to your local hard drive for later use by both the AWS Schema Conversion Tool and your preferred database management tool.

## 2.4 Setup AWS Schema Conversion Tool

In this step, you will install the AWS Schema Conversion Tool locally.

*For those participants not wishing to install the AWS Schema Conversion Tool locally, you can use the Schema Conversion Tool via Amazon AppStream 2.0 resources that will have been temporarily provisioned for your use during this lab. See [Setup: Accessing Amazon AppStream 2.0 Tools](#)*

### 2.4.1 AWS SCT Download

Download the latest version of AWS Schema Conversion Tool (SCT) from the following link:

<http://amzn.to/aws-sct> (=> [http://docs.aws.amazon.com/SchemaConversionTool/latest/userguide/CHAP\\_SchemaConversionTool.Installing.html](http://docs.aws.amazon.com/SchemaConversionTool/latest/userguide/CHAP_SchemaConversionTool.Installing.html))

*If you already have SCT installed, we recommend that you download and install the latest version*

### 2.4.2 Download JDBC Drivers

For connecting to your source database (Oracle) and target database (PostgreSQL), you will need the appropriate JDBC drivers for both databases. If you have not already done so, download the [JDBC Drivers](#) before moving forward.

### 2.4.3 Configure AWS SCT with JDBC Drivers

Once downloaded, launch AWS Schema Conversion Tool. On first launch, you will be presented with a terms and conditions statement, click **Agree** if you agree to the terms and conditions specified.

Next, you should see the following page:

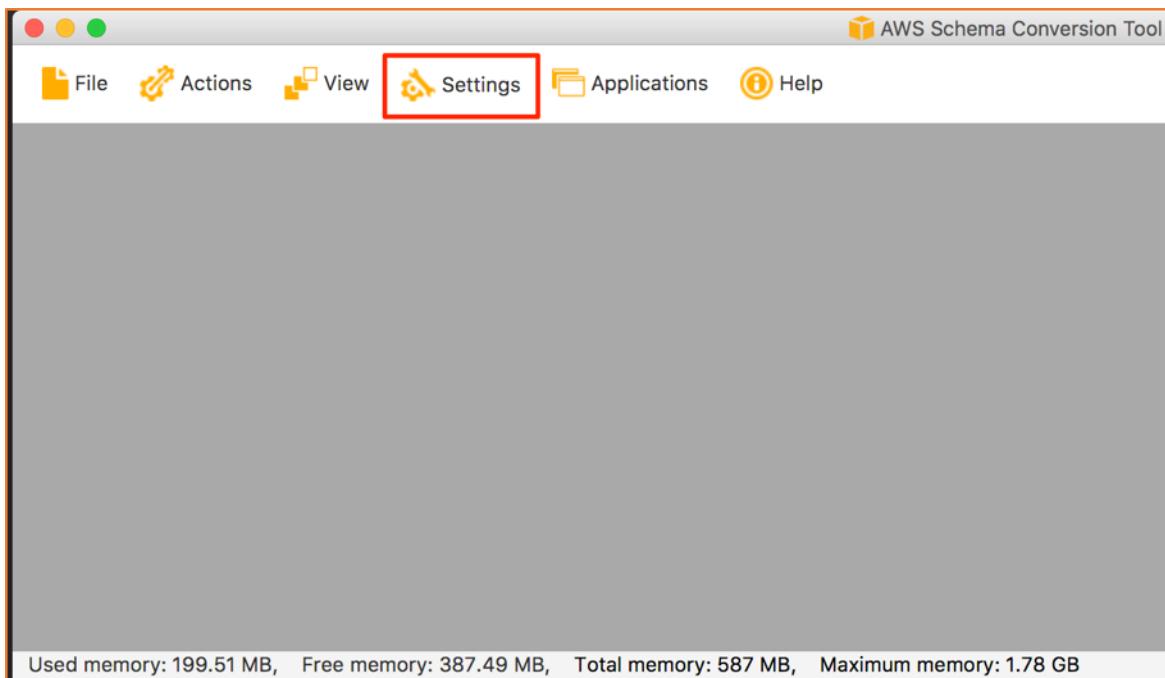


Figure 19: AWS Schema Conversion Tool: Initialized

Click on **Settings > Global Settings**

Now you should see the following Global Settings dialog:

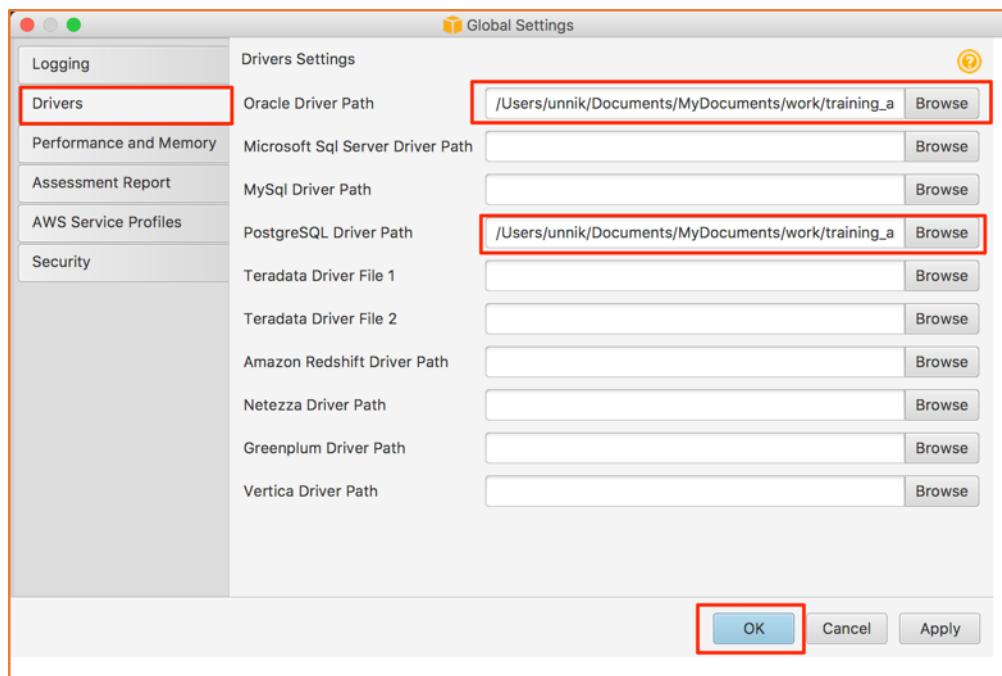


Figure 20: AWS Schema Conversion Tool: Global Settings

Make the following changes to the Global Settings:

- Select **Drivers** on the left-side panel
- For the **Oracle Driver Path**, select the location of your local Oracle jar file
- For the **PostgreSQL Driver Path**, select the location of your local PostgreSQL jar file
- Click **OK** to Proceed

#### 2.4.4 Permit Local Access to Source/Target Databases

You will now modify both Source and Target database permissions so that you can connect to those databases with the AWS SCT locally.

To do so, you will modify the Security Groups attached to the databases. The following link will provide you access to the list of Security Groups in the region, filtered by the default CloudFormation stack name of **workshop**:

<http://amzn.to/aws-tokyo-sg-workshop> (=> <https://ap-northeast-1.console.aws.amazon.com/ec2/v2/home?region=ap-northeast-1#SecurityGroups:search=workshop;sort=groupId>)

The list should look similar to the following, with two different SGs created by the earlier CloudFormation template, one for Oracle and the other for PostgreSQL:

Name	Group ID	Group Name	VPC ID	Description
<input type="checkbox"/>	sg-ad303ccb	workshop-OraVPCSecurityG...	vpc-76d2cf12	Security group for Oracle Instance.
<input type="checkbox"/>	sg-d5323eb3	workshop-PostgresVPCSec...	vpc-76d2cf12	Security group for RDS PostgreSQL Instances.

Figure 21: AWS Schema Conversion Tool: List of Security Groups

Open the following ports to provide access from your current IP address.

- Modify **workshop-oracle-sg** Security Group as follows:
  - Add rule Oracle Port – 1521 > Open to 'My IP'
- Modify **workshop-postgres-sg** Security Group as follows:
  - Add rule Postgres Port – 5432 > Open to 'My IP'

## 2.5 Setup SQL database management tools (Optional)

In this step, we will install a database management tool of your choice locally.

*For those participants not wishing to install a database management tool locally, you can use the DBeaver tool via Amazon AppStream 2.0 resources that will have been provisioned for you temporarily. See [Setup: Accessing Amazon AppStream 2.0 Tools](#)*

Some popular and free tools include:

- SQL WorkbenchJ: <http://www.sql-workbench.net/downloads.html>
- DBeaver: <http://dbeaver.jkiss.org/>
- SQuirrel: <http://squirrel-sql.sourceforge.net/>

In this lab, we will be using SQL WorkbenchJ screenshots to demonstrate the lab activities.

## 3 Lab Steps

### 3.1 Create an AWS SCT Project

In AWS SCT, select **File > New Project Wizard**

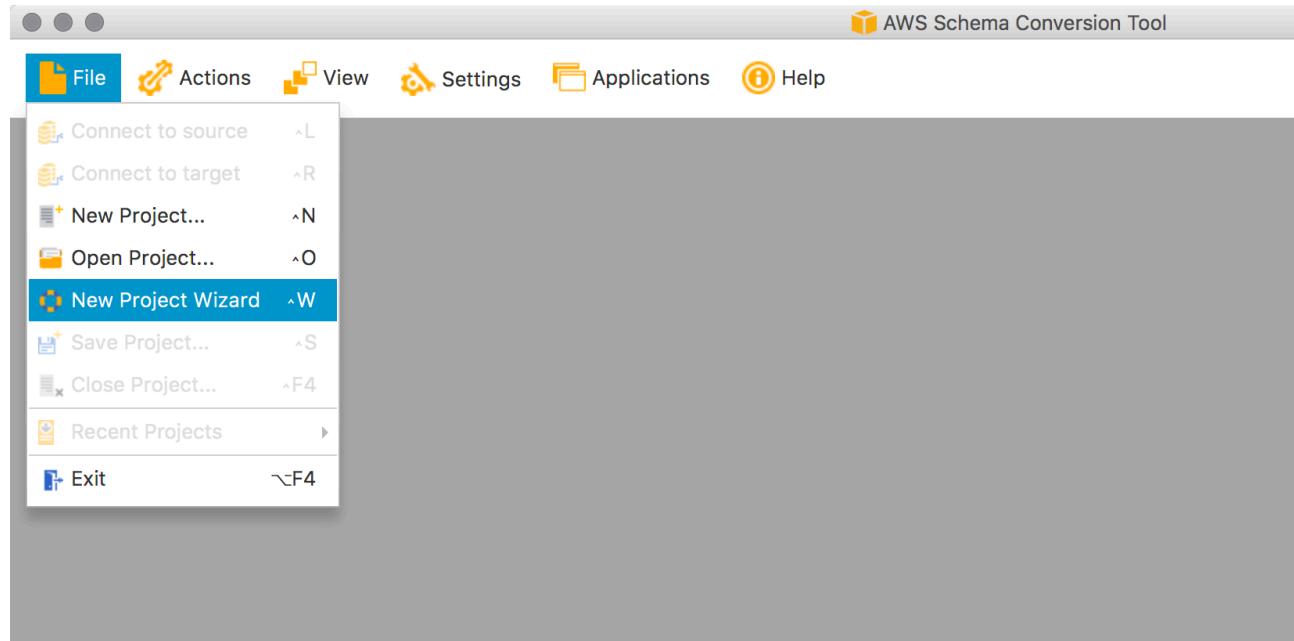


Figure 22: AWS SCT New Project Wizard

#### 3.1.1 New Project Wizard – Select Source

Enter the following in the dialog displayed:

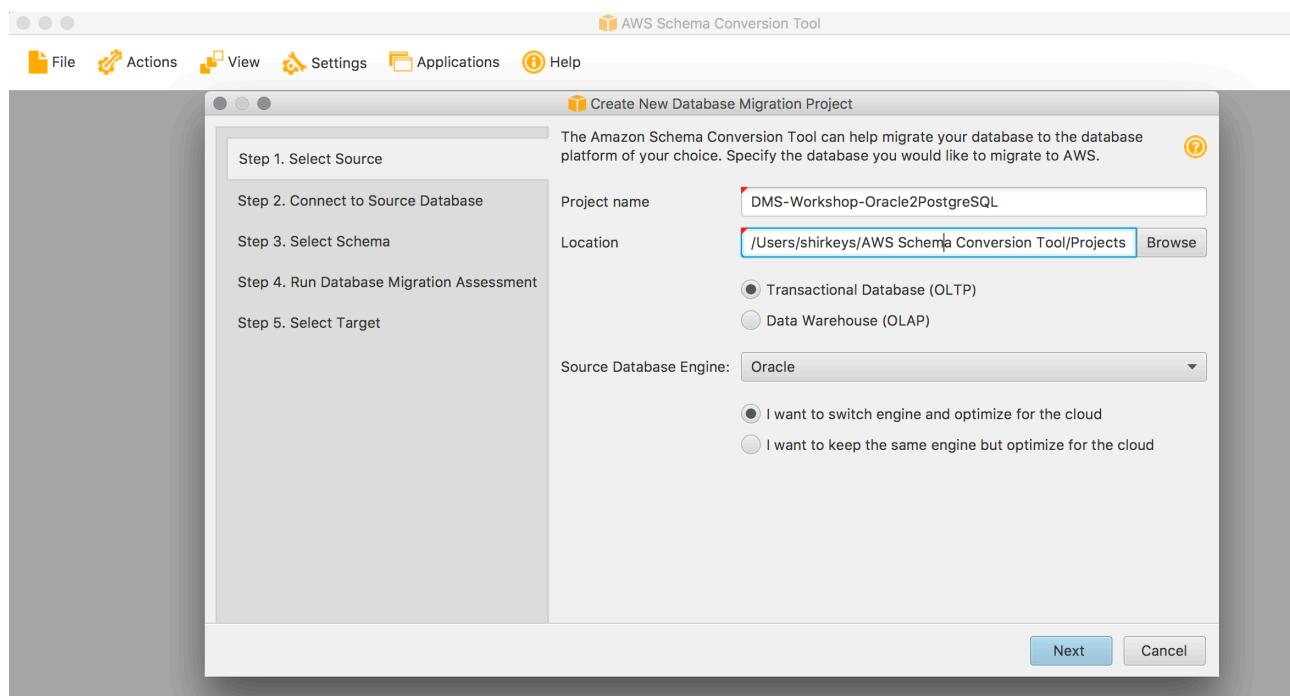


Figure 23: AWS SCT New Project Wizard - Step 1

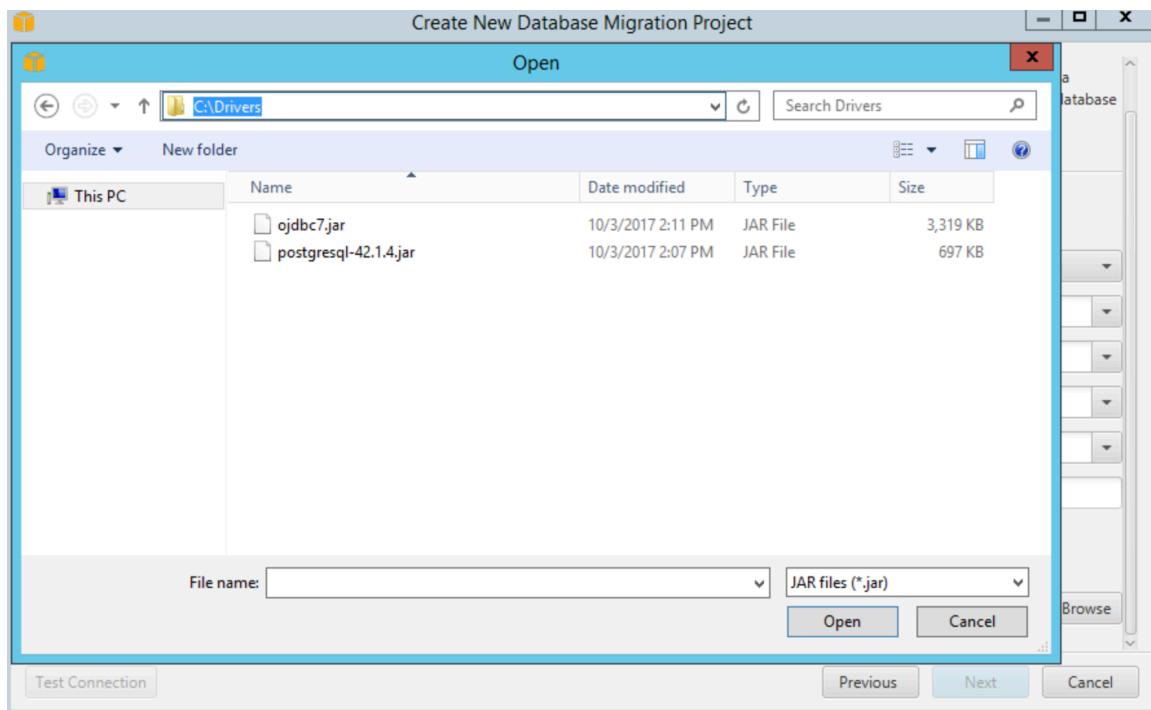
- **Project Name** | DMS-Workshop-Oracle2PostgreSQL|
- **Location:** (leave default)
- For **Source Database Engine**, specify:
  - Transactional Database (OLTP)
  - Oracle
  - I want to switch engine and optimize for the cloud

Click **Next** to continue

### 3.1.2 New Project Wizard – Connect to Source Database

Enter the following in the next dialog displayed:

- **Type:** SID
- **Server Name:** (enter DNS name of your Oracle instance)
- **Server Port:** 1521
- **Oracle SID:** (enter database name, default is Oracle)
- **User name:** dbmaster
- **Password:** (enter the password for your Oracle instance)
- **Oracle Driver Path:** (see notes below)
  - Local: when running AWS SCT locally, then the JDBC jar file for Oracle must be selected from where it was downloaded to earlier
  - DMS Workshop AppStream 2.0 Clients: the path is **C:\Drivers** as shown below:



When finished, click **Test Connection**. If you receive a **Connection Successful** message, then proceed, otherwise reconfirm the values you have entered earlier and try again.

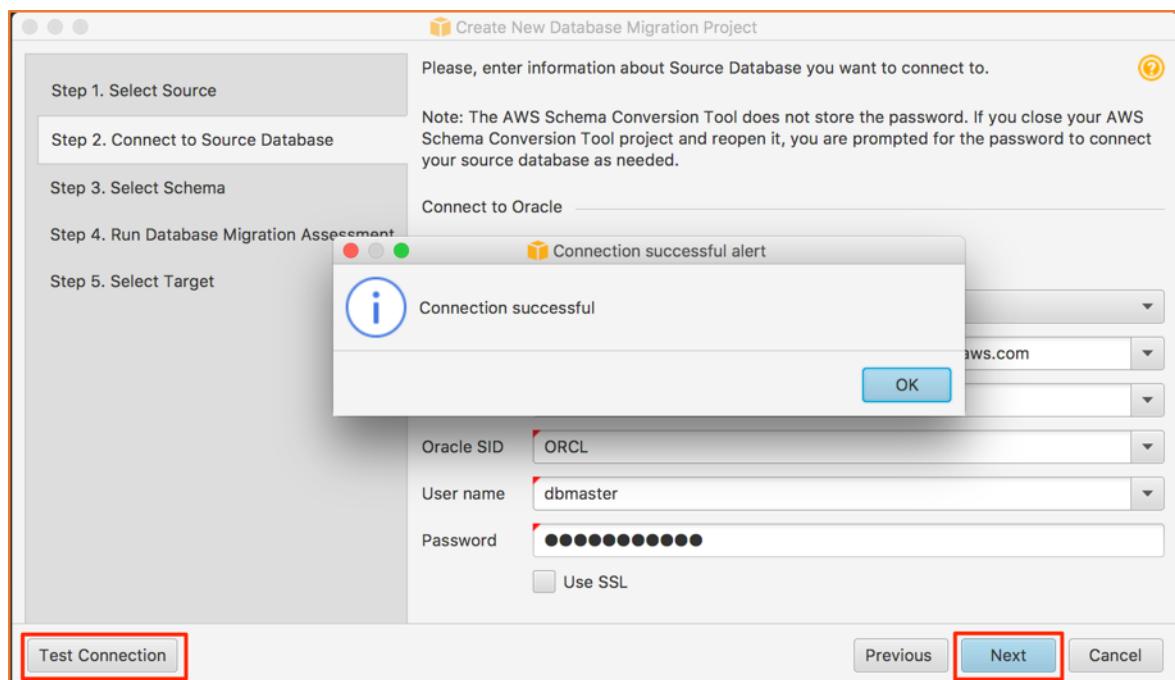


Figure 24: AWS SCT New Project Wizard - Test Source Connection

### 3.1.3 New Project Wizard - Select Schema

From the Select Schema step, select **DBMASTER** as the Source Schema

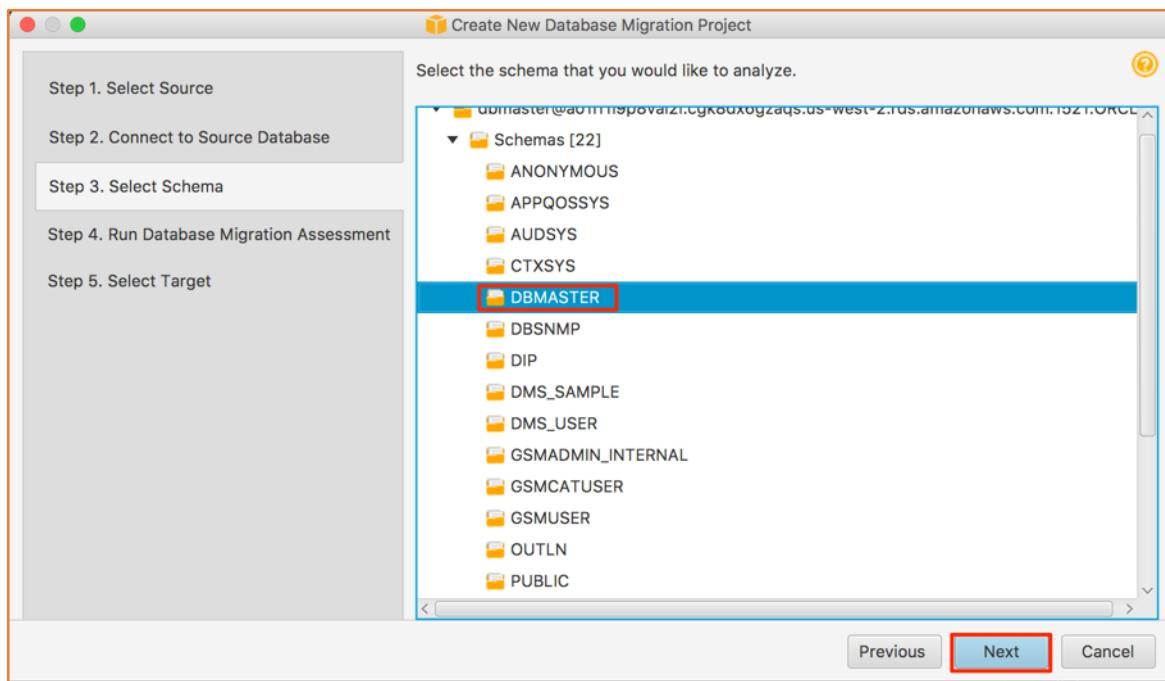


Figure 25: AWS SCT New Project Wizard - Select Schema

### 3.1.4 New Project Wizard - Run Database Migration Assessment

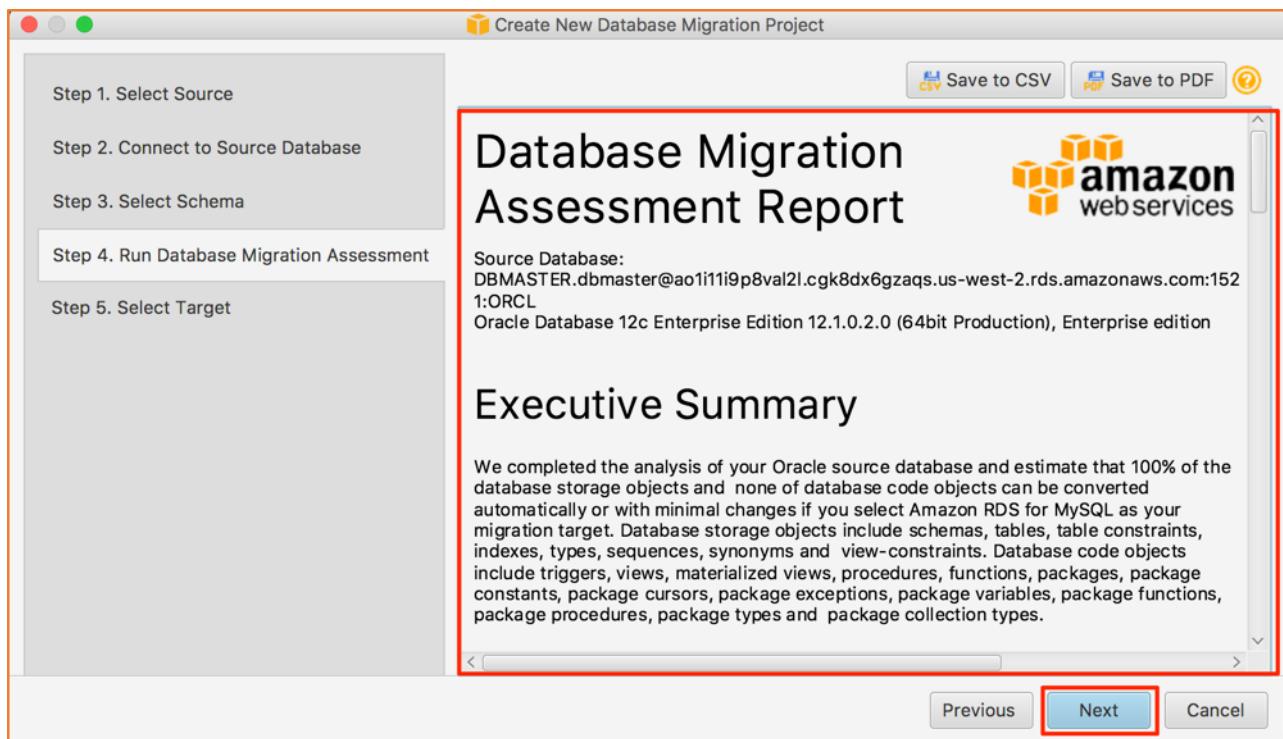


Figure 26: AWS SCT New Project Wizard - Database Migration Assessment

### 3.1.5 New Project Wizard - Select Target

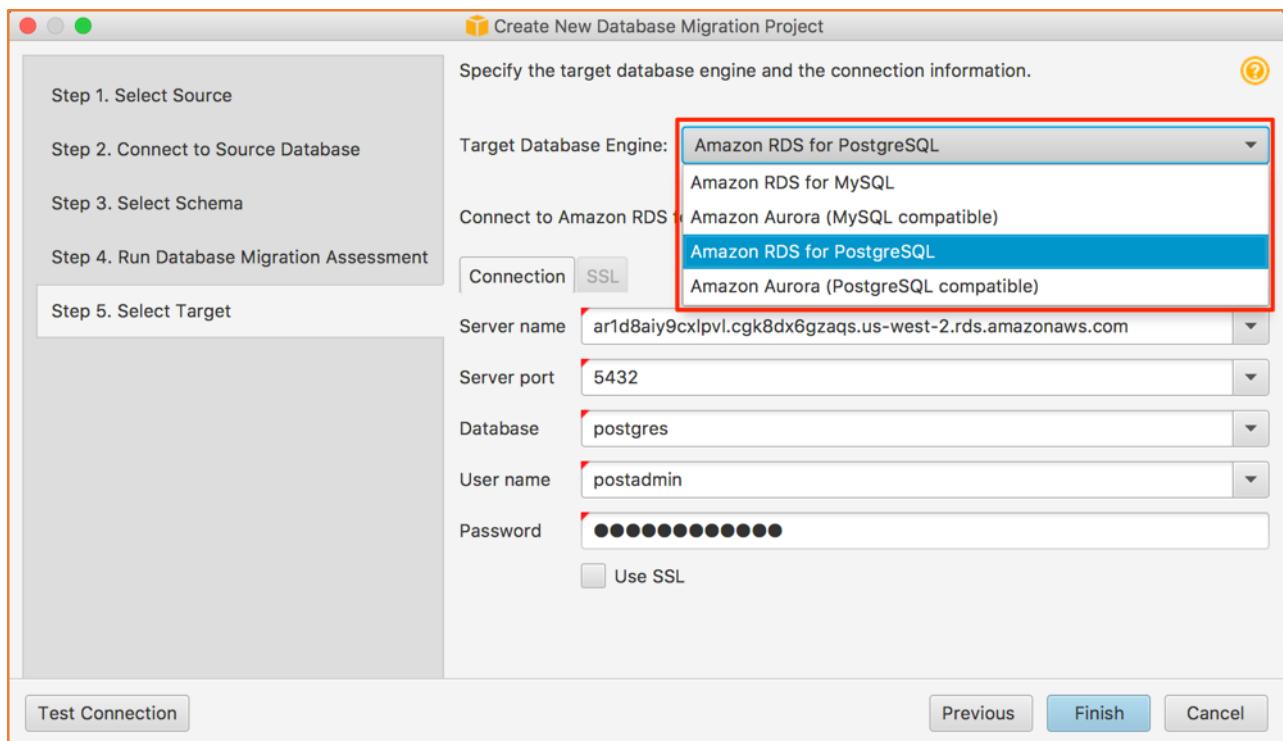


Figure 27: AWS SCT New Project Wizard - Select Target

### 3.1.6 New Project Wizard - Test Target Connection

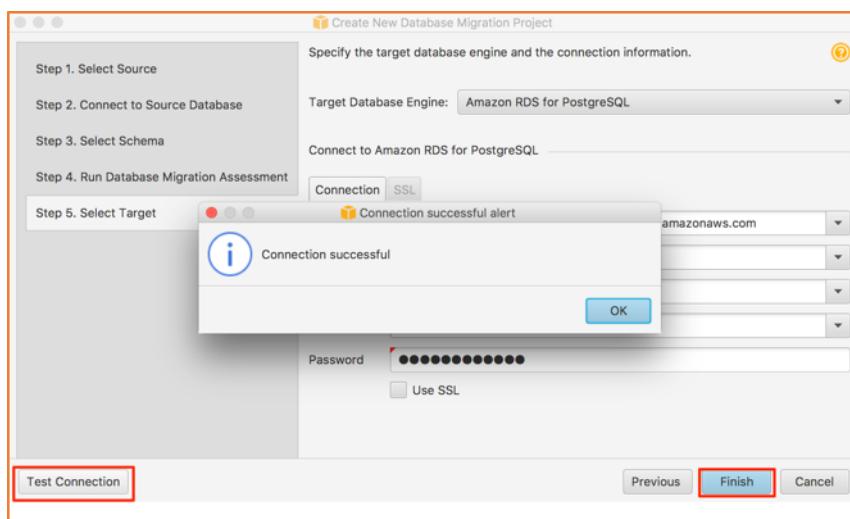


Figure 28: AWS SCT New Project Wizard - Test Target Connection

## 3.2 Schema Conversion in AWS SCT

### 3.2.1 Schema Conversion - Review Report

Review the project screen:

- Uncheck all schemas on the left-pane except for the DMS\_SAMPLE schema.
- Click **Actions > Create Report**
- Go to the **Summary** tab on the top and review the generated report

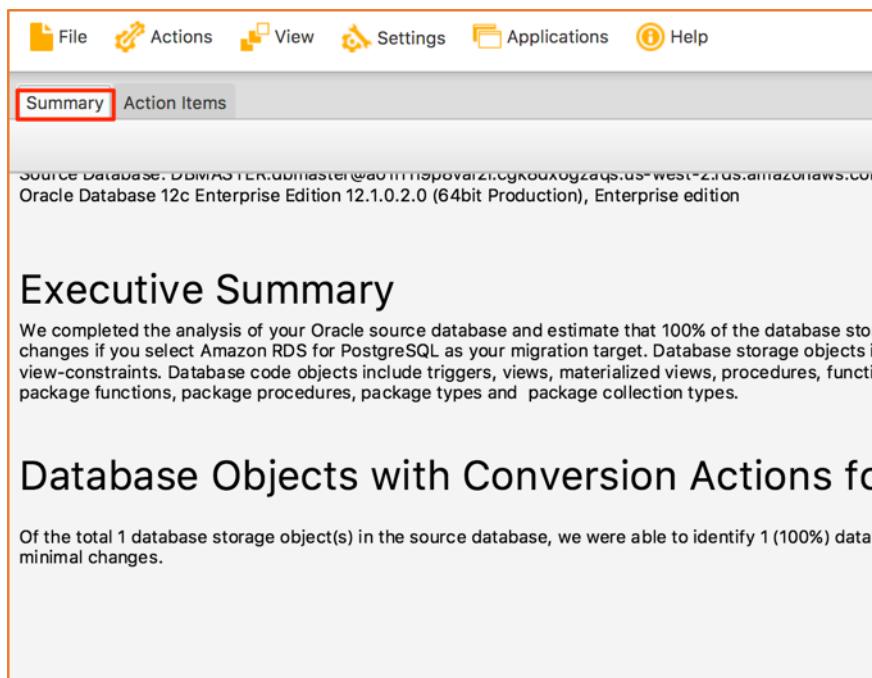


Figure 29: Schema Conversion - Review Conversion Report

### 3.2.2 Schema Conversion - Review and Convert Schema

On the left-hand pane, look through the schema tree of Oracle objects and note what could be automatically converted and what could not be converted.

### 3.2.3 Schema Conversion - Convert Source Schema

Now, right-click and click **Convert Schema** as shown below:

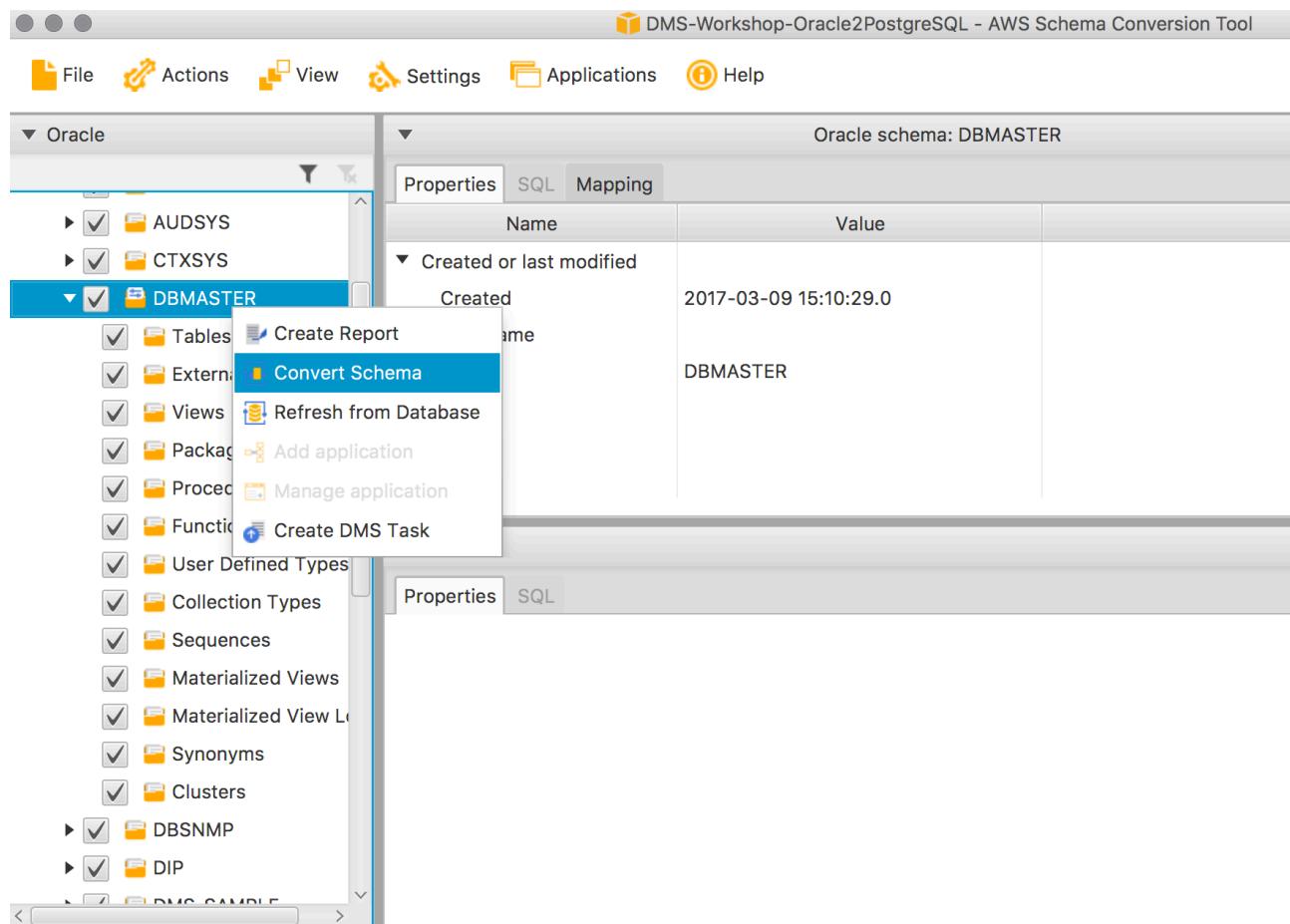


Figure 30: Schema Conversion - Source Apply (via right-click)

If right-click is not available to you, you can also select the source database and click **Actions > Convert Schema** as shown below:

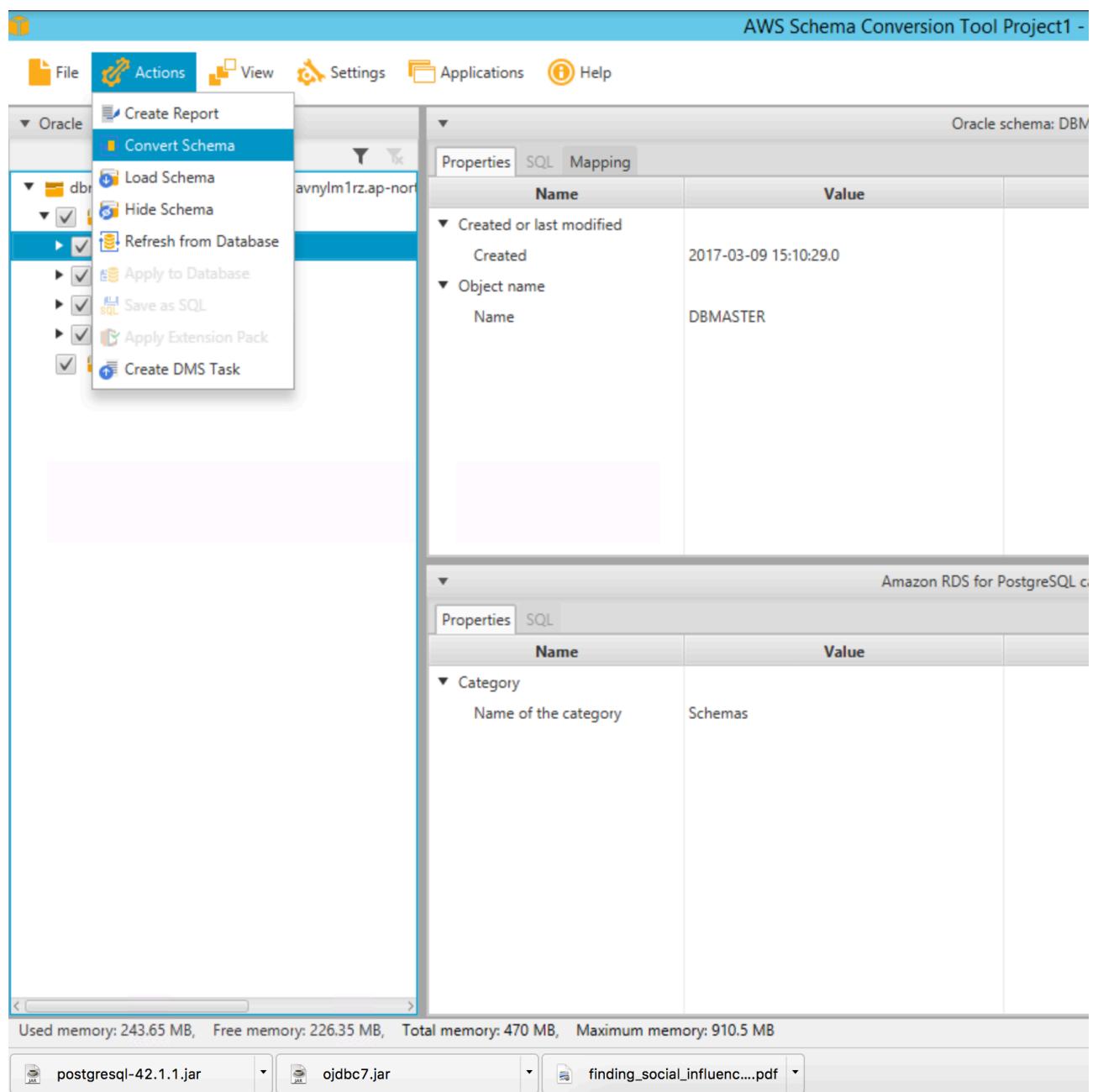


Figure 31: Schema Conversion - Source Apply (via Actions)

### 3.2.4 Schema Conversion - Review Target Schema

The schema will be converted and shown on the PostgreSQL instance (it has not been applied yet) as shown below:

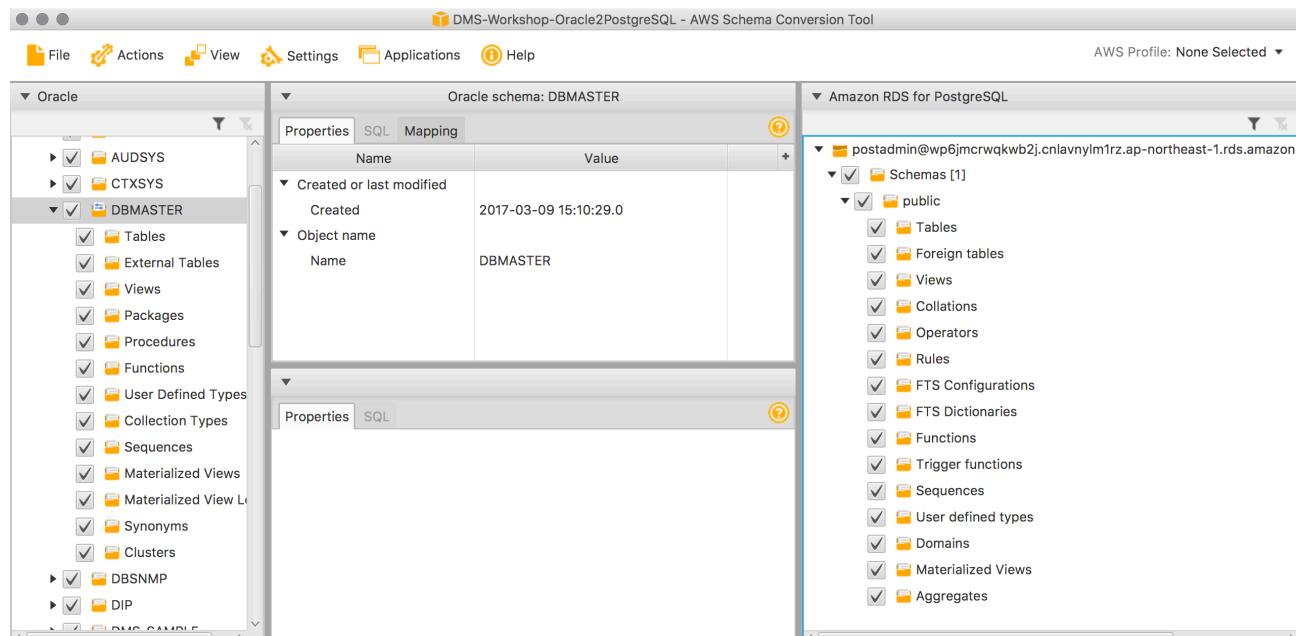


Figure 32: Schema Conversion - Target Review

Take a few minutes to review the objects being converted.

Since the majority of the objects which could not be converted are secondary objects like functions or procedures, we will proceed with the migration.

### 3.2.5 Schema Conversion - Apply Target Schema

Right click on the created schema on the right-hand panel, representing the target Postgres database, and click **Apply to database**, as shown below:

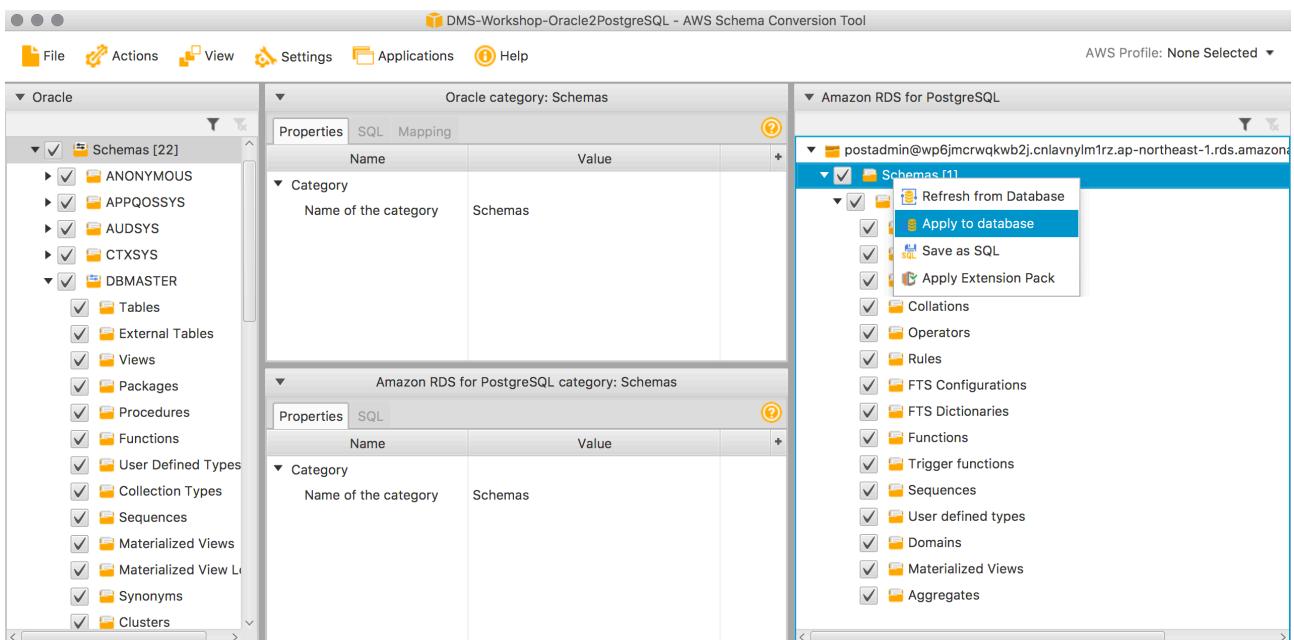


Figure 33: Schema Conversion - Target Apply (via right-click)

If right-click is not available, then select the target database name and select **Actions > Apply to Database** as shown below:

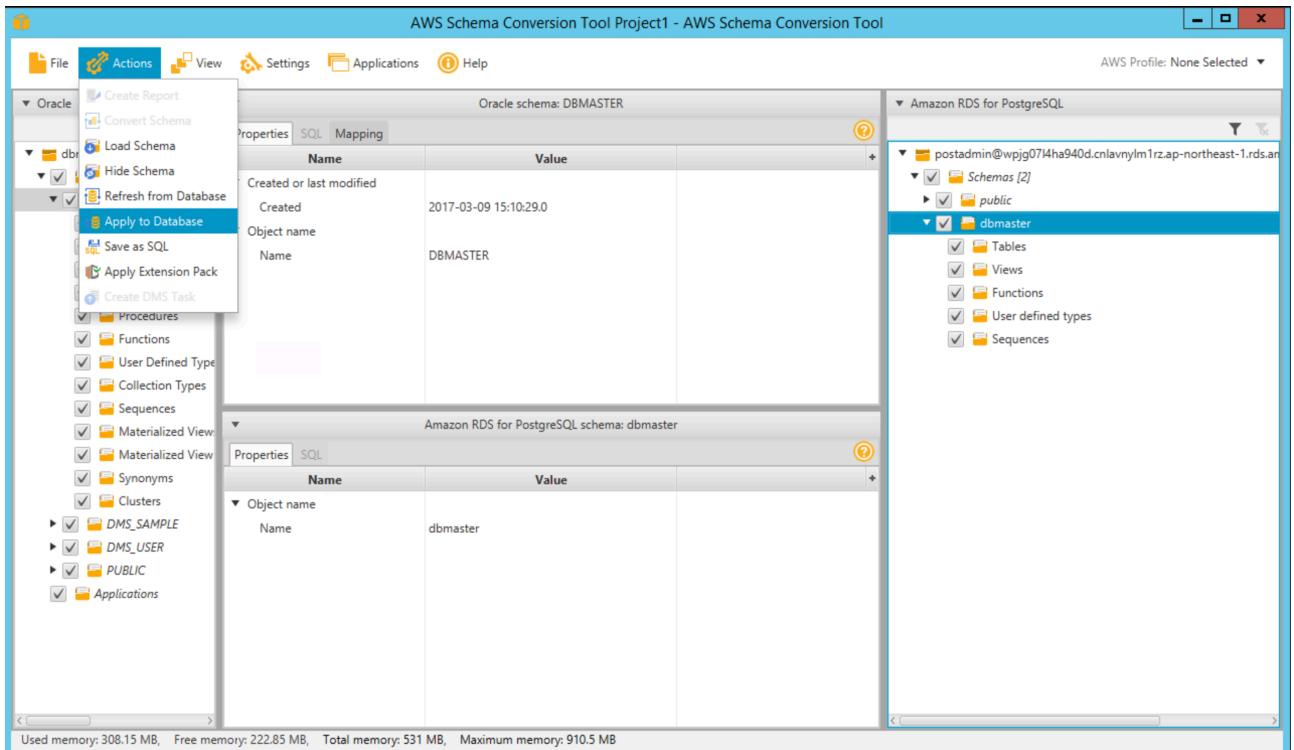


Figure 34: Schema Conversion - Target Apply (via Actions)

This will apply all those converted objects in the PostgreSQL target.

The above steps will convert all your Oracle objects into PostgreSQL objects. Objects which could not be converted automatically must be taken care of manually after migration at a later time.

## 4 Lab Teardown

### 4.1 Teardown AWS CloudFormation Stack