DOCUMENT – JULY 2021

PRINTED 1 JULY 2021

MANUALLY CREATING OPTIMIZED WINDOWS IMAGES FOR VMWARE HORIZON VMS

VMwareHorizon

vmware®

Table of Contents

Manually Creating Optimized Windows Images for VMware Horizon VMs

Introduction

Overview

Considerations you must take into account when creating a Windows system image are different if you plan to deploy virtual desktops rather than physical desktops:

- **Physical desktops** – Resource usage on a physical machine impacts only the user who is using that machine. The operating system on a physical machine determines whether or not resources are available. One-time actions impact the user only the first time they are performed because the machine is never refreshed. For example, a user typically gets a new user profile the first time they log on, and they continue to use that same profile with all subsequent logons.
- **Virtual desktops** – In contrast, in a virtual environment, the guest operating system behaves as if it has exclusive access to the CPU cores, but in reality the cores are shared between 2 to 8 virtual machines. When using nonpersistent VMware Horizon® VMs or user profiles, the actions that are intended to run only once could run every time a user logs on.

Therefore, with virtual desktops, one-time system actions must be configured in the base image, and one-time user actions must be configured in the default user profile. In addition, to reach a higher consolidation ratio, increasing the number of VMs hosted on a single VMware vSphere® host, VMware recommends turning off features that are not needed.

Purpose of This Guide

Manually Creating Optimized Windows Images for VMware Horizon VMs provides step-by-step procedures for creating optimized images. These procedures include creating a VM, installing and configuring a Windows operating system, optimizing the OS, and installing the various VMware agents required for desktop deployment.

This guide also includes a chapter on day-2 operations, such as updating VMware Tools, in vSphere-based VMs, and updating Windows.

Important: The procedures in this guide are sequential and build on one another, so make sure to complete each procedure in each chapter before moving on to the next.

An alternative to manually creating the VM image is to use automation, which is provided by Microsoft Deployment Toolkit (MDT). For step-by-step instructions, see the companion guide Using Automation to Create Optimized Windows Images for VMware Horizon VMs.

Intended Audience

This guide is intended for IT administrators and product evaluators who are familiar with VMware vSphere and VMware vCenter Server®. Familiarity with networking and storage in a virtual environment, Active Directory, identity management, and directory services is assumed. Knowledge of other technologies, such as Horizon is also helpful.

Advantages of an Optimized Image

Optimizing the golden image is well worth the time and effort involved. Savings are returned on a variety of fronts.

Initial Deployment Time Savings

By trimming the image, you can reduce the amount of required disk space by up to 80 percent, which translates to a significant reduction in the time it takes to create desktop pools (up to 3 times faster).

By default, Windows generates native images and performs disk cleanup actions after being idle for 10 minutes, which can use a full core for up to an hour. When deploying a large pool, this means that the cluster might not be usable for up to an hour after deployment. With image optimization, however, this process could be reduced to 30 seconds.

User Logon Time Savings

When a user logs on, the portion of logon time devoted to creating a standard user profile can take up to 30 seconds, but when optimized, this portion of logon time could be reduced to 3.5–10.5 seconds.

Host Memory Savings

A default deployment can use up to 2 GB of active memory, but with optimization, memory requirements can be reduced significantly (up to 50 percent).

Host CPU Savings

An optimized deployment can reduce CPU usage by up to 40 percent, allowing for up to a 40-percent increase in VM density on the physical vSphere host.

Storage and IOPS Savings

Because of the earlier-mentioned disk-space savings, you realize cache-usage improvements as well. Disabling unneeded features and compressing the OS files means a larger portion can fit in the cache, which can reduce the amount of IOPS required by up to 250 percent.

Tested Operating Systems

The following operating systems have been tested using the procedures included in this guide. The table shows the example sizing and login duration that we achieved in our testing.

Only 64-bit operating systems were tested, but any 32-bit operating system that has a corresponding 64-bit version listed should work in the same way. All operating systems were tested with all updates available as of mid-June 2021. For a complete list of supported Windows 10 operating systems, see the VMware knowledge-base article Supported versions of Windows 10 on Horizon Agent Including All VDI Clones (Full Clones, Instant Clones, and Linked Clones on Horizon 7) (2149393).

Note: Most screenshots in this guide are from Windows 10 21H1. If you have a different OS version, some screens might look slightly different, but in general they are quite similar.

Important: Use an OS version that has a Microsoft Windows volume license key using the Key Management Service (KMS). KMS treats each activated clone as a computer with a newly issued license. In a production environment, you must activate Windows. In an evaluation environment, you can create the VM and log in without activating Windows.

Operating System	Version	Build	Edition	Architecture	Used Space	New Profile Creation Duration
Windows 10	1607	14393.4467 (2021-06-08)	LTSB*	x64	4.84 GB	2.5 S
Windows 10	1809**	17763.1999 (2021-06-08)	LTSC*	x64	5.32 GB	2.5 S
Windows 10	1909**	18362.1621 (2021-06-08)	Education	x64	6.22 GB	4 S
Windows 10	1909**	18363.1621 (2021-06-08)	Enterprise	x64	6.31 GB	4 S
Windows 10	2004**	19041.1052 (2021-06-08)	Education	x64	5.94 GB	4.5 S
Windows 10	2004**	19041.1052 (2021-06-08)	Enterprise	x64	6.00 GB	4.5 S
Windows 10	2004**	19041.1052 (2021-06-08)	Professional	x64	6.10 GB	4.5 S
Windows 10	20H2**	19042.1052 (2021-06-08)	Education	x64	6.22 GB	4.5 S
Windows 10	20H2**	19042.1052 (2021-06-08)	Enterprise	x64	6.00 GB	4.5 S
Windows 10	20H2**	19042.1052 (2021-06-08)	Professional	x64	6.22 GB	4.5 S
Windows 10	21H1**	19043.1052 (2021-06-08)	Education	x64	6.08GB	4 S
Windows 10	21H1**	19043.1052 (2021-06-08)	Enterprise	x64	5.97 GB	4 S
Windows 10	21H1**	19043.1052 (2021-06-08)	Professional	x64	6.06 GB	4 S
Windows Server 2016	1607	14393.4467 (2021-06-08)	Datacenter	x64	6.50 GB	2.5 S
Windows Server 2016	1607	14393.4467 (2021-06-08)	Standard	x64	6.51 GB	2.5 S
Windows Server 2019	1809**	17763.1999 (2021-06-08)	Datacenter	x64	6.41 GB	3.5 S
Windows Server 2019	1809**	17763.1999(2021-06-08)	Standard	x64	6.85GB	3 S

* *LTSB* means long-term servicing branch. *LTSC* means long-term servicing channel. This edition receives only security updates but no feature updates. OS upgrades are released only once every three years or so. This edition does not include Edge or any Microsoft Store (Universal Windows Platform, or UWP) apps, or Cortana, the voice-activated digital assistant. This edition is meant for specialized systems that perform a single important task—such as PCs that control medical equipment, point-of-sale systems,

and ATMs.

** For 1809+ vSphere 6.5/6.7 U3 or higher is recommended, as there are known problems with earlier versions of vSphere. In general, the latest version is recommended, which, at the time of writing, is 7.0 Update 2b.

Infrastructure Prerequisites

Before you can perform the procedures in this guide, you must have certain infrastructure components installed and configured.

If you are using a VMware vSphere infrastructure, which can reside either on-premises or on one or more cloud platforms, verify that you have the following components installed and configured:

- VMware vSphere and vCenter Server. We used vSphere 7.0 U2b and Horizon 2103 in our testing. For information and installation instructions, see the VMware vSphere documentation.
- VMware ESXi™ host or hosts configured in the vCenter Server instance.
- An authentication infrastructure that includes Active Directory, DNS, and DHCP.
- If you intend to use VMware App Volumes™, you must have the host name or IP address of the server on which App Volumes Manager is installed or the load balancer fronting the server on which App Volumes Manager is installed. You will enter this information when you install the App Volumes Agent on the primary VM image.

If you plan to create Horizon desktop pools or RDSH server farms, ideally at this point you would also have Horizon Connection Server installed and configured. For installation instructions, see the Quick-Start Tutorial for VMware Horizon 8.

If you are using VMware Horizon® Cloud Service™ on Microsoft Azure, rather than a vSphere infrastructure, you must provide your own Microsoft Azure IaaS capacity, and configure the Microsoft Azure prerequisites for a Horizon Cloud Service deployment. The Horizon Cloud Service is a VMware-managed virtual desktop and application solution that provides desktops as a service using a Microsoft Azure public cloud infrastructure. For more information, see the VMware Horizon Cloud Service Documentation.

Using Automation

Using Automation to Create an Optimized Windows Image

This guide you are currently reading describes how to manually create a VM image. However, it is recommended to automate the process of image creation. For step-by-step instructions for using the Microsoft Deployment Toolkit (MDT) to automate the process of image creation, see the companion to this guide, titled Using Automation to Create Optimized Windows Images for VMware Horizon VMs. It also explains how to use the VMware OS Optimization Tool MDT plugin and how to add VMware Agents and VMware Tools using MDT.

Creating a vSphere-Based VM

Create a vSphere-Based Virtual Machine

Each desktop pool or RDSH server farm uses a golden virtual machine (VM) image, which serves as the model for the deployed virtual desktops. For a vSphere-based infrastructure, you use VMware vSphere® Web Client to create the golden VM.

For a VMware Horizon Cloud on Microsoft Azure infrastructure, see the chapter Creating a VM in Horizon Cloud and Installing Agents.

Prerequisites

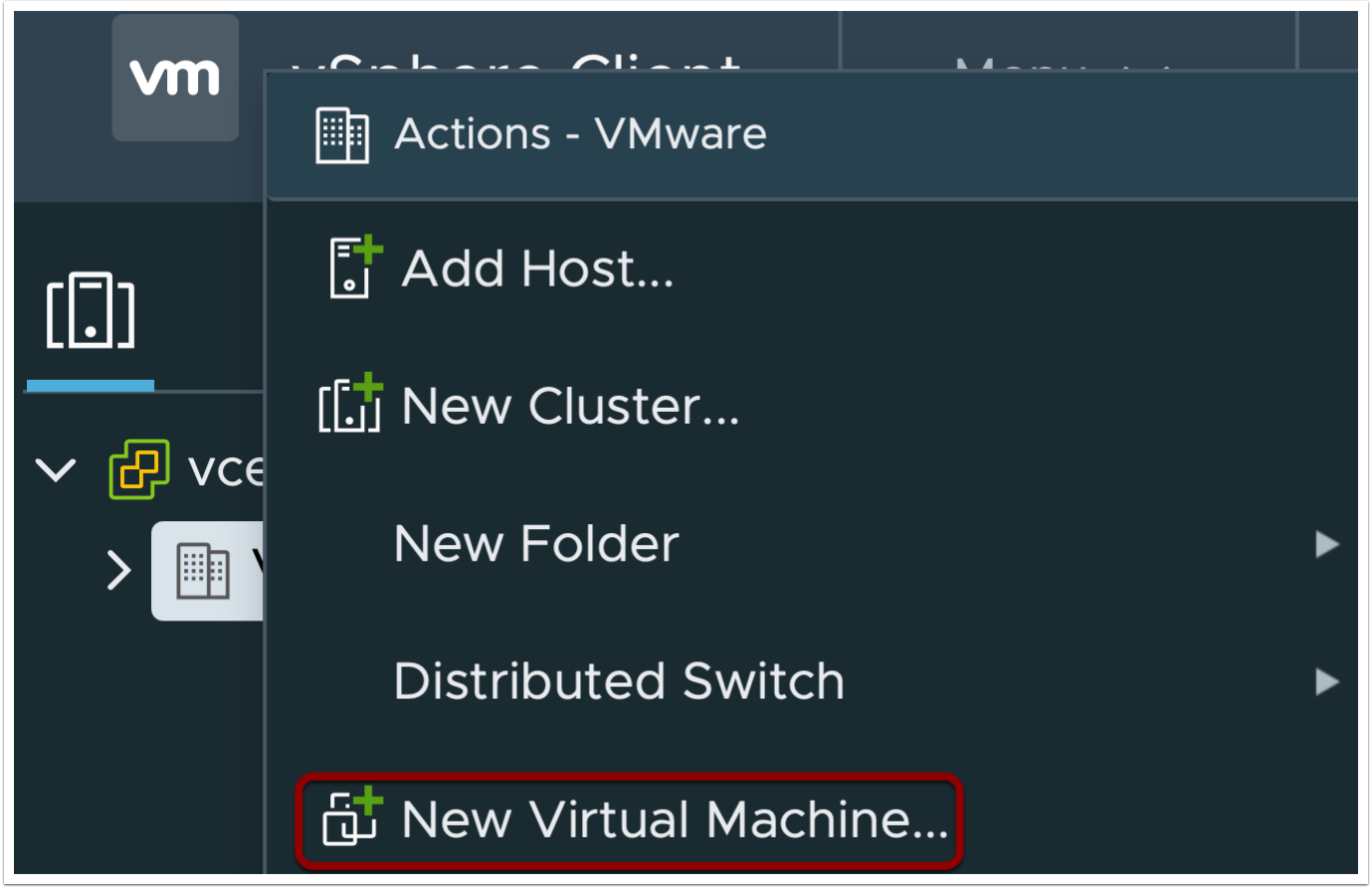
Before you complete this procedure, you will need the following:

- **Windows ISO file** – You must have uploaded an ISO file to a vSphere datastore. The ISO file must contain a supported version of the Windows operating system. You will point to this file when completing the New Virtual Machine wizard. For a list of the operating systems we tested, see Tested Operating Systems. For a complete list of supported Windows 10 operating systems, see the VMware knowledge-base article Supported versions of Windows 10 on Horizon Agent Including All VDI Clones (Full Clones, Instant Clones, and Linked Clones on Horizon 7) (2149393).

Important: Use an OS version that has a Microsoft Windows volume license key using the Key Management Service (KMS). KMS treats each activated clone as a computer with a newly issued license. In a production environment, you must activate Windows. In an evaluation environment, you can create the VM and log in without activating Windows.

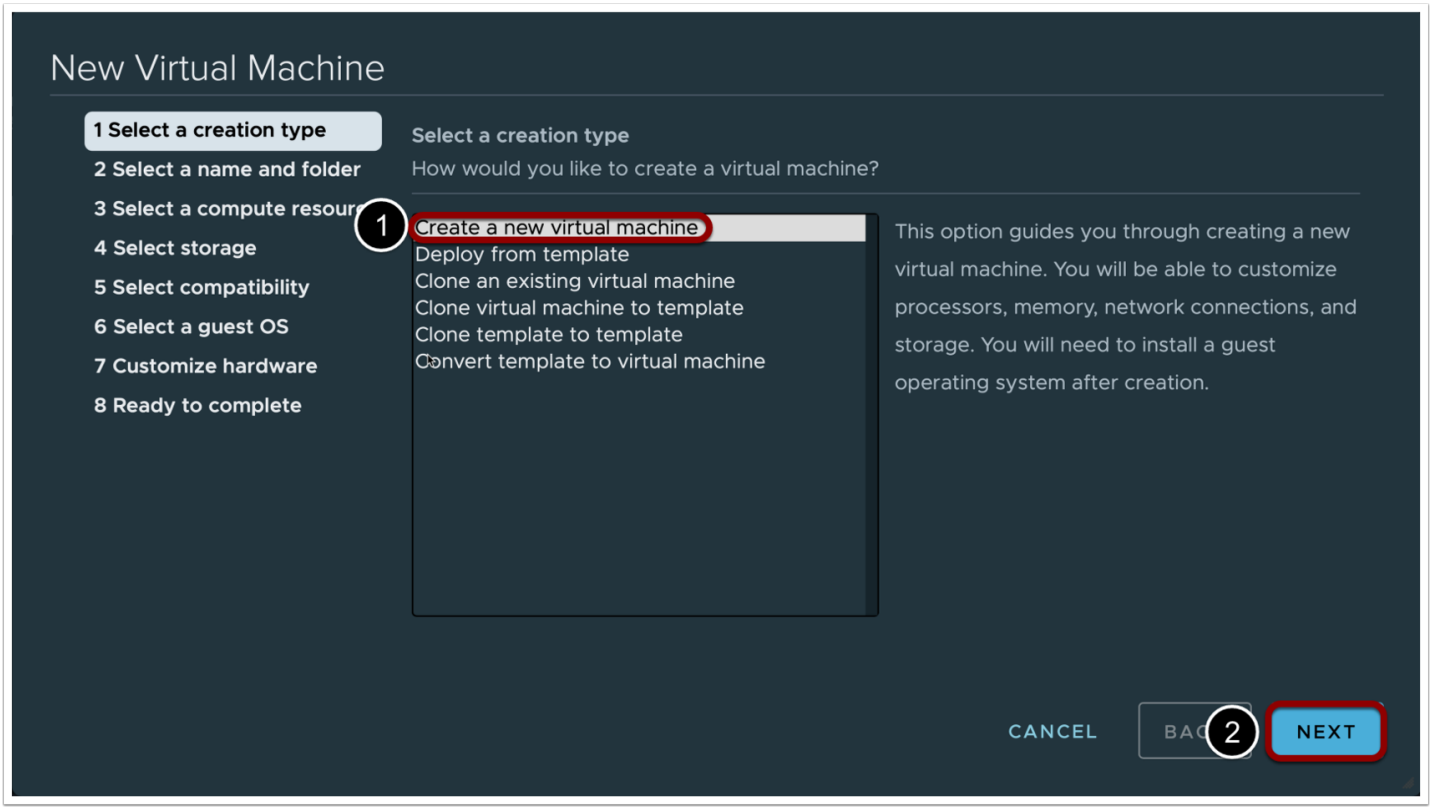
- **User account** – When you log in to vSphere Web Client, the account you use must have the privileges required to create a VM. See the "Prerequisites" section of the product documentation topic Create a Virtual Machine with the New Virtual Machine Wizard.

1. Start the New Virtual Machine Wizard in the vSphere Web Client



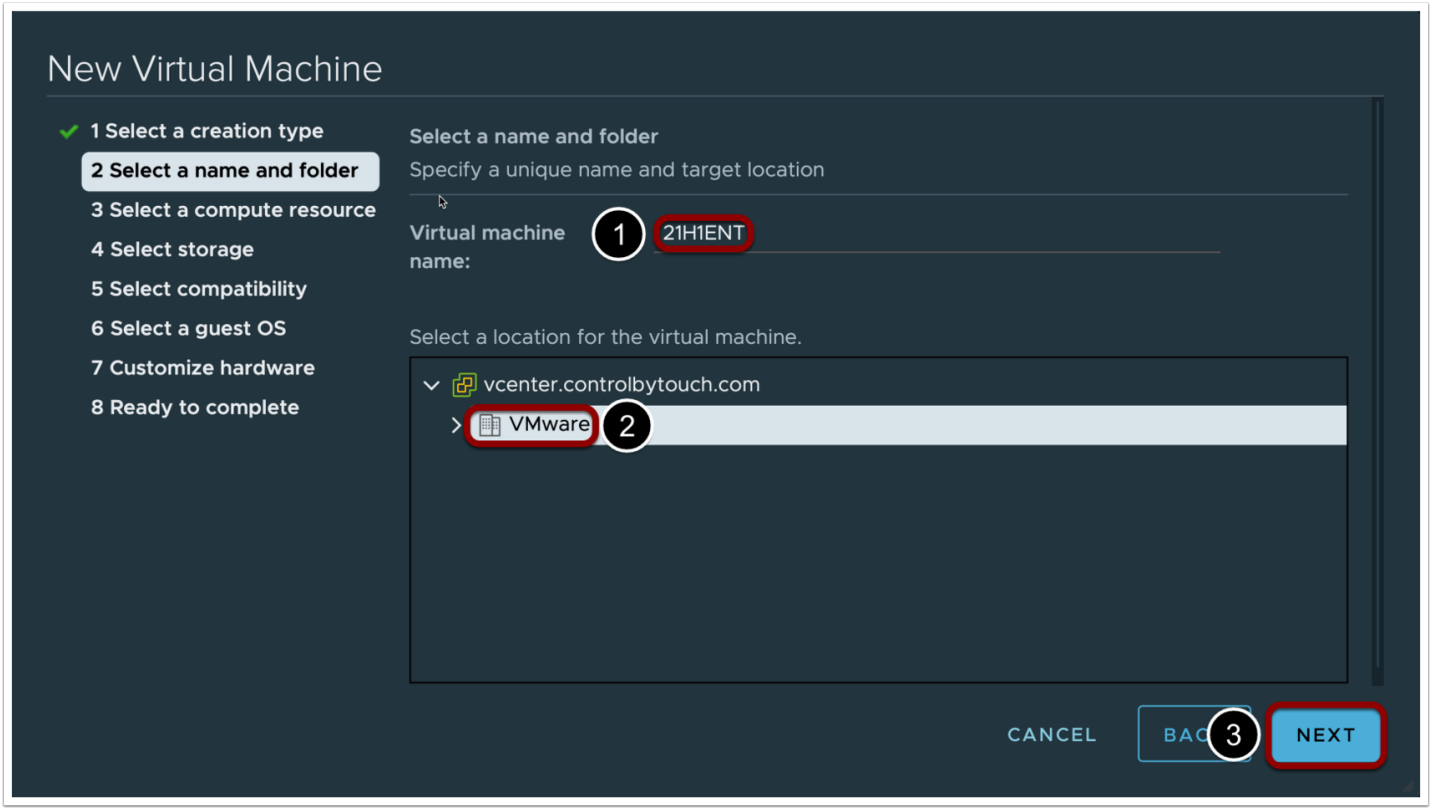
1. In vSphere Web Client, right-click a data center, cluster, host, or VM folder.
2. Select **New Virtual Machine**.

2. Select the New Virtual Machine Creation Type



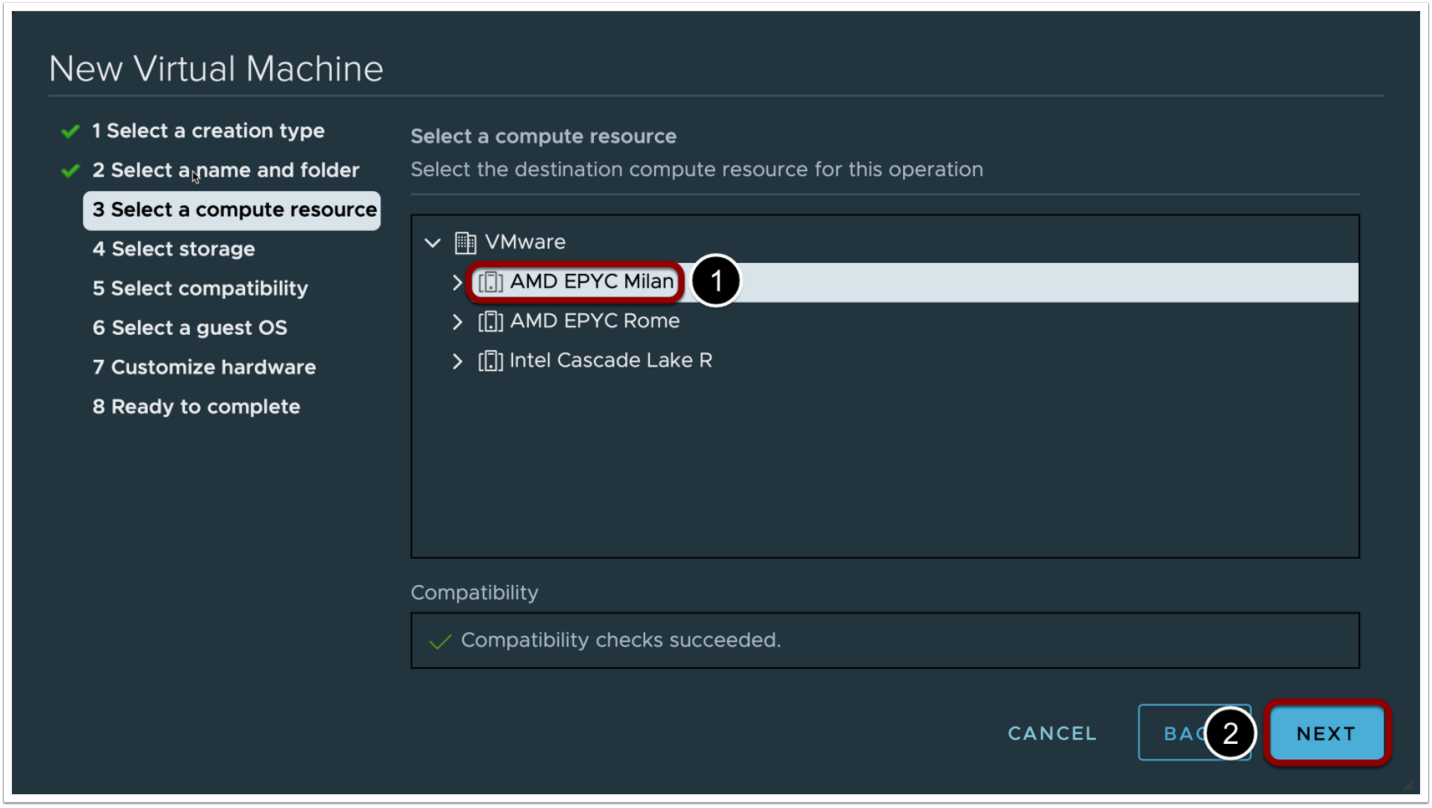
1. Select **Create a new virtual machine**.
2. Click **NEXT**.

3. Select a VM Name and Folder



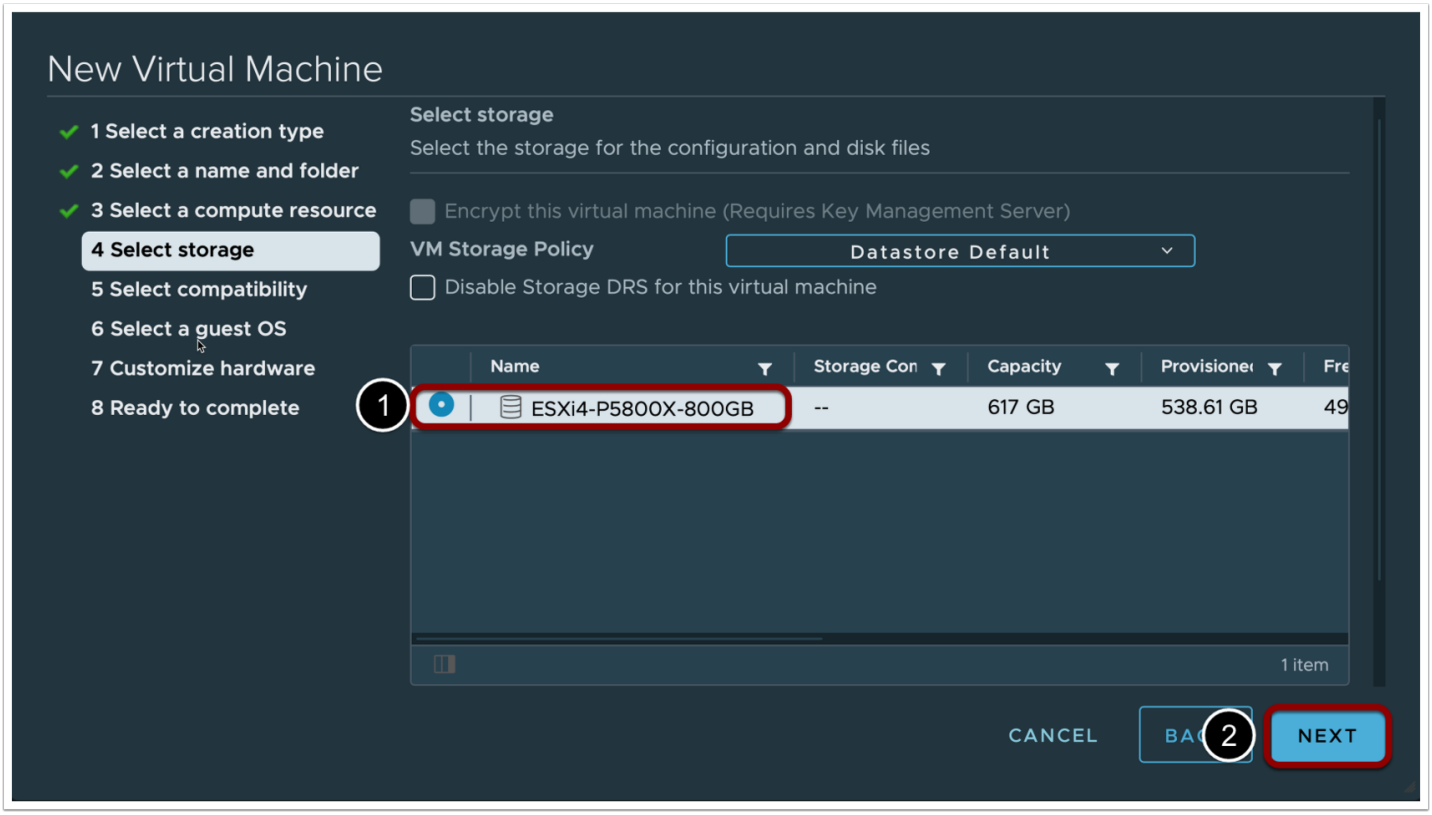
1. Provide a name in the **Virtual machine name** field.
2. Select a location.
3. Click **NEXT**.

4. Select a Cluster or Host



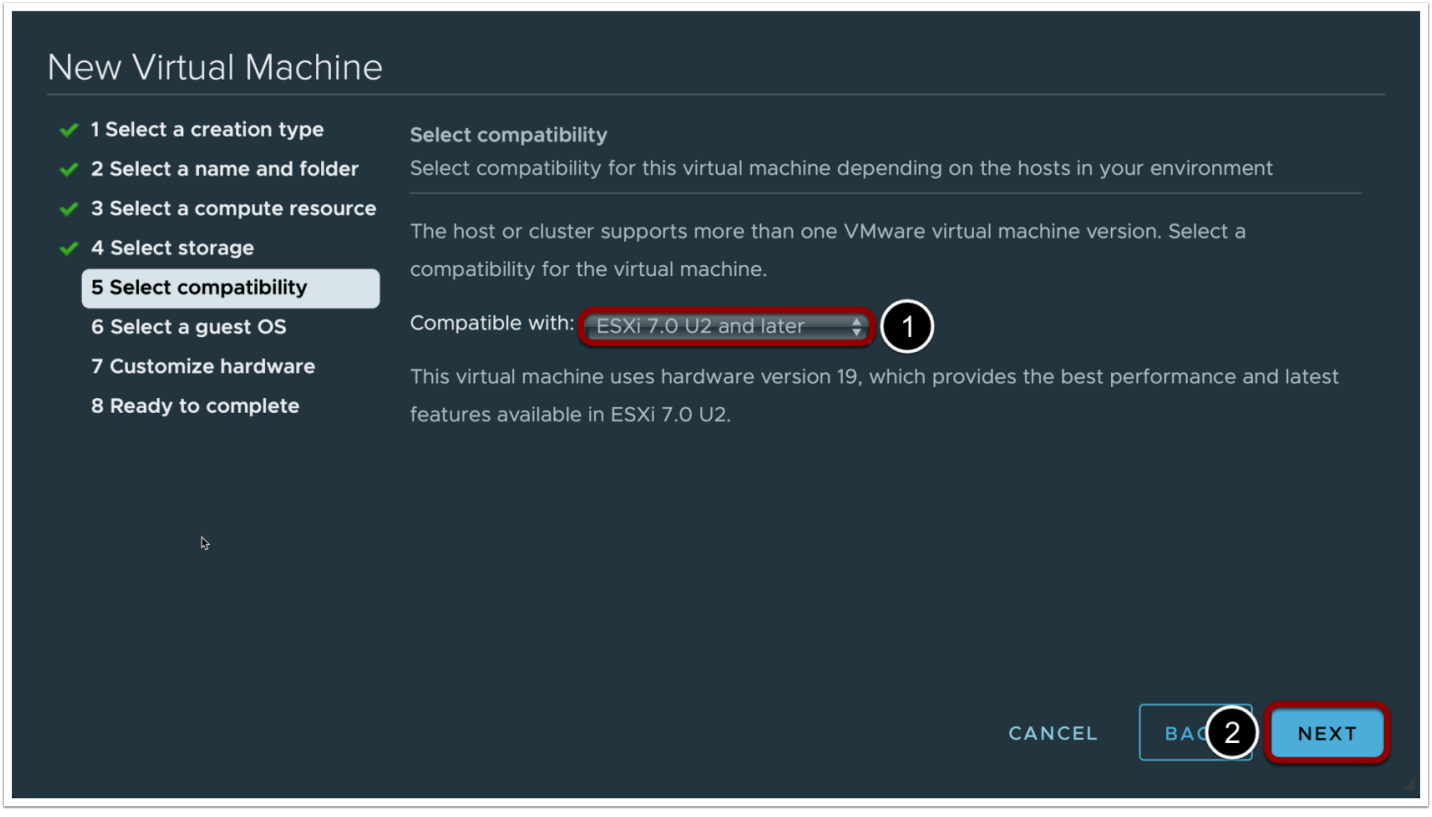
1. Select a cluster or host as the compute resource.
2. Click **NEXT**.

5. Select a Datastore for the VM



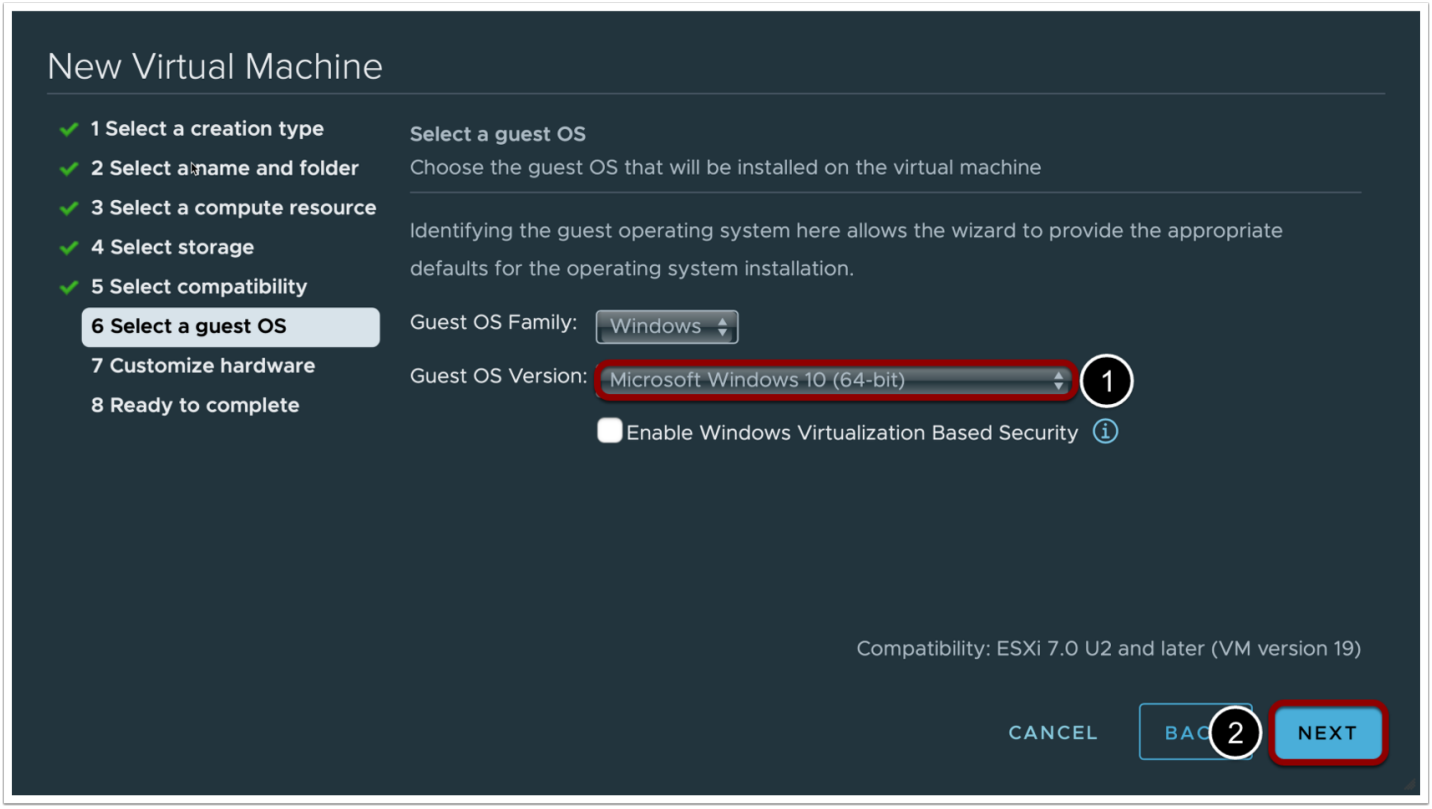
1. Select a datastore or datastore cluster where you would like to store the VM.
2. Click **NEXT**.

6. Select the vSphere Compatibility Level



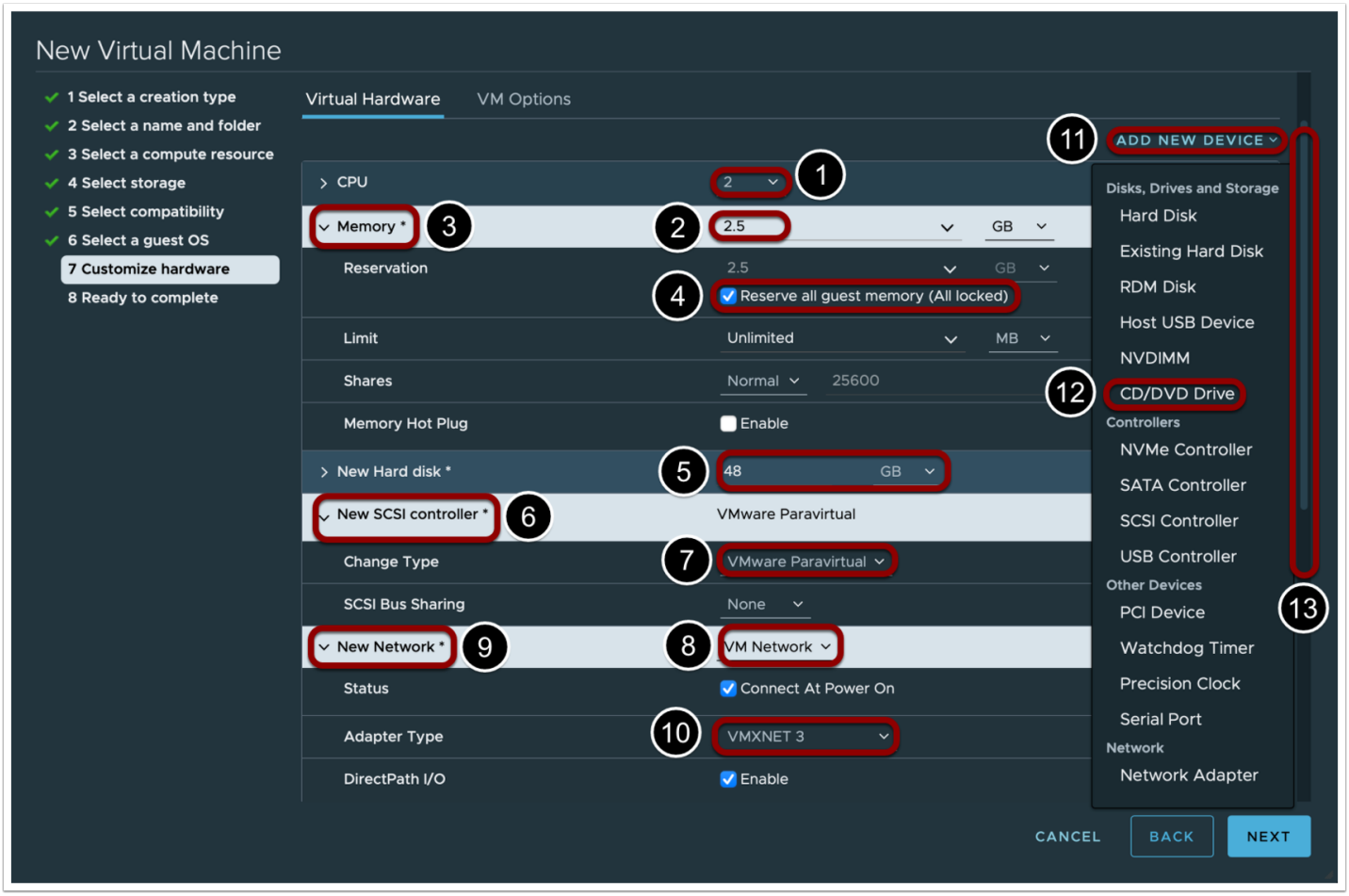
1. Select the lowest version of ESXi that this VM would be deployed to.
   Tip: See Hardware Features Available with Virtual Machine Compatibility Settings.
2. Click **NEXT**.

7. Select the Windows Version and Architecture



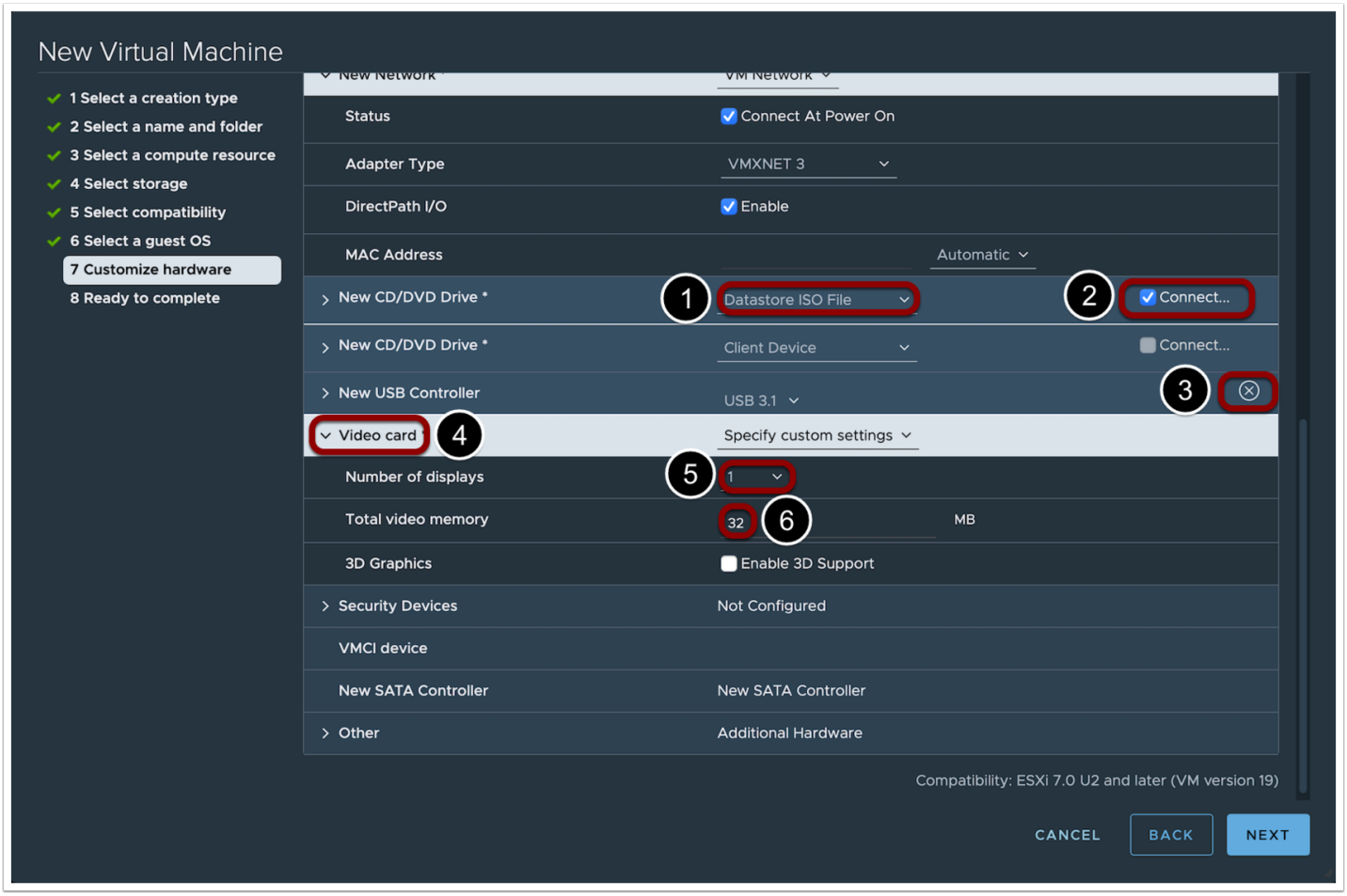
1. Select the **Guest OS Version** with the correct architecture (32- or 64-bit) and, when required, enable VBS. (Choose **Microsoft Windows Server 2016** when deploying Windows Server 2019 on ESXi 6.x.)
2. Click **NEXT**.

8. Specify Virtual Hardware Settings



1. Select **2** CPUs. (This should be tested and adjusted to real production values later.)
2. Select **2.5** GB of memory. (This should be tested and adjusted to real production values later.)
3. Expand the **Memory** section.
4. Select **Reserve all guest memory (All locked)**.
5. Choose an appropriate hard disk size.
6. Expand the **New SCSI controller** section.
7. Select **VMware Paravirtual**.
8. From the **VM Network** list, select the appropriate network.
9. Expand **New Network**.
10. Select **VMXNET3**.
11. Click on **ADD NEW DEVICE**.
12. Select **CD/DVD Drive**.
13. Scroll down

9. Continue Specifying Hardware Settings



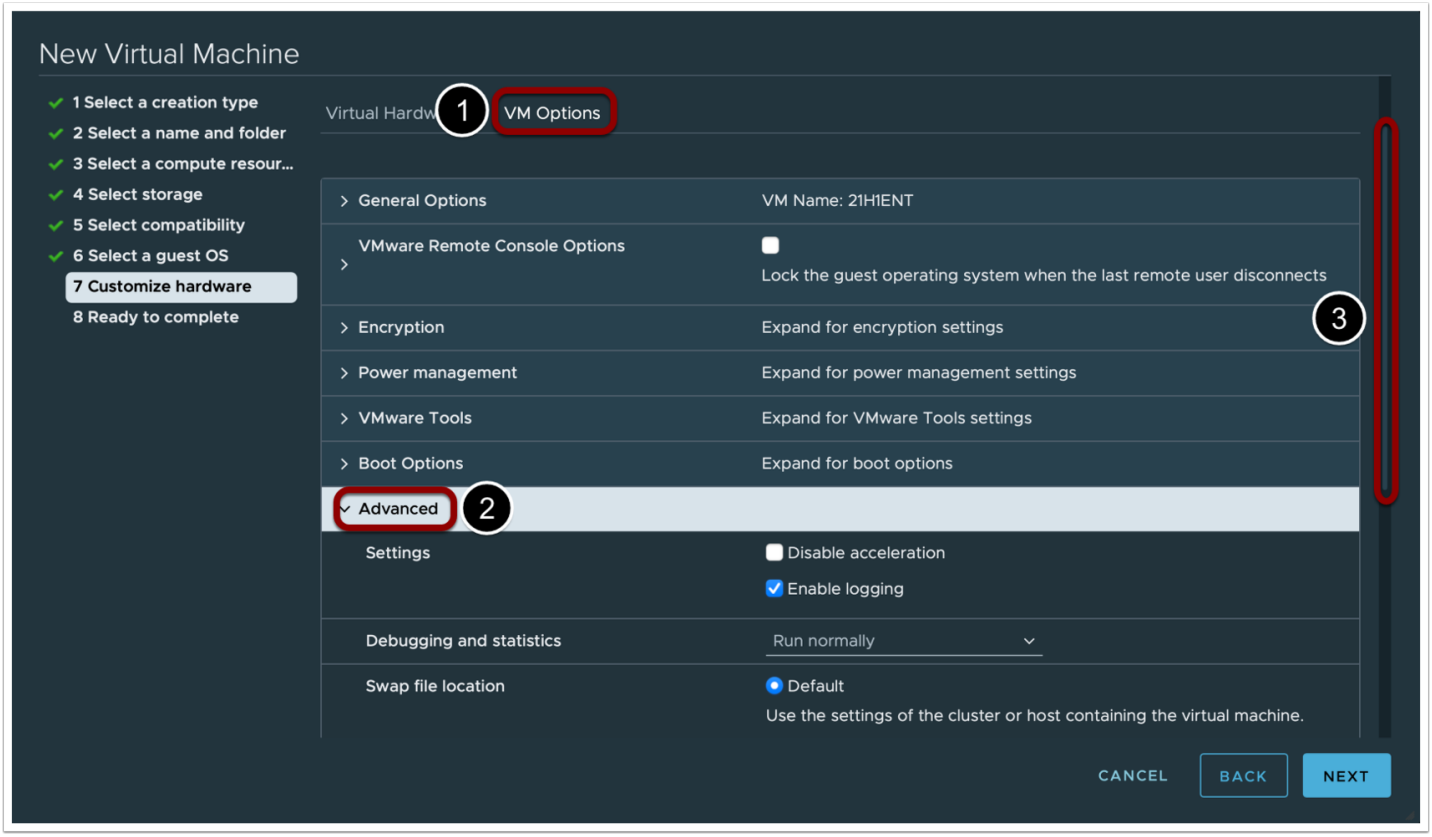
1. Select **Datastore ISO File** and browse to the Windows ISO file.
2. Select **Connect**.
3. Delete the **New USB Controller**.
4. Expand the **Video card** section.
5. Select the maximum **Number of Displays** that will be used.
6. Use the following table to determine which number to enter in the **Total amount of video memory** field.

Note: The table that follows describes the small amount of RAM on the ESXi host that is required for video overhead in addition to system memory. This VRAM size requirement depends in on the display resolution and number of monitors configured for end users.

Display Resolution Standard	Width, in Pixels	Height, in Pixels	1-Monitor Overhead	2-Monitor Overhead	3-Monitor Overhead	4-Monitor Overhead
VGA	640	480	1.20 MB	3.20 MB	4.80 MB	5.60 MB
WXGA	1280	800	4.00 MB	12.50 MB	18.75 MB	25.00 MB
1080p	1920	1080	8.00 MB	25.40 MB	38.00 MB	50.60 MB
WQXGA	2560	1600	16.00 MB	60.00 MB	84.80 MB	109.60 MB
UHD (4K)	3840	2160	32.00 MB	78.00 MB	124.00 MB	Not supported

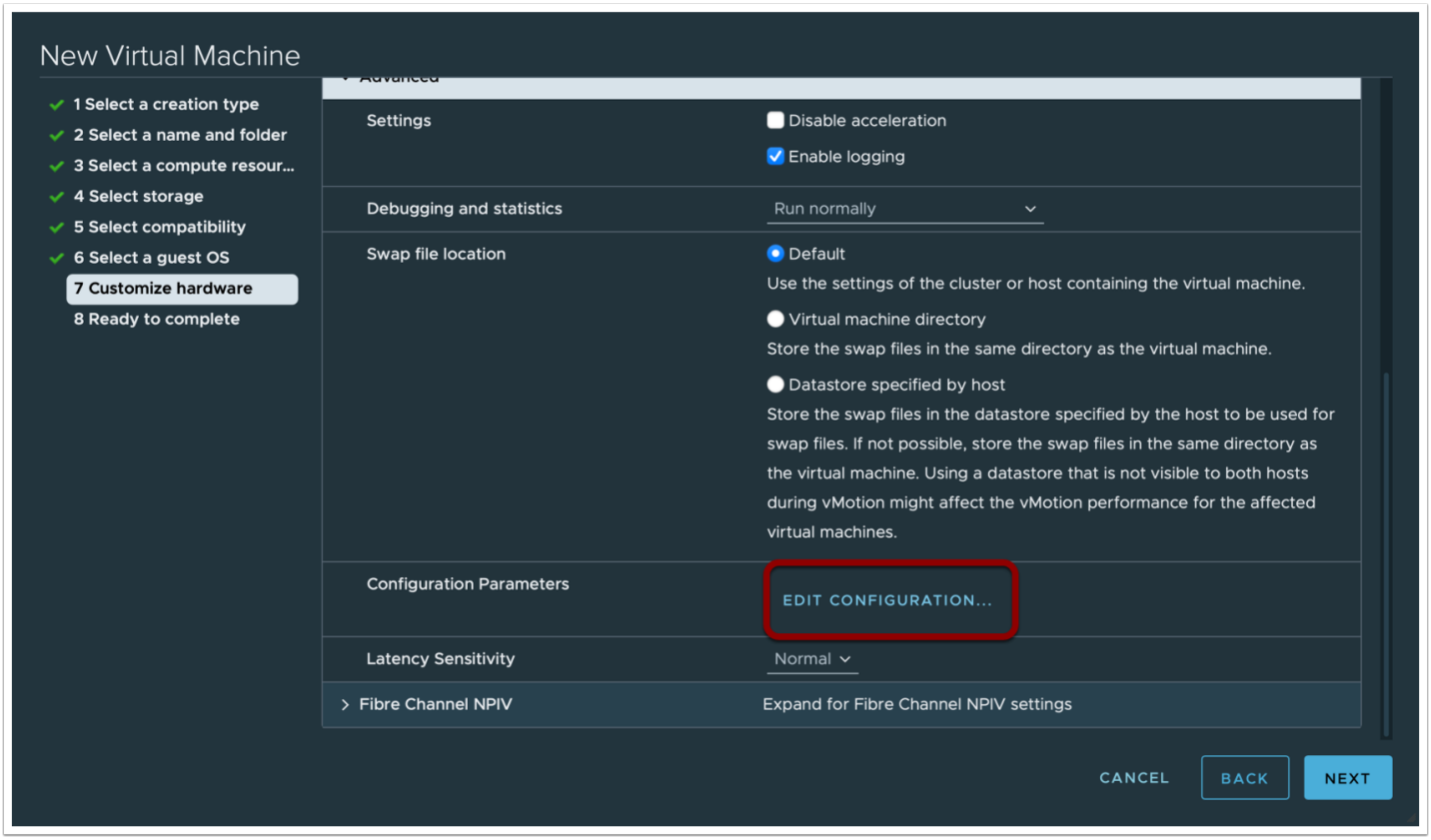
Important: You are not yet finished with the Customize Hardware wizard page. Now that you have edited the virtual hardware settings, you can configure the VM options.

10. Specify VM Options



1. At the top of the page click on **VM Options**.
2. Expand the **Advanced** section.
3. Scroll down.

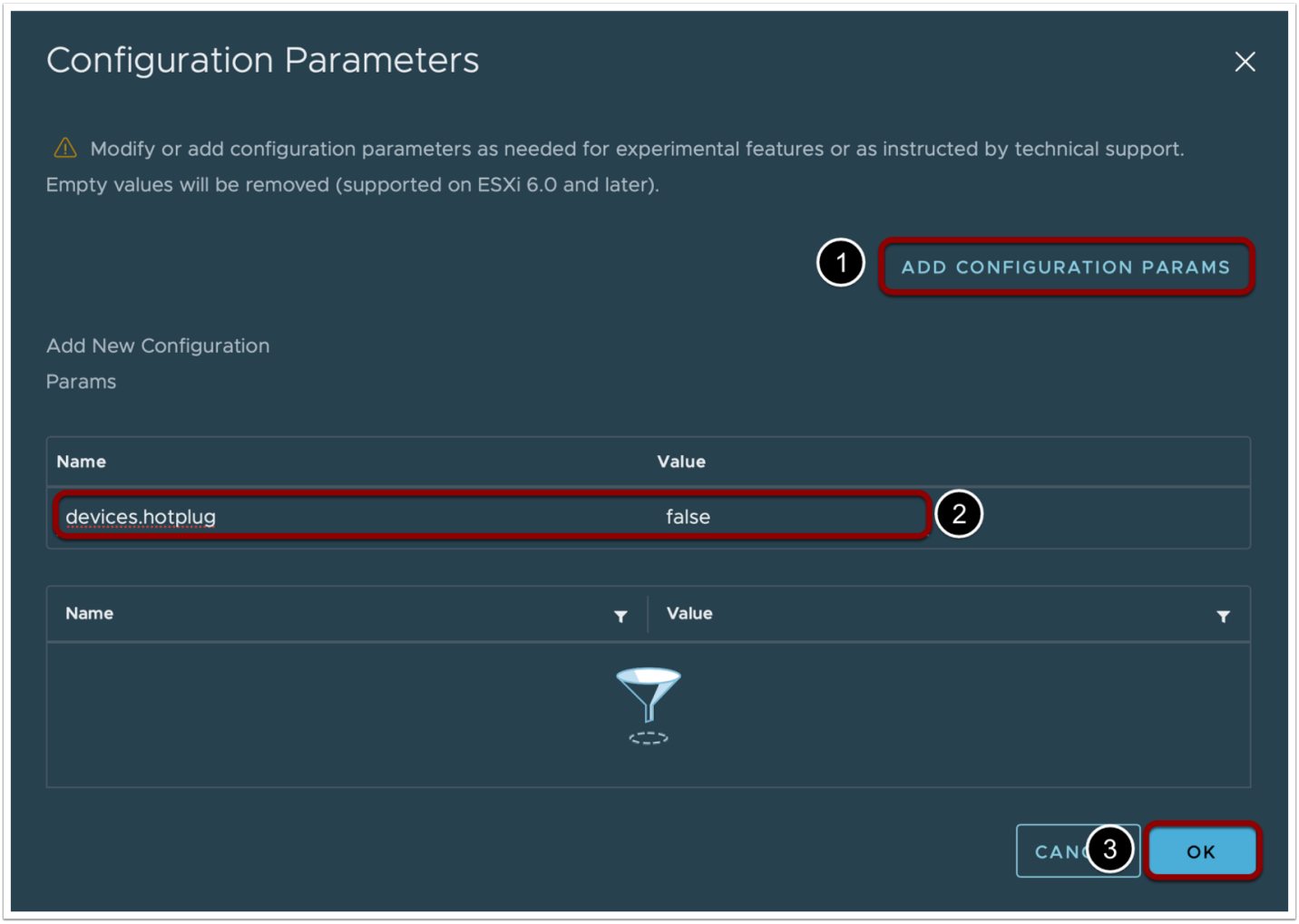
11. Edit the Configuration Parameters



Click **EDIT CONFIGURATION**.

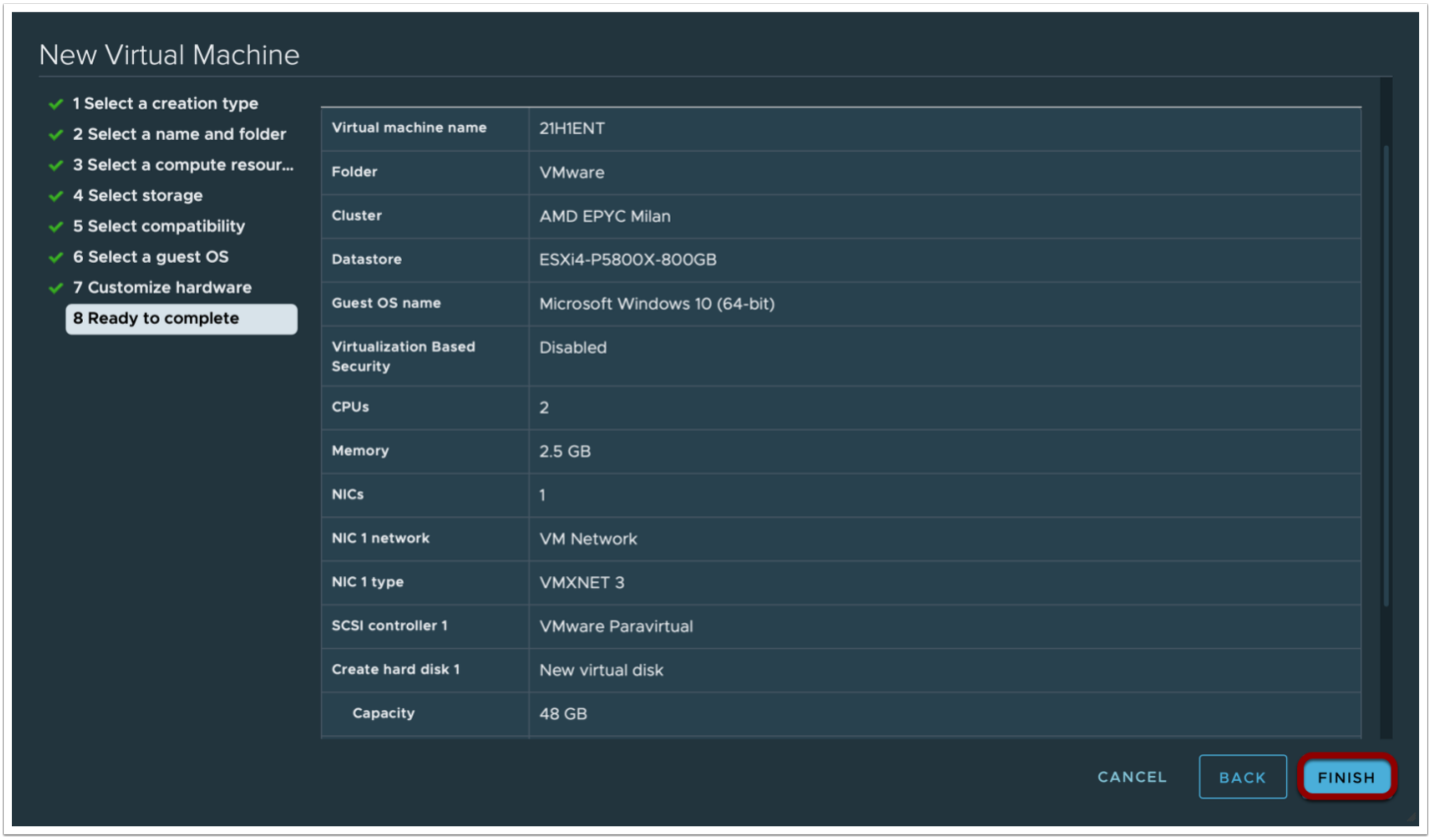
Note: In the next step, you are going to disable the hotplug feature. With hotplug enabled, NICs and SCSI controllers appear as removable devices, and the *Safely Remove Hardware* option for the virtual hardware appears in the Windows System Tray (notification area). To prevent this option from appearing, you will disable the capability. When using VMware App Volumes, you must either add enough controllers for the maximum number of disks you will be using or not set this option.

12. Disable the Ability to Add and Remove Virtual Hardware While the VM Is Running



1. Click **ADD CONFIGURATION PARAMS**.
2. For **Name**, type `devices.hotplug`, and for **Value**, type `false`.
3. Click **OK**. You are returned to the Customize Hardware > **VM Options** tab of the wizard.
4. Click **NEXT** on the wizard page.

13. Complete the Wizard

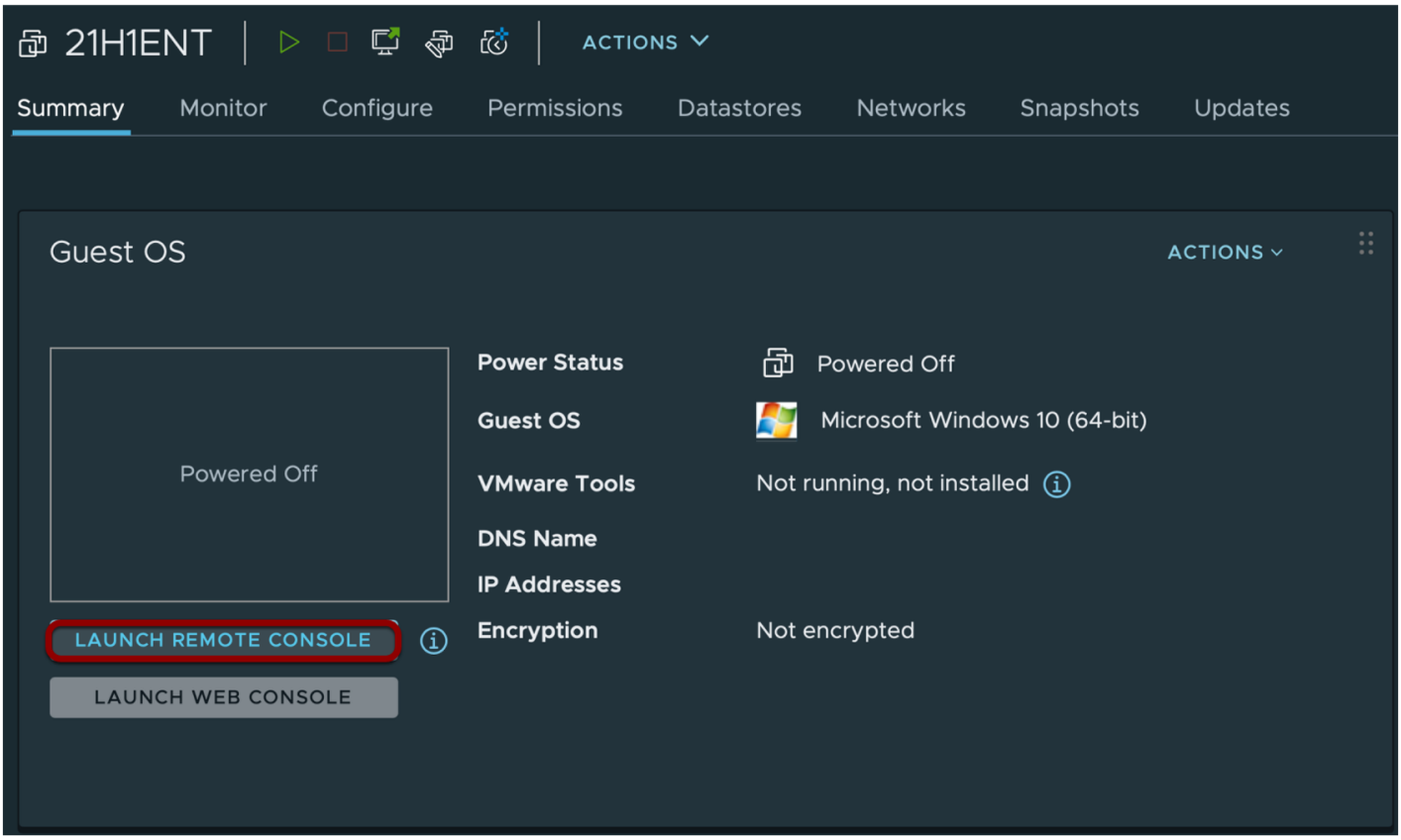


Click **FINISH**.

Install Windows

After you boot the VM, installation of the Windows OS begins automatically. You will accept most of the default settings and specify that you are doing a new installation rather than an update.

1. Open a Remote Console for the VM

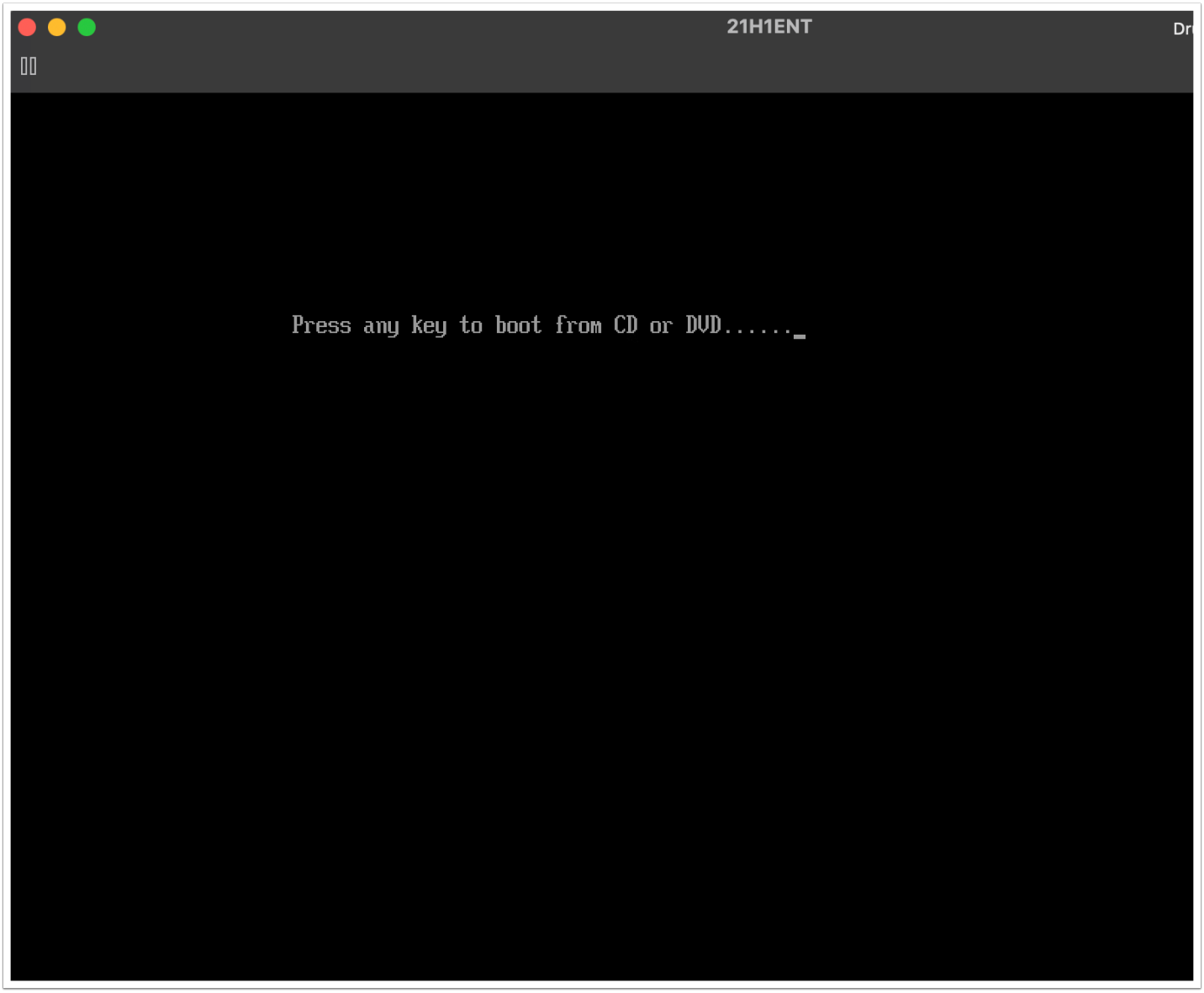


1. Using the vSphere Web Client, from the inventory list, select the newly created Windows VM.
2. Launch a console for the VM by clicking either **Launch Web Console** or **Lauch Remote Console**.
   Note: To launch a remote console, you must have downloaded and installed the VMware Remote Console. If necessary, you can click the "**i**" button to download and install it.

2. Power on the VM

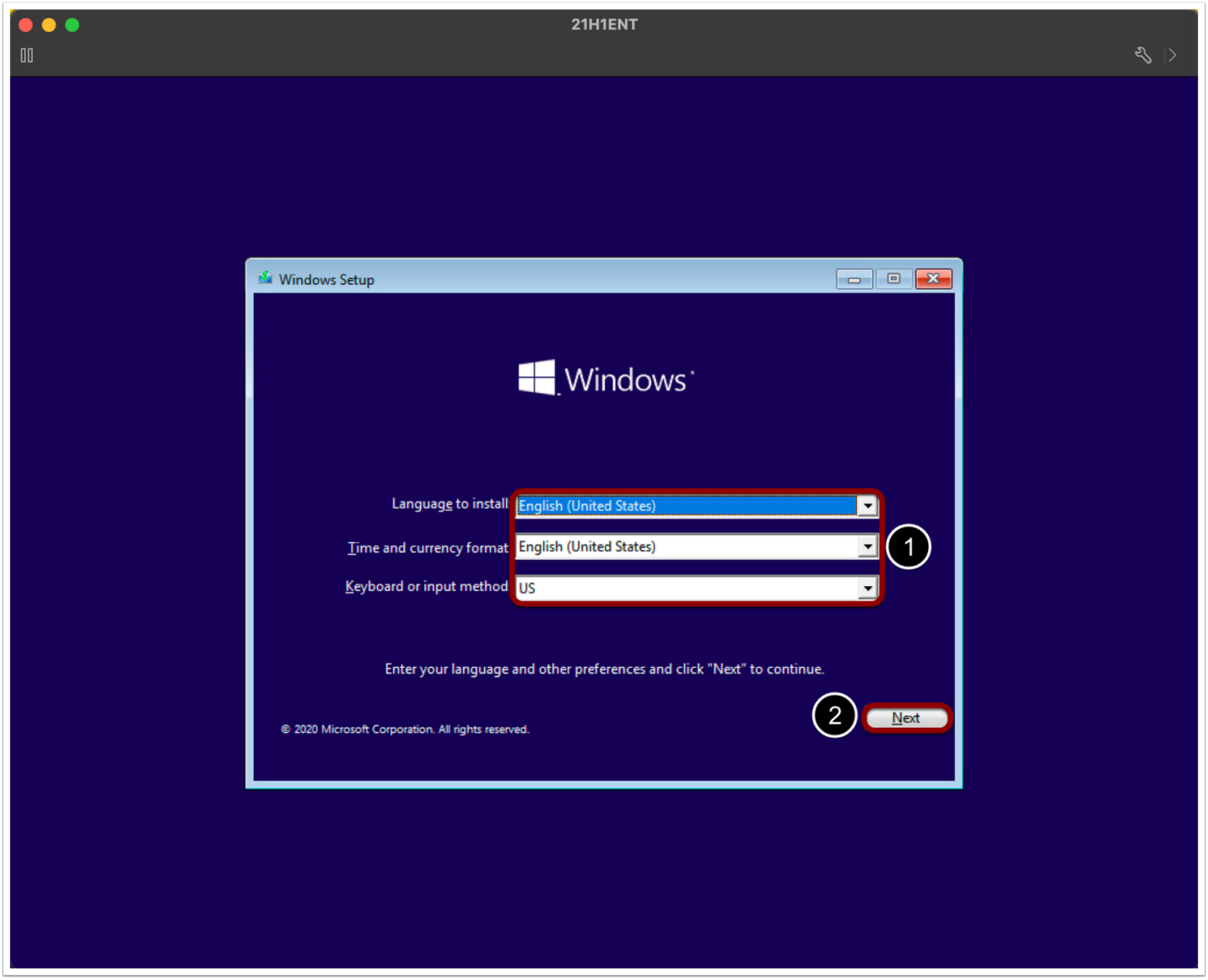
Click the play icon, which is a small triangle-shaped button at the top of the window.

3. Boot the VM from the Virtual CD



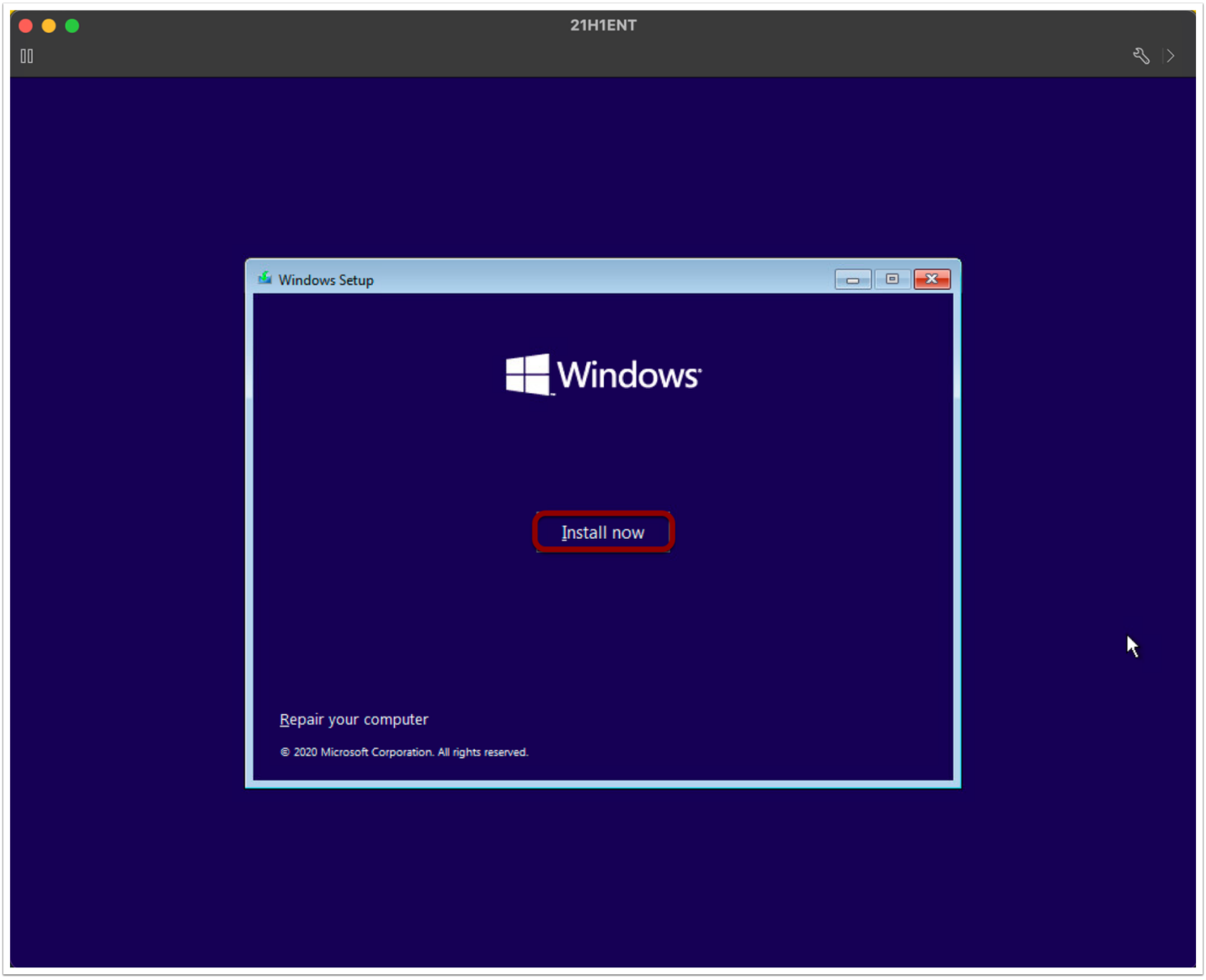
Press a key on your keyboard.

4. Select Settings for Your Region



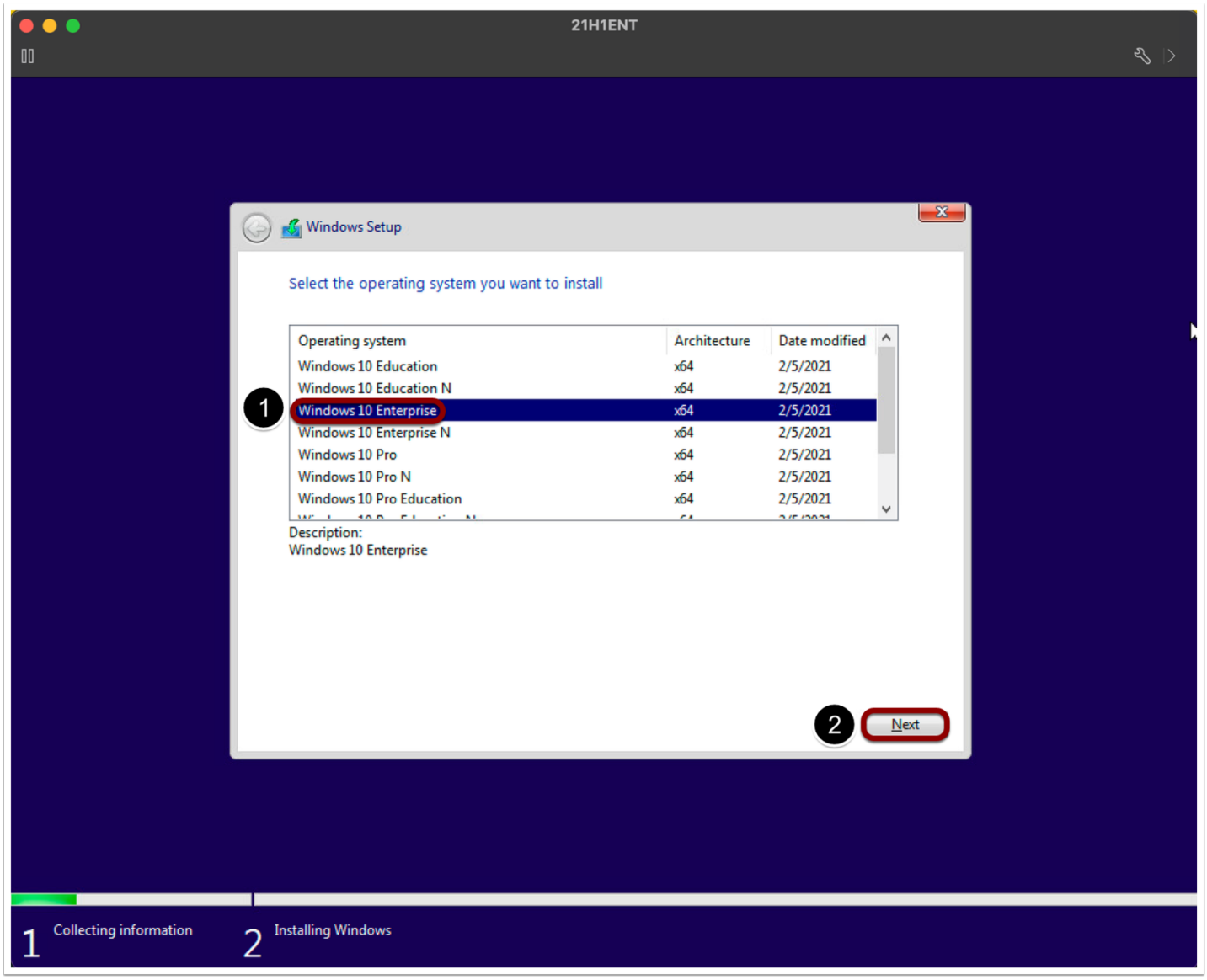
1. Select the correct regional options.
2. Click **Next**.

5. Begin Installing Windows



Click **Install now**.

6. Select the Edition

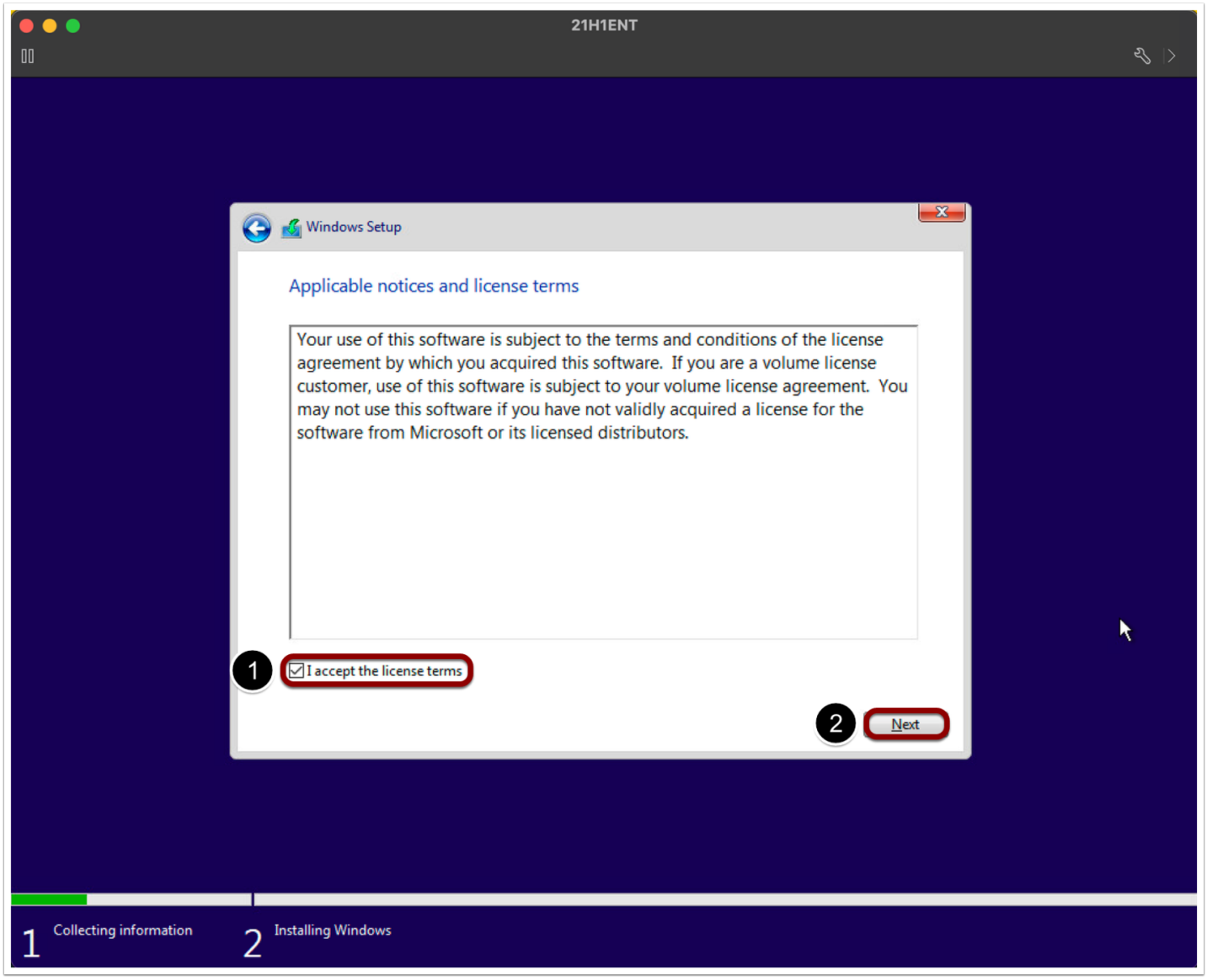


This screen is only shown for an ISO that contains multiple editions.

1. Select the Windows edition.

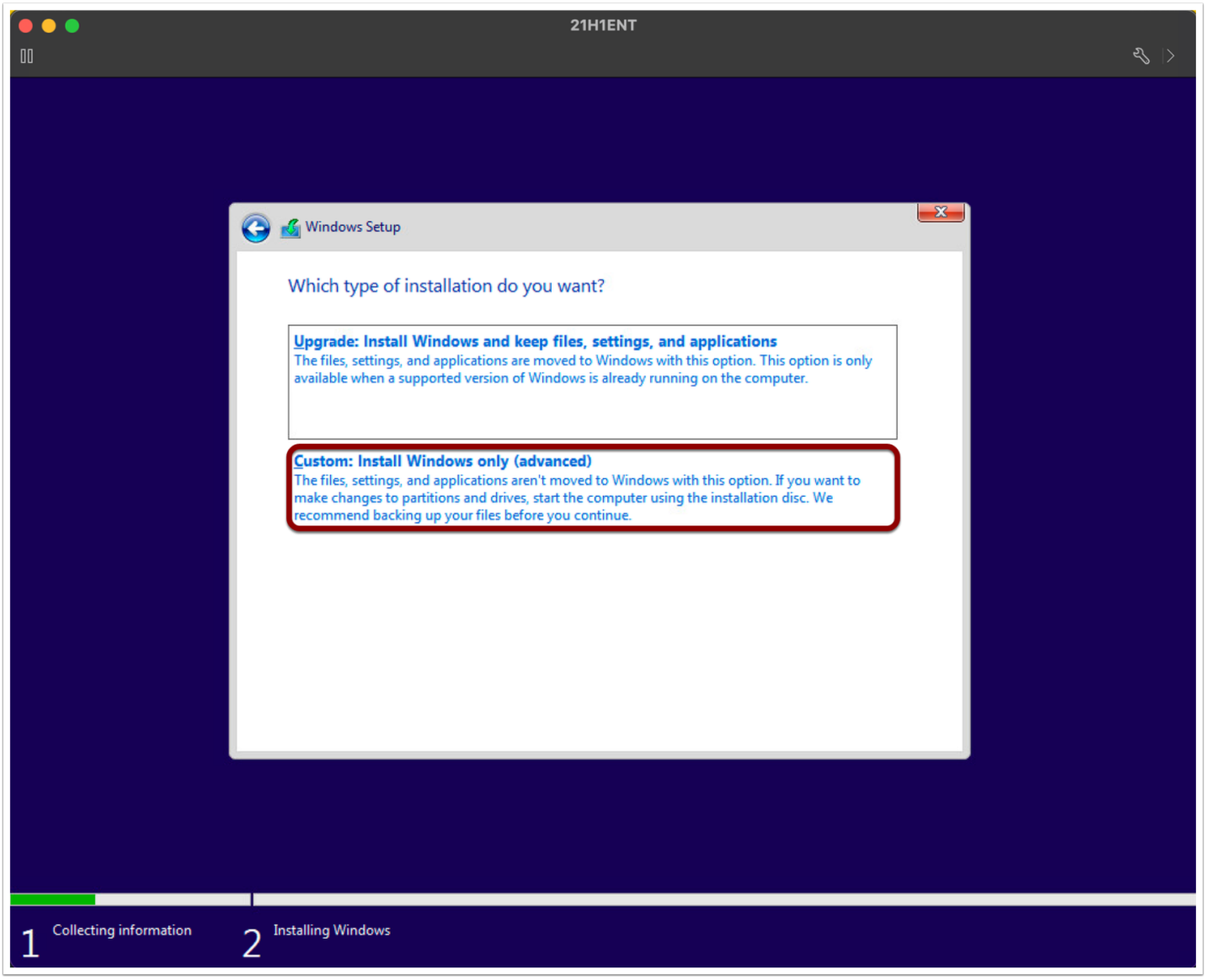
   Important: For Windows Server 2016/2019, select one of the following "Desktop Experience" editions:
   - **Windows Server 2016 Standard (Desktop Experience)**
   - **Windows Server 2016 Datacenter (Desktop Experience)**
   - **Windows Server 2019 Standard (Desktop Experience)**
   - **Windows Server 2019 Datacenter (Desktop Experience)**
2. Click **Next**.

7. Accept the License Agreement



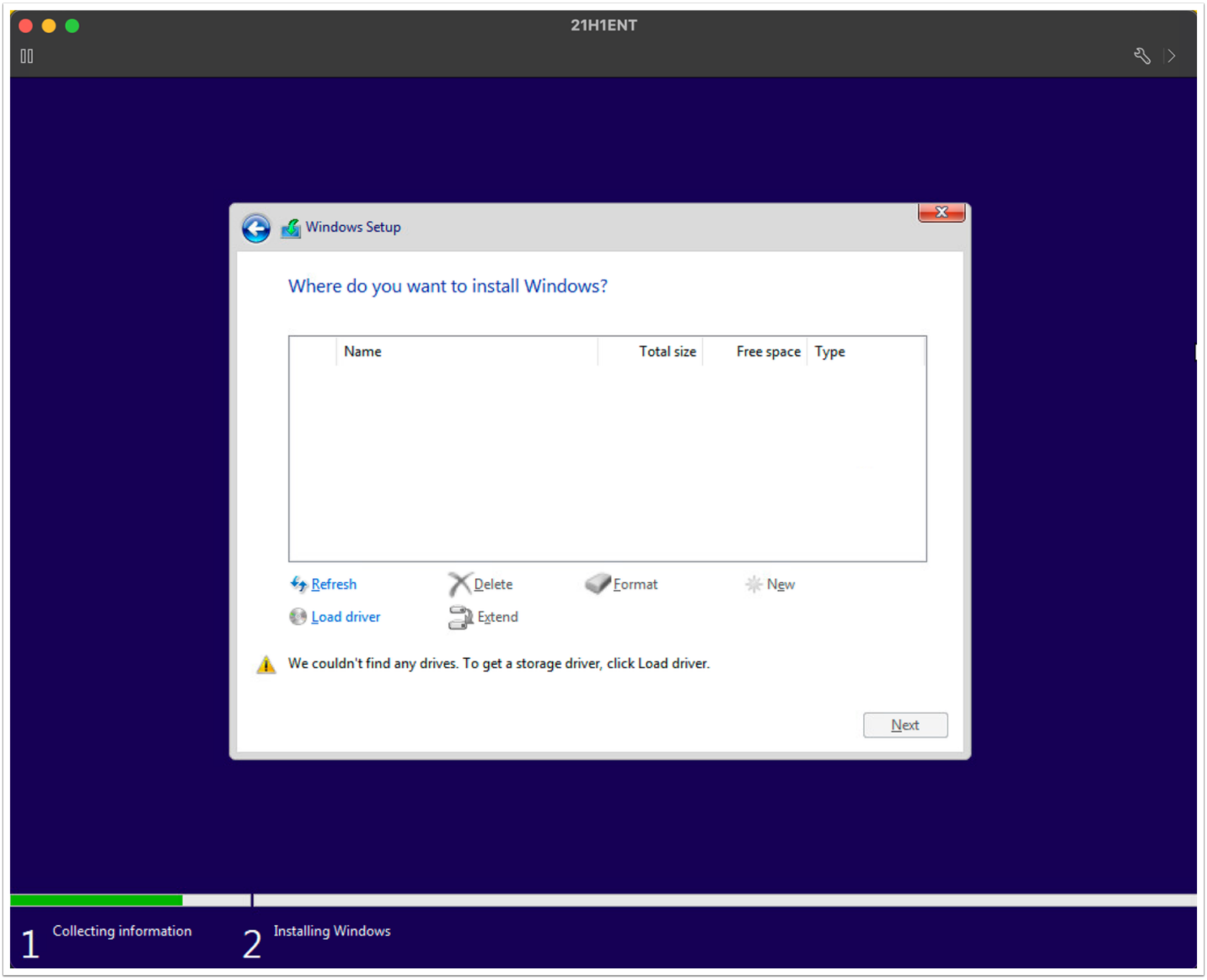
1. Select the **I accept the license terms** check box.
2. Click **Next**.

8. Select the Custom Installation



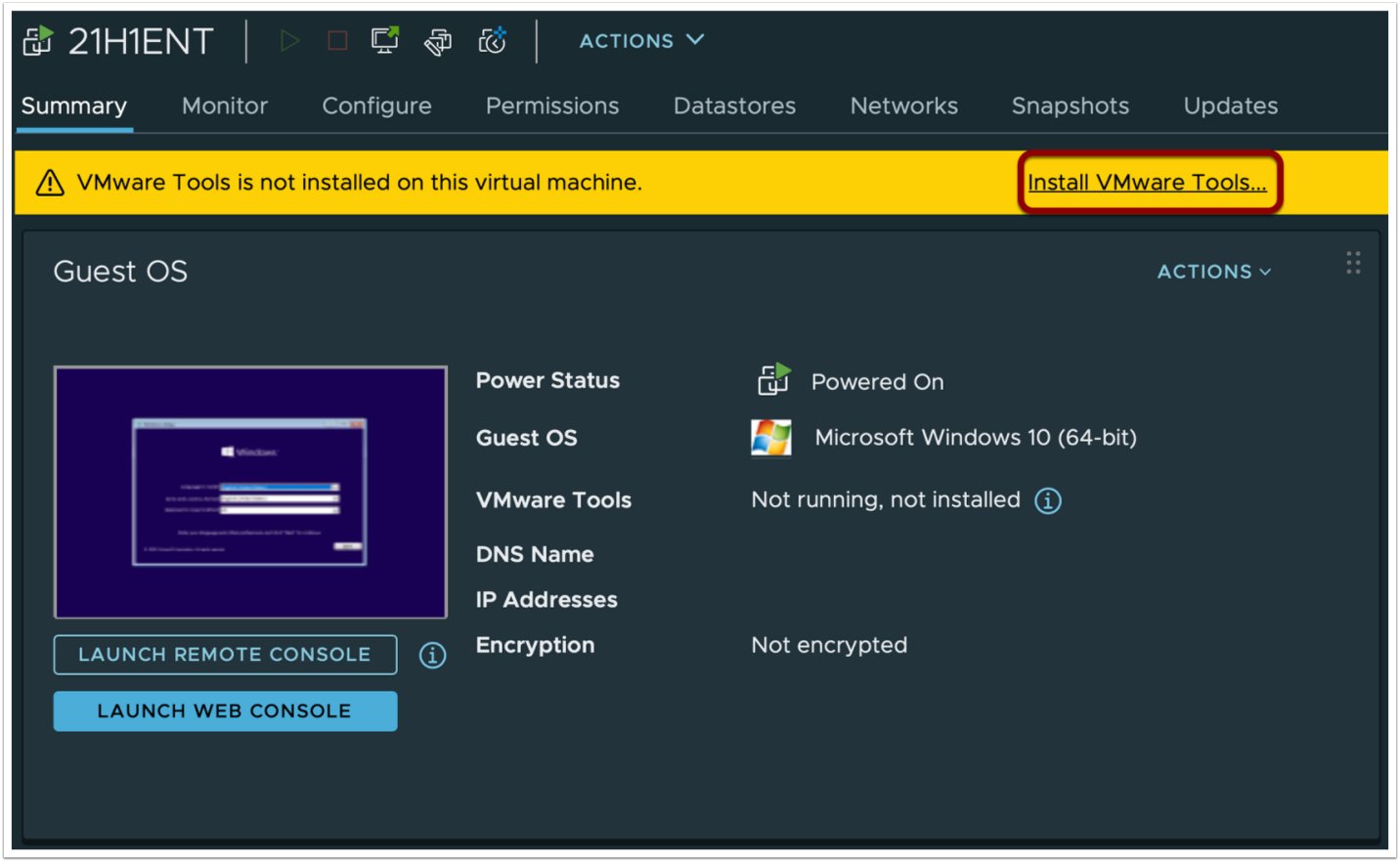
Select **Custom: Install Windows only (advanced)**.

9. Load the PVSCSI Driver from the VMware Tools Disk Image



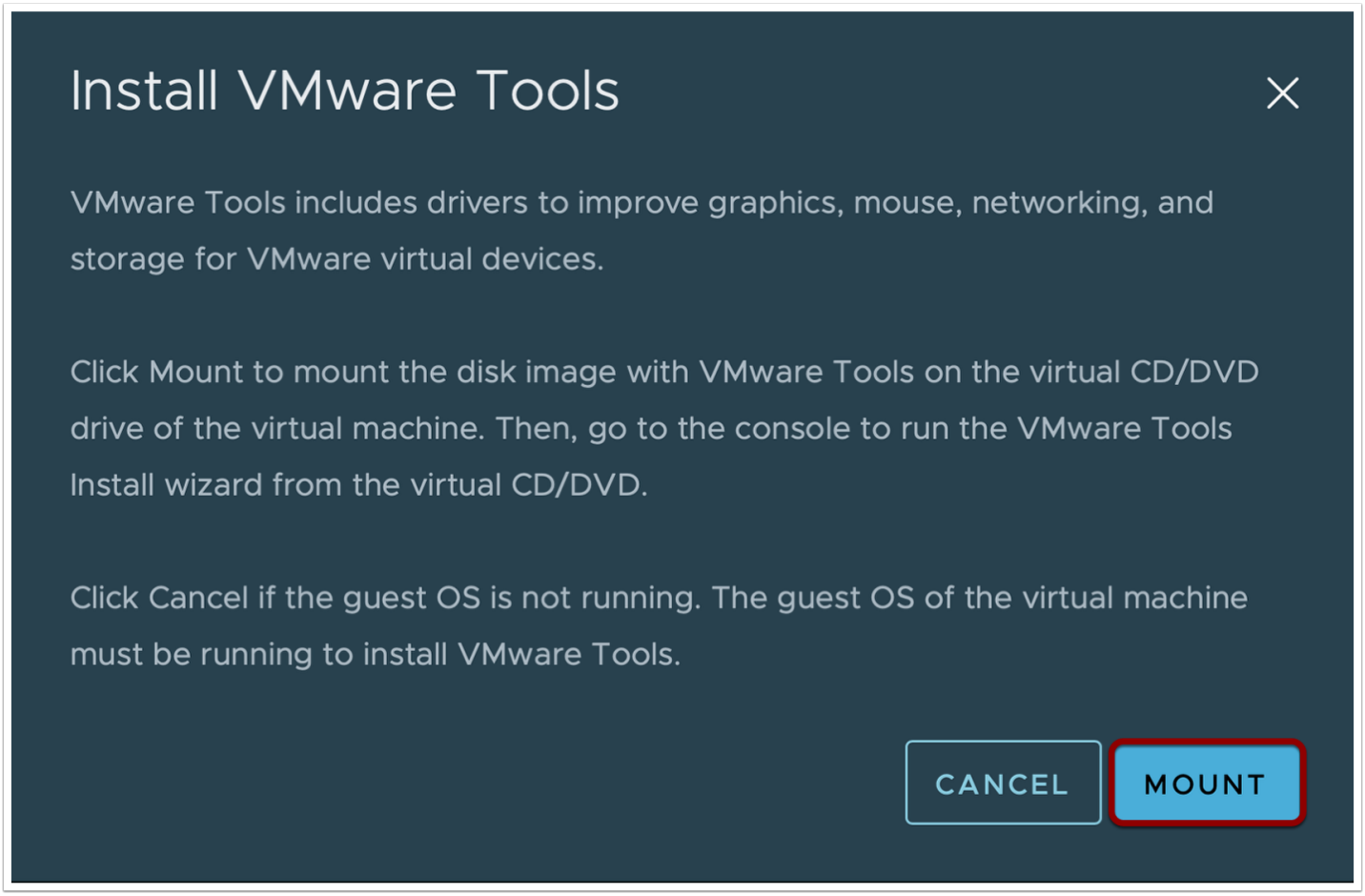
When this page is displayed go back to the vSphere Client.

9.1. Access the VMware Tools Disk Image from vSphere Web Client



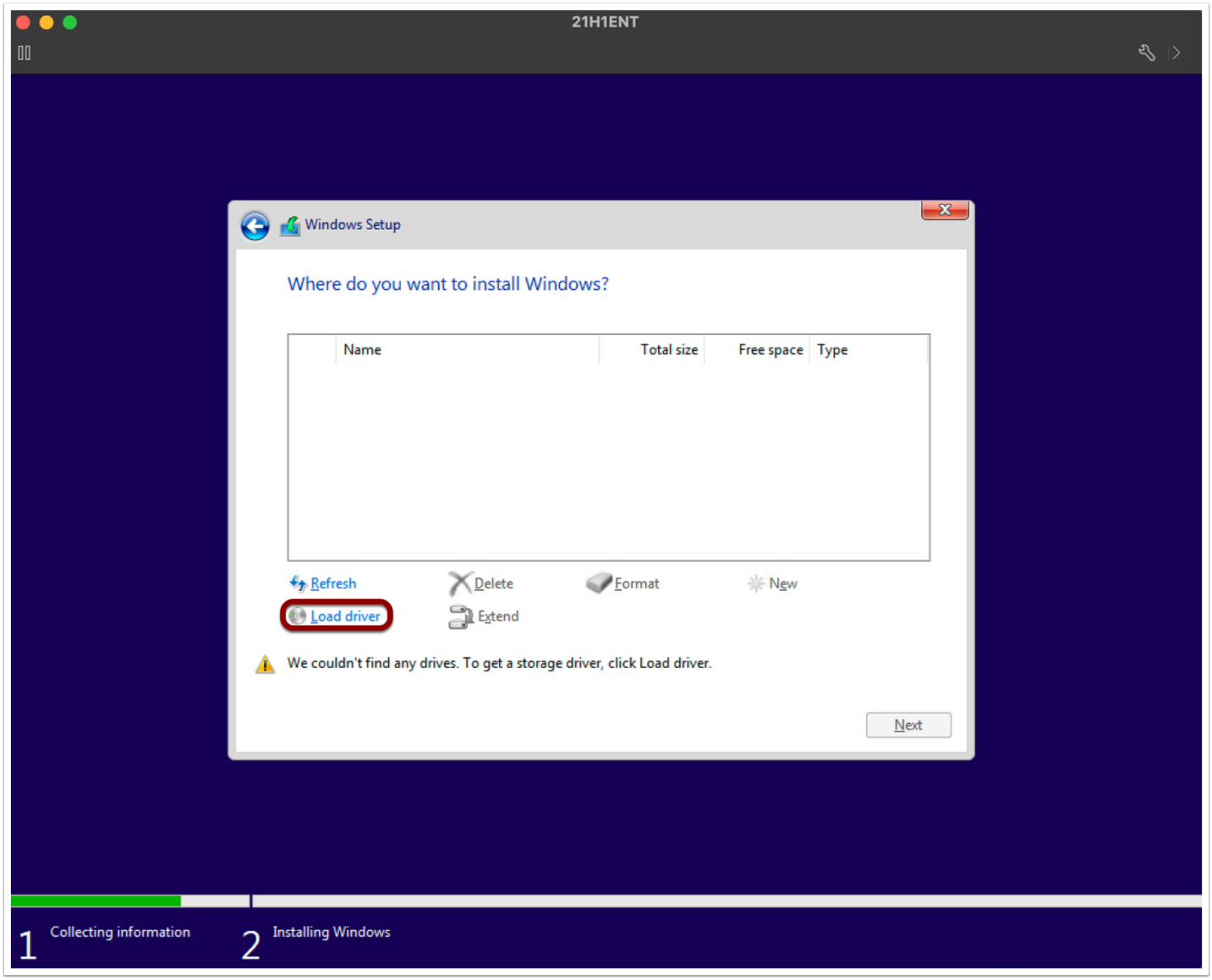
Click **Install VMware Tools**.

9.2. Mount the VMware Tools Disk Image on a Virtual Drive of the VM



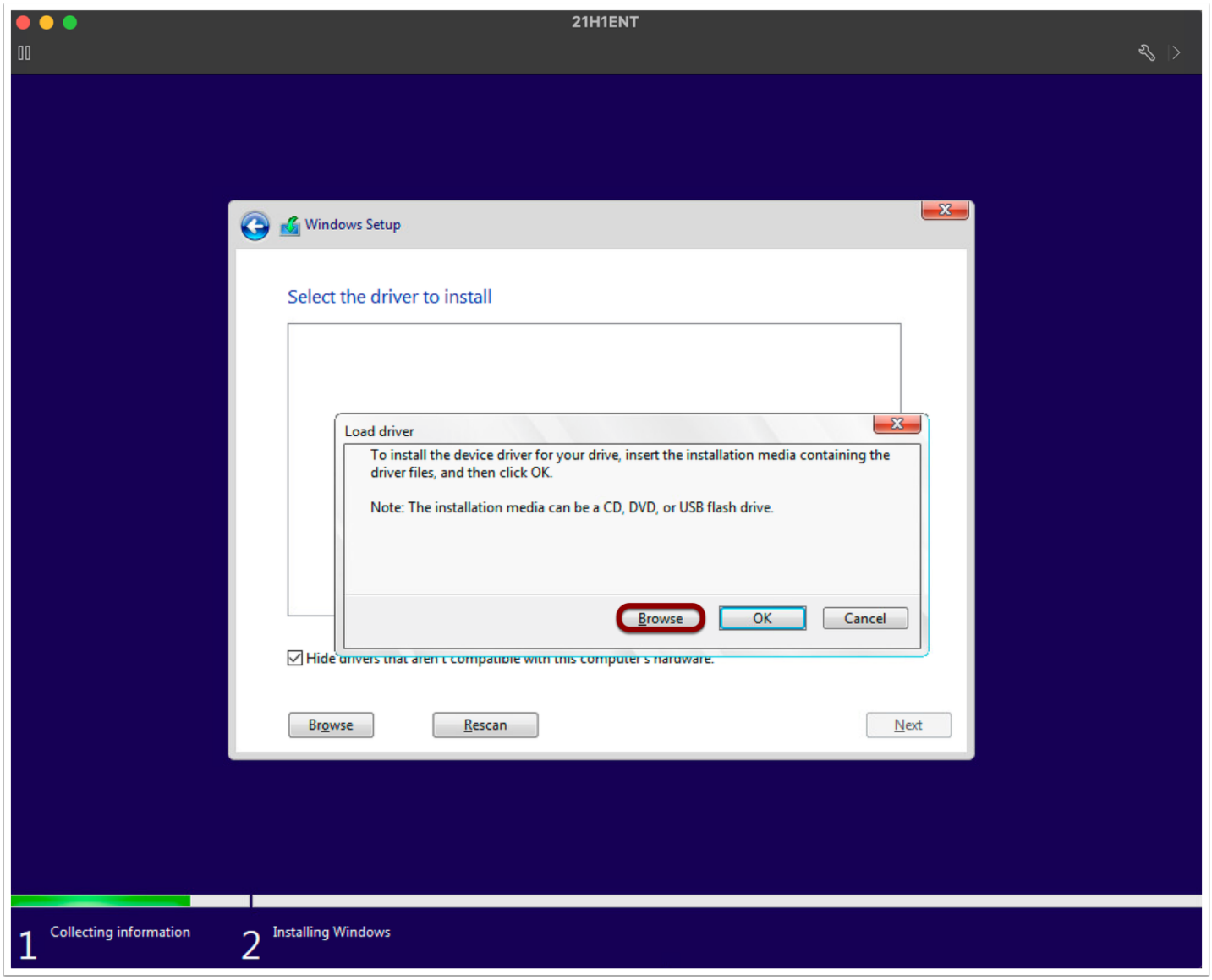
Click on **MOUNT** and go back to the the remote console.

9.3. Open the Load Driver Dialog Box



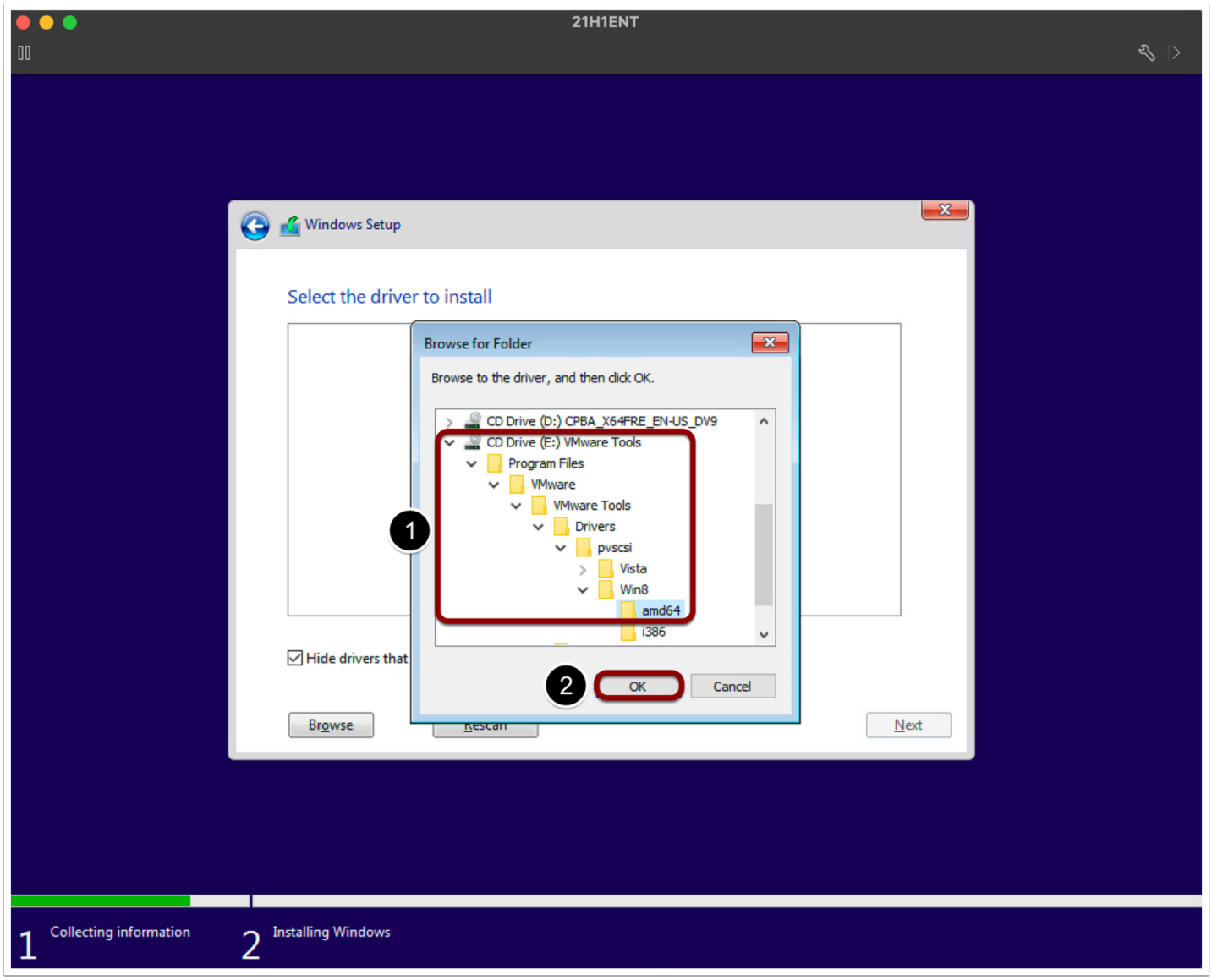
Click **Load driver**.

9.4. Open the File Browser



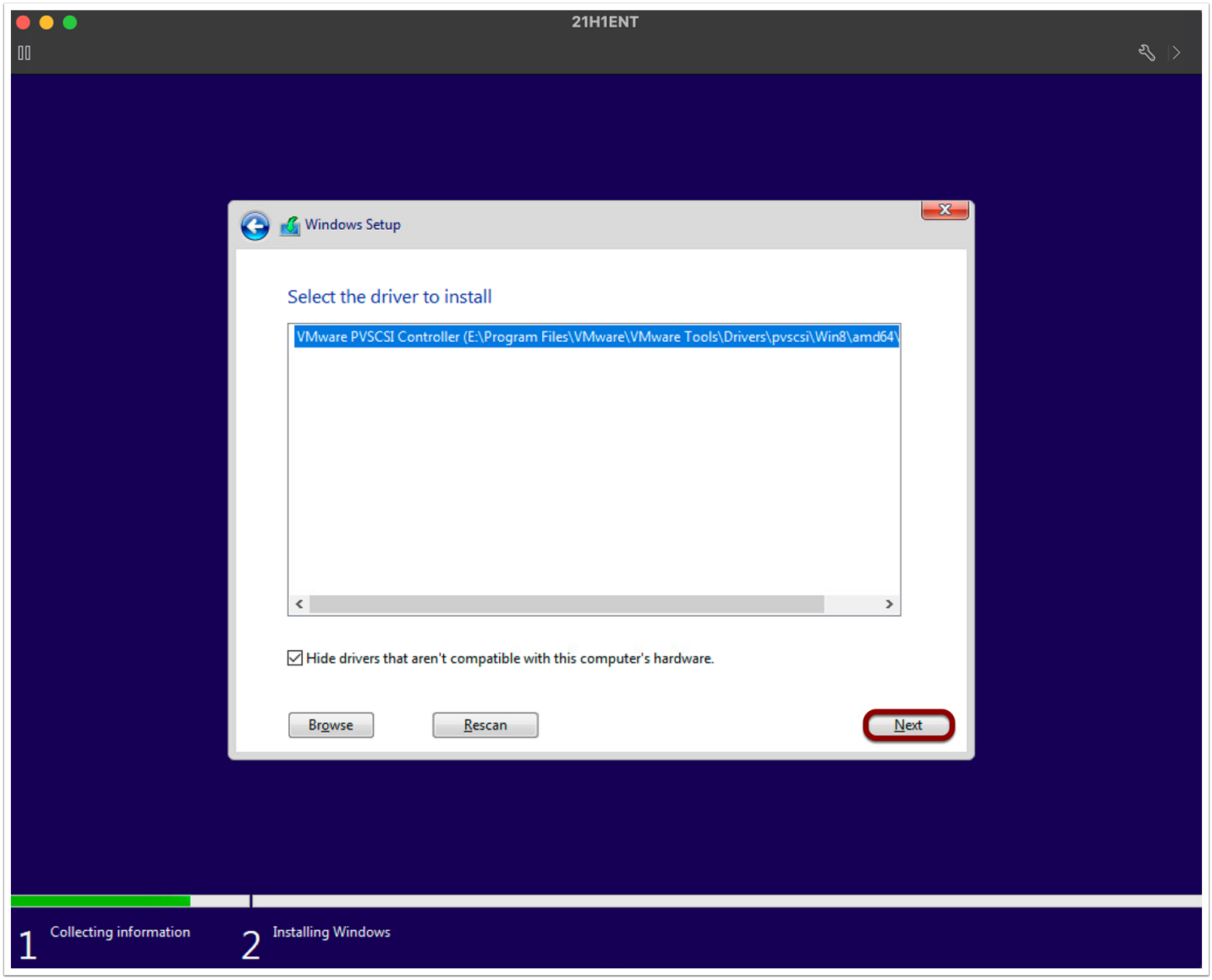
Click **Browse**.

9.5. Browse to the Correct PVSCSI Driver



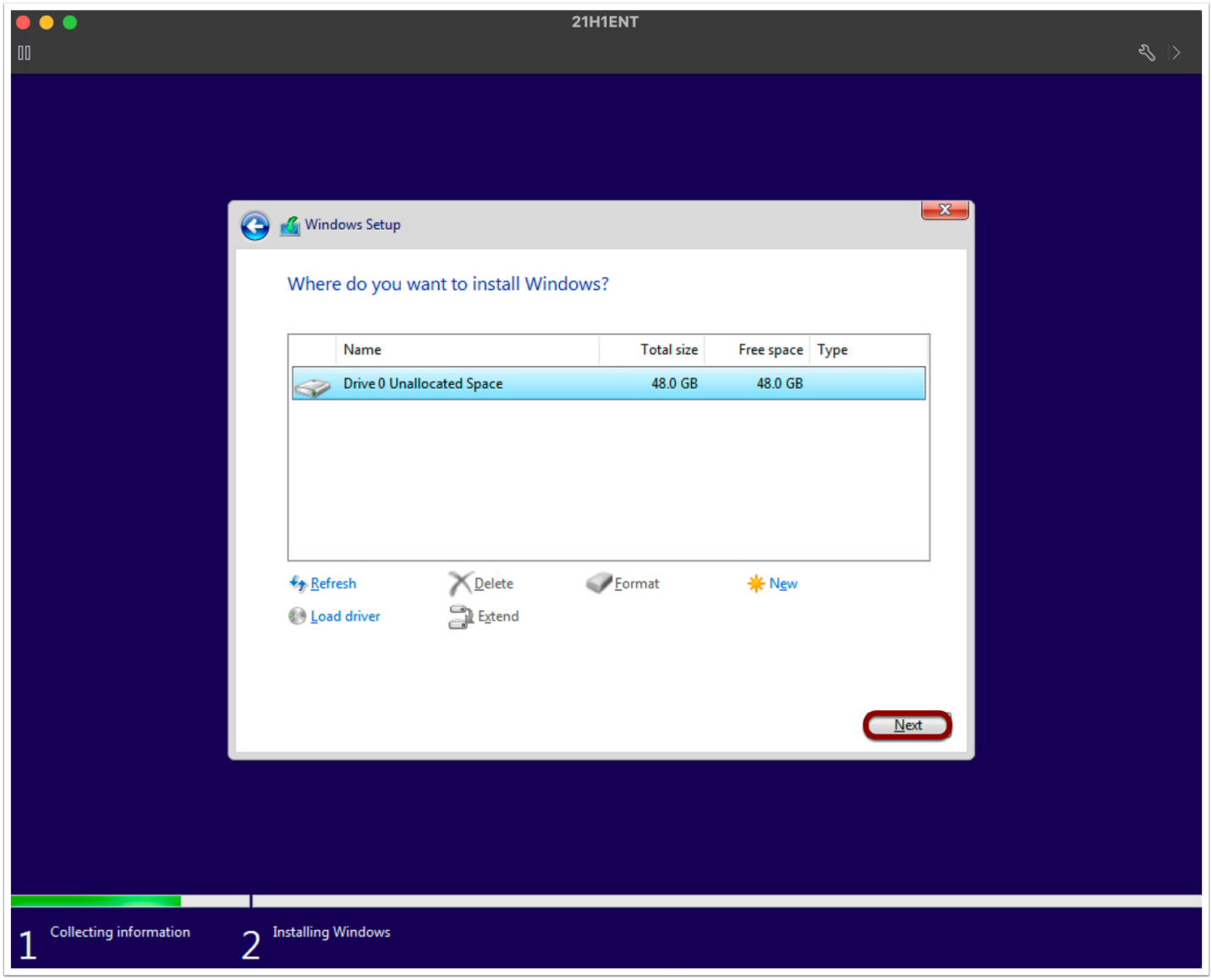
1. Go to **E:\Program Files\VMware\VMware Tools\Drivers\pvscsi\Win8\amd64**.
2. Click **OK**.

9.6. Select the Driver



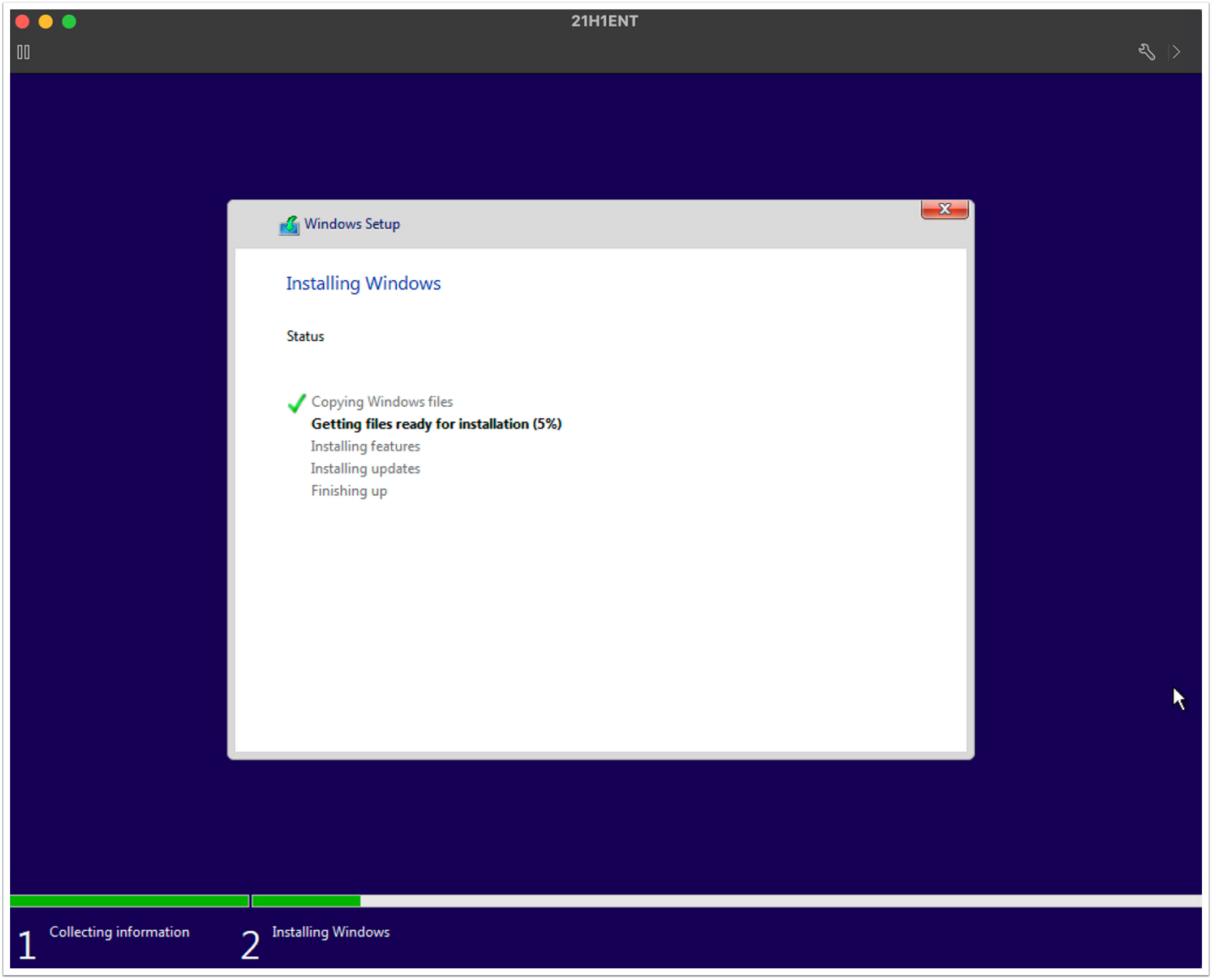
With the VMware PVSCSI driver selected, click **Next**.

10. Use the Default Installation Location



Click **Next**.

11. Monitor Installation Progress



Wait for Windows to be installed.

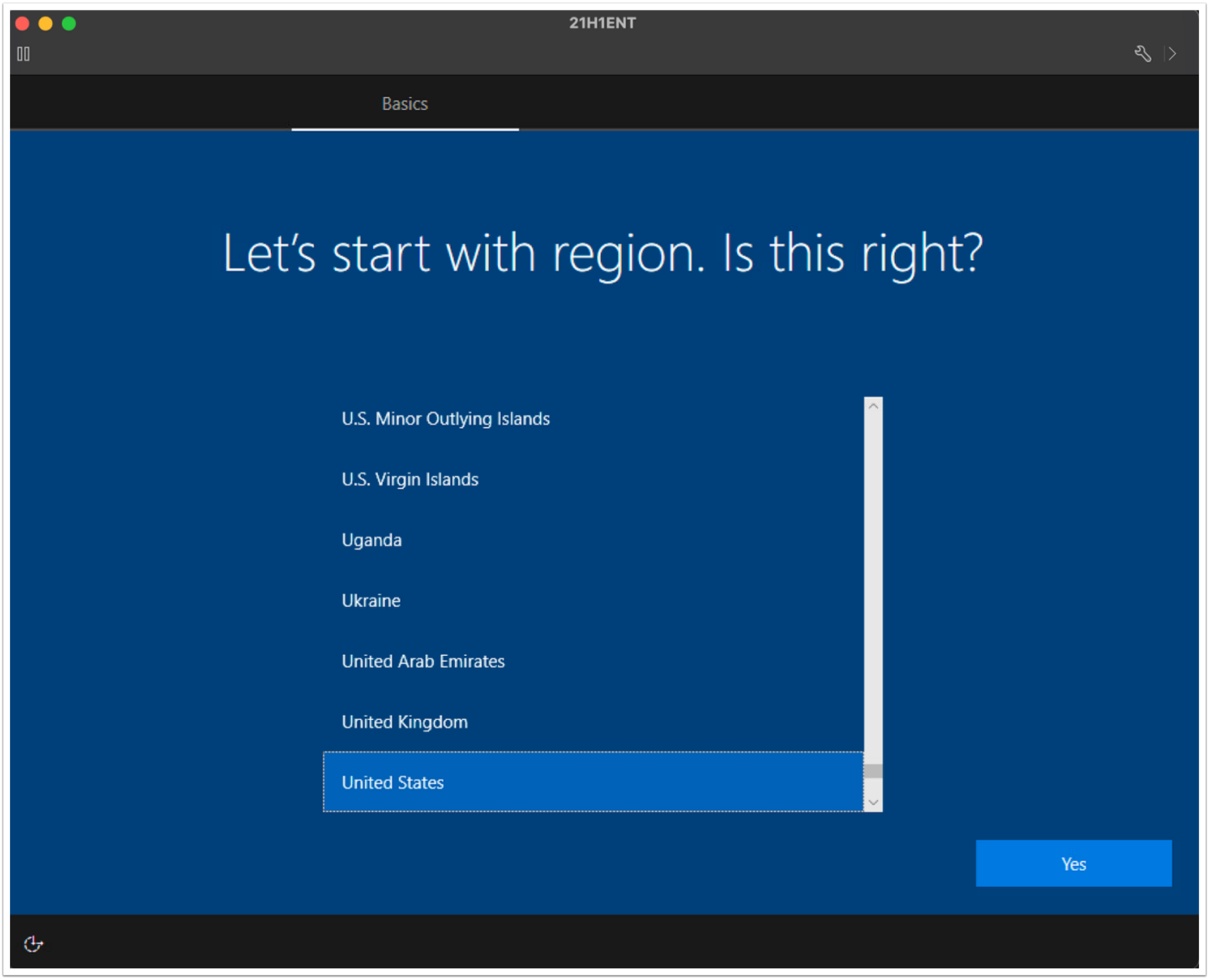
12. Enter Audit Mode by Pressing CTRL+SHIFT+F3

After the Windows operating system is installed, you need to enter audit mode.

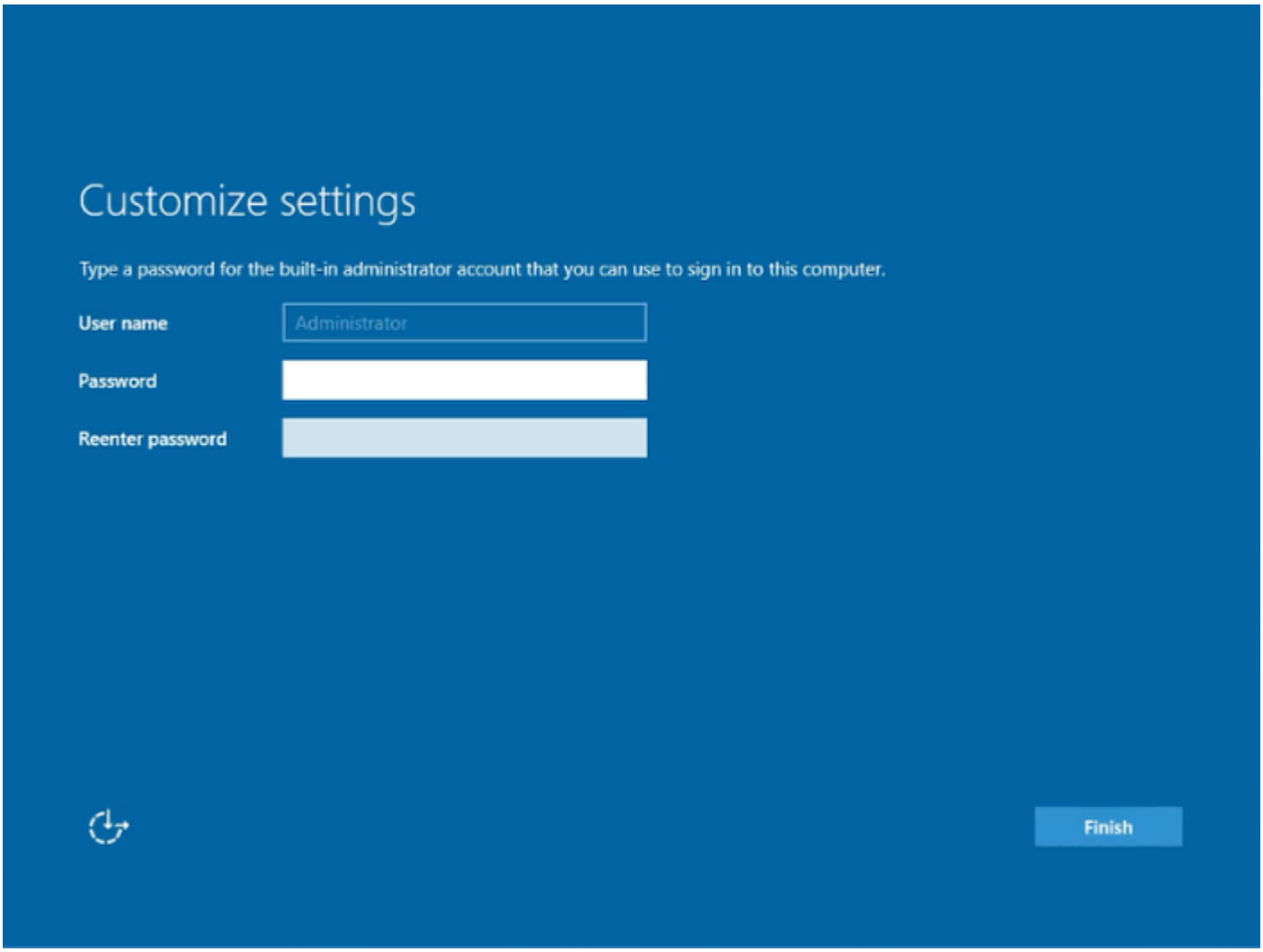
The screen at which you enter audit mode depends on which Windows operating system you are using. For example, some operating systems will automatically log in to Windows after a restart operation, while others will prompt for user credentials. If prompted, use **Administrator** for the user name and leave the password field blank.

When you are prompted with **Let's start with a region** or **Get going fast**, or **Personalize**, or **Customize Settings**, or **Setup Windows**, press CTRL+SHIFT+F3 to switch to audit mode.

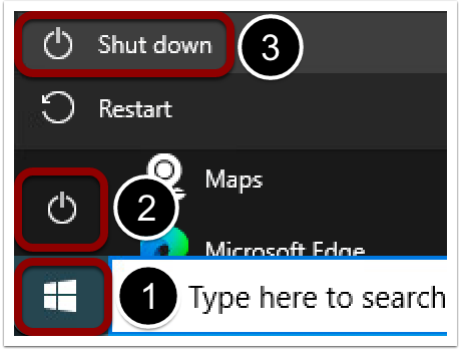
Note: Different Windows operating systems provide different prompts after the initial installation. The following screenshot shows the prompt after you install Windows 10 21H1. You would press CTRL+SHIFT+F3 to switch to audit mode in Windows 10 21H1 when you see this prompt.



The following screenshot shows the prompt after you install Windows Server 2016/2019. You would press CTRL+SHIFT+F3 to switch to audit mode in Windows Server 2016/2019 when you see this prompt.



13. Power Off



1. Click the **Start** icon.
2. Click the **Power** icon.
3. Select **Shut down**.

Install VMware Tools

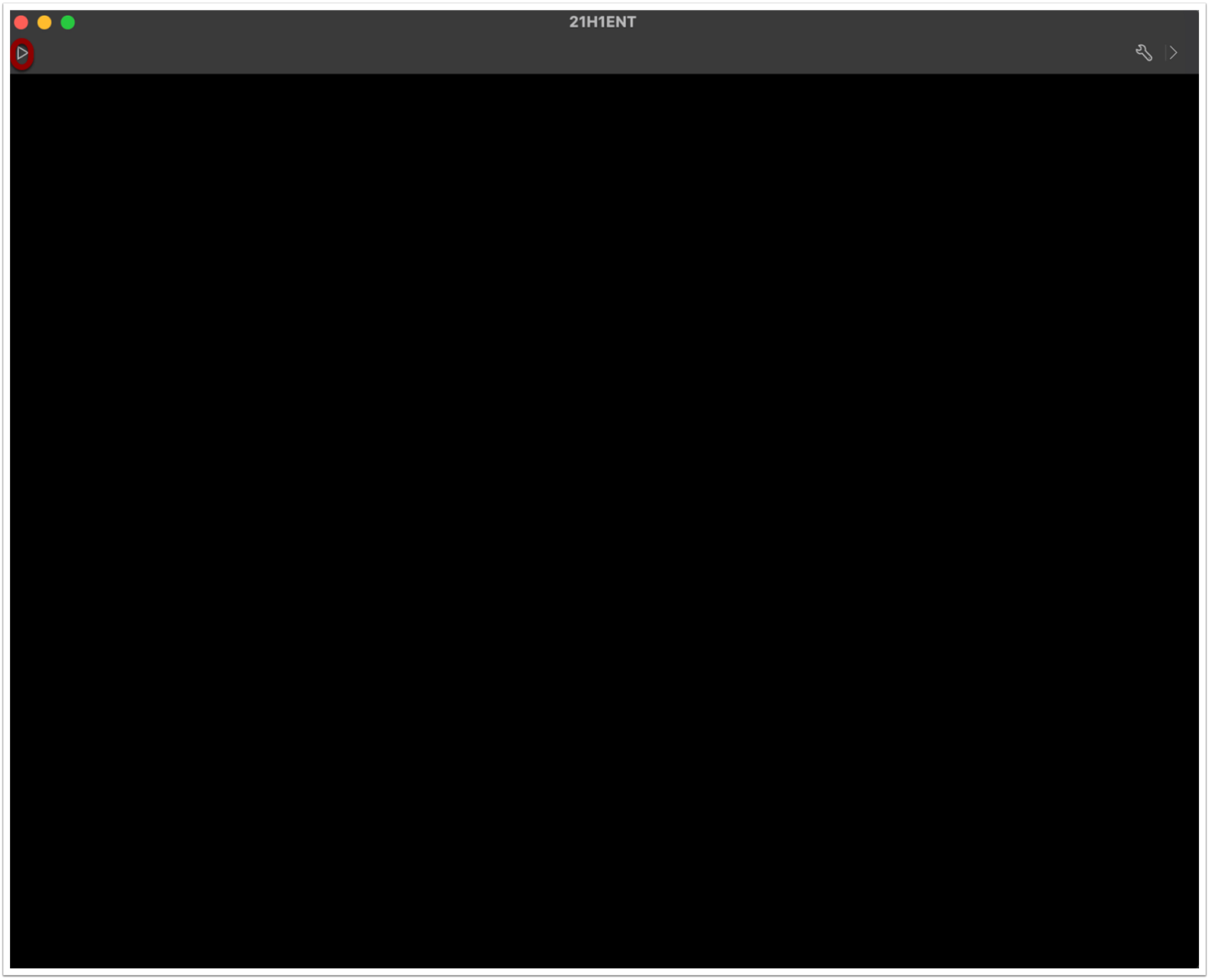
VMware Tools is a set of services and modules that enable several features in VMware products for better management of, and seamless user interactions with, guests operating systems.

For example, VMware Tools can run scripts that automate OS operations and can synchronize the time in the guest operating system with the time on the vSphere host. You must install VMware Tools in vSphere-based VMs used for desktop and application

pools.

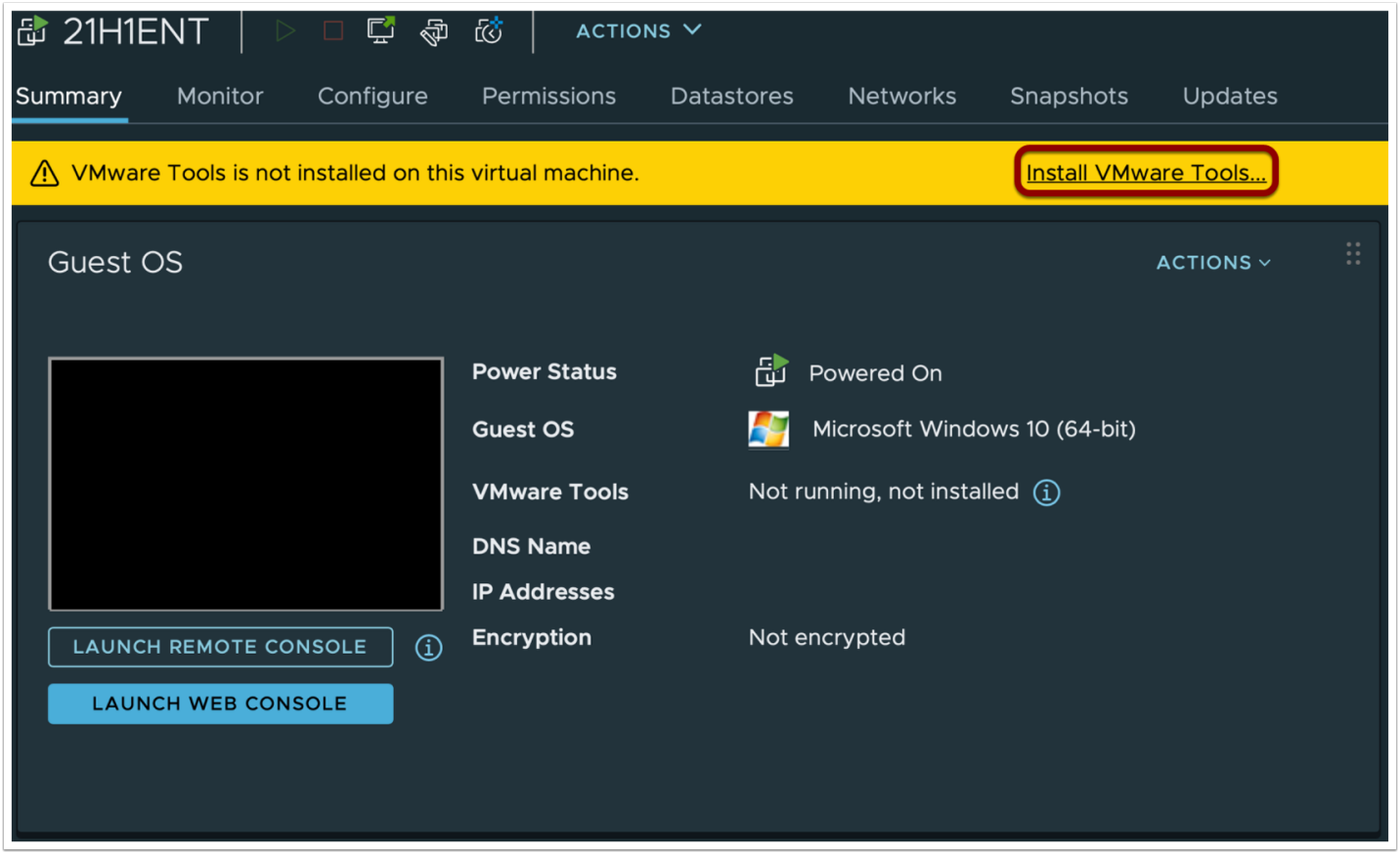
At the end of the previous exercise, Install Windows, you powered off the VM, which left the remote VM console dark, as shown in the following screenshot. If you closed that console, you need to open it again before you can begin this exercise. If you did not power off the VM, you must do so or the **Install VMware Tools** link will not be available in the second screenshot.

1. From the Remote VM Console Start the VM



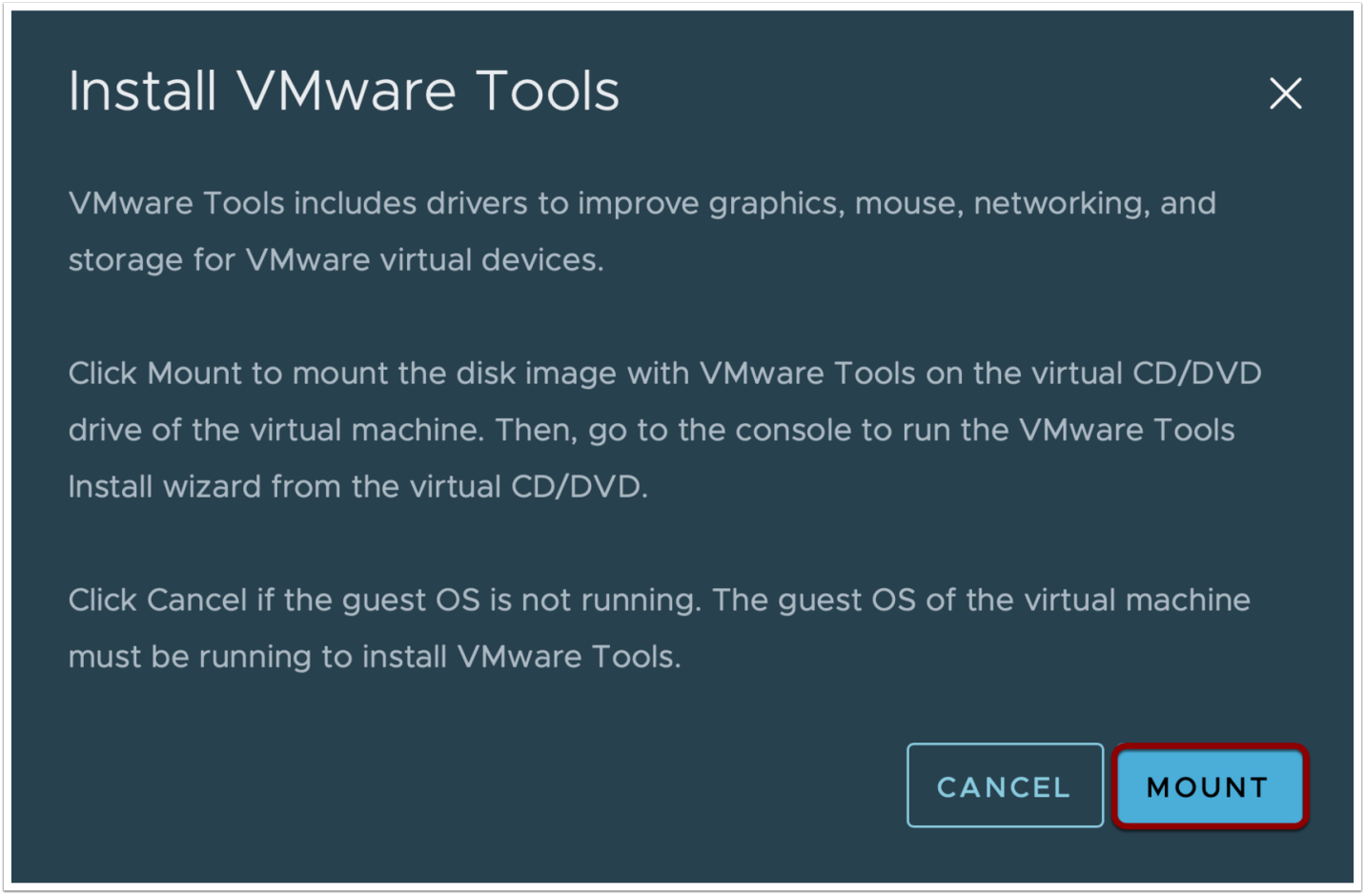
Click on the play icon, which is a triangle-shaped icon at the top of the VM console.

2. Access the VMware Tools Disk Image



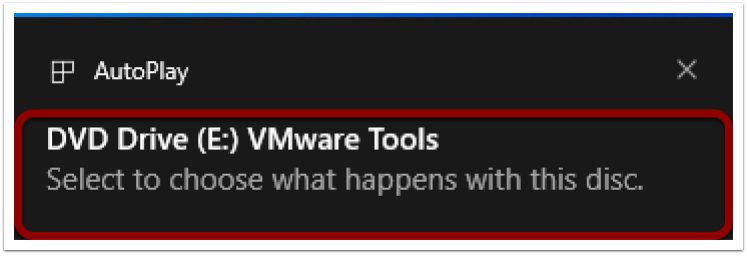
From the **Summary** tab for the VM in vSphere Web Client, click **Install VMware Tools**.

3. Mount the VMware Tools Disk Image



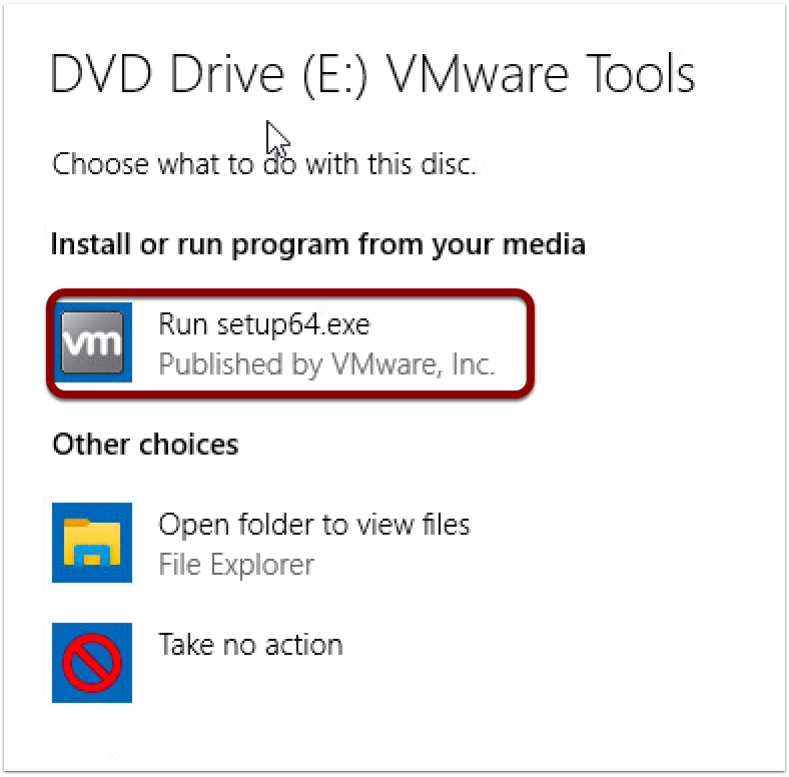
Click **MOUNT** and go back to the vSphere remote console for the VM.

4. Select the VMware Tools Virtual Drive in the AutoPlay Window



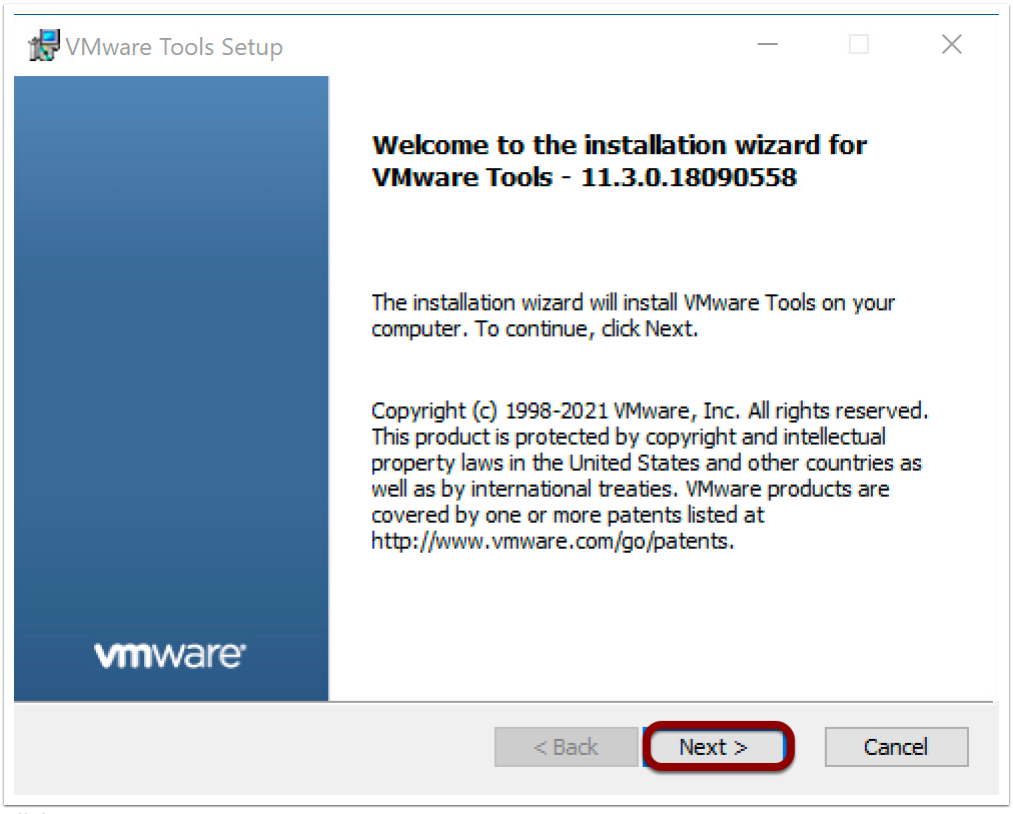
Click **Select to choose what happens with this disc**.

5. Start the Installation Wizard



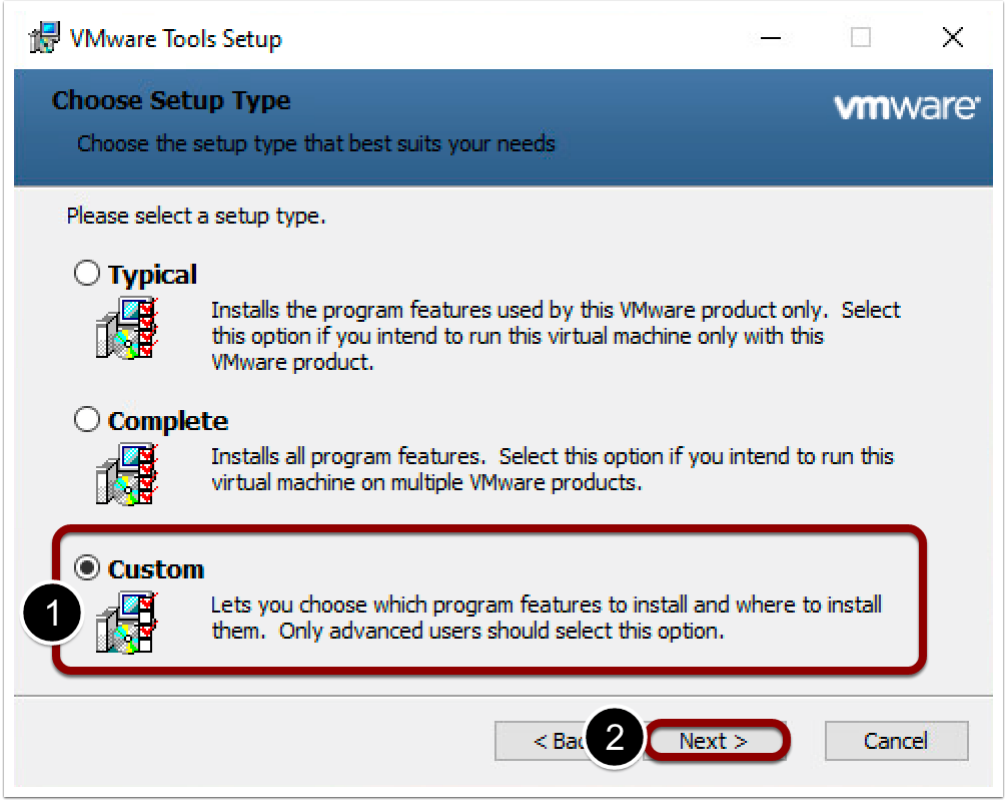
Click **Run setup64.exe**.

6. Click Next on the Welcome Page



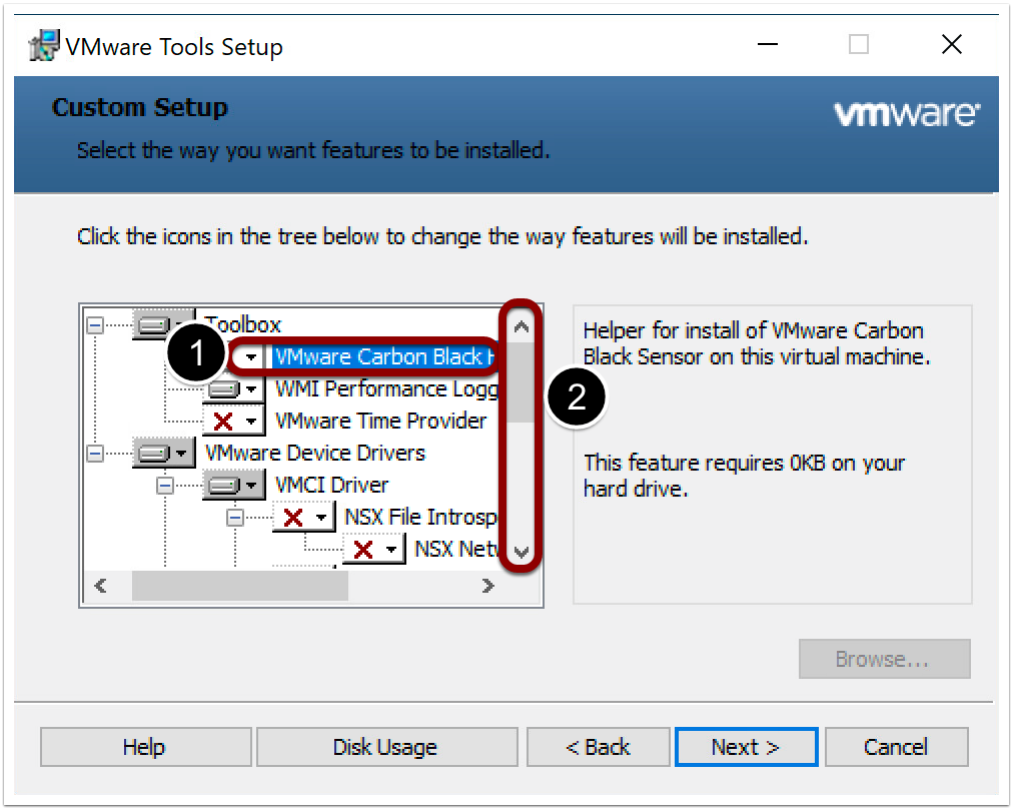
Click **Next**.

7. Select the Custom Setup Type



1. Select **Custom**.
2. Click **Next**.

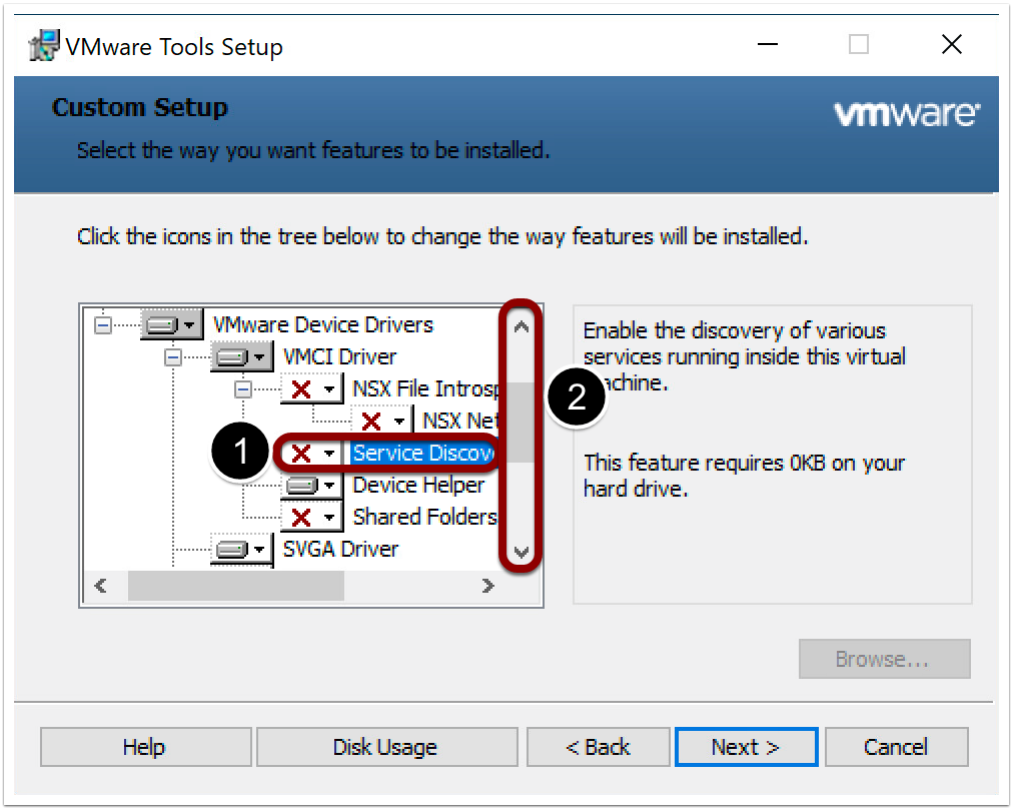
8. Disable the Carbon Black Helper Component If Not Required



1. Deselect **VMware Carbon Black Helper**, unless you use Carbon Black.
2. Scroll down.

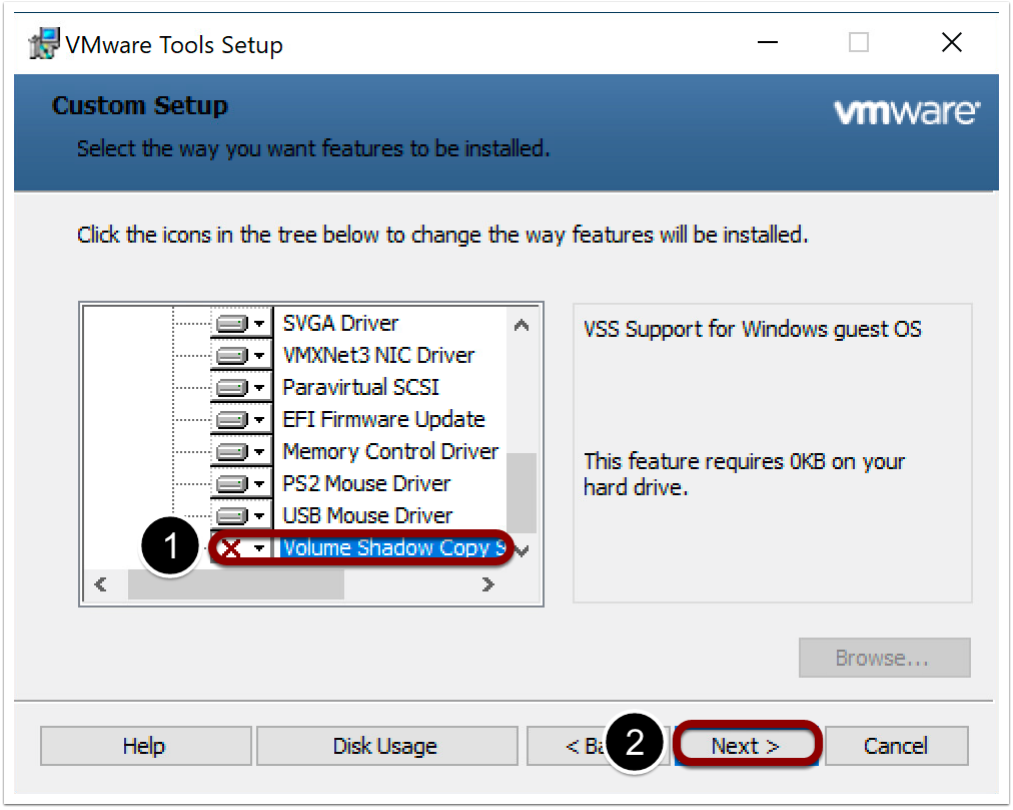
Note: If you leverage NSX enable the NSX File and Network Introspection drivers.

9. Exclude the Service Discovery Component



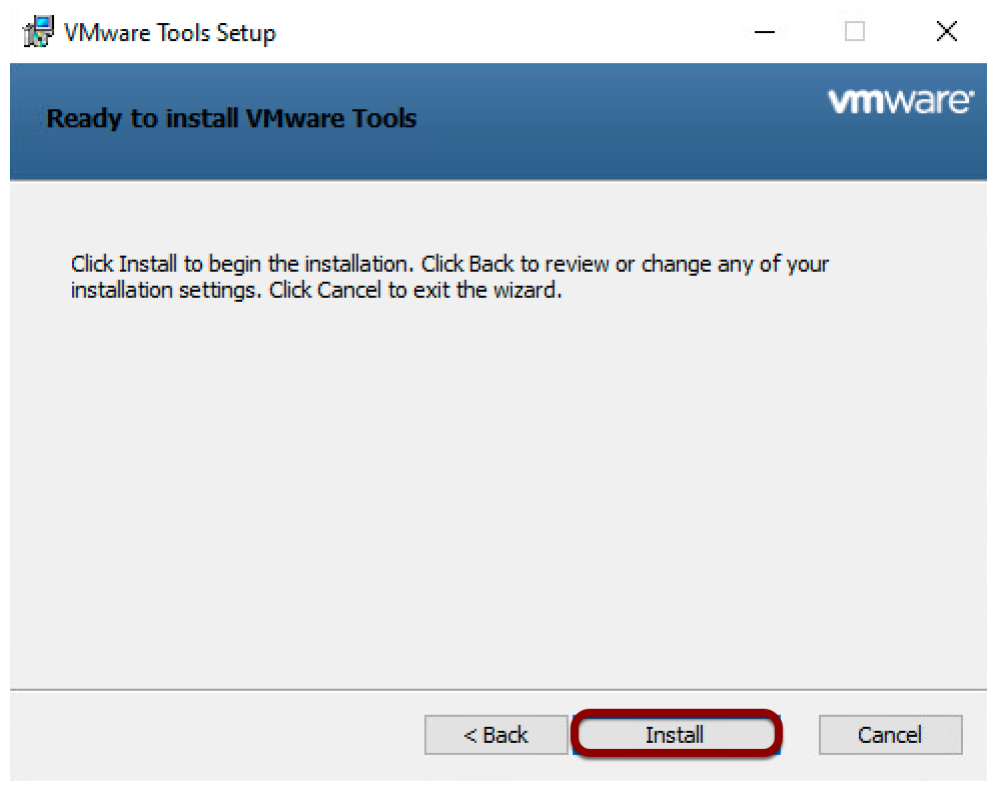
1. Deselect **Service Discovery**, which enables the discovery of various services running inside a virtual machine. This component is not necessary.
2. Scroll down.

10. Exclude the Volume Shadow Copy Component



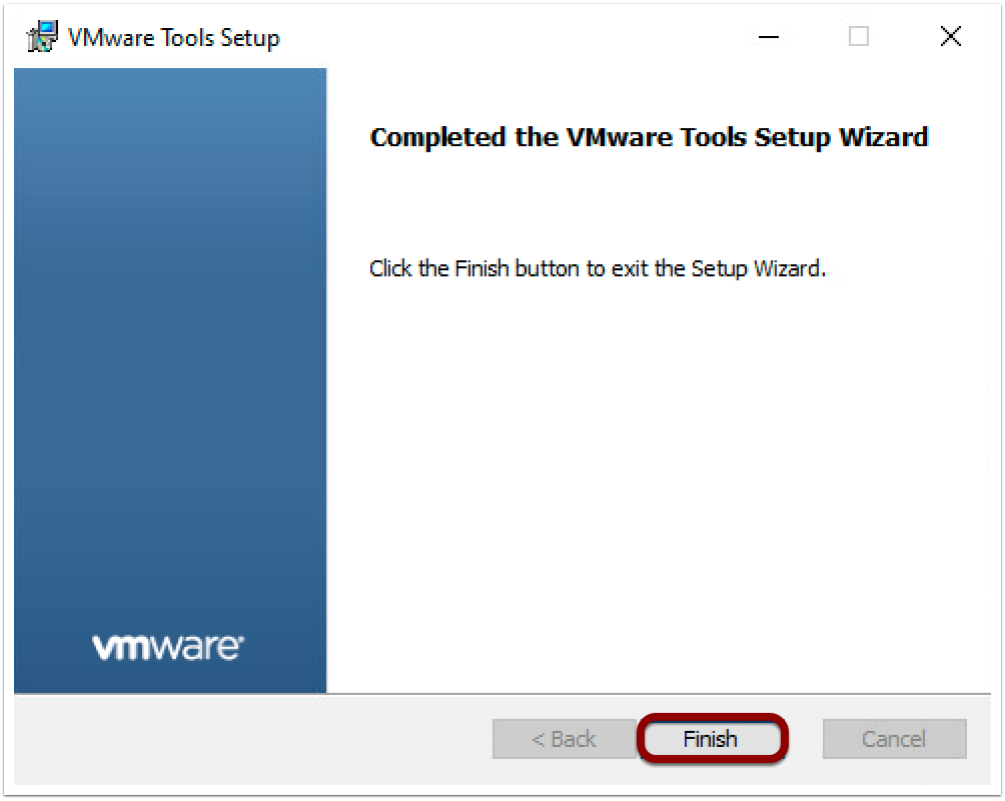
1. Deselect **Volume Shadow Copy Services Support**. This component is not necessary.
2. Click **Next**.

11. Begin Installation of VMware Tools



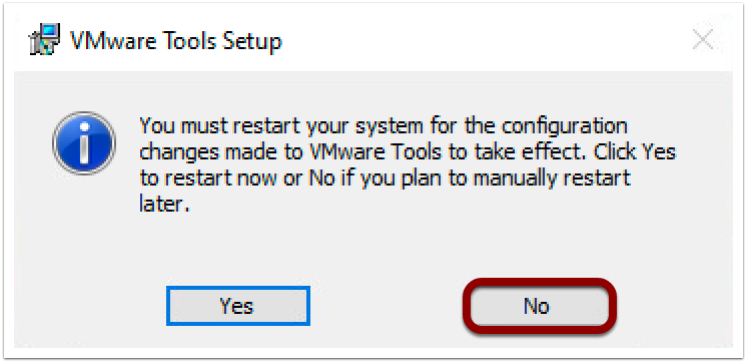
Click **Install**.

12. Exit the Installation Wizard



Click **Finish**.

13. Do Not Restart the VM



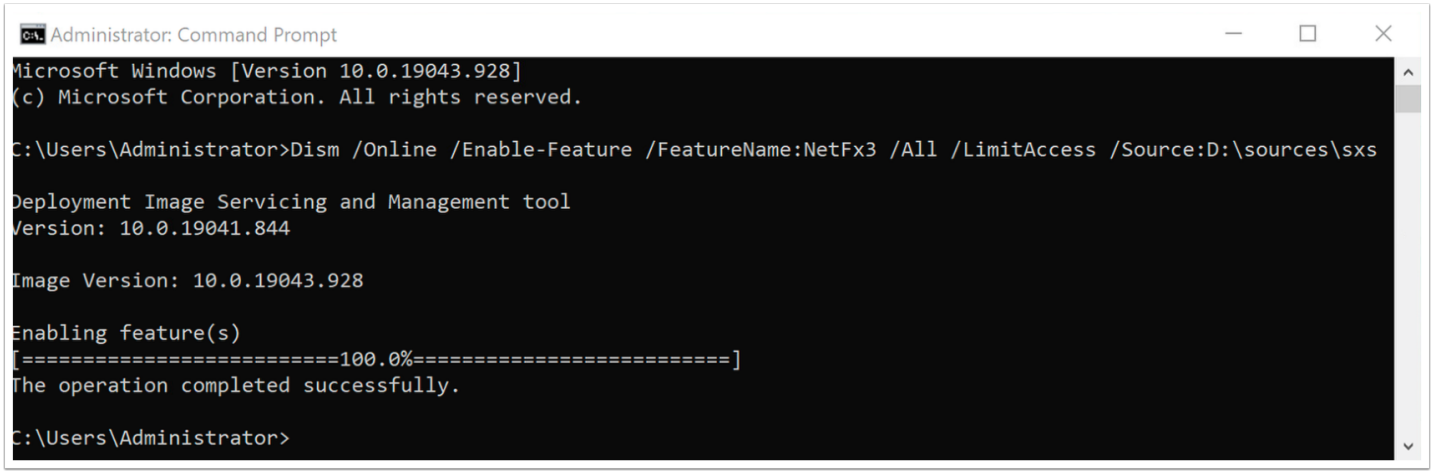
Click **No**.

Install .Net Framework 3.5

Open a command prompt and run the following command:

```
DISM /Online /Enable-Feature /FeatureName:NetFx3 /All /LimitAccess
/Source:D:\sources\sxs
```

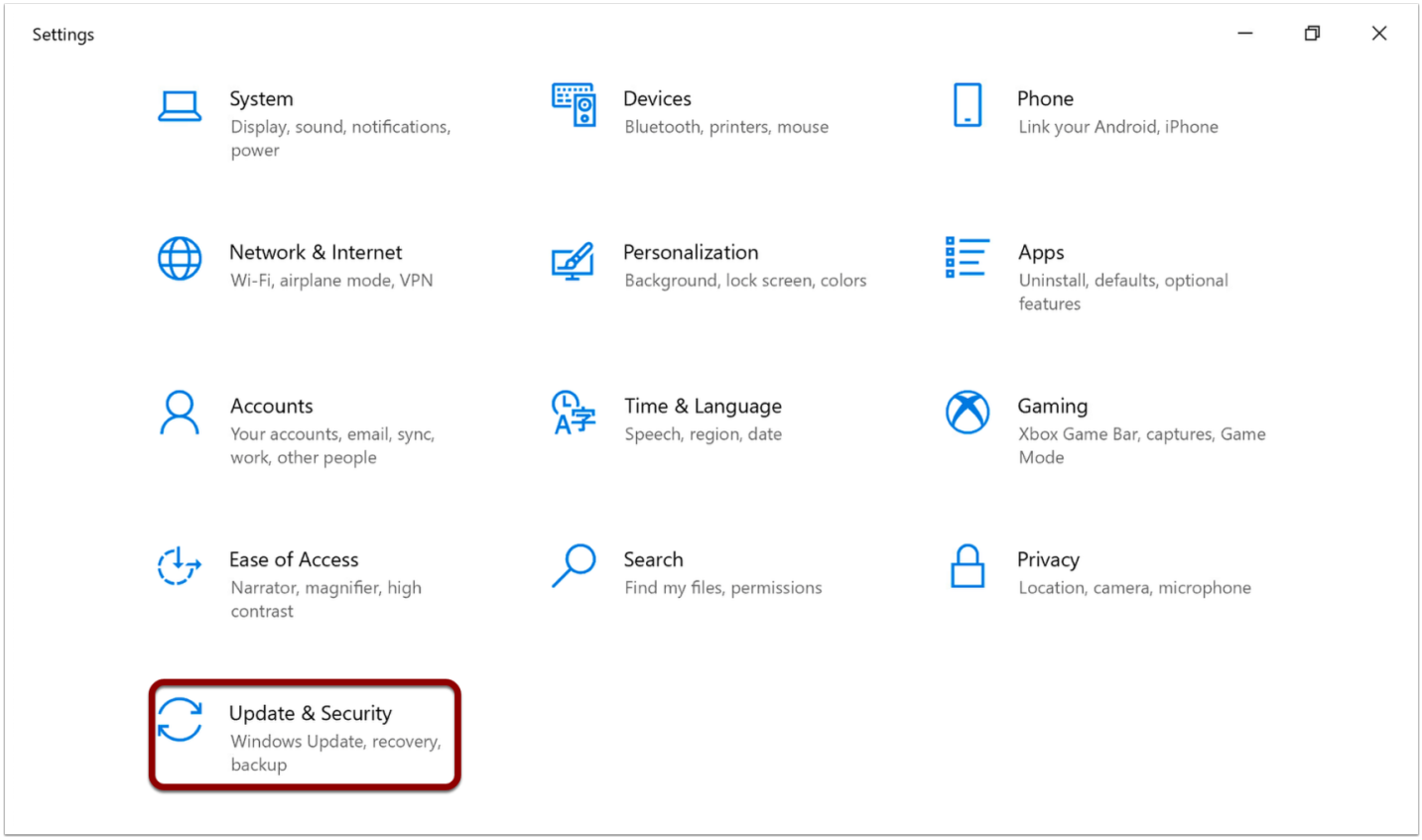
Install any required component that leverages Windows Update, such as C++ runtimes, Office, and so on. The following screenshot shows an example of successfully running this command.



Update Windows

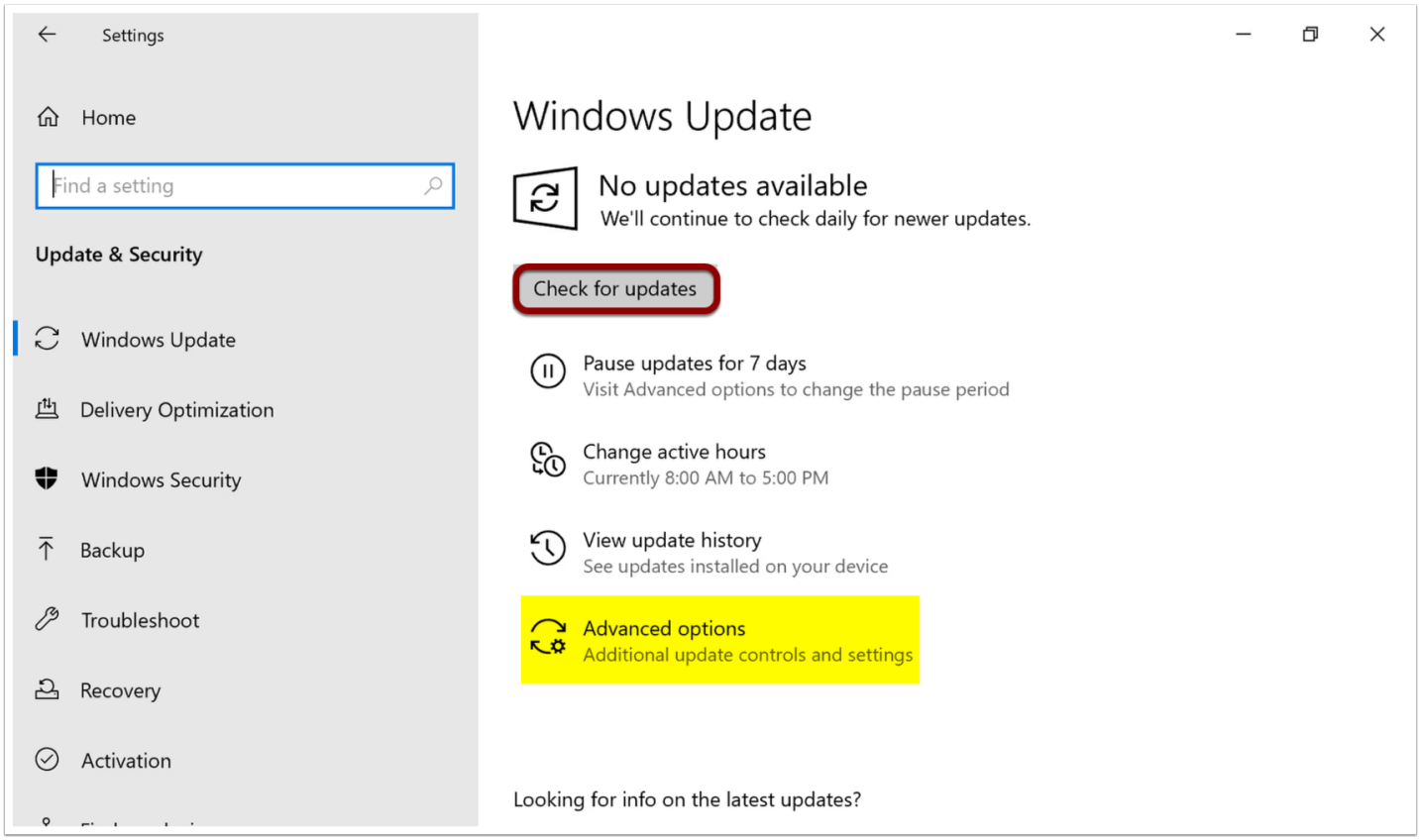
Install the latest Windows OS updates.

1. Select the Update & Security Settings in Windows Settings



Press Windows Key+I, to open Windows Settings, and click **Update & Security**.

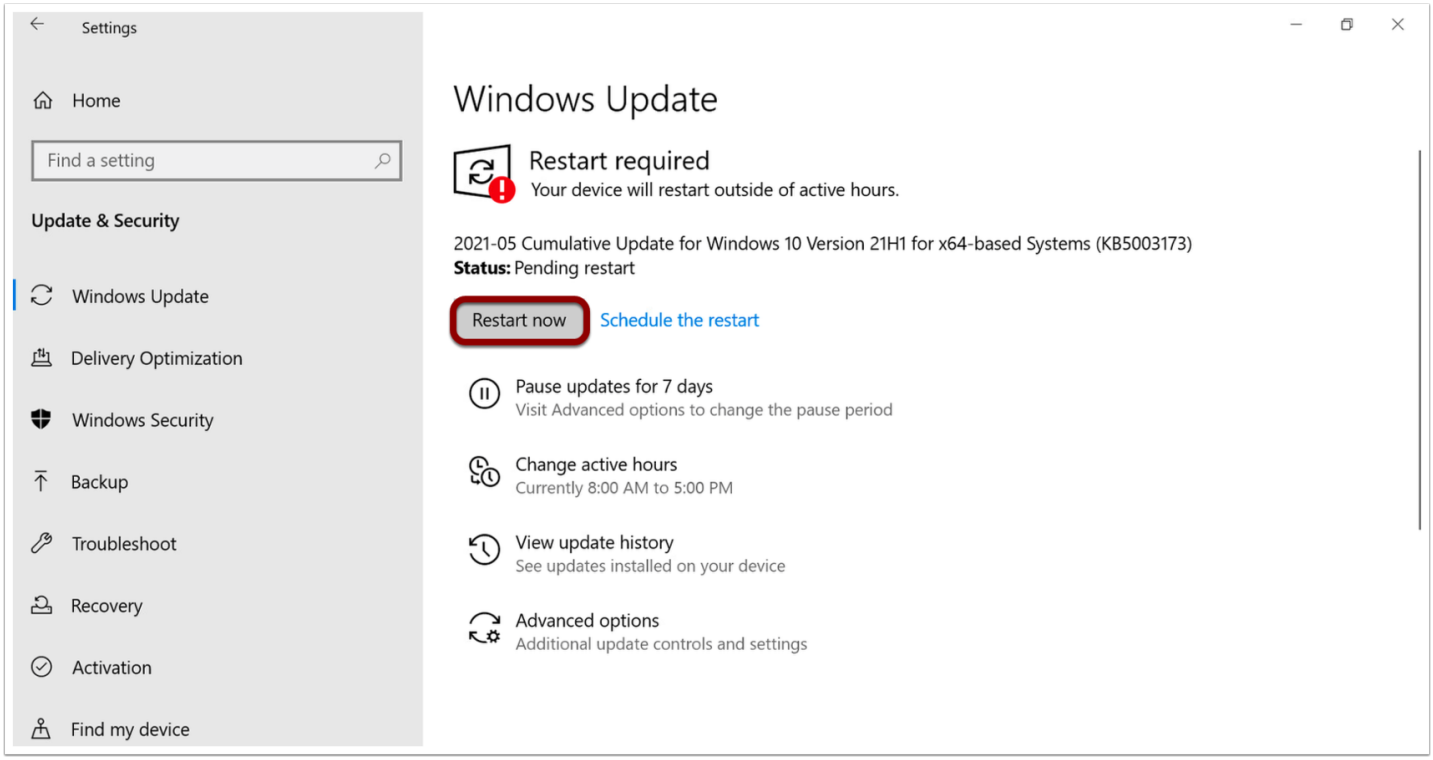
2. Select Check for Updates



Note: For earlier non-LTSB/LTSC Windows 10 versions, click **Advanced options** first and select **Defer feature upgrades** so that new features are not downloaded and installed. Deferring feature upgrades does not affect security updates.

Click **Check for updates** and wait for the updates to be installed.

3. Restart the VM



Click **Restart now**. Run Windows Update again until no more updates are available and no restarts are required.

Installing Virtual Desktop Agents and Applications in a vSphere-Based VM

Install Horizon Agent

If you plan to create VMware Horizon desktop or application pools or server farms, you must install Horizon Agent on the golden VM image so that VMware Horizon servers can communicate with and manage the VMs that you deploy. The Horizon Agent also communicates with VMware Horizon® Client™ on end users' computers to provide features such as connection monitoring, virtual printing, access to the local file system, and access to locally connected USB devices.

Note: This procedure describes running the Horizon Agent installer in the guest operating system of a vSphere-based VM. If instead you are using Horizon Cloud on Microsoft Azure, installing the Horizon Agent is included in the process of importing a VM from the Azure Marketplace, as described in the exercise Import a VM in Horizon Cloud on Microsoft Azure.

Prerequisites for Installing Horizon Agent

To perform this procedure, you need the following:

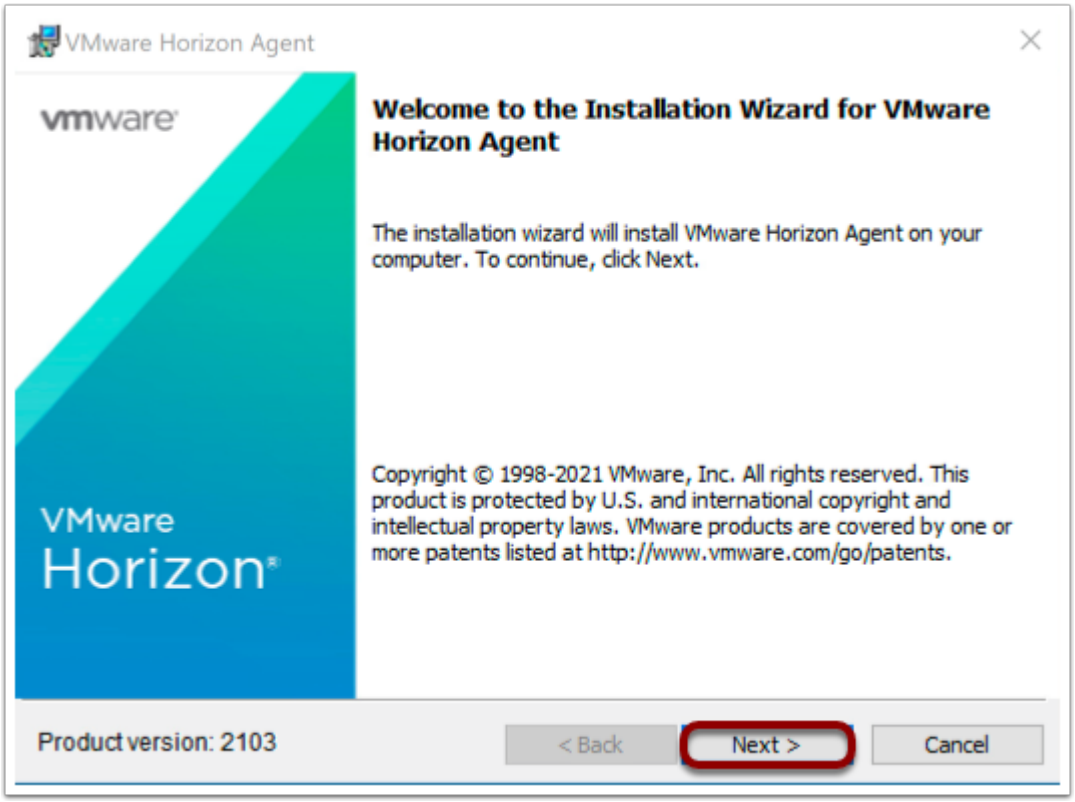
- **User account** – When you log in to the OS of the golden image to run the installer, the account you use must have local administrative privileges.
- **Installer** – Horizon Agent installer (`.exe`) files are available from the Download VMware Horizon page. You must download the file and copy it to the system where it will run or to a location accessible to the system.
- **VM with supported Windows OS** – The virtual machine must be running a Windows operating system that Horizon Agent supports. For a list of the systems we tested, see Tested Operating Systems. For a complete list of supported Windows 10 operating systems, see the VMware knowledge-base article Supported versions of Windows 10 on Horizon Agent Including All VDI Clones (Full Clones, Instant Clones, and Linked Clones on Horizon 7) (2149393).

Important: If you install Horizon Agent on a Windows Server machine on which the Remote Desktop Services (RDS) role is not installed, the wizard will prompt you to **Install VMware Horizon Agent in 'desktop mode'**.

Selecting this option configures the Windows Server machine as a single-user virtual desktop rather than as an RDS host. If you

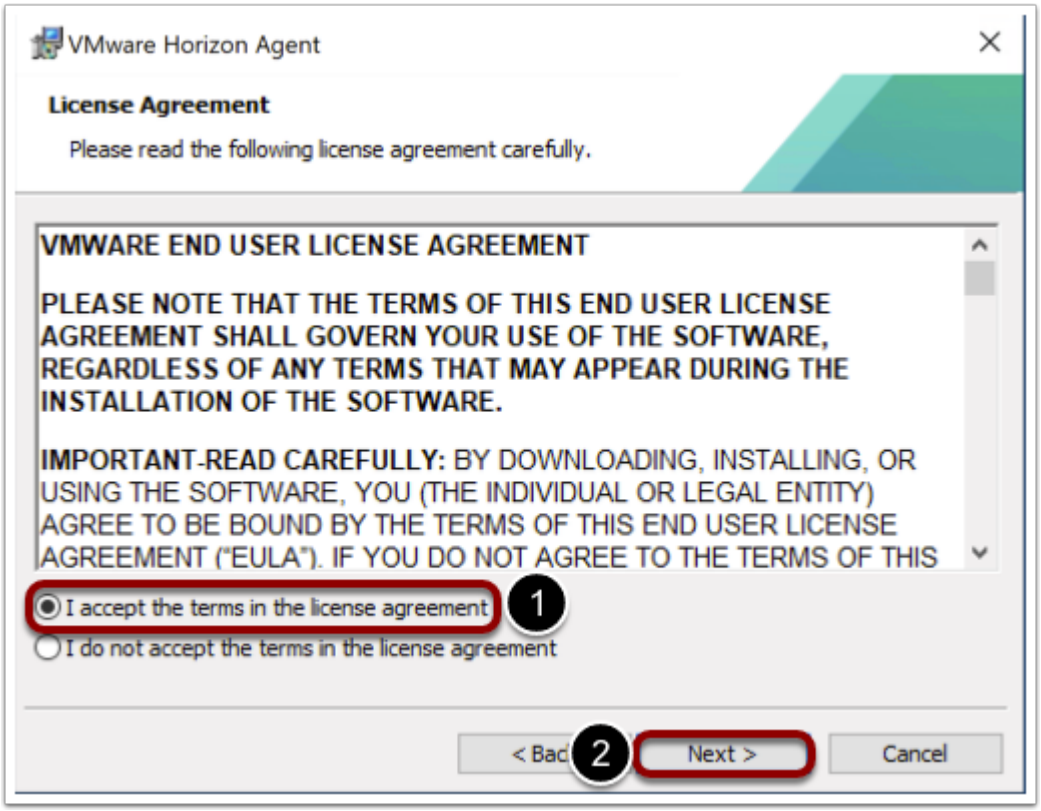
intend the machine to function as an RDS host, cancel the Horizon Agent installation, install the RDS role on the machine, and restart the Horizon Agent installation.

1. Start the Horizon Agent Wizard



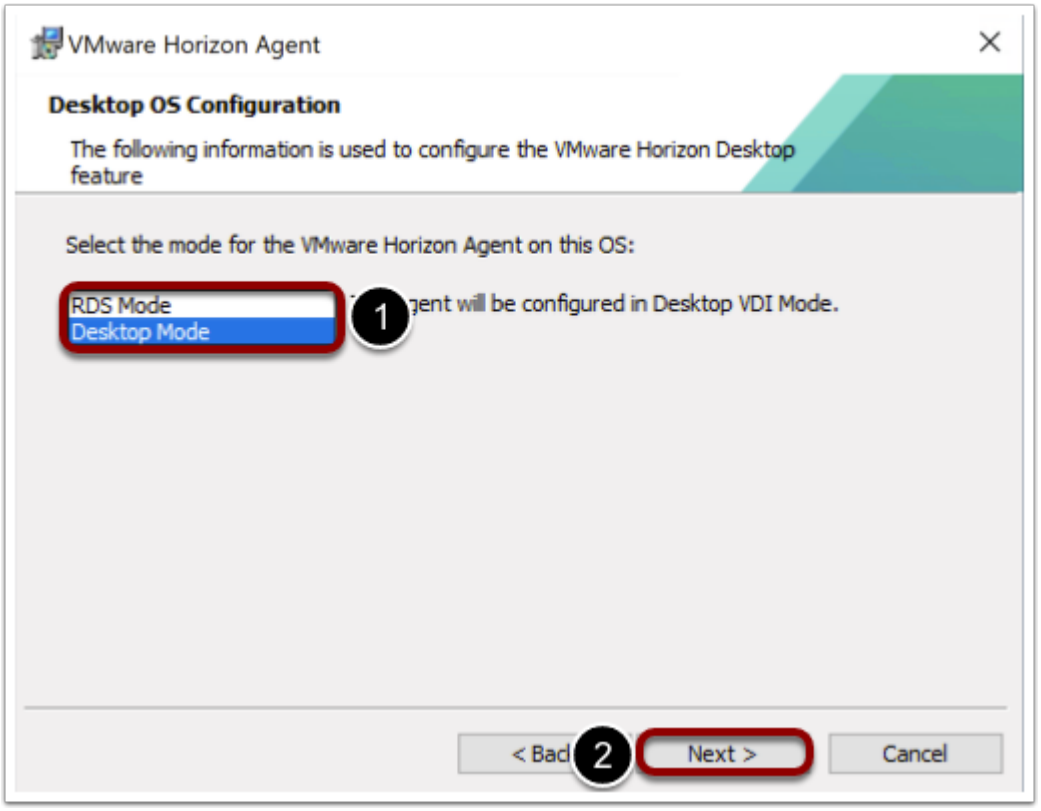
Log in to the OS of the VM as an Administrator, double-click the installer file to start the wizard, and click **Next** on the Welcome page.

2. Accept the License Agreement



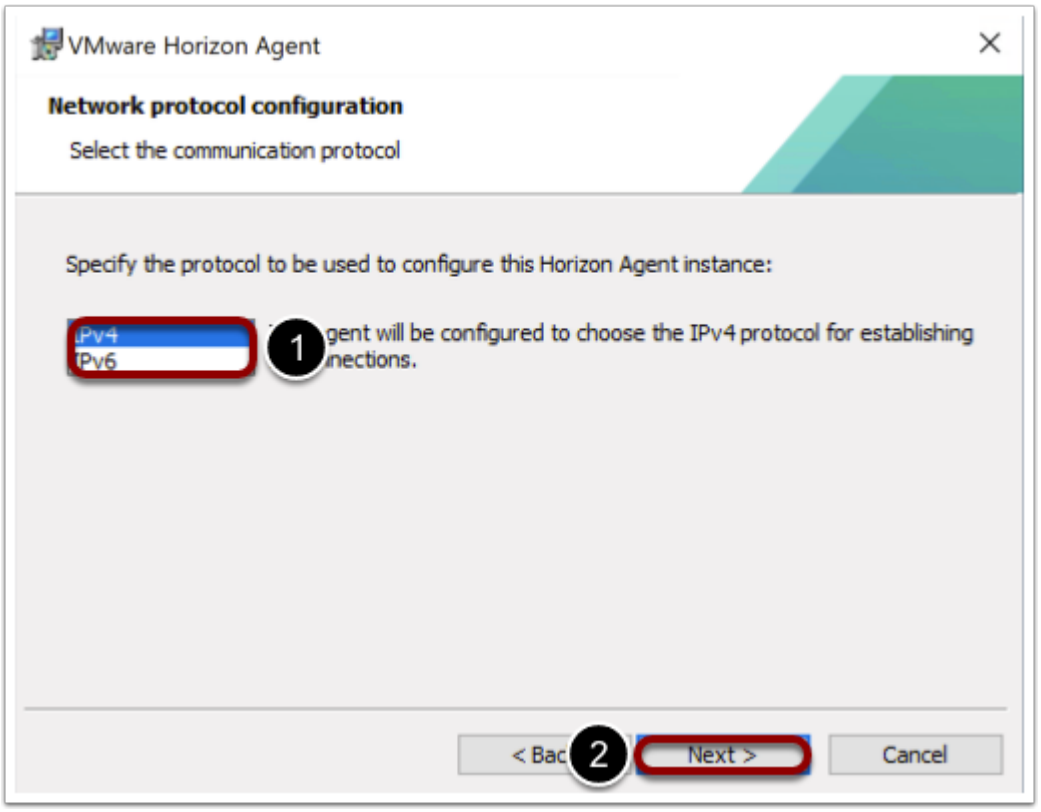
1. Select **I accept the terms in the license agreement**.
2. Click **Next**.

3. Select the Mode



1. When you install Horizon Agent on Windows Server 2016 or 2019, you must select either **RDS Mode**, for shared multi-user sessions, or **Desktop Mode**, for single-user (VDI) desktops. If you select **RDS Mode** the RDS role is installed and you are prompted to restart, after which you can launch the agent installer again.
2. Click **Next**.

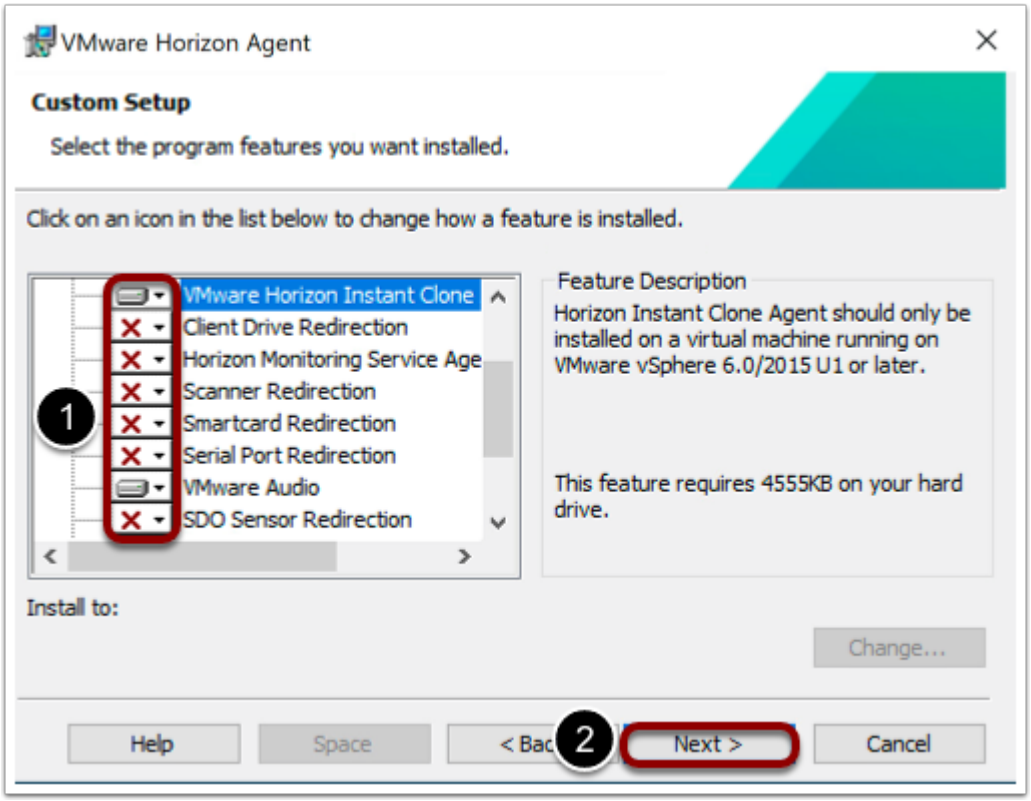
4. Select Whether to Use IPv4 or IPv6



1. Select **IPv4** or **IPv6.**
2. Click **Next**.

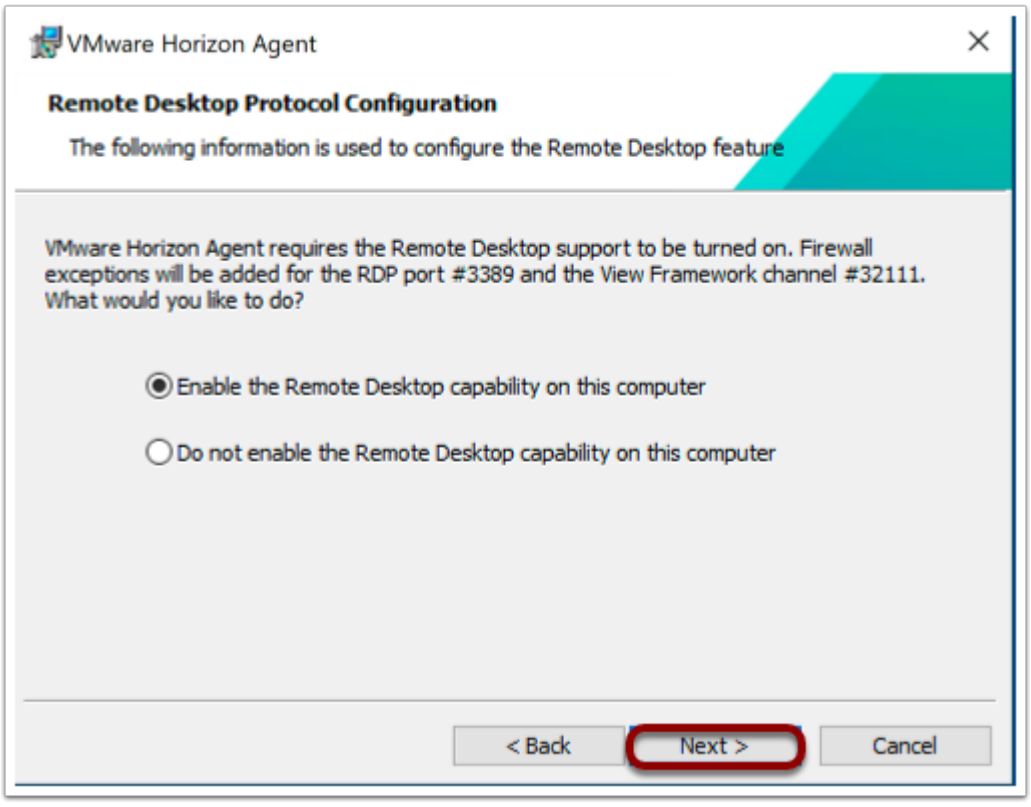
The environment must be either IPv6 only or IPv4 only. Horizon does not support a mixed IPv6 and IPv4 environment.

5. Select Required Features



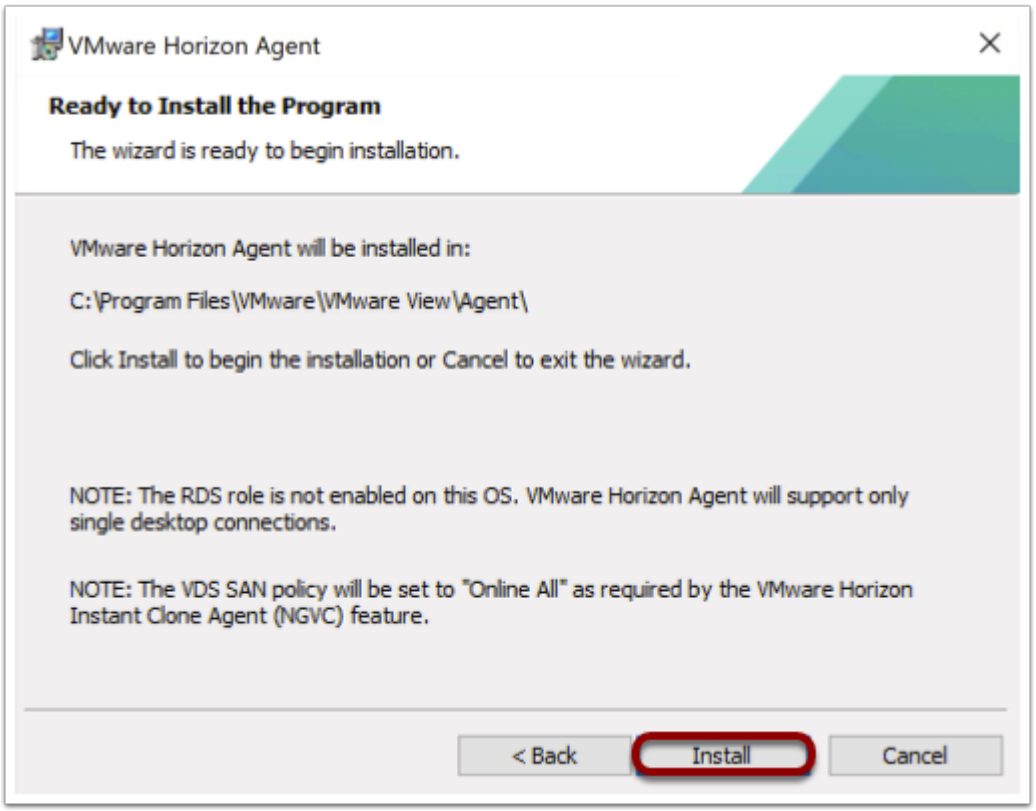
1. Select only the features that will be used. For most environments these are **Core**, **VMware Horizon Instant Clone Agent**, **VMware Audio**, and **VMware Integrated Printing**.
2. Click **Next**.

6. Enable Remote Desktop support

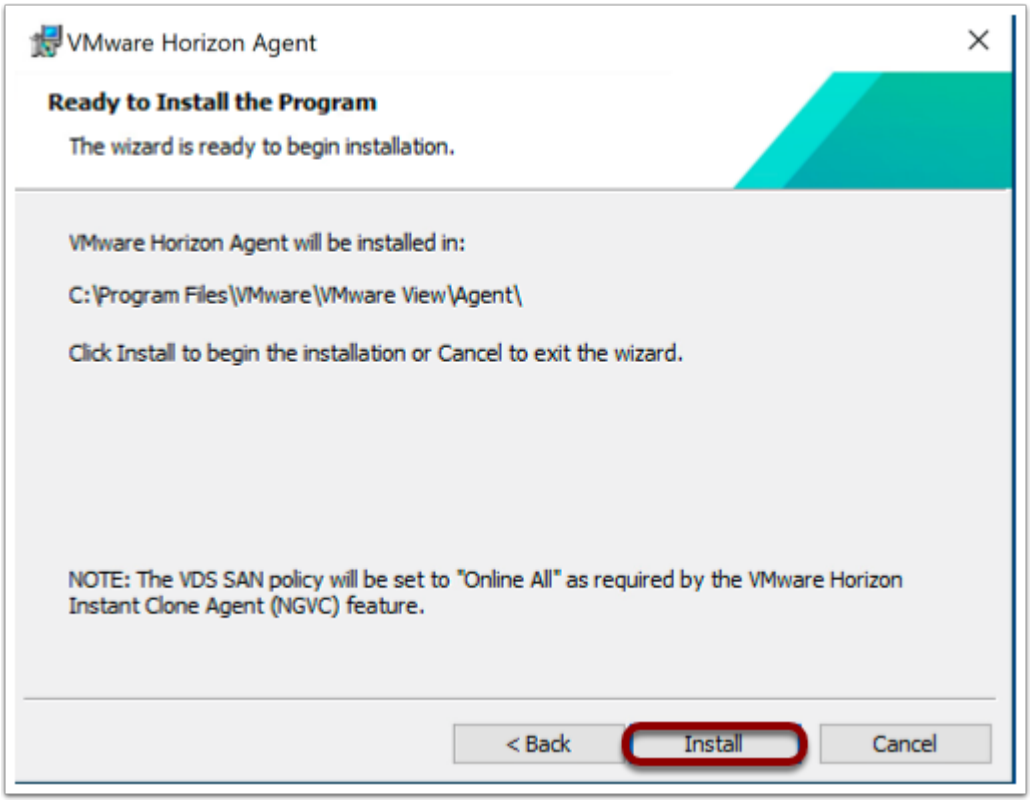


Click **Next**

7. Click Install

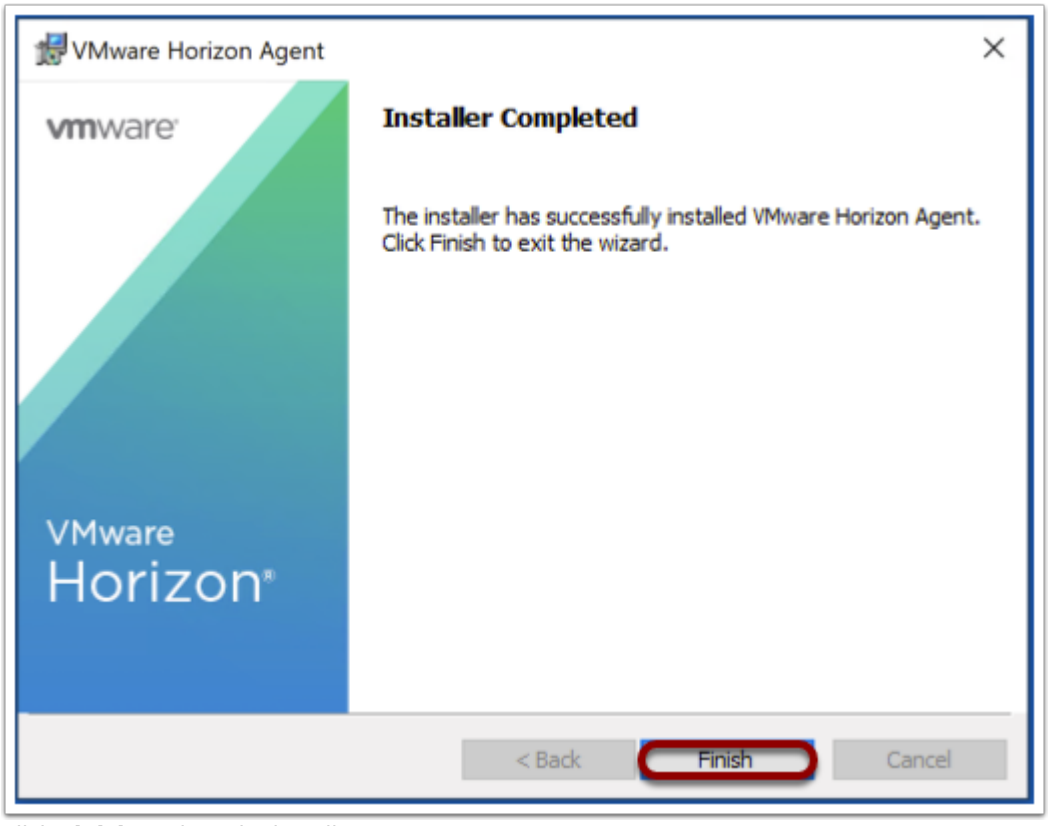


This screenshot shows an example of the screen that might appear when installing the agent on Windows Server. The following screenshot shows an example of a screen for Windows 10.



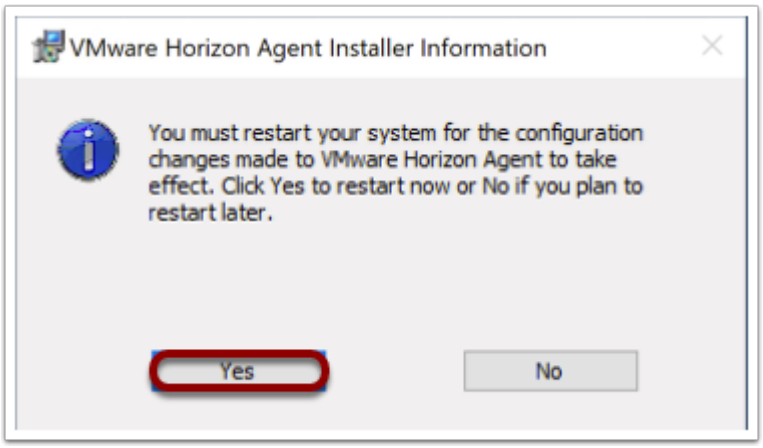
Now that all the correct components are configured to be installed, click **Install**.

8. Click Finish When Installation Is Complete



Click **Finish** to close the installer.

9. Restart the VM



When prompted to restart, click **Yes**.

Install the Dynamic Environment Manager Agent

VMware Dynamic Environment Manager™ (formerly called *User* Environment Manager) provides profile management by capturing user settings for the operating system and applications. Unlike traditional application profile management solutions, Dynamic Environment Manager captures only the settings that the administrator specifies. This reduces login and logout time because less data needs to be loaded. User data is managed through folder redirection.

FlexEngine, the Dynamic Environment Manager Agent component, applies the policies that the IT administrator creates with the Dynamic Environment Manager Management Console. To install this component, you run the same VMware Dynamic Environment Manager Setup wizard that you run to install the management console.

Notes: Installing the Dynamic Environment Manager Agent is an optional step. Install this agent only if you plan to use this functionality.

This procedure describes running the FlexEngine installer in the guest operating system of a vSphere-based VM. If instead you are using Horizon Cloud on Microsoft Azure, installing the agent is included in the process of importing a VM from the Azure Marketplace, as described in the exercise Import a VM in Horizon Cloud on Microsoft Azure.

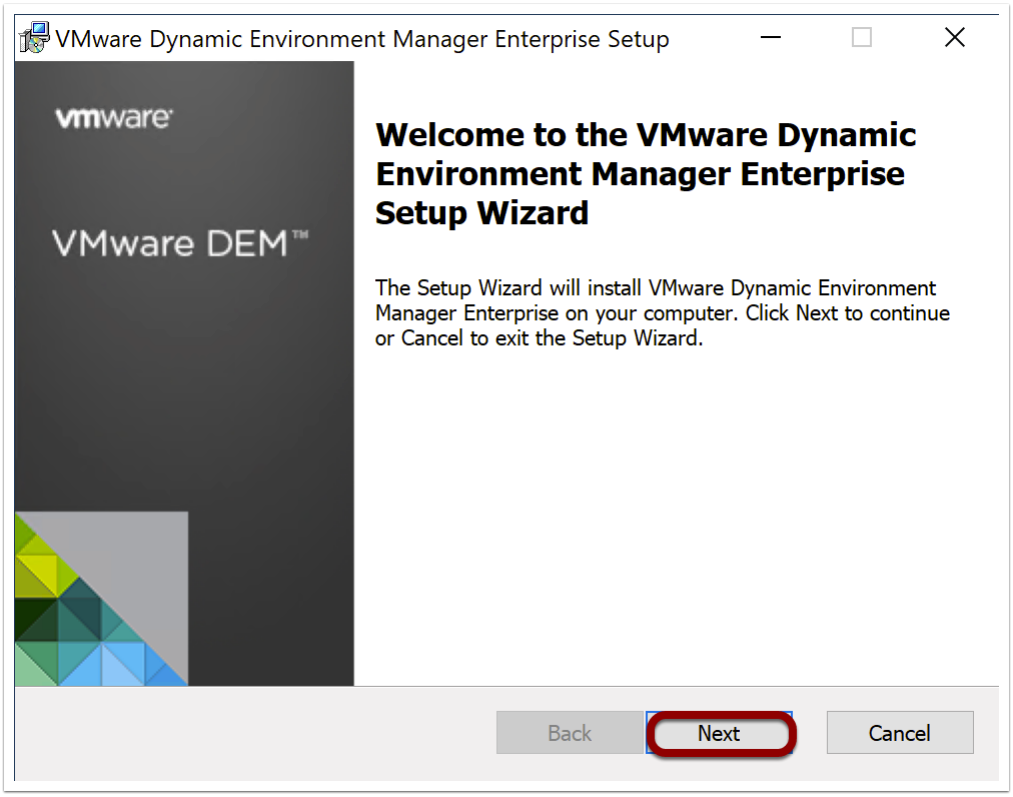
Prerequisites for FlexEngine Installation

To perform this exercise, you need the following:

- **User account** – When you log in to the OS to run the installer, the account you use must have administrative privileges.
- **Installer** – If necessary, you can download the installer from the VMware Downloads page. The installer is included in a ZIP file. You must download the file, extract the Dynamic Environment Manager MSI file, and copy it to the system where it will run or to a location accessible to the system.
- **Internet access** – The installation process includes a certificate revocation check to verify the digital signature of the MSI file. This check requires Internet access.

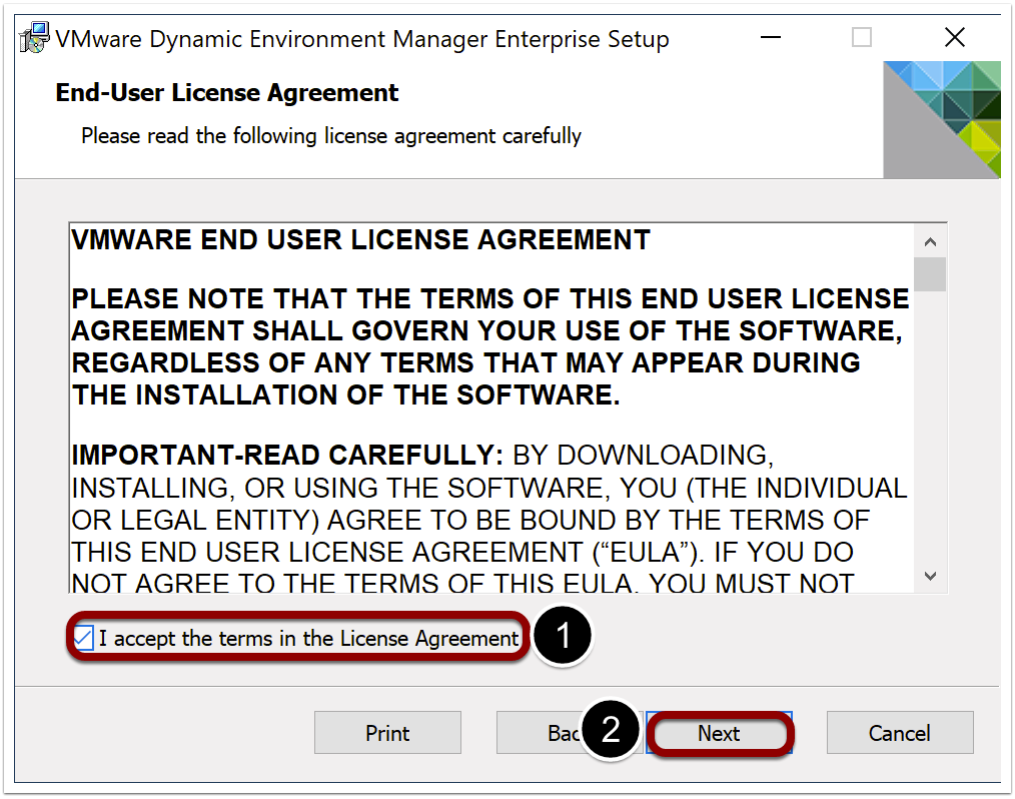
Note: When you install the Dynamic Environment Manager Agent on a VM where Horizon Agent is already installed, you are not required to specify a Dynamic Environment Manager license file. However, you are required to have purchased Dynamic Environment Manager. Dynamic Environment Manager Enterprise is included with Horizon Enterprise, and Dynamic Environment Manager Standard is included with Horizon Standard.

1. Start the Installer



Log in to the OS of the VM as an Administrator, double-click the installer file to start the wizard, and click **Next** on the Welcome page.

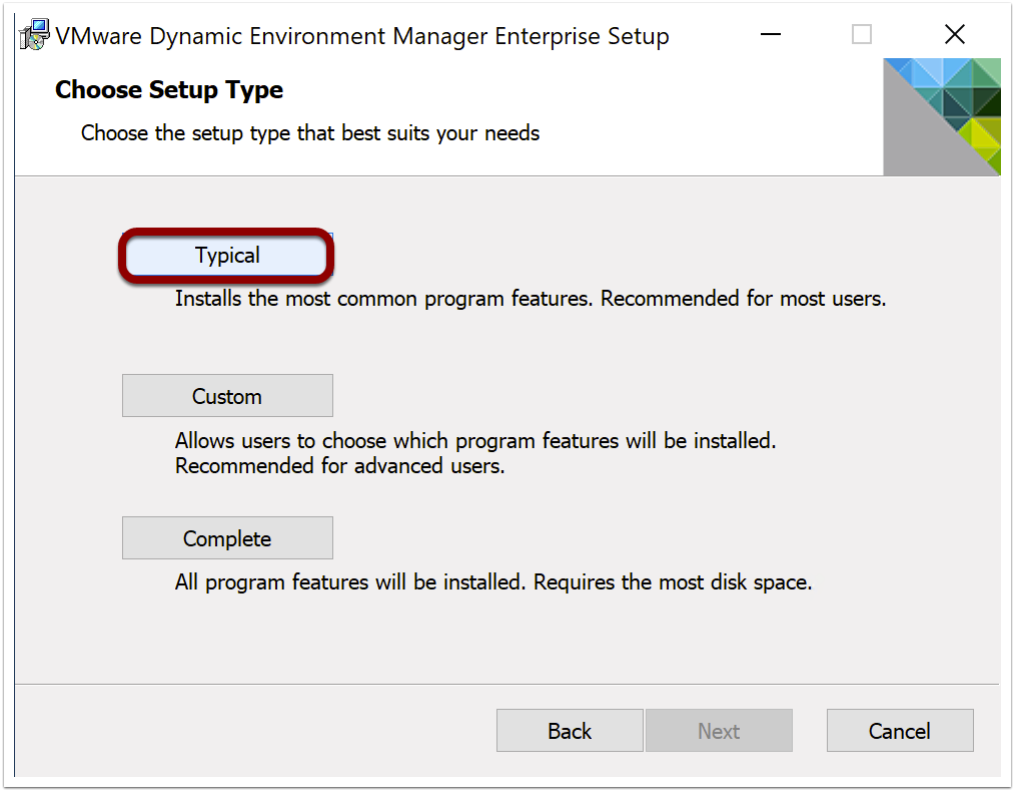
2. Accept the License Agreement



1. Select **I accept the terms in the License Agreement**.

2. Click **Next**.

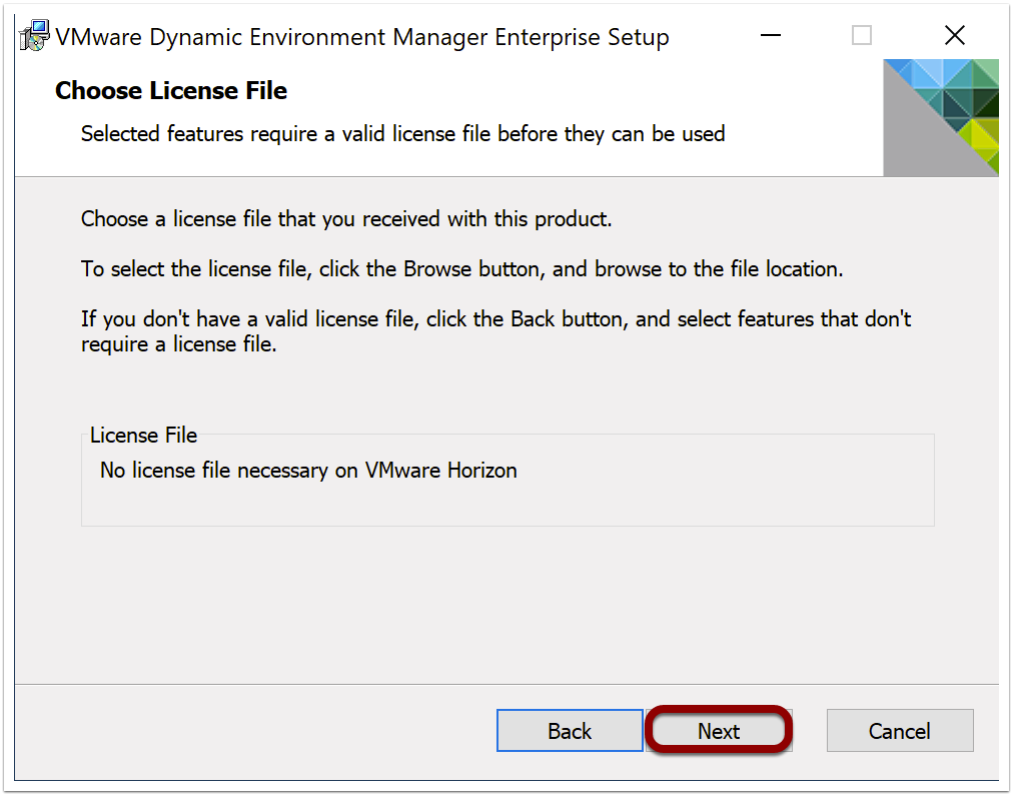
3. Choose the Typical Setup Type



Click **Typical**.

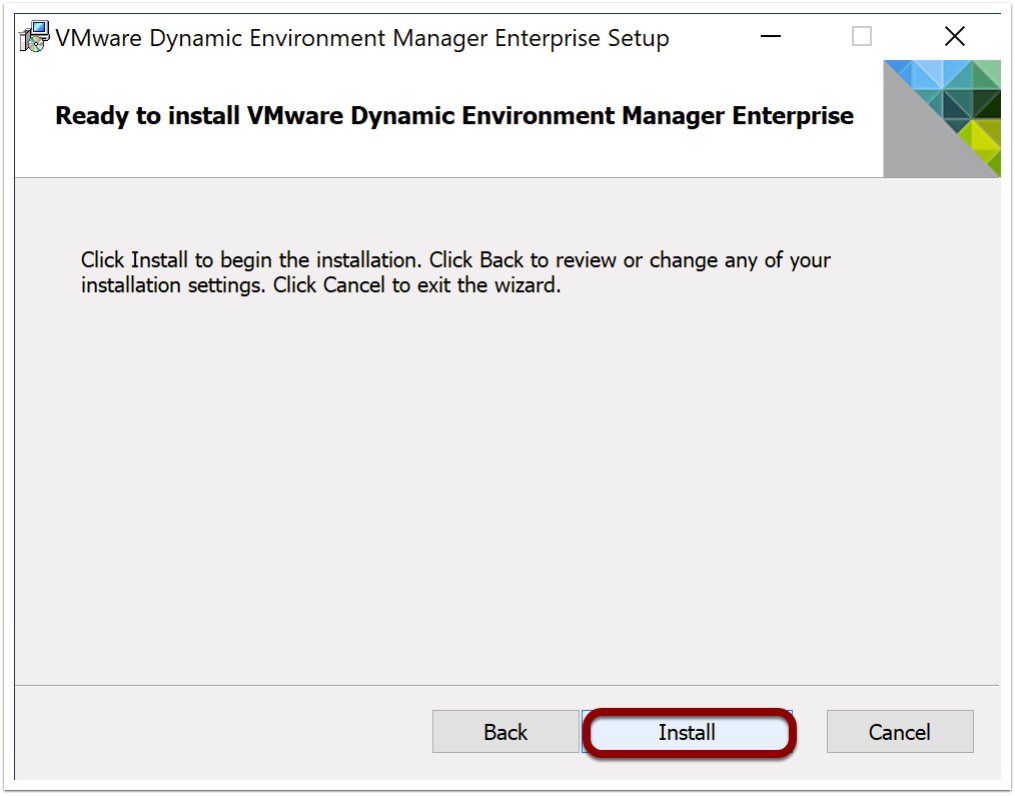
The typical setup installs the **VMware DEM FlexEngine** agent component, along with the optional components: Application Migration and Self-Support.

4. Click Next on the License File Page



Click **Next**.

5. Begin Installation



Click **Install**.

Install Applications in the Base Image

Although our primary application-delivery mechanism is App Volumes, it might be desirable to install select applications in the primary VM so that all clones get those applications in their base disk.

Many applications have integrated auto-update functionality. Install these applications and update them to the latest version, and then turn off or disable the auto-update functionality to prevent the clones from updating individually.

After you install any applications and drivers that you want to have in the base image, proceed to Running the OS Optimization Tool to Optimize, Generalize, and Finalize the OS.

Creating a VM in Horizon Cloud and Installing Agents

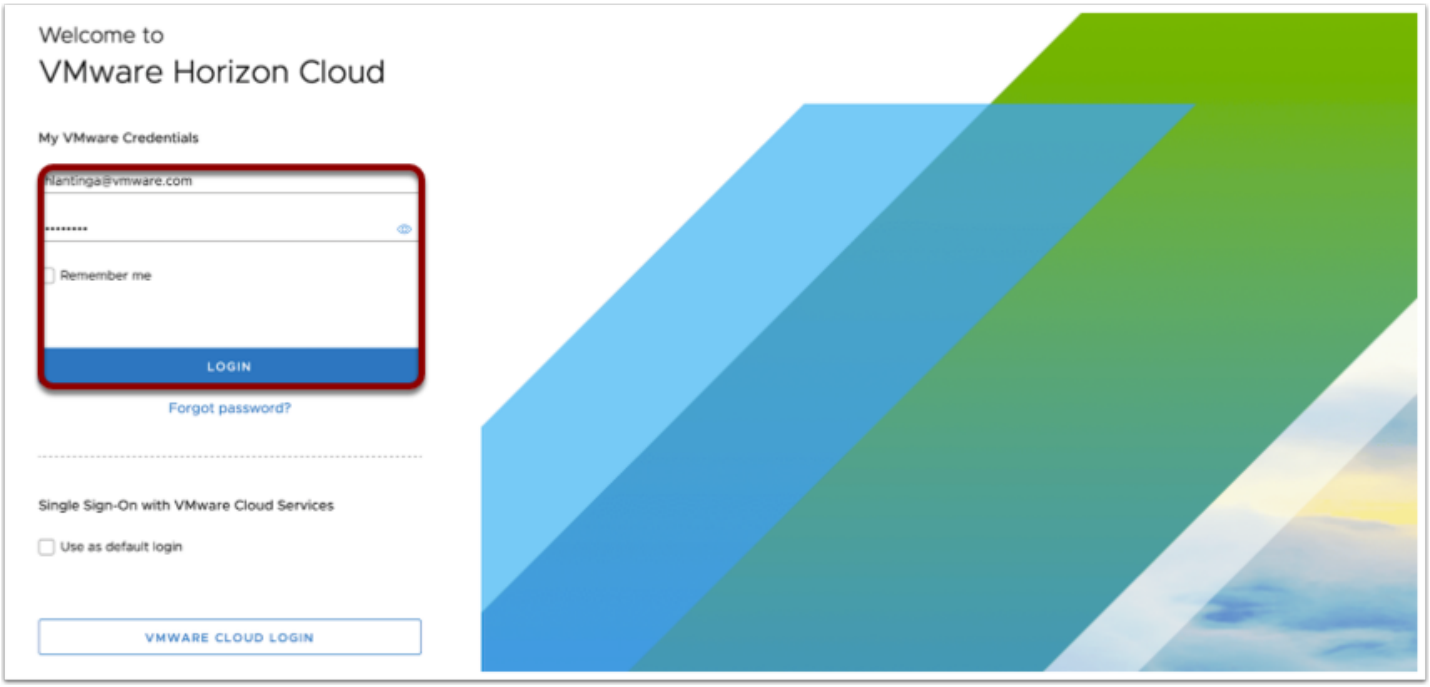
Import a VM in Horizon Cloud on Microsoft Azure

Introduction

Horizon Cloud delivers feature-rich virtual desktops and applications using a purpose-built cloud platform that is scalable across multiple deployment options, including fully managed infrastructure from VMware and public cloud infrastructure from Microsoft Azure. The service supports a cloud-scale architecture that makes it easy to deliver virtualized Windows desktops and applications to any device, anytime. And, with a flexible subscription model, organizations can easily get up and running quickly.

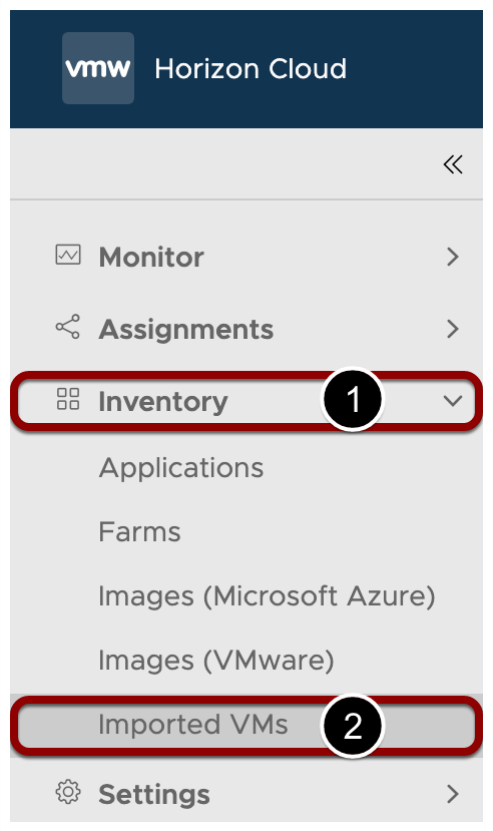
If you are using Horizon Cloud on Microsoft Azure rather than Horizon 8, instead of creating a VM (as described in Creating a vSphere-Based VM) and then manually running various agent installers on that VM (as described in Installing Virtual Desktop Agents and Applications in a vSphere-Based VM), you import the VM from the Azure Marketplace. When completing the import wizard, you select various check boxes in order to automatically install Horizon Agent and the App Volumes Agent. The Dynamic Environment Manager Agent and vRealize Operations Desktop Agent are not listed as the options but will also be installed. The following procedure describes the process.

1. Log In to the Horizon Universal Console



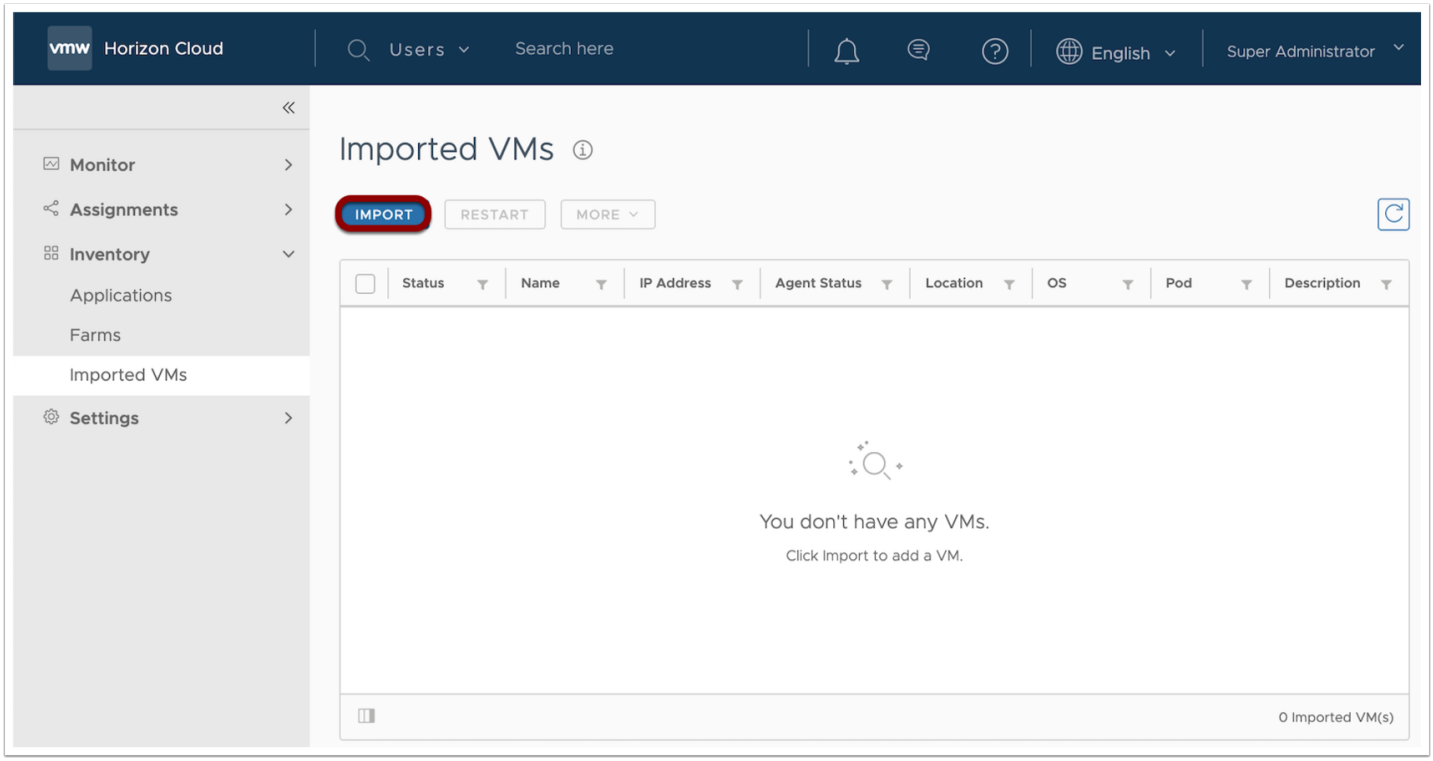
Go to the Horizon Universal Console with the URL from the welcome email and log in with your My VMware credentials. When prompted, log in with your AD credentials.

2. Navigate to the Imported VMs Page



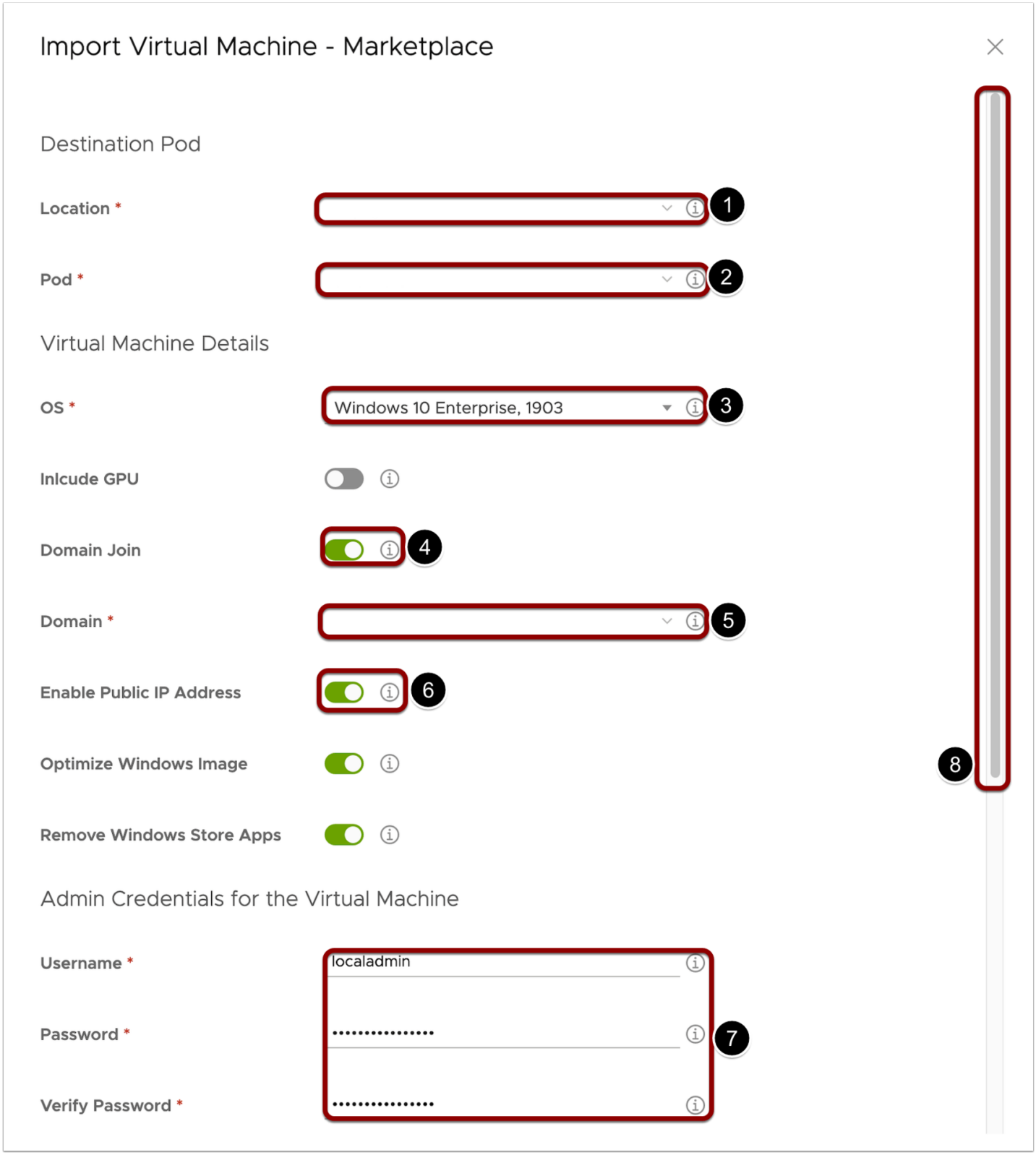
1. Click **Inventory**.
2. Click **Imported VMs**.

3. Start the VM Import Wizard



Click **IMPORT**.

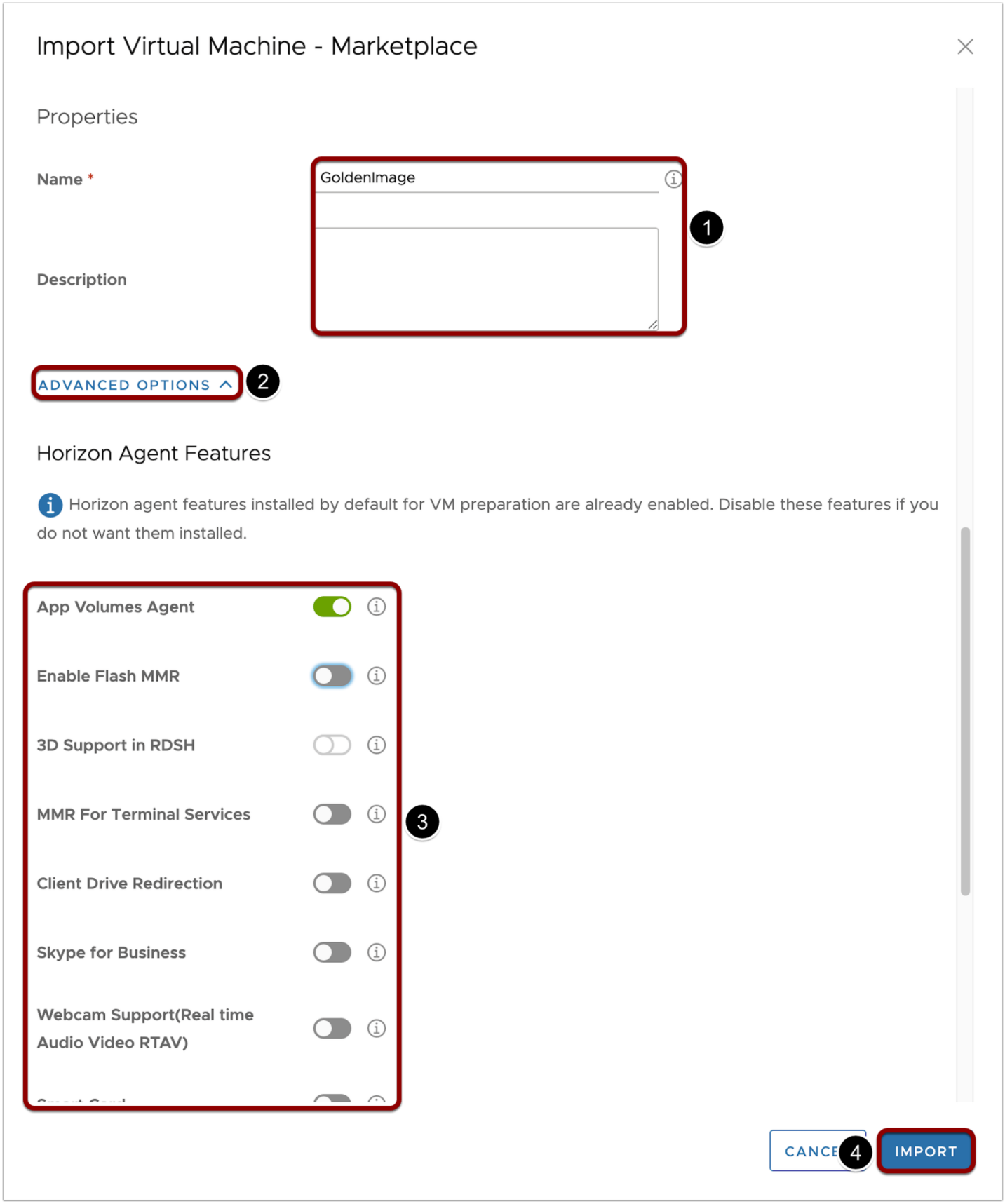
4. Specify the Destination, VM Details, and Admin Credentials



1. Select a **Location**.
2. Select a **Pod**.
3. Select an **OS**.
4. Enable **Domain Join**.
5. Select a **Domain**.
6. Enable **Public IP Address** when you do not have direct access to the VNET.
7. Provide a local administrator **Username** and **Password**.

8. Scroll down.

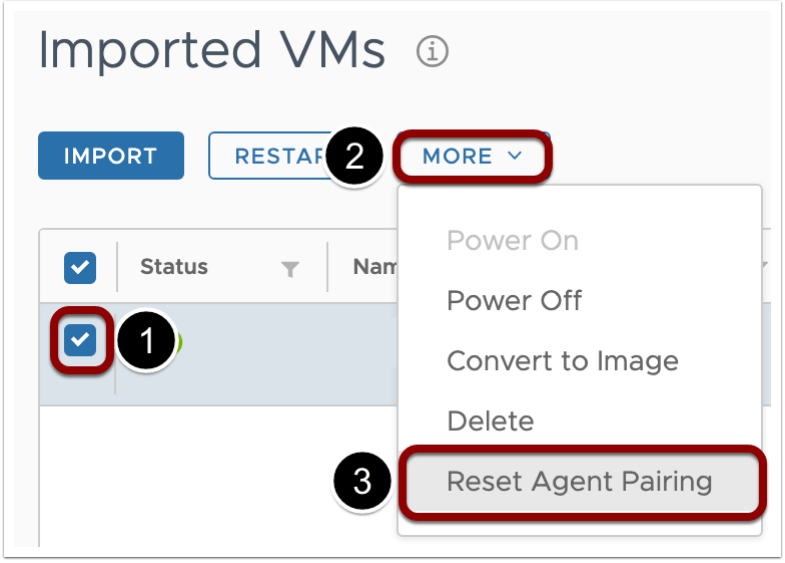
5. Specify the Machine Name and Select Horizon Agent Features



1. Provide a **Name** and optionally a **Description**.
2. Click **Advanced Options**.
3. Choose only the **Horizon Agent Features** that are required.

4. Click **IMPORT**.

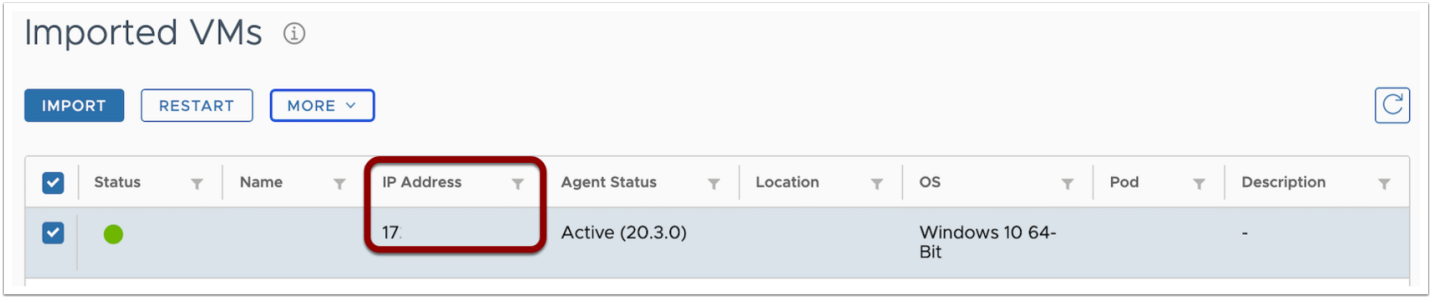
6. Select Reset Agent Pairing



After the import is finished:

1. Select the VM.
2. Click **MORE**.
3. Select **Reset Agent Pairing**.

7. Install Applications



RDP to the machine using the IP address listed and install any applications and drivers that you want to have in the base image. Next, proceed to Running the OS Optimization Tool to Optimize, Generalize, and Finalize the OS.

Running the OS Optimization Tool to Optimize, Generalize, and Finalize the OS

Introduction to OSOT

The VMware OS Optimization Tool (OSOT) fling helps optimize Windows 7/8/10 and Windows Server 2008 R2/2012/2016/2019 systems for use as VDI or RDSH server VMs. OSOT includes customizable templates to enable or disable Windows system services and features, according to VMware recommendations and best practices, across multiple systems. Because most Windows system services are enabled by default, OSOT can be used to easily disable unnecessary services and features to improve performance.

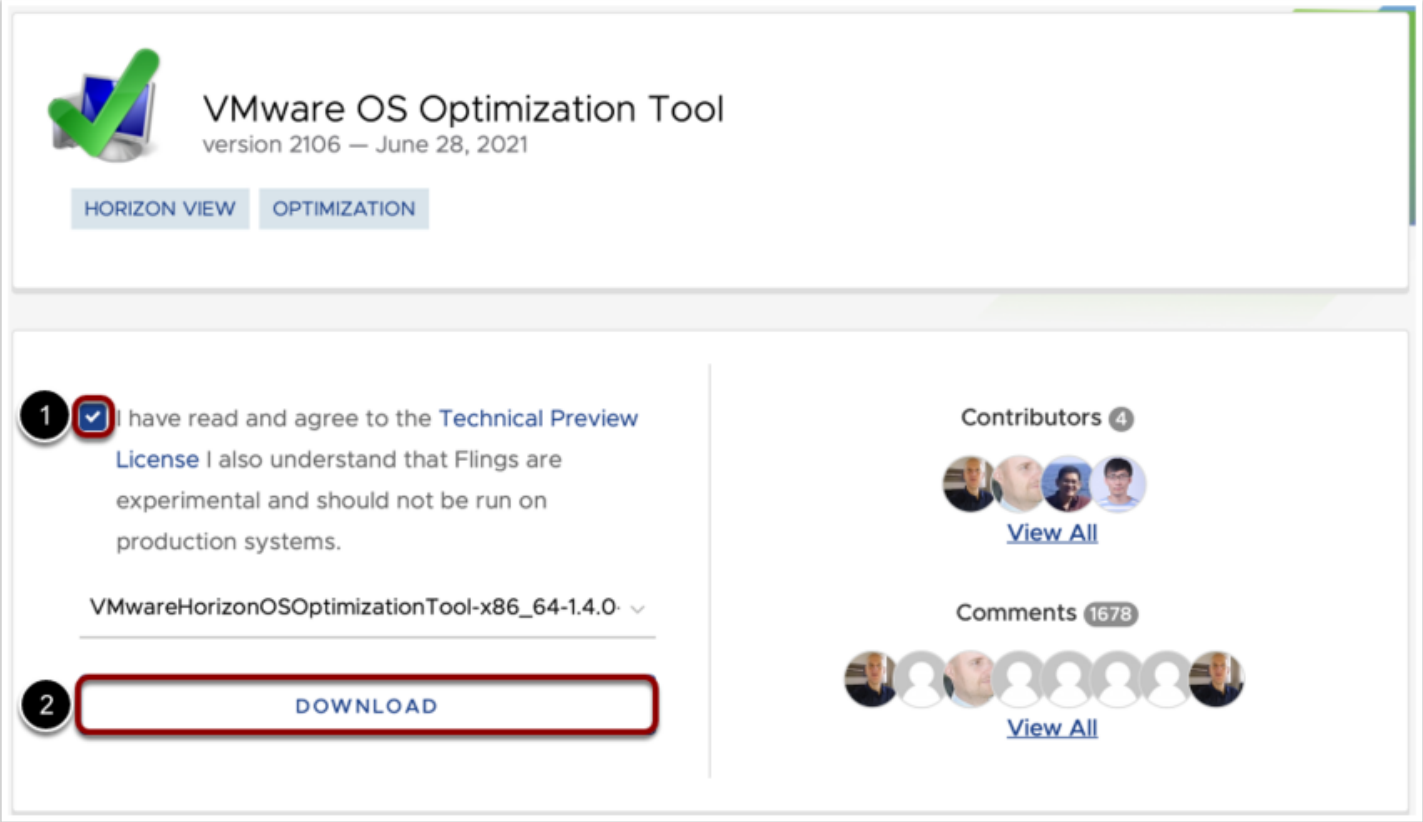
OSOT also includes the ability to run commonly used Windows tools for image creation and optimization, including the Native Image Generator (`Ngen.exe`), NTFS Compression (`compact.exe`), and Deployment Image Servicing Management (`DISM.exe`). These tools can now be run from the new **Finalize** tab of OSOT.

Note: This version of this document does not include instructions for using Windows mandatory profiles. we found that this feature does not work reliably when used with Windows 10 version 1809 and later. We decided that, for consistency's sake, we would remove the recommendation for all versions. We found that login times are nearly equivalent if you use default user profiles instead of mandatory user profiles.

Analyze and Optimize the OS Using Customizable Templates

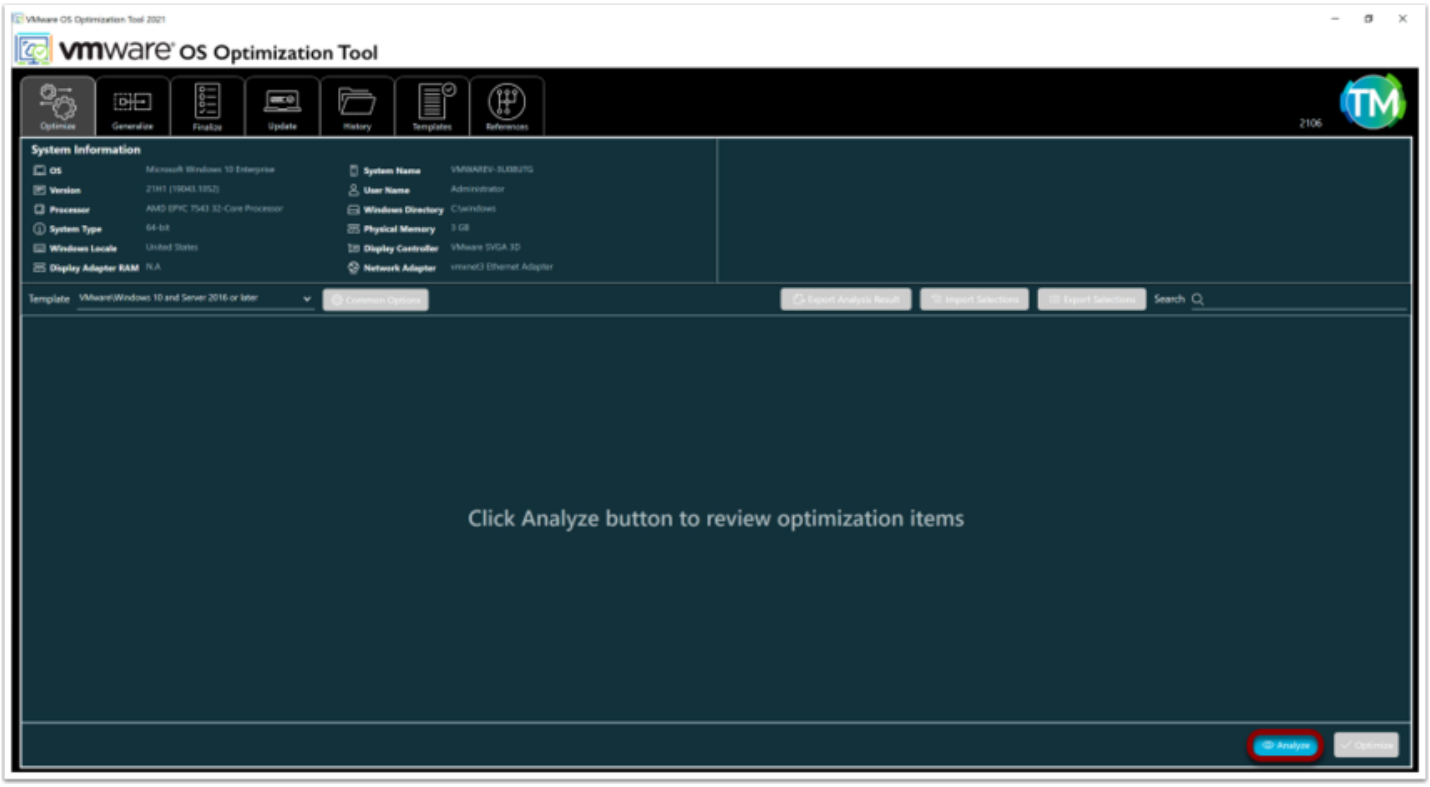
In this procedure, you download the OSOT, check for template updates, analyze the list of recommended optimizations, and select and apply those optimizations.

1. Download the OS Optimization Tool



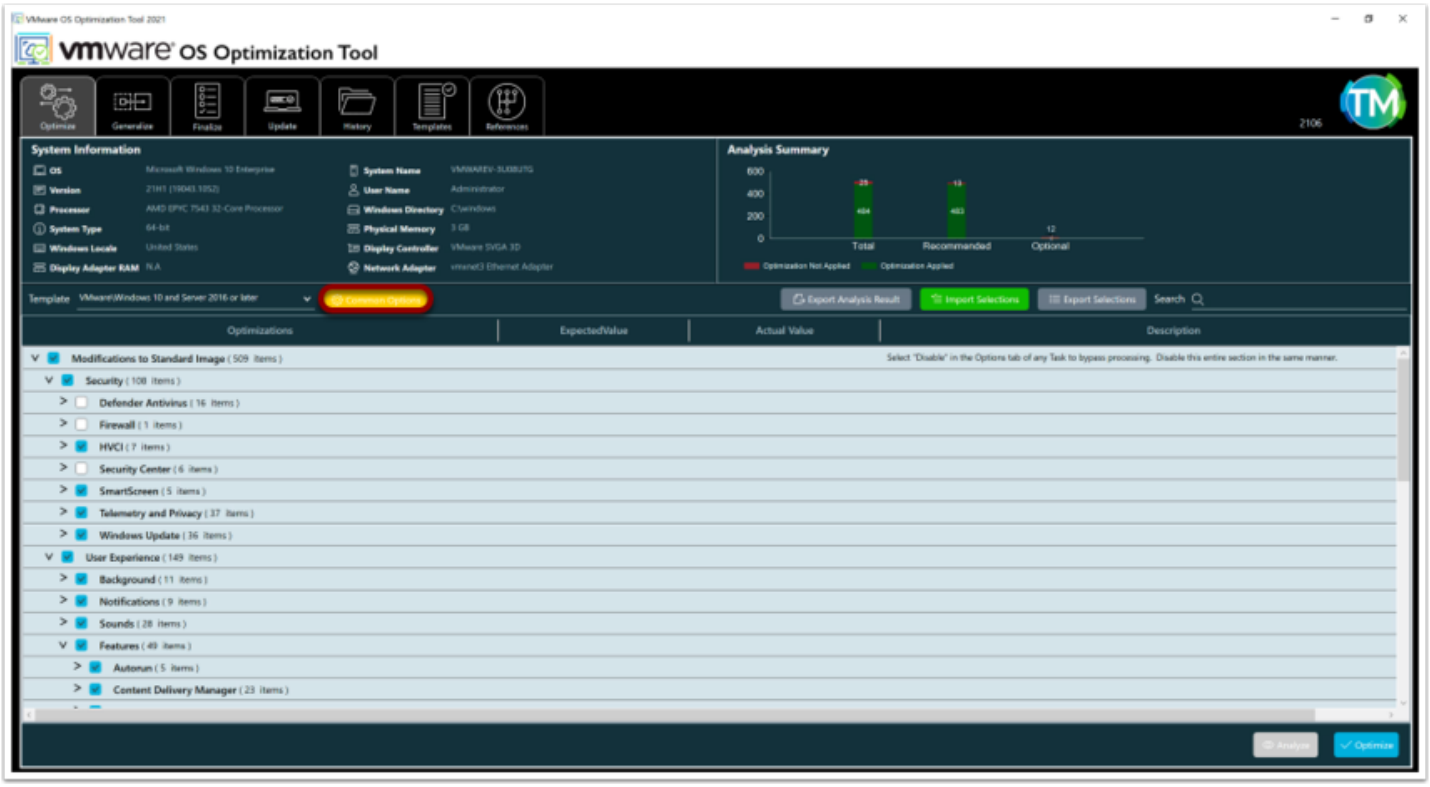
1. Select **I have read and agree to the Technical Preview License** on the VMware OS Optimization Tool Flings page.
2. Click **DOWNLOAD**.
3. Extract the files to a non-profile location (for example `c:\OSOT`), and start the executable (`VMwareOSOptimizationTool.exe`).

2. Analyze Recommended System Optimizations to Apply



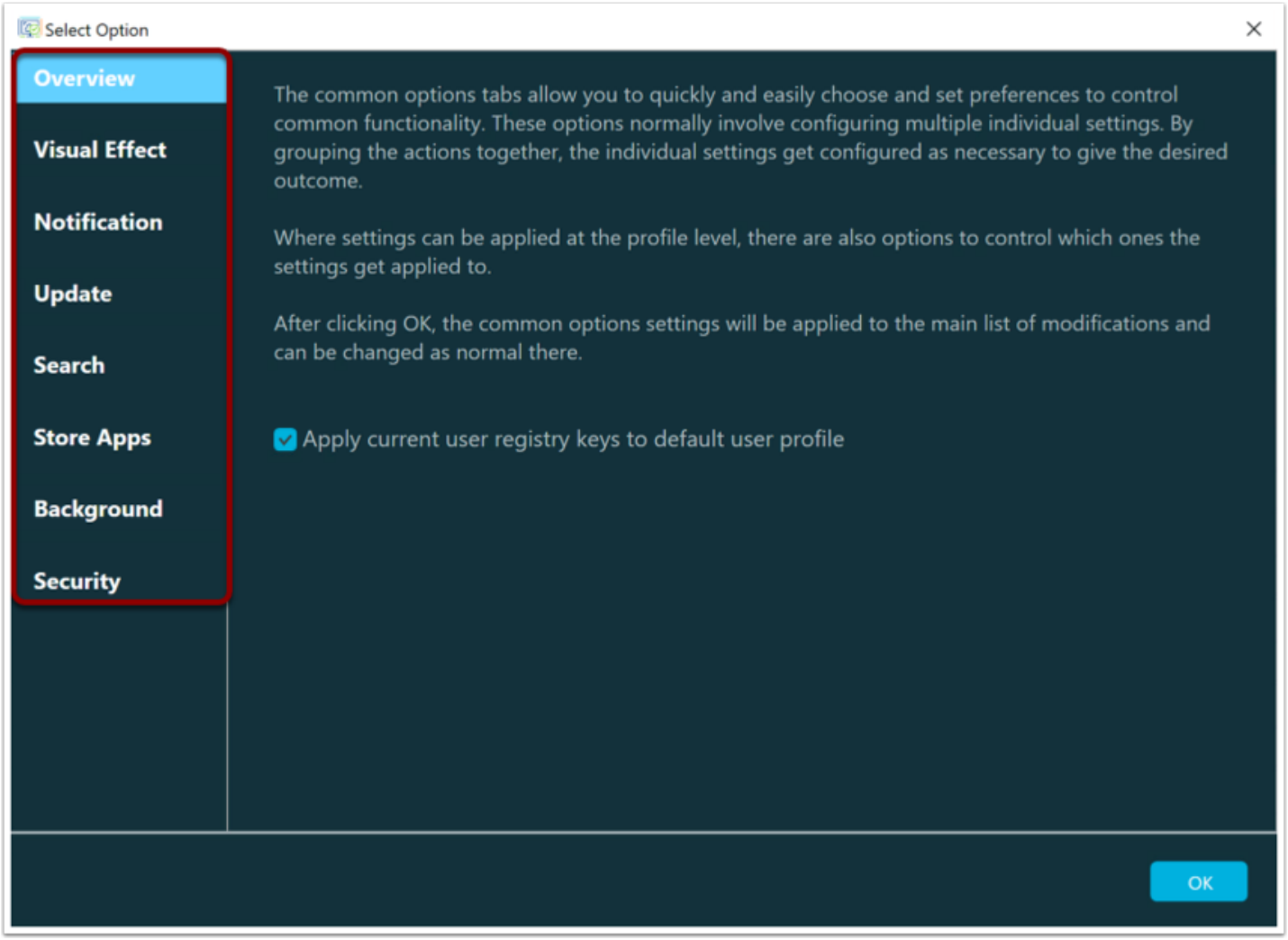
Click **Analyze**.

3. Select Common Options



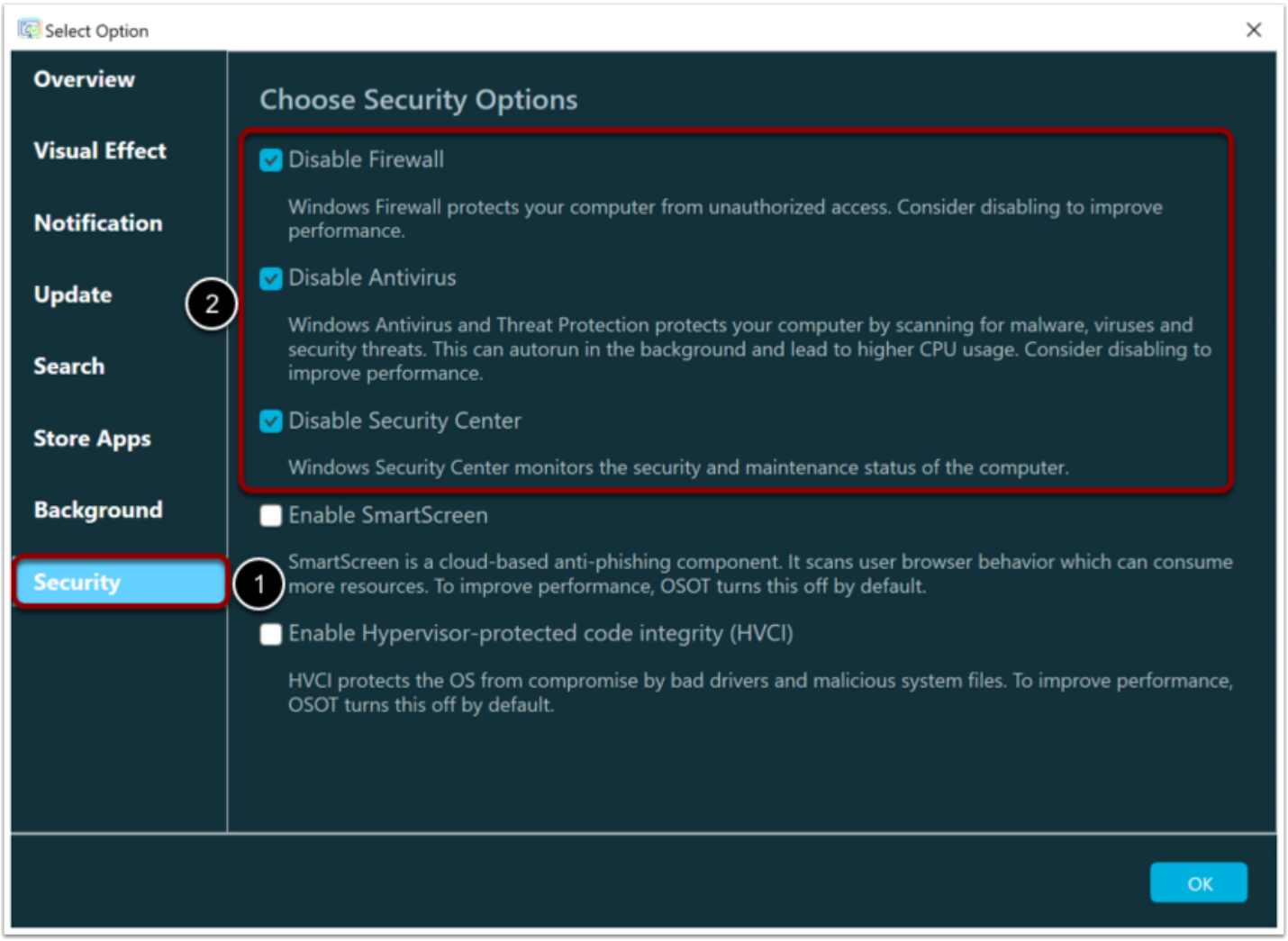
Click the **Common Options** button.

4. Review the Tabs to Determine Which Options to Set



Here you can select alternate defaults that will change the selection of optimizations. As an example for a persistent VM, you probably want to make changes to Windows **Update**, **Search**, and **Security**, or you might want to keep certain **Store Apps**.

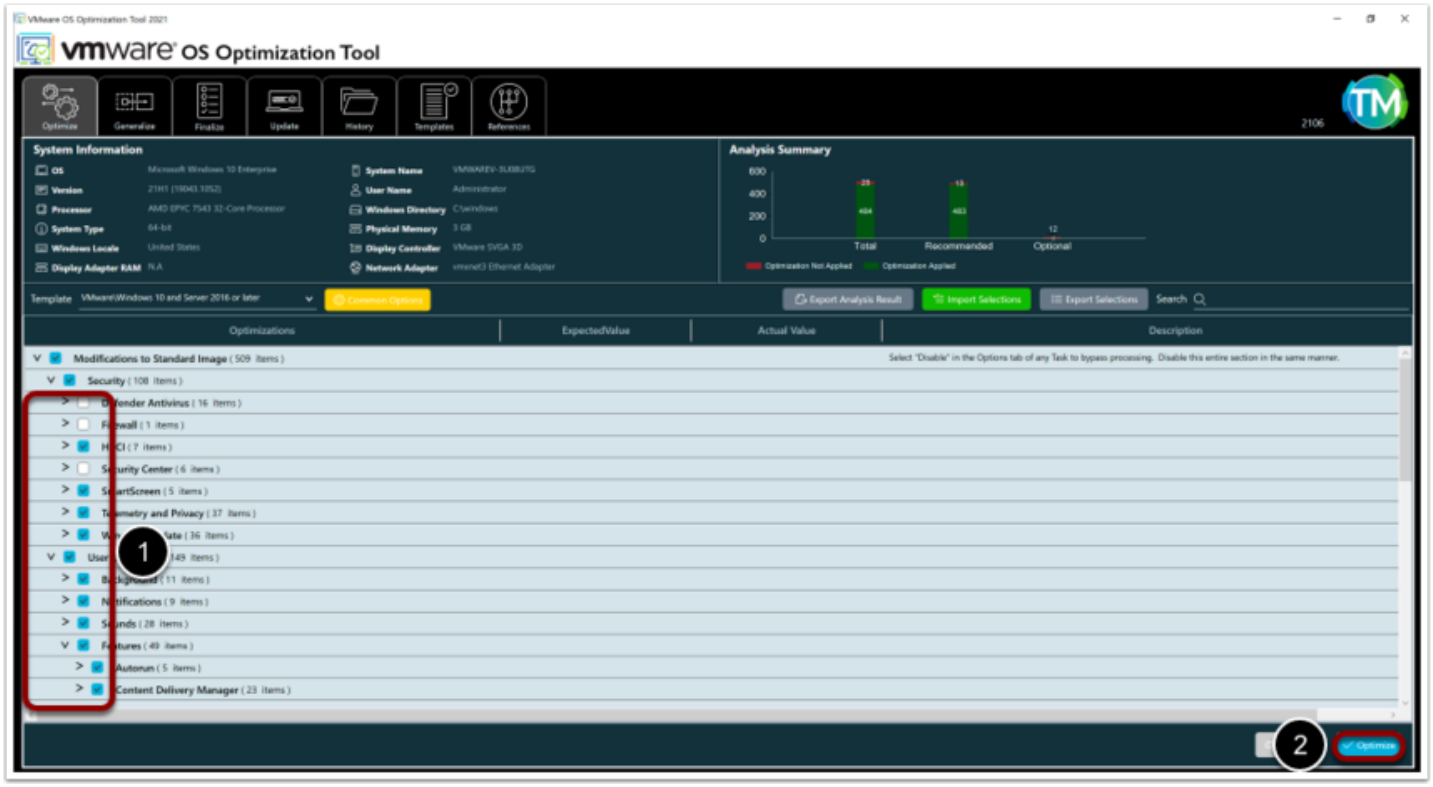
5. (Optional) Revert to Security Defaults Used in Older Versions of OSOT



Note: The default behavior of Windows Security Center, Antivirus, and Firewall have changed since OSOT 2106. If you prefer, you can revert to the old behavior in the Common Options:

1. Click **Security**.
2. Select **Disable Firewall**, **Disable Antivirus**, and **Disable Security Center**, and click **OK**.

6. Select the Optimizations to Apply



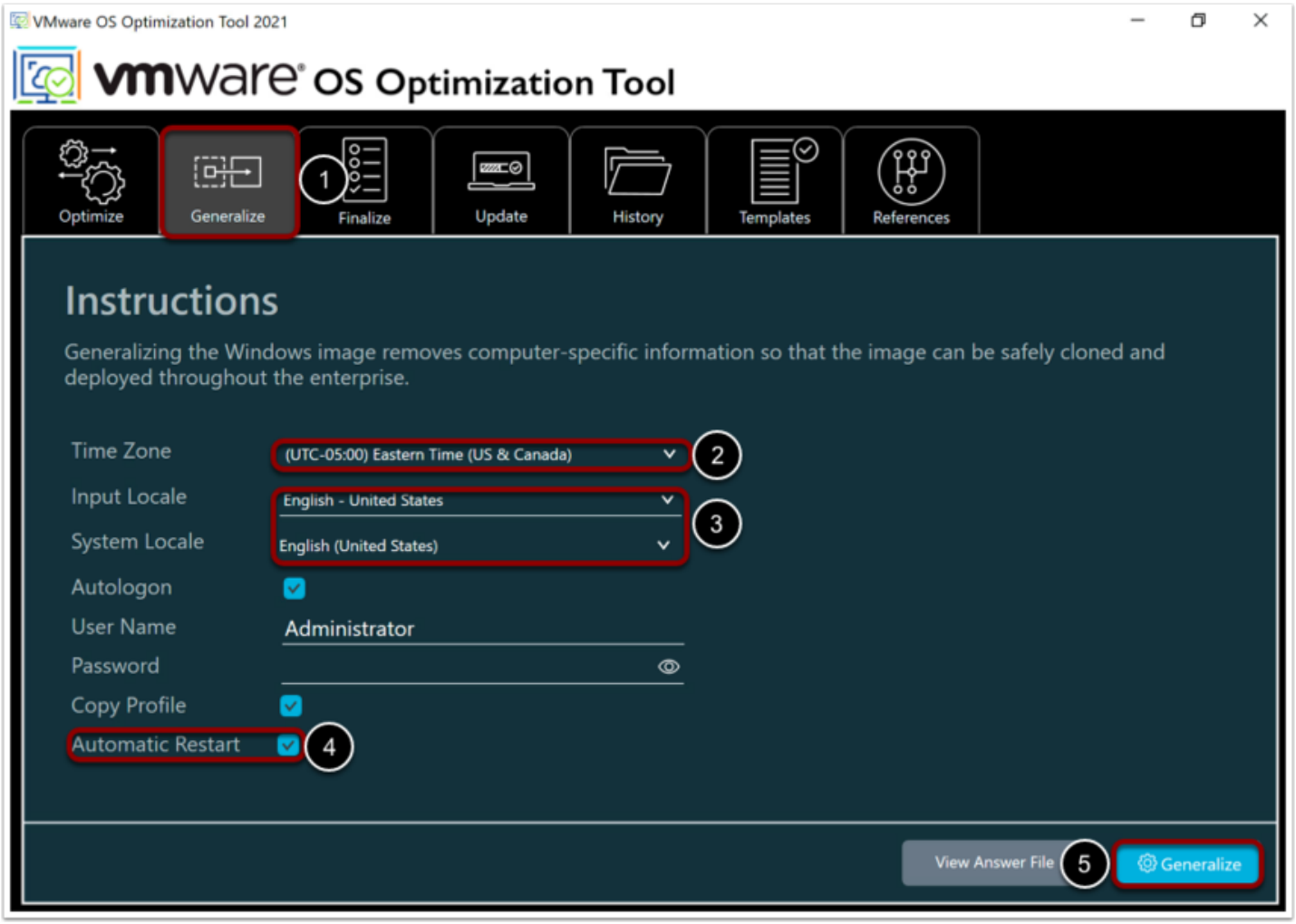
1. Select the appropriate optimizations from the extensive list. For most VDI environments, use the default selection.
2. Click **Optimize**.
3. Monitor the optimization results, until the process is complete:
    - If using Horizon Cloud on Microsoft Azure, reboot the VM, and you are ready to publish the image from within the Horizon Universal Console.
    - Otherwise, continue on to the next step and generalize the image.

Use the OSOT Generalize Tab to Run Sysprep

Generalizing a Windows image means removing computer-specific information so that the image can be deployed throughout an enterprise. Use the **Generalize** tab of the OSOT to run the system preparation tool (Sysprep) with a supplied and editable `unattend.xml` answer file.

Note: This procedure pertains to vSphere-based VMs. If you are using Horizon Cloud on Microsoft Azure, you will instead use the Horizon Universal Console to publish the image, which is when Sysprep is run on VMs in Horizon Cloud.

1. Set Generalize Options



1. Click **Generalize**.
2. Select the correct **Time Zone**.
3. Select the correct **Locale**.
4. Select **Automatic Restart**.
5. Click **Generalize**.

Use the OSOT Finalize Tab to Perform Final Cleanup Tasks

The OSOT can perform the following tasks, which you were previously required to do manually for VMs that you plan to use in a vSphere infrastructure:

- Clear KMS settings
- Release the IP address
- Delete unnecessary files
- Zero empty disk space

With the OSOT, you can also use the **Finalize** tab to run the following tools:

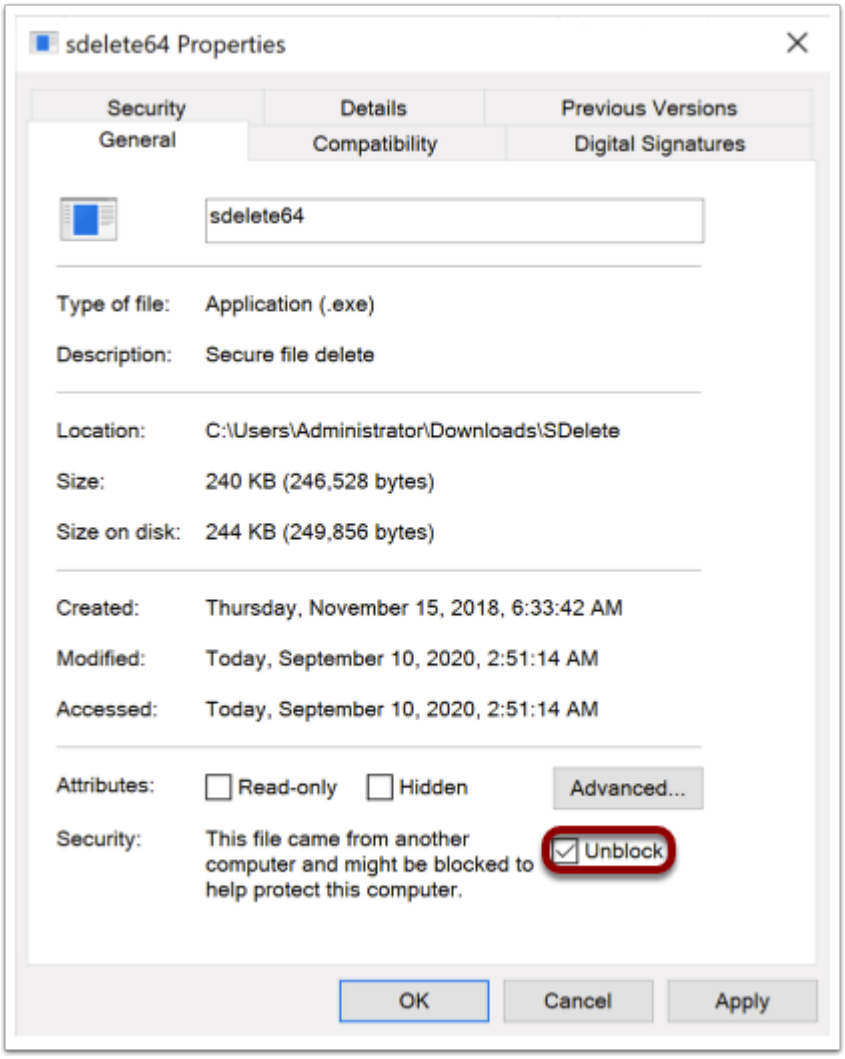
- **Native Image Generator** (`Ngen.exe`) – Improves the performance of managed applications.
- **NTFS Compression** (`compact.exe`) – Saves space on the Windows image by running the operating system and other system files from compressed files. This strategy reduces the number of IOPS required for storage with cache and has a negligible impact on the CPU.
- **Deployment Image Servicing Management** (`DISM.exe`) – Cleans unused files from the Side by Side component store.
- **Local Group Policy Object Utility** (`LGPO.exe`) – Manages local group policy.
- **Secure Delete** (`sdelete64.exe`) – Provides the ability to overwrite empty space with zeros.

Note: If you are using Horizon Cloud on Microsoft Azure, you can skip this procedure.

1. Download Third-Party Tools

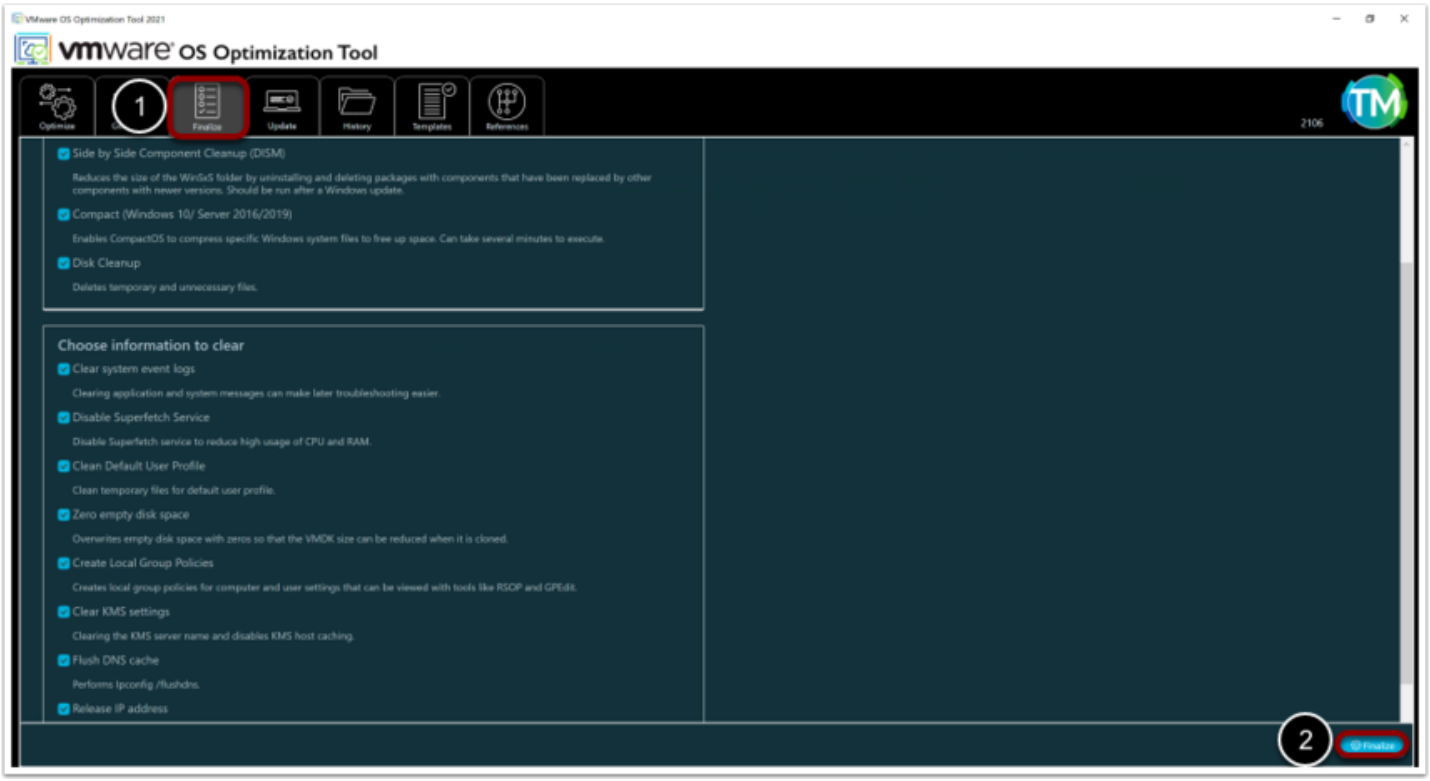
- **Local Group Policy Object Utility** can be downloaded as a zip file, as part of the Microsoft Security Compliance Toolkit, from https://www.microsoft.com/en-us/download/details.aspx?id=55319.
- **Secure Delete** can be downloaded by clicking https://download.sysinternals.com/files/SDelete.zip.

2. Unblock and Copy the Tools to the OSOT Folder



After downloading and extracting the executables, right-click each file (`sdelete64.exe` and `lgpo.exe`), select **Properties**, and in the Properties dialog box, select **Unblock** and click **OK**. Then move the executables to the same folder as the OS Optimization Tool and launch the OS Optimization Tool.

3. Execute Final Cleanup Tasks



1. In the OSOT, click the **Finalize** tab.
2. Click **Finalize**.
3. When all steps are completed, click **OK** .

Install the App Volumes Agent in vSphere-Based VMs

App Volumes delivers applications that are not in the golden VM image. Application containers, called AppStacks (in App Volumes 2.x) or application packages (in App Volumes 4), are assigned to a user, group, OU, or machine and mounted each time the user logs in to a desktop. With this strategy, user changes can persist between sessions.

App Volumes can also provide user-writable volumes, which allow users to install their own applications and have those applications follow the user as they connect to different virtual desktops.

Administrators install the App Volumes Agent on the golden VM image so that the App Volumes Manager can communicate with the cloned desktops that are deployed and attach the correct applications when a user logs in.

Notes: Installing the App Volumes Agent is an optional step for VMs that you plan to use in a vSphere infrastructure. Install this agent only if you plan to use this functionality.

This procedure describes running the App Volumes Agent installer in the guest operating system of a vSphere-based VM. If instead you are using Horizon Cloud on Microsoft Azure, installing the agent is an option you can select in the process of importing a VM from the Azure Marketplace, as described in the exercise Import a VM in Horizon Cloud on Microsoft Azure.

Prerequisites for Installing the App Volumes Agent

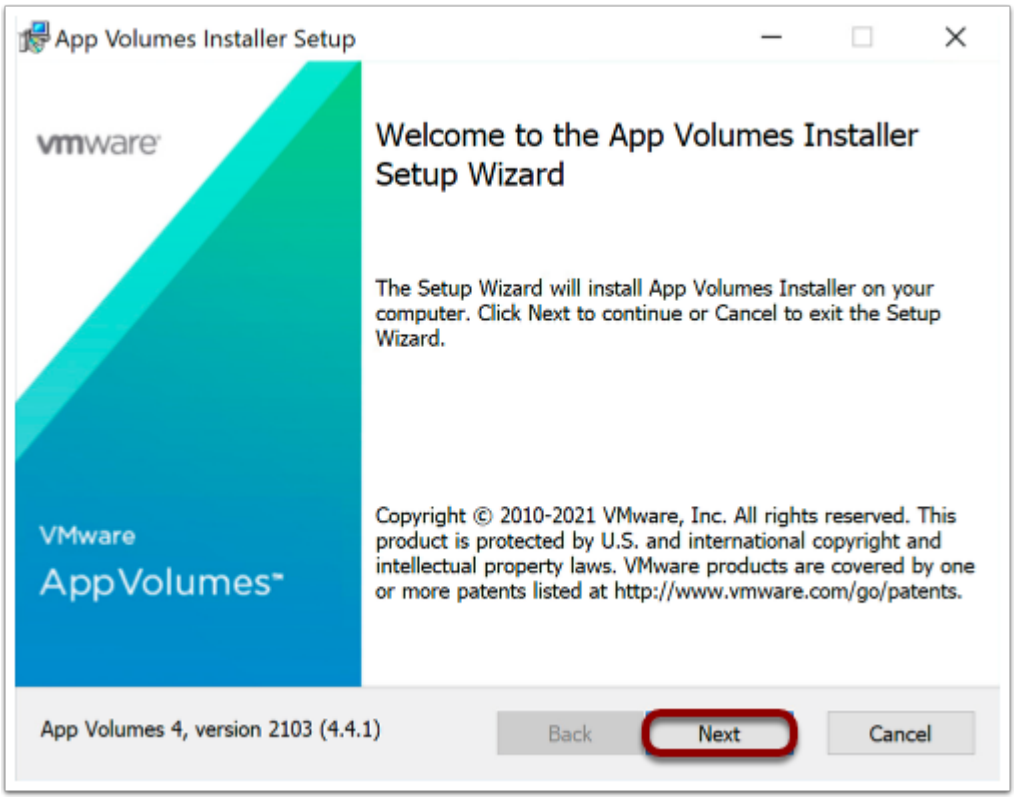
To perform this exercise, you need the following:

- **User account** – When you log in to the OS of the golden image to run the installer, the account you use must have local administrative privileges.
- **Installer** – App Volumes is included with Horizon Enterprise Edition, available from the Download VMware Horizon page. The App Volumes installer is distributed as an ISO file. You can mount the ISO on the machine where you want to create the App Volumes component, or you can also extract the ISO contents to a shared folder. This option allows you to install each component without mounting the ISO each time.
- **VM with a supported Windows OS** – The machine must be running a supported Windows version. For a list of the

systems we tested, see Tested Operating Systems. For a complete list of supported Windows 10 operating systems, see the VMware knowledge-base article Supported versions of Windows 10 on Horizon Agent Including All VDI Clones (Full Clones, Instant Clones, and Linked Clones on Horizon 7) (2149393).

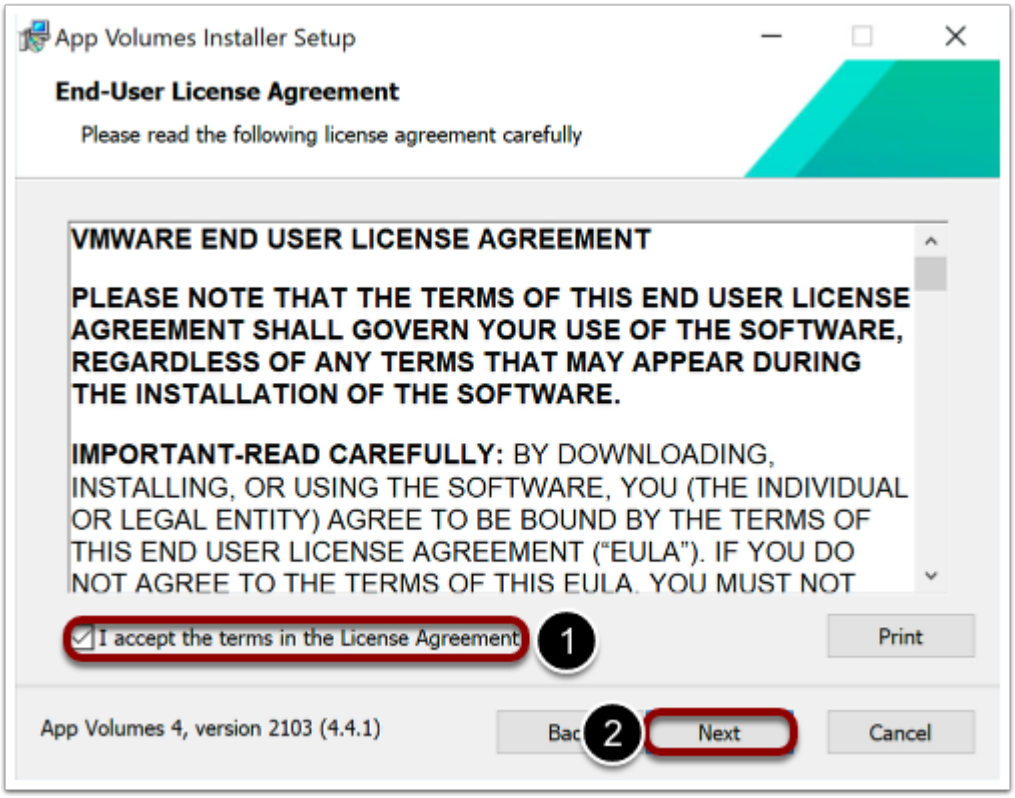
- **App Volumes Manager server information** – During agent installation, you will be prompted to enter the host name or IP address and port number of the App Volumes Manager that this agent will communicate with.

1. Run the Installer



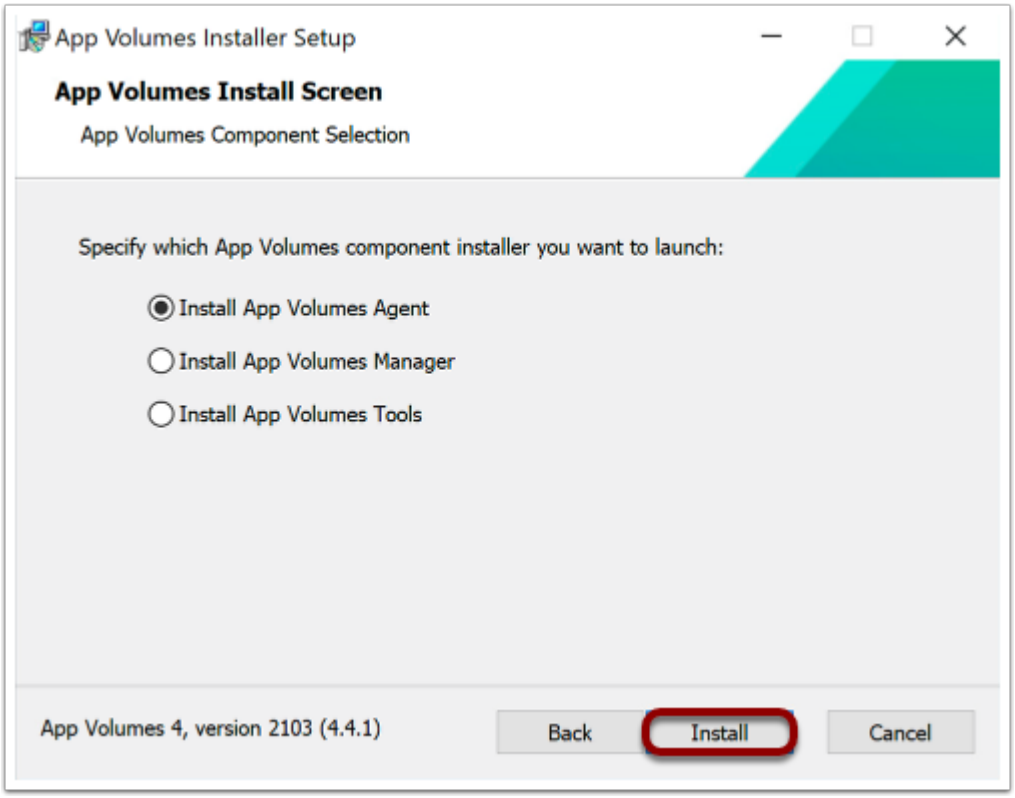
Double-click the App Volumes ISO file, start the `setup.msi` file in the installation folder, and click **Next** on the Welcome page.

2. Accept the License Agreement



1. Select the check box to accept the License Agreement.
2. Click **Next**.

3. Select the App Volumes Agent Component

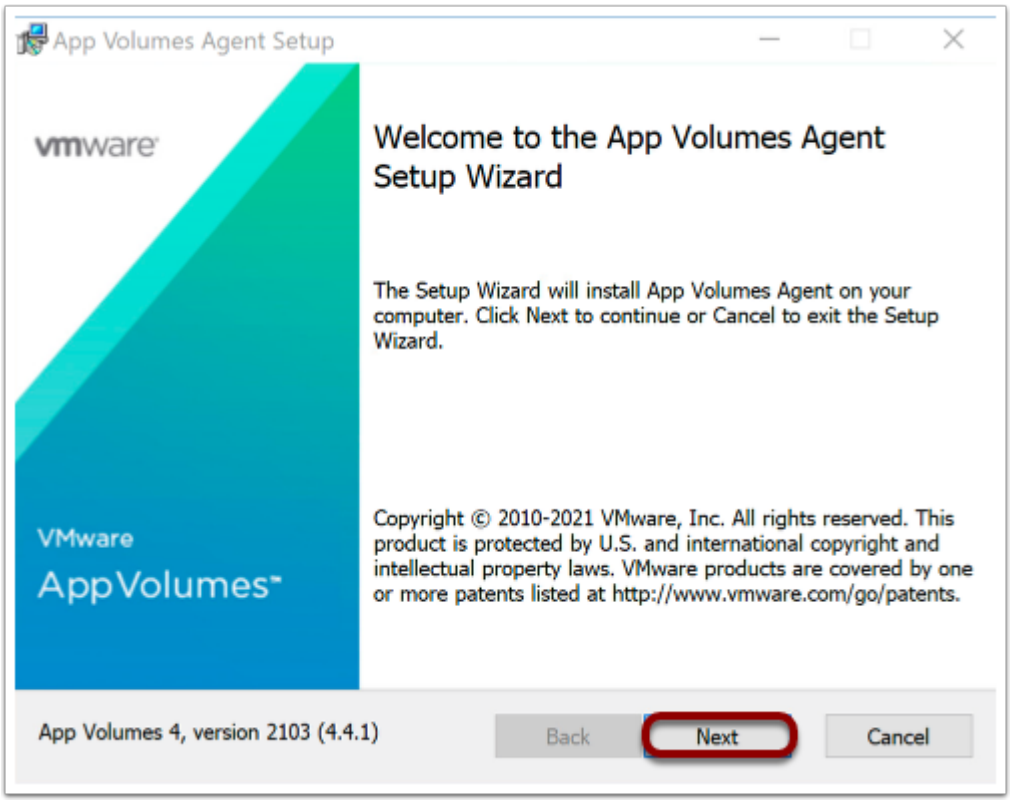


Click **Install**.

4. Allow the Windows Installer to Make Changes

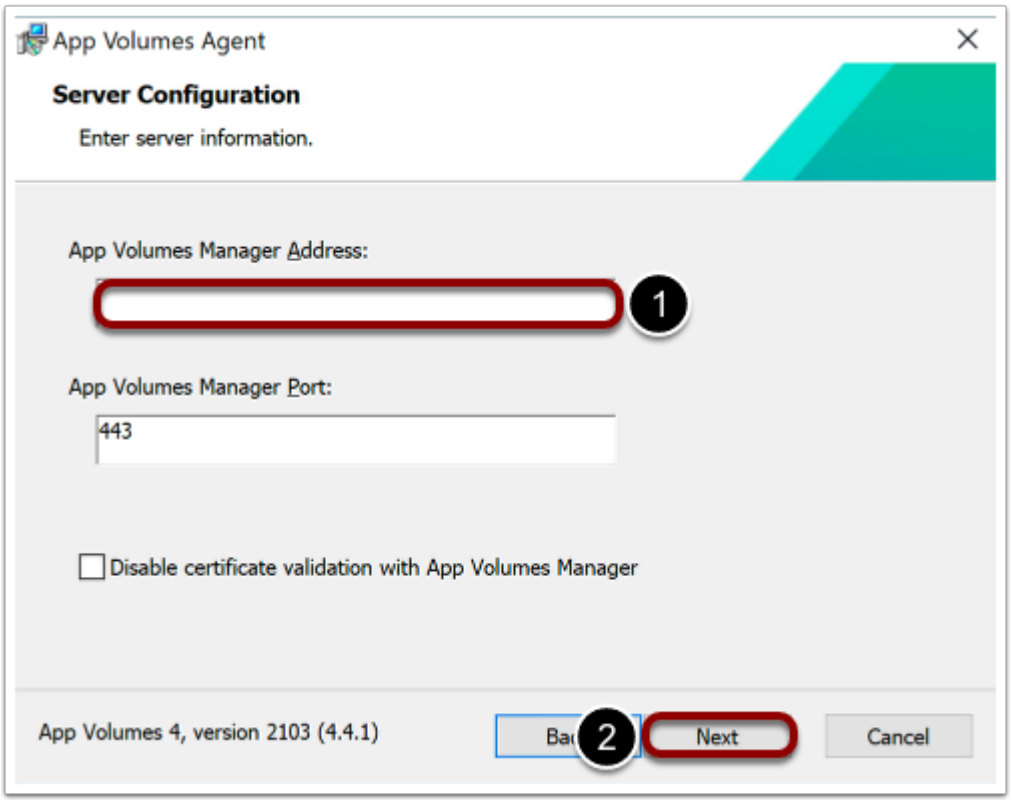
Click **Yes**.

5. Click Next on the Agent Setup Welcome Page



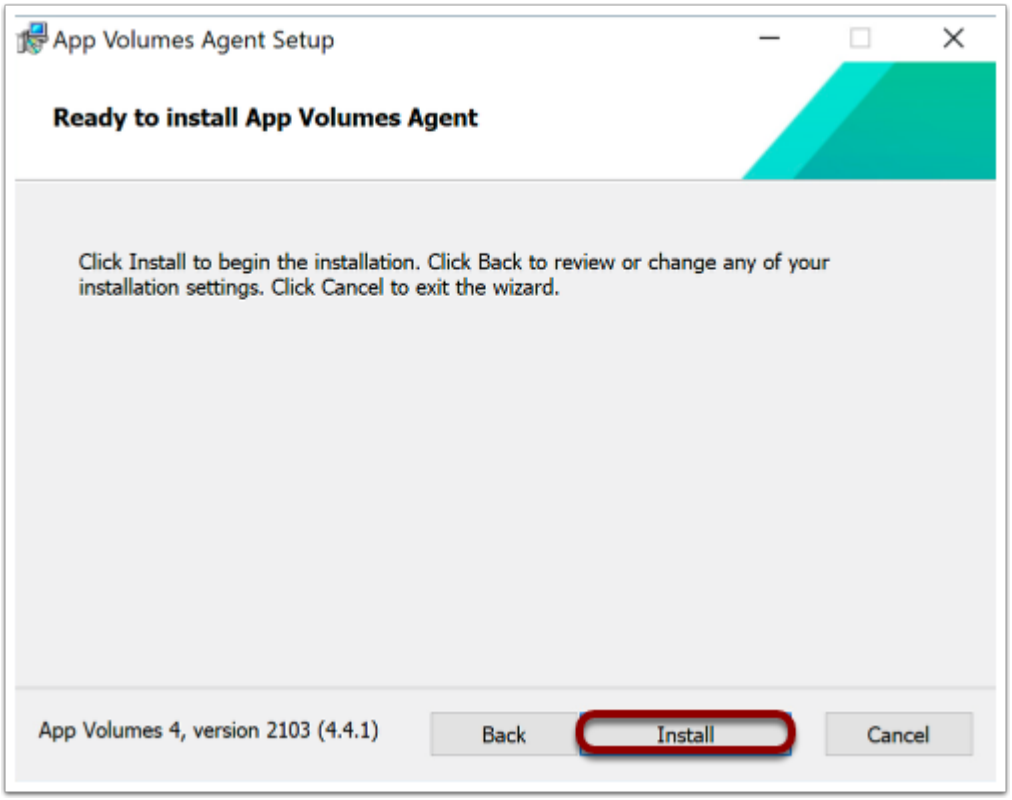
Click **Next**.

6. Supply App Volumes Manager Information



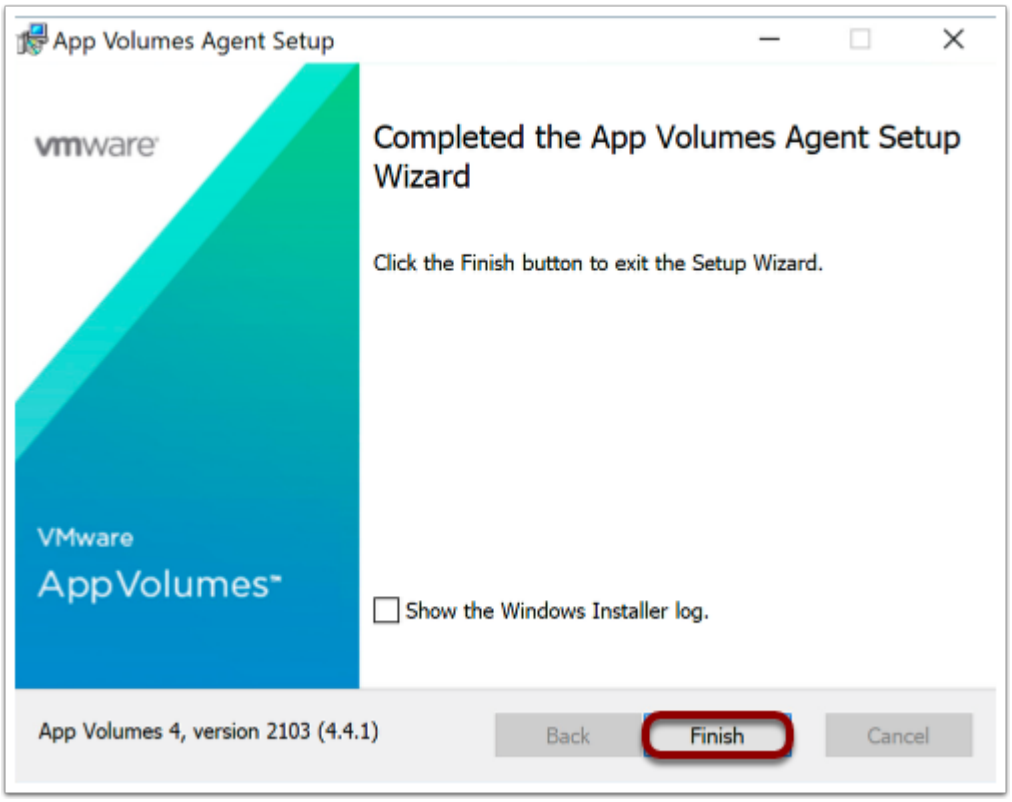
1. Provide the **App Volumes Manager Address** and ensure that **Disable certificate validation with App Volumes Manager** is not selected.
2. Click **Next**.

7. Begin Installation



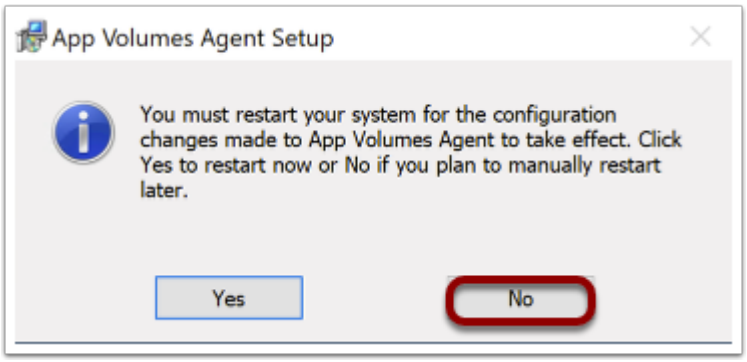
Click **Install**.

8. Exit the Wizard



Click **Finish**.

9. Do Not Restart the VM



Click **No**.

Use the Shutdown Command

Run the following command:

```
shutdown /s /t 0 /c "Image Ready"
```

`shutdown /s /t 0 /c "Image Ready"` shuts down the local computer, with 0 seconds between the time the command is given and the time the shutdown occurs, and leaves the comment "Image Ready."

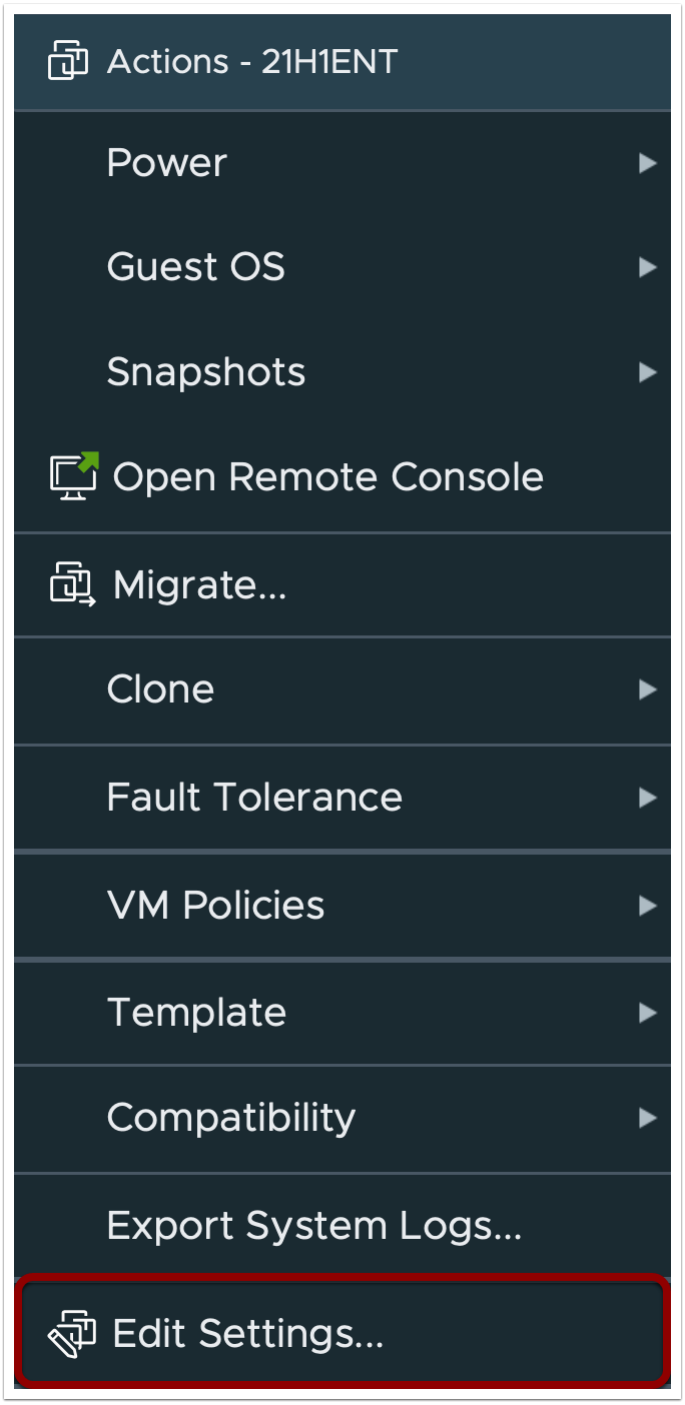
Optimizing the Virtual Machine Hardware

Remove Virtual Hardware Devices That You Do Not Plan to Use

Because we no longer need the virtual CD/DVD drives, we can remove those. Likewise, we can remove the SATA controller.

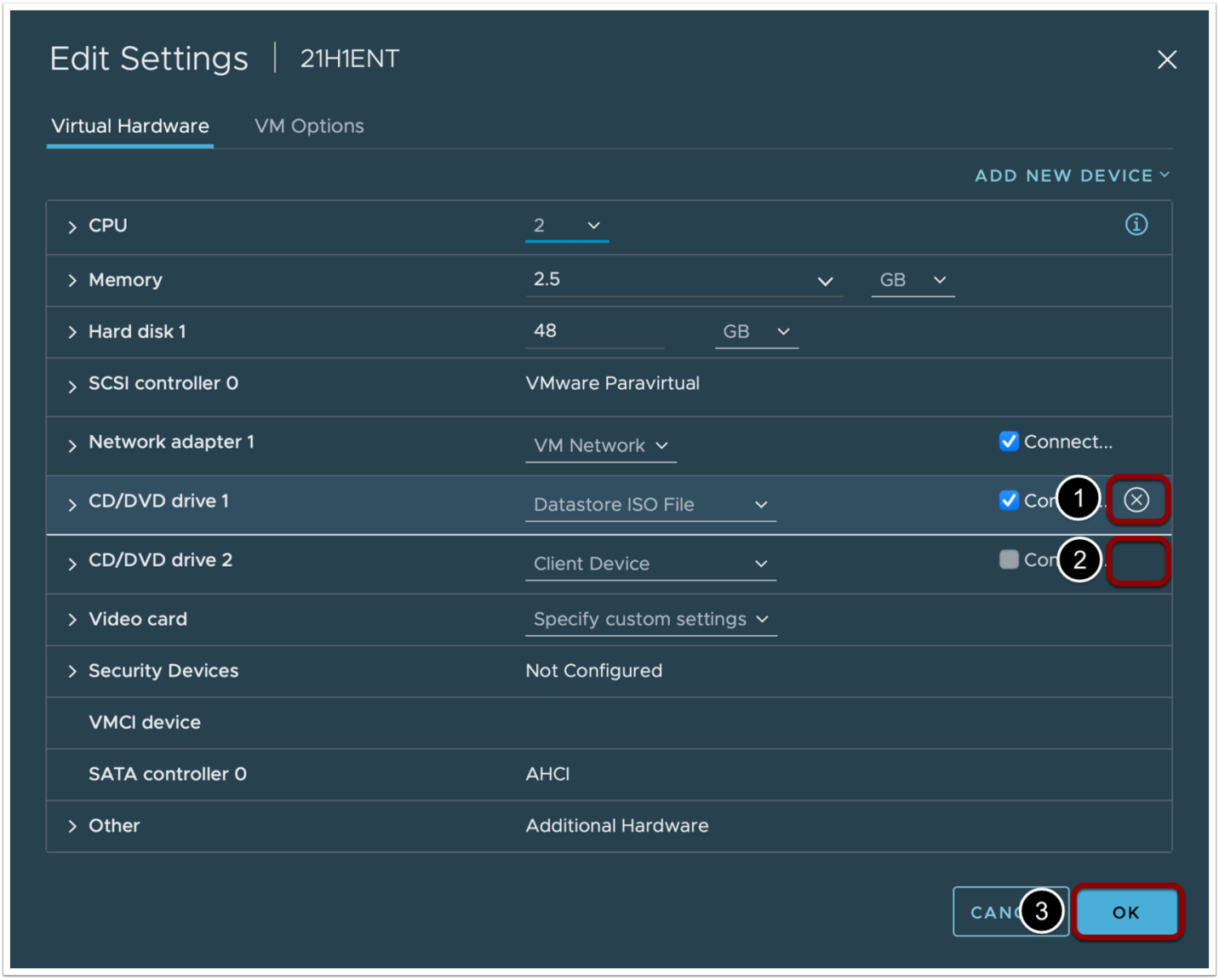
Note: If you are using Horizon Cloud on Microsoft Azure, you can skip this procedure.

1. Use vSphere Web Client to Open the Edit Settings Dialog Box



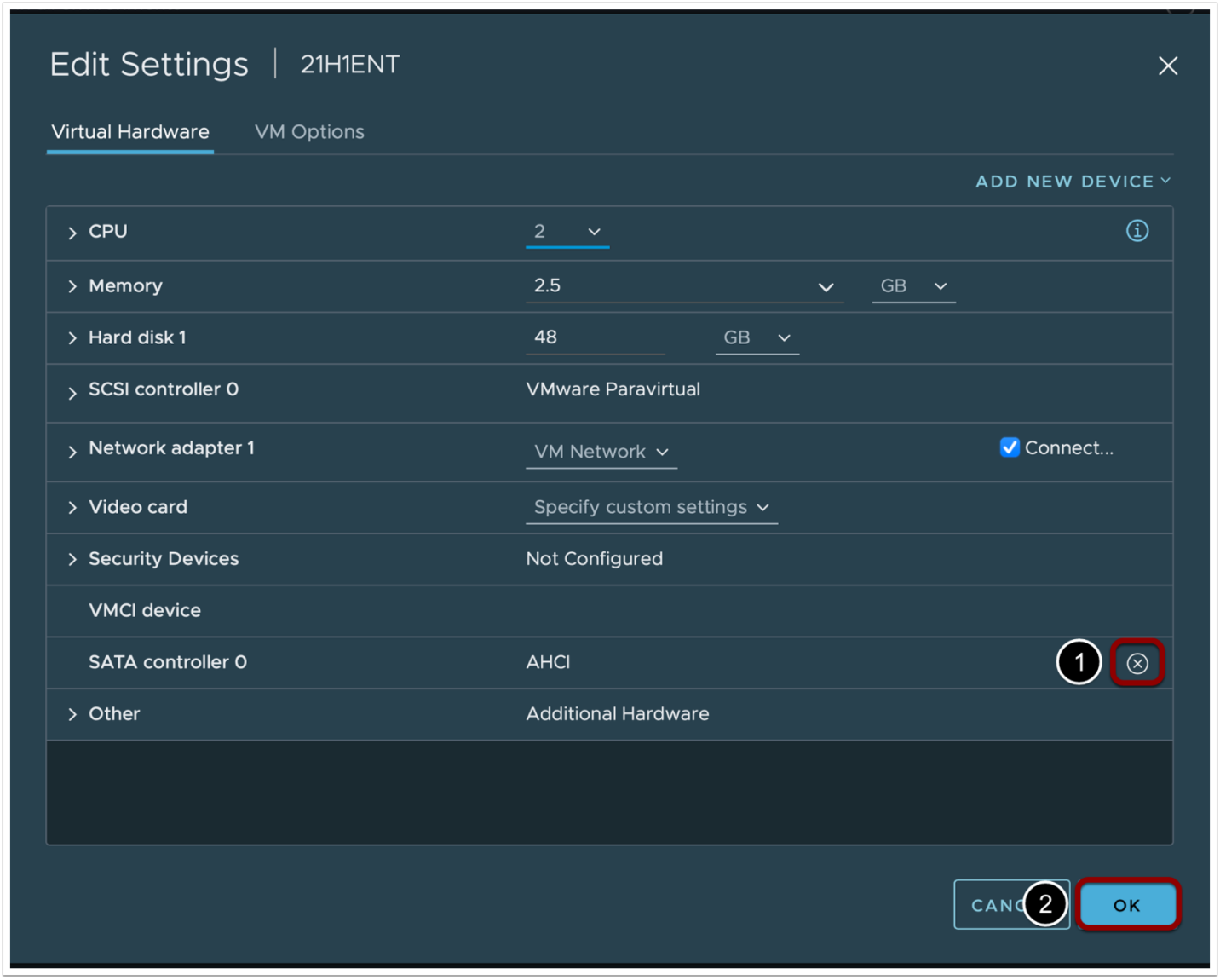
In the vSphere Web Client, right-click the VM and select **Edit Settings**.

2. Remove the CD/DVD Drives



1. To remove the virtual CD/DVD drive from the VM, click the **X** that appears when you hover your pointer over **CD/DVD drive 1** row.
2. Do the same with **CD/DVD drive 2**.
3. Click **OK** and edit the VM again.

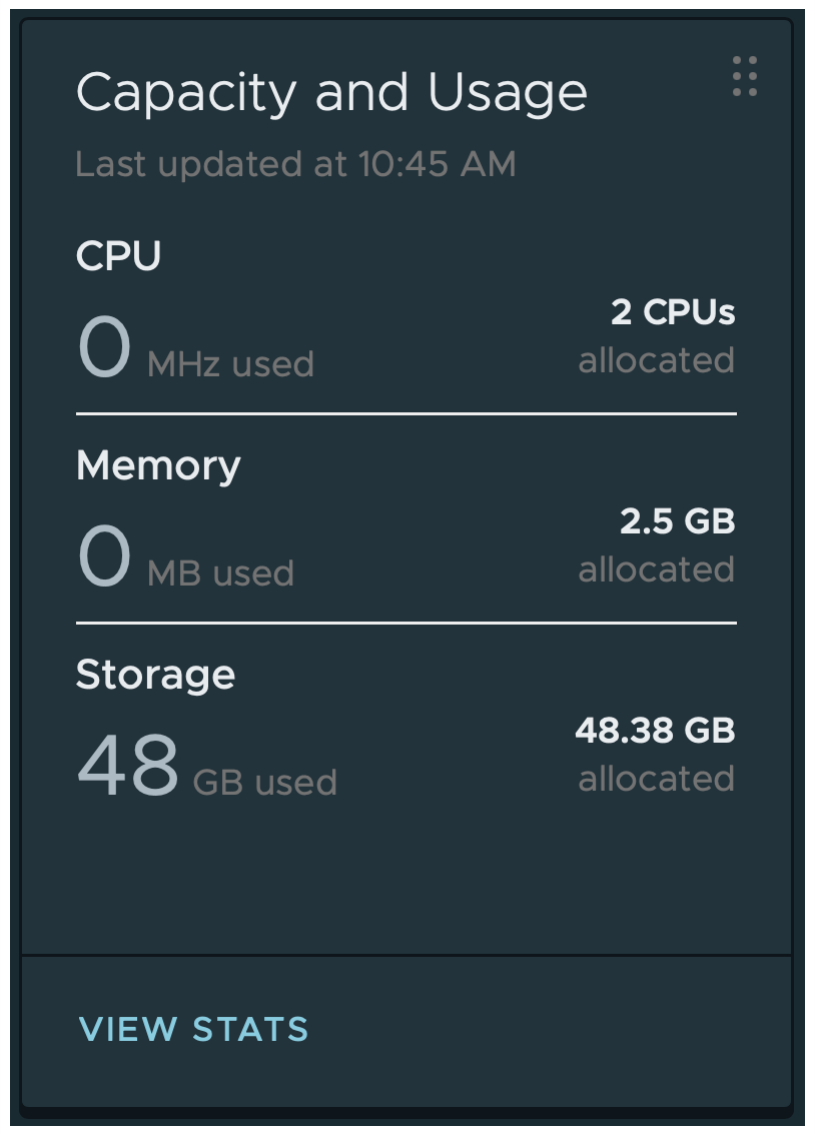
3. Remove the SATA Controller



1. To remove the virtual SATA controller from the VM, click the **X** that appears when you hover your pointer over the **SATA Controller 0** row.
2. Click **OK**.

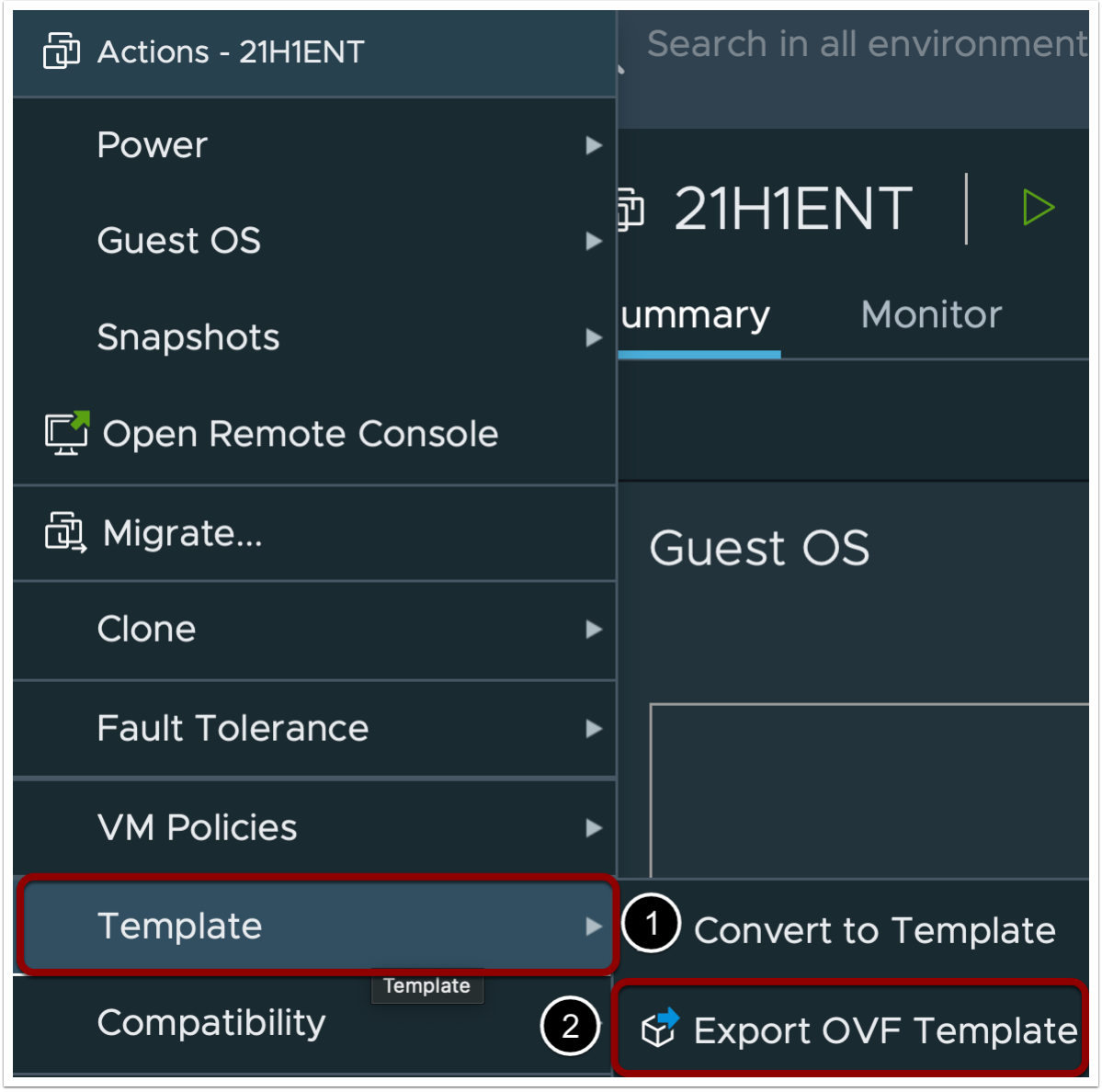
Export the VM to Adjust Disk Size

If you used the same settings as shown in Specify Virtual Hardware Settings when you created the golden VM image, your VM has 48 GB of disk space. The storage usage of the VM can amount to the size of the disk as specified plus the amount of RAM.



Using the export/import process described in this section, we can select the thin-disk option and shrink the size of the VM according to the number of zeroes written during the finalize procedure, when the Secure Delete tool (`sdelete64.exe`) was run to overwrite empty space with zeros.

1. Export to OVF (Open Virtualization Format)

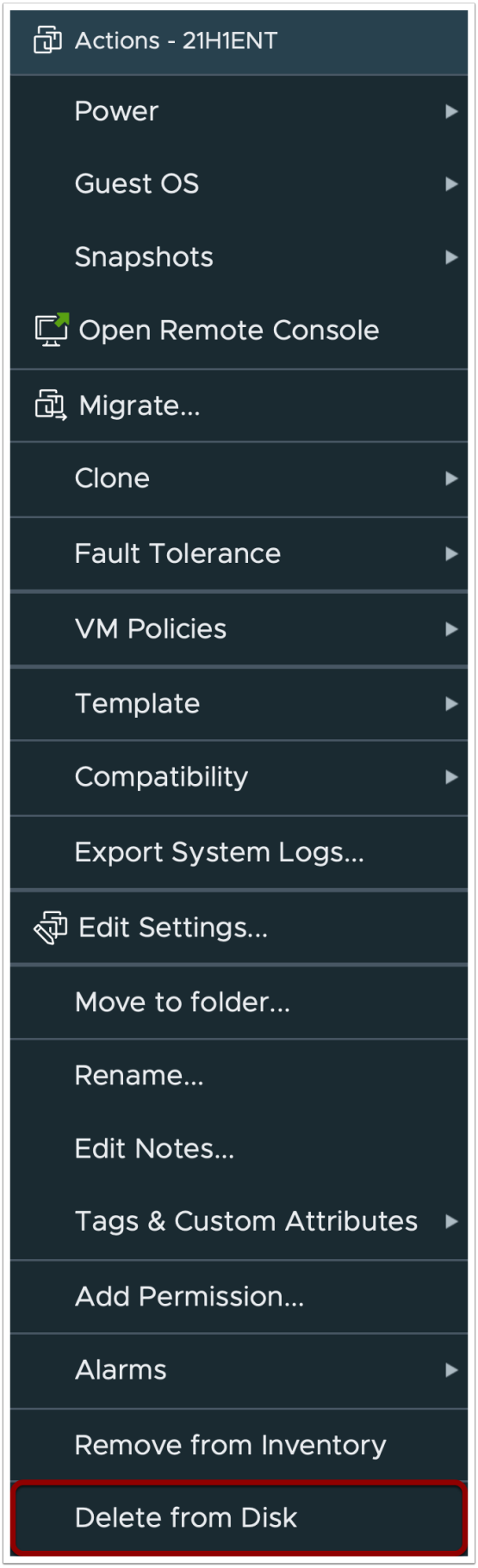


1. Using vSphere Web Client, right-click the VM in the inventory list, and select **Template**.
2. Select **Export OVF Template**.

2. Supply OVF Template Information

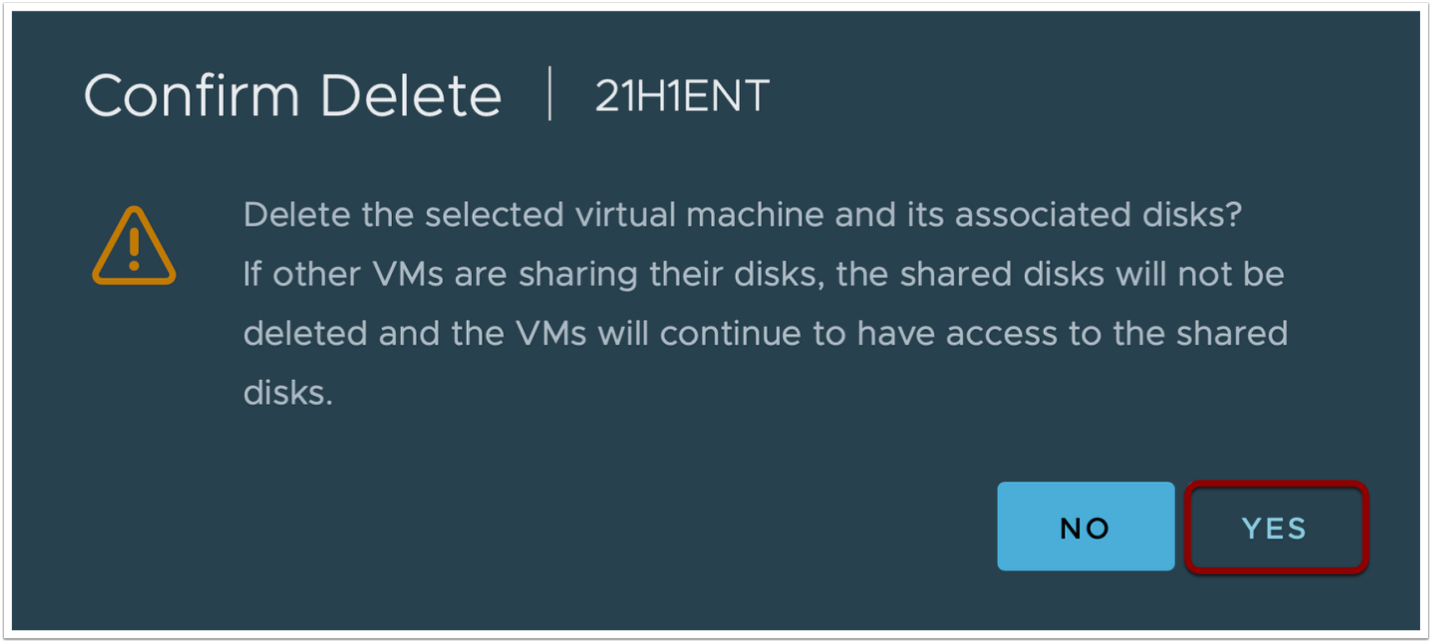
1. Optionally provide an **Annotation**; for example, you could specify the Windows build number.
2. Select **Enable advanced options**.
3. Select **Include extra configuration**.
4. Click **OK**.

3. Delete the VM


Actions - 21H1ENT
Power
Guest OS
Snapshots
Open Remote Console
Migrate...
Clone
Fault Tolerance
VM Policies
Template
Compatibility
Export System Logs...
Edit Settings...
Move to folder...
Rename...
Edit Notes...
Tags & Custom Attributes
Add Permission...
Alarms
Remove from Inventory
Delete from Disk

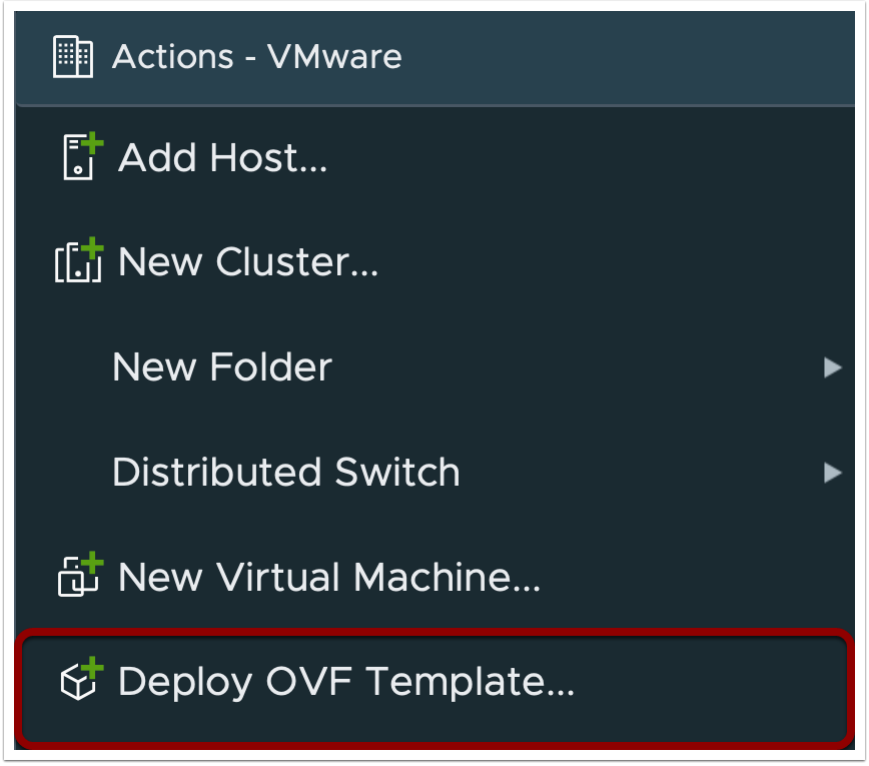
Right-click the VM in the inventory list, and select **Delete from Disk**.

4. Confirm the Deletion



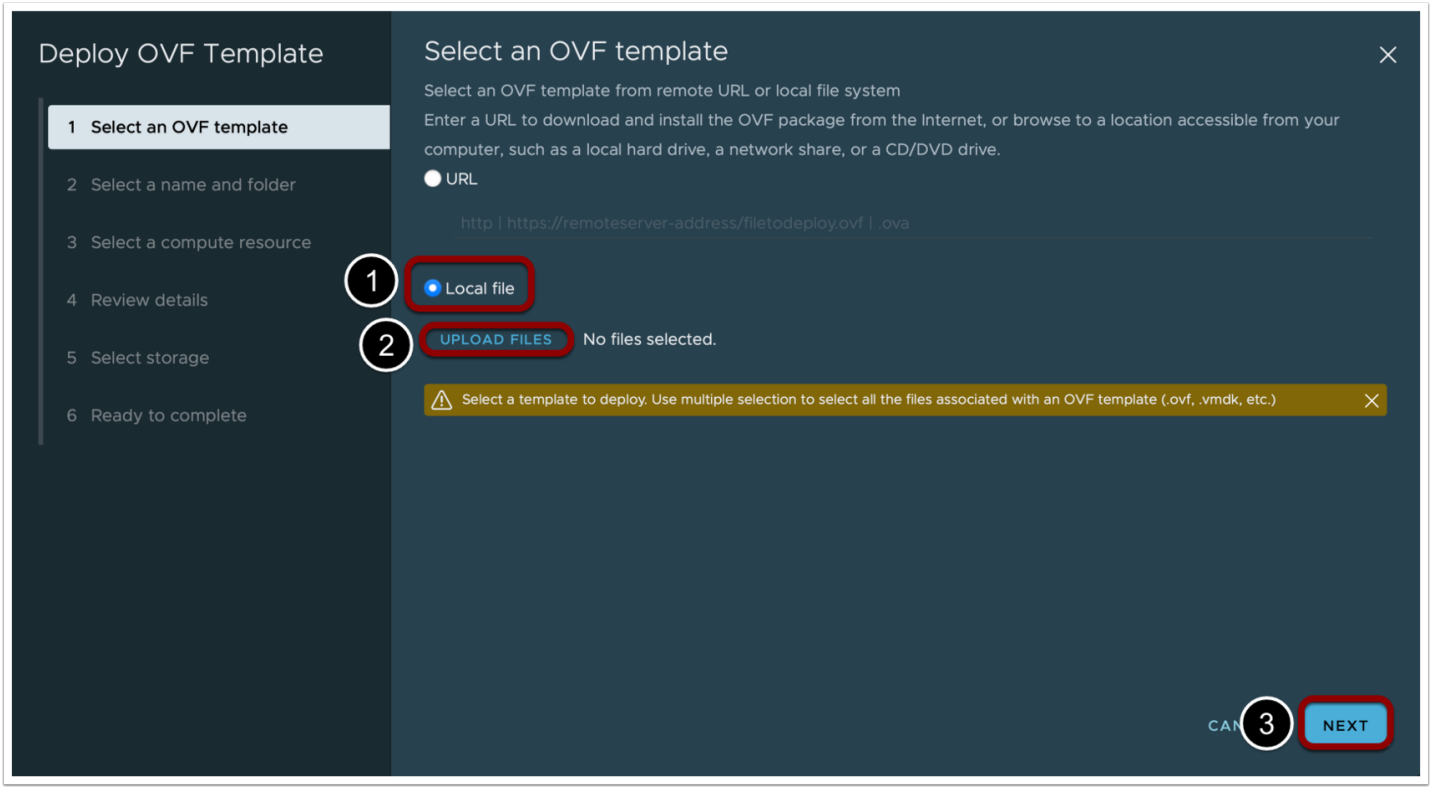
Click **YES**.

5. Deploy the OVF Template



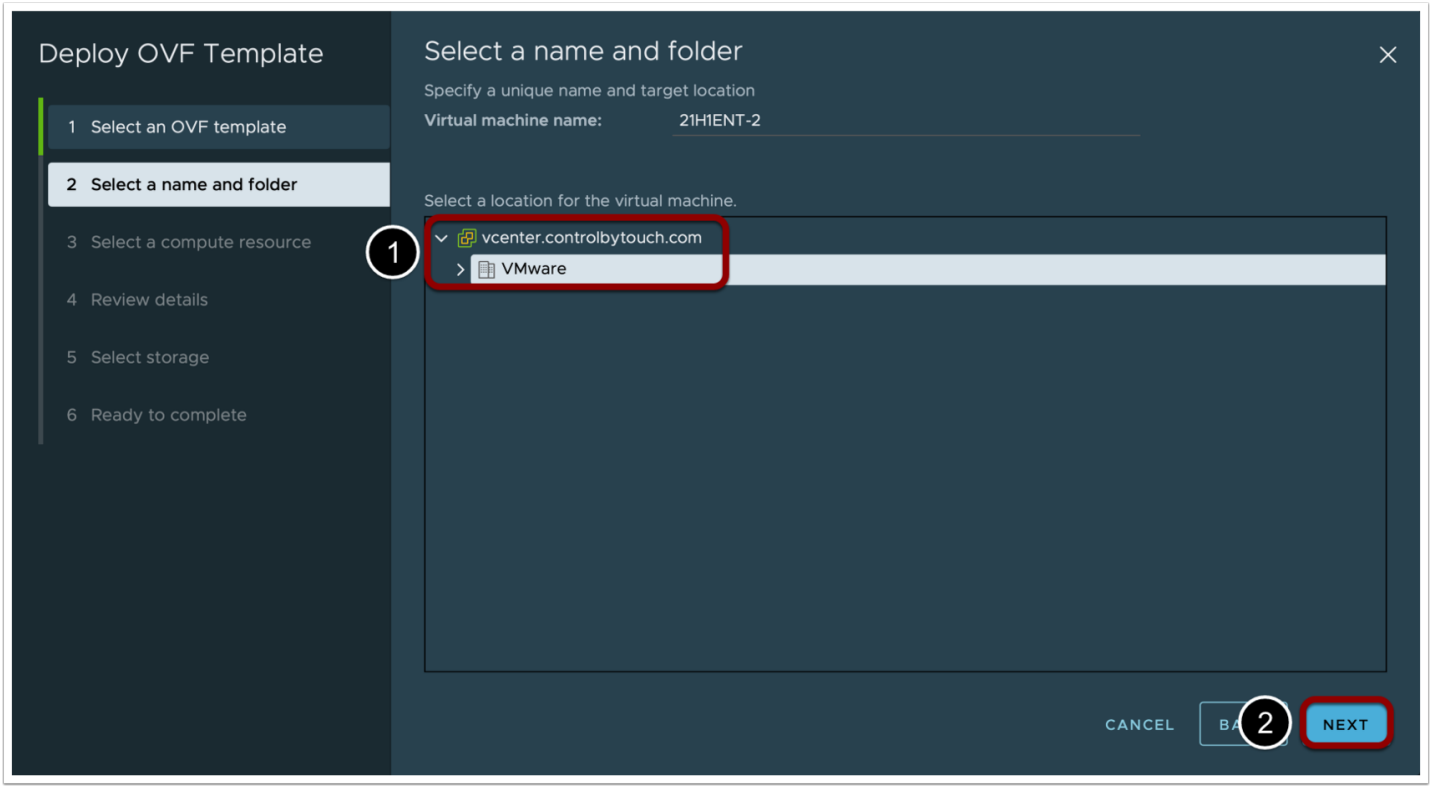
Right-click a VM folder, host, or cluster and select **Deploy OVF Template**.

6. Select the OVF Template You Just Exported



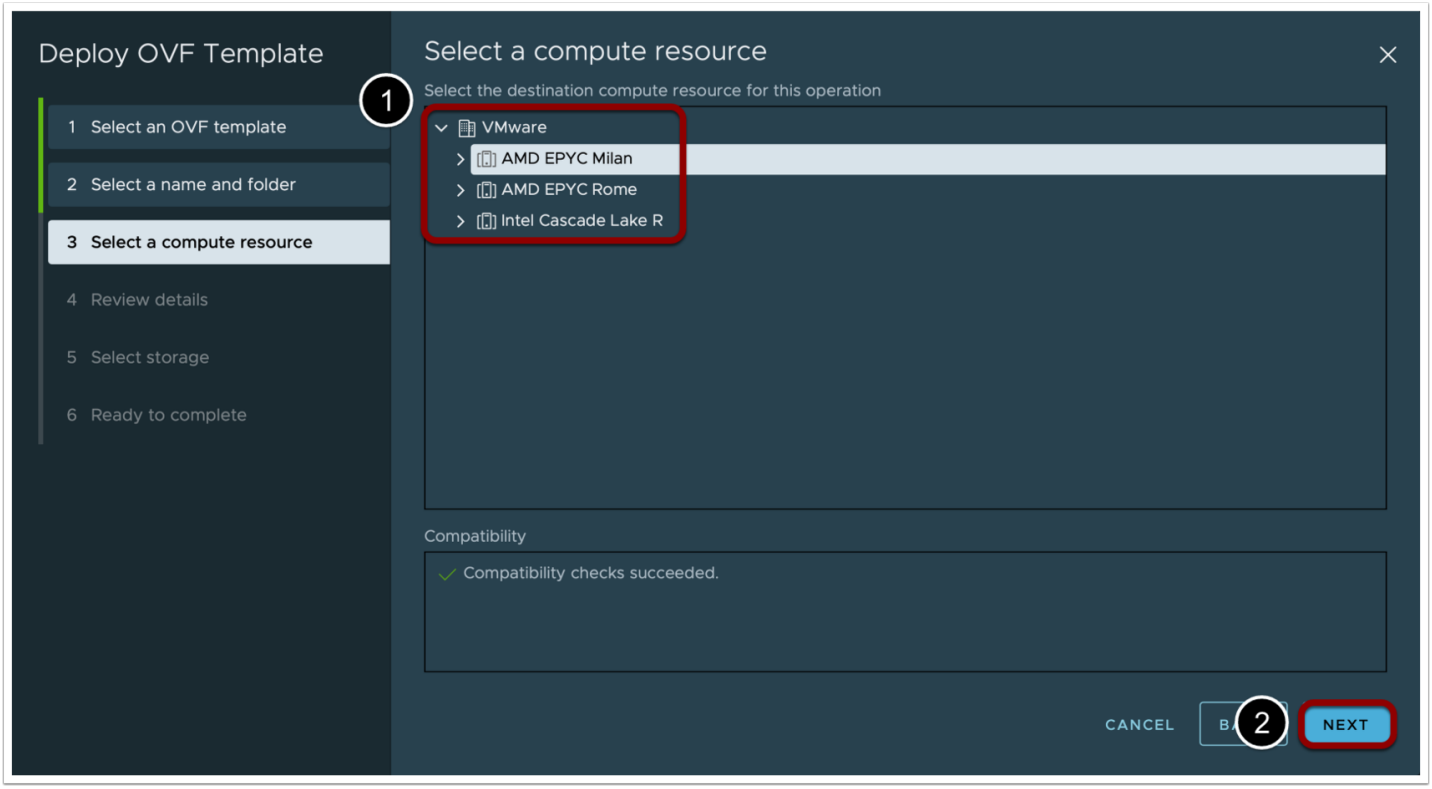
1. Select **Local file**.
2. Click **UPLOAD FILES** (**Browse** with older versions of vSphere) and select all files you have just downloaded when exporting to OVF.
3. Click **NEXT**.

7. Select a Folder



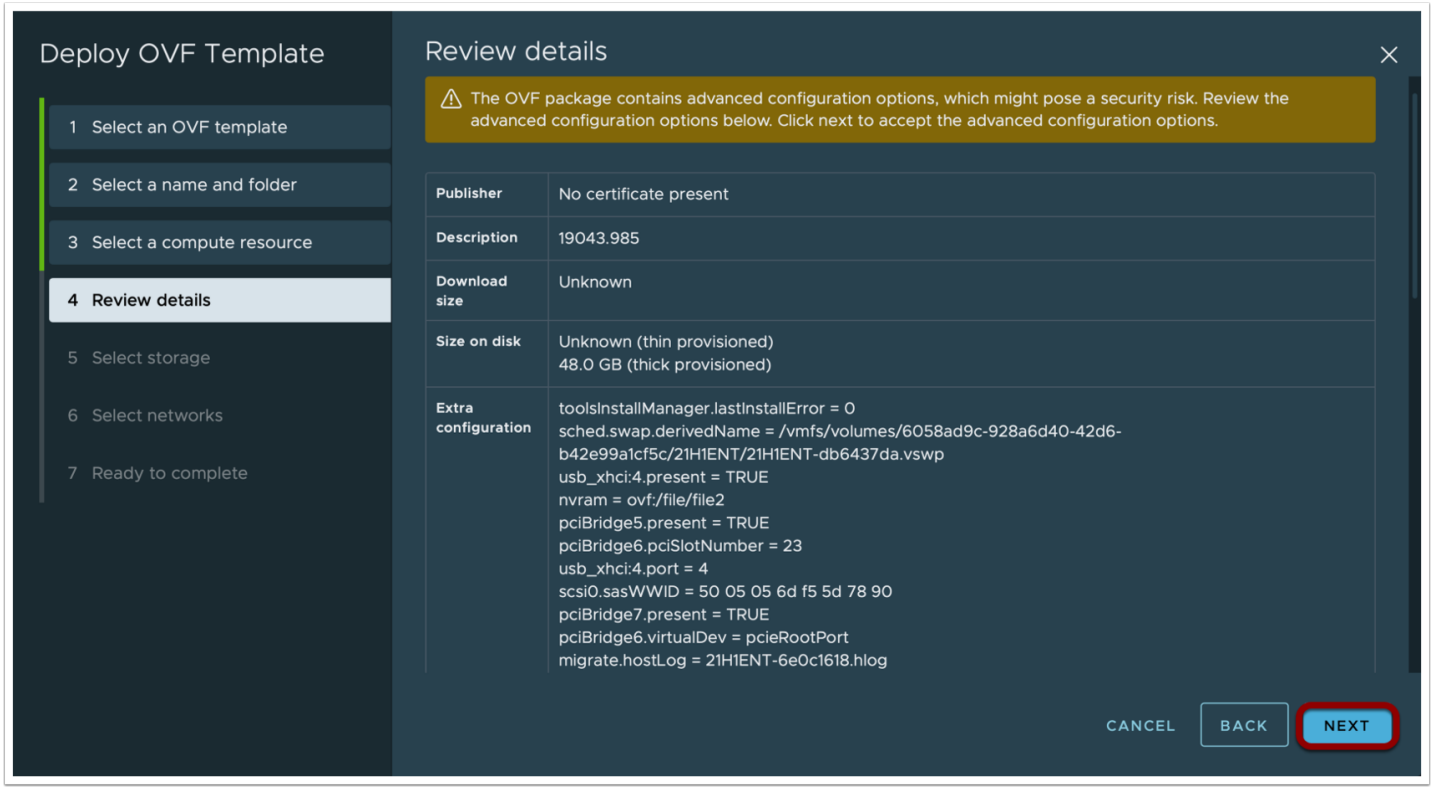
1. Select a folder.
2. Click **NEXT**.

8. Select a Compute Resource



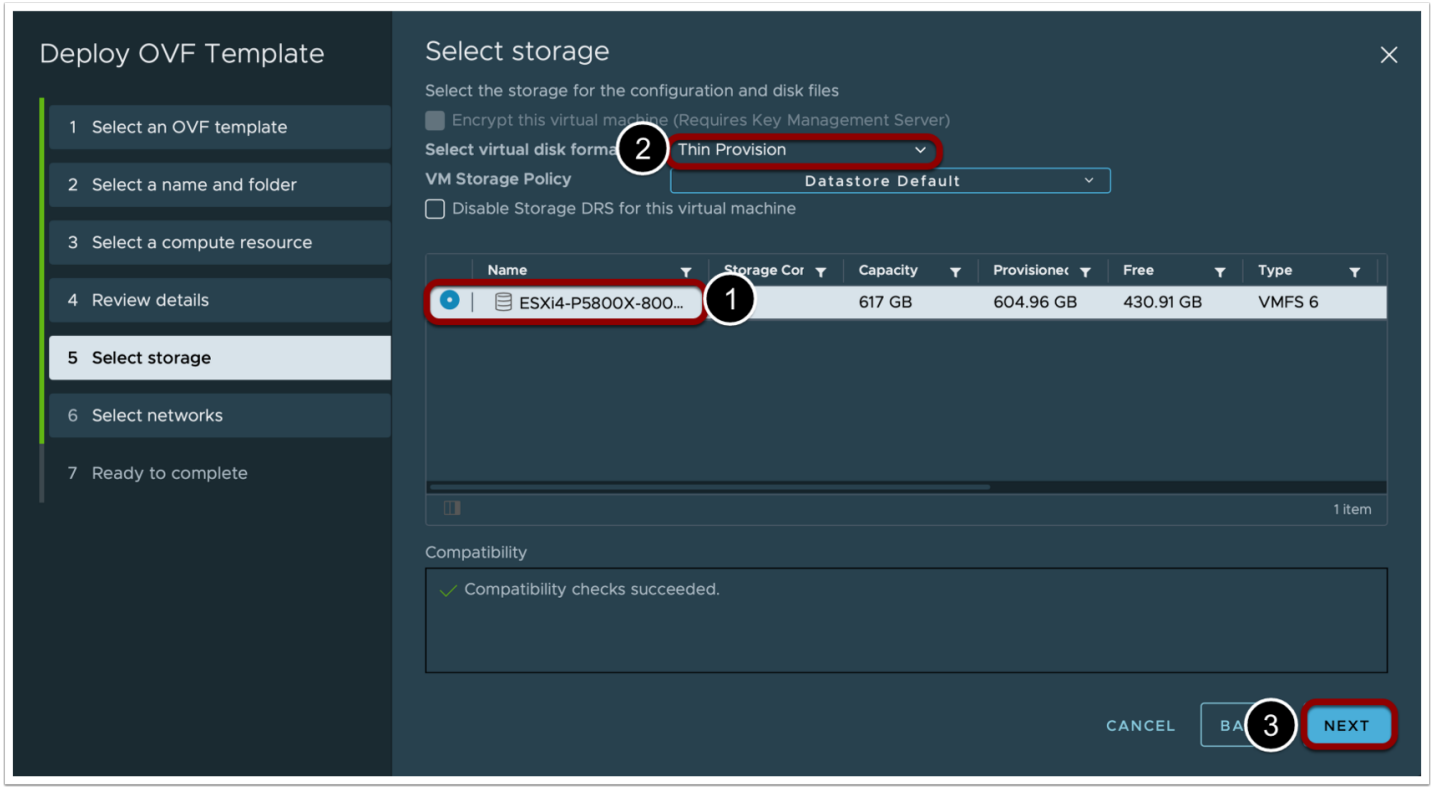
1. Select a compute resource.
2. Click **NEXT**.

9. Review Details



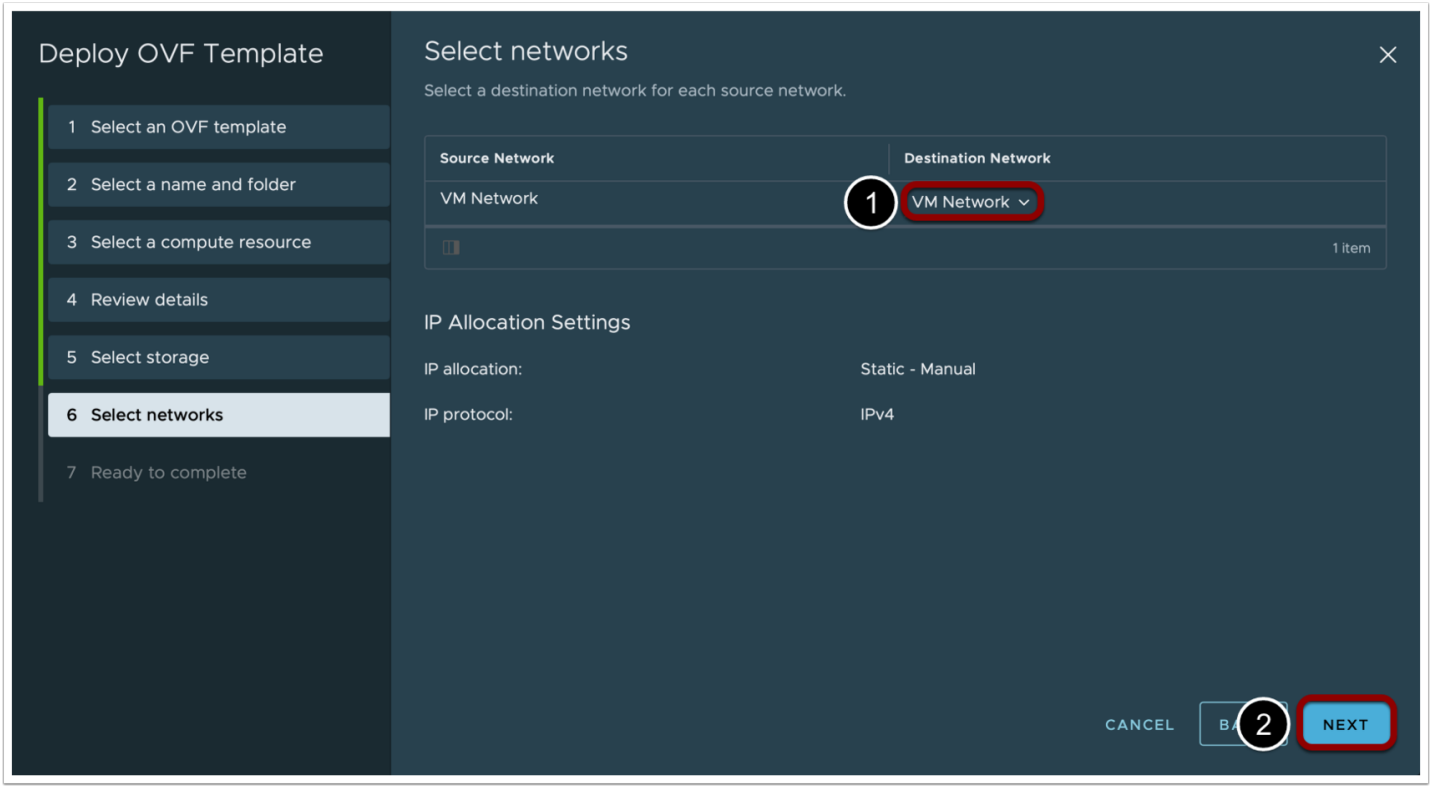
Click **NEXT**.

10. Select Storage



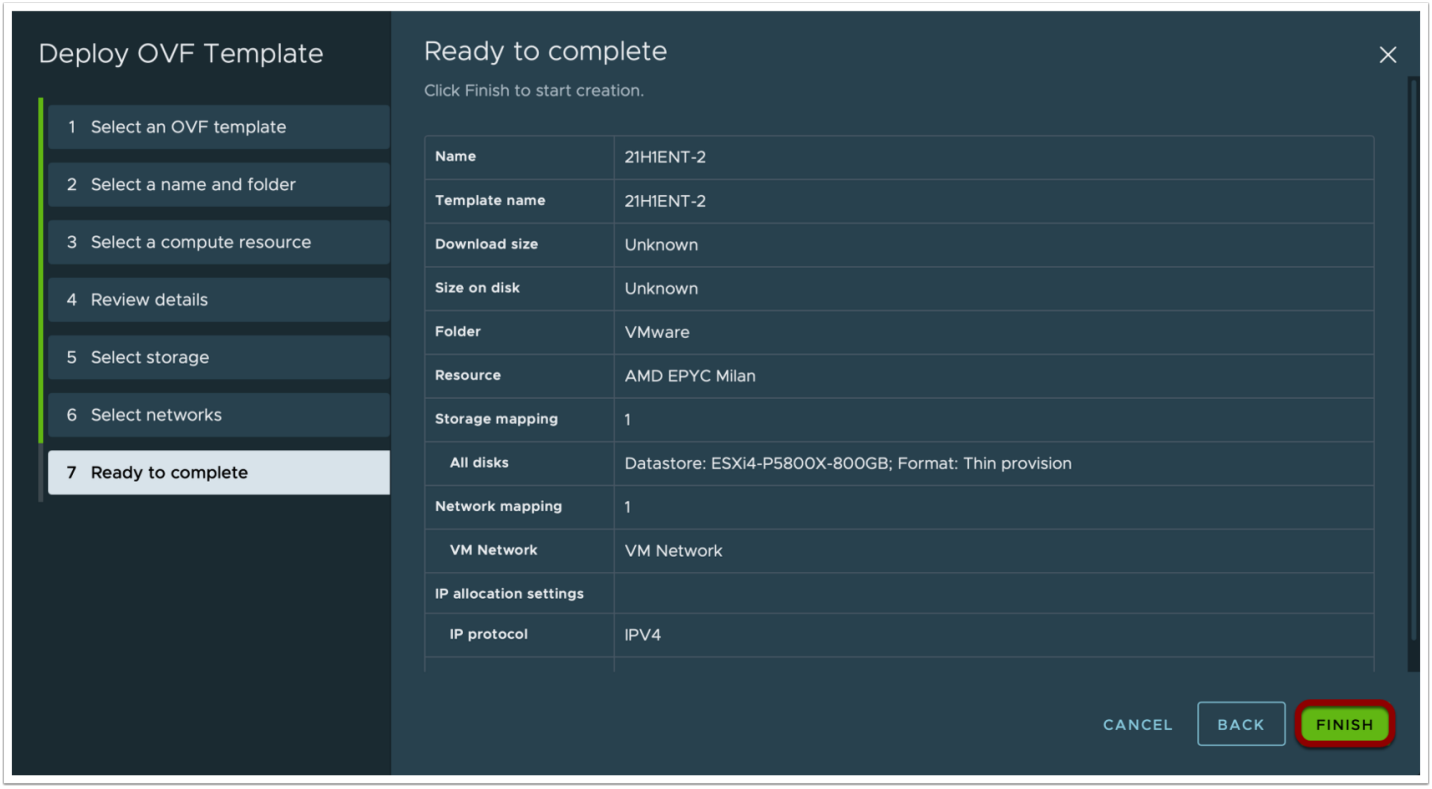
1. Select a datastore.
2. When using storage without storage policies, select **Thin Provision**; otherwise, select an item from the **VM Storage Policy** list that has thin provisioning**.**
3. Click **NEXT**.

11. Select Networks



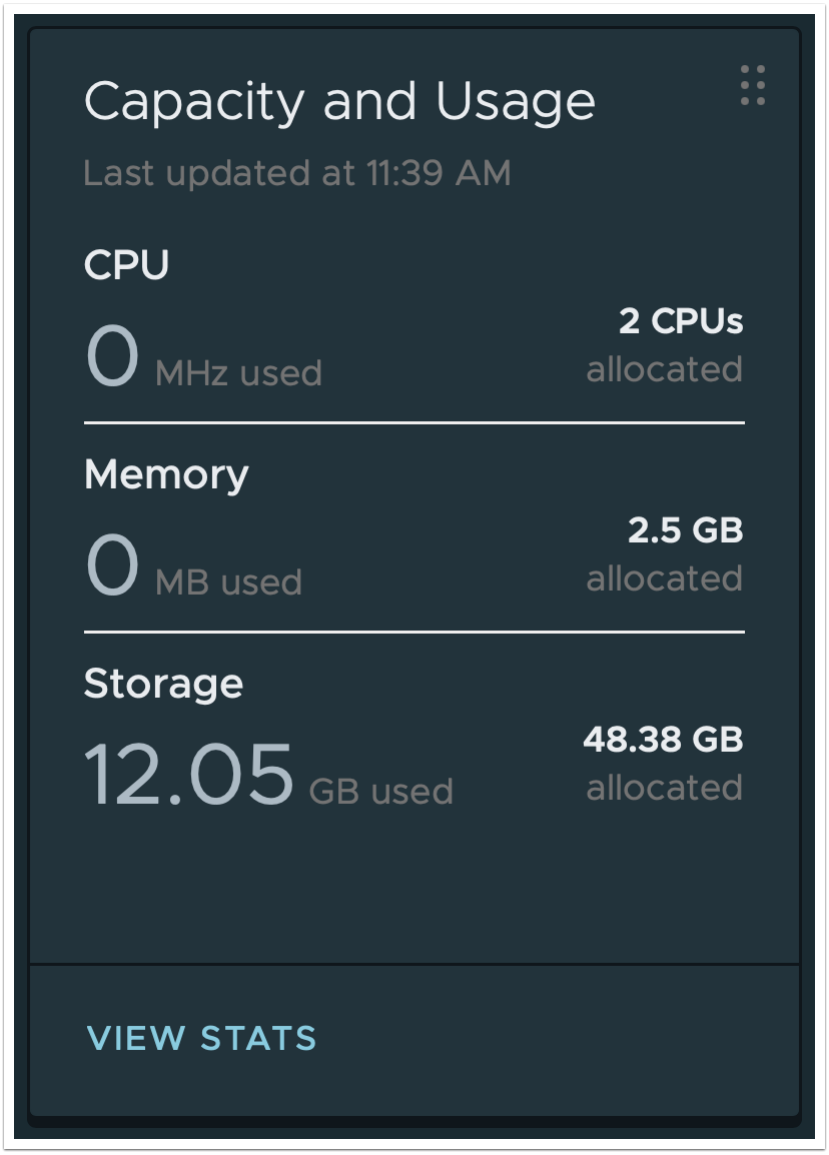
1. Select a **VM Network**.
2. Click **NEXT**.

12. Click Finish on the Ready to Complete Page



Click **FINISH**.

13. Verify the Storage Savings



For example, in this screenshot, the value for **Storage** usage is 12.05 GB. The VM **Summary** tab from the screenshot at the beginning of this section, before the VM underwent the export/import process, showed 48.38 GB.

Preparation for Deployment

Take a VM Snapshot

To create a desktop pool of cloned VMs, or to create a farm of cloned RDSH server VMs, you need to create a frozen state, or base image, from which the clone can be derived.

- For instant-clone pools and server farms, you achieve this state by taking a VM snapshot of the primary VM.
- For full-clone pools, you achieve this state by cloning the primary VM to a VM template.

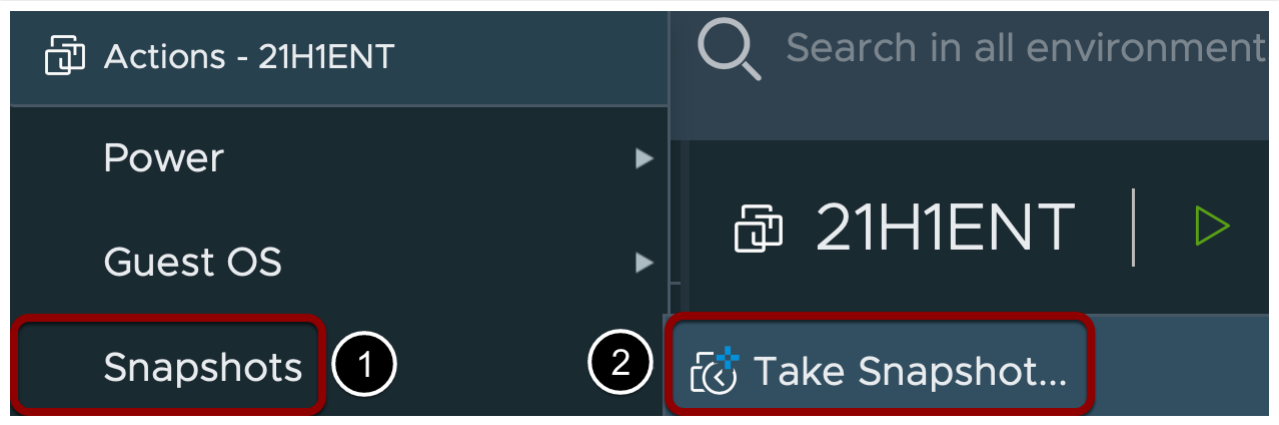
This procedure describes taking a VM snapshot. For information about cloning a VM to a VM template, see Clone a Virtual Machine to a Template.

Note: If you are using Horizon Cloud on Microsoft Azure, you can skip this procedure.

Prerequisites for Taking a Snapshot

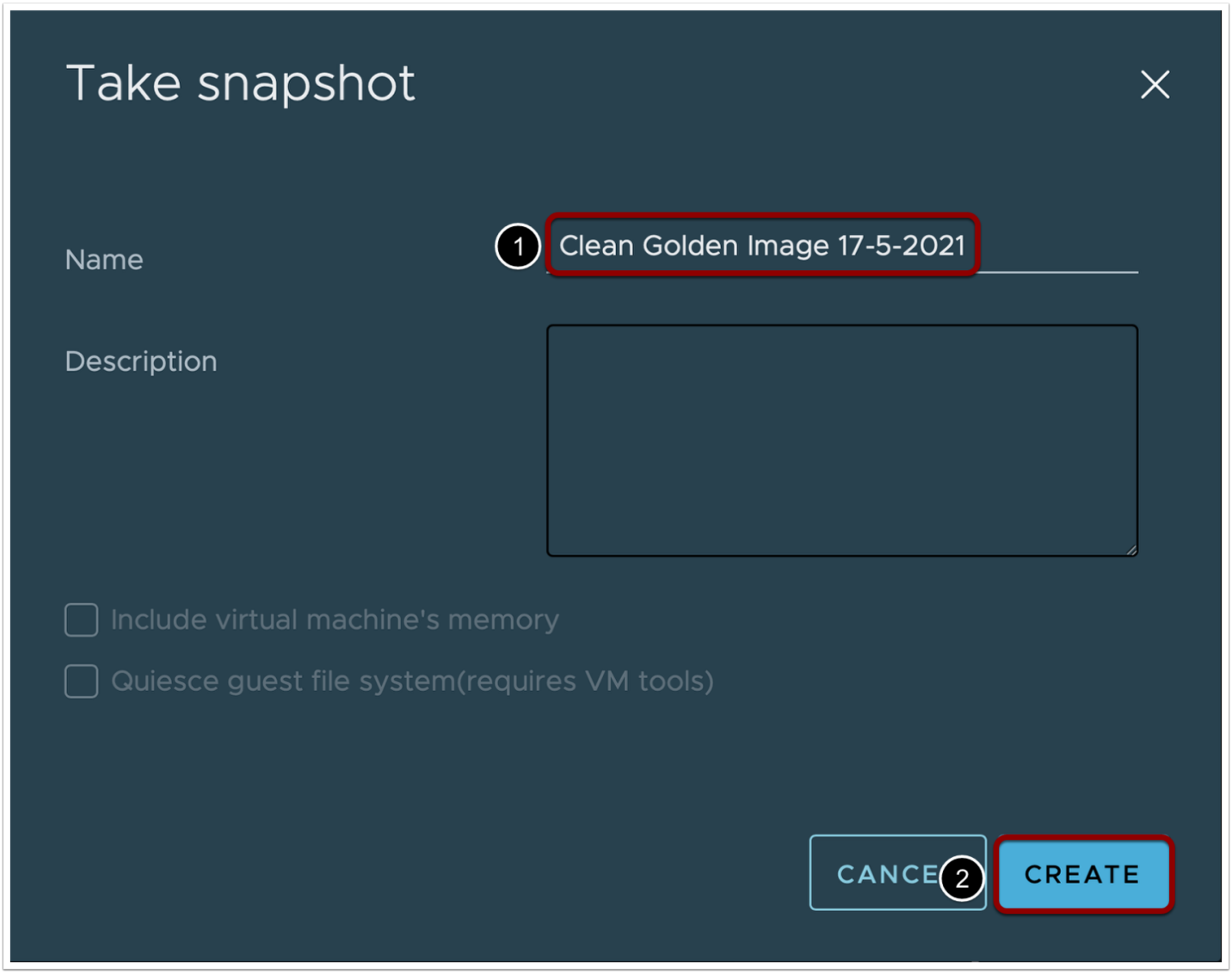
Although it is possible to take a snapshot of a VM that is powered on, for the purposes of creating a base image for a Horizon desktop pool or server farm, the VM must be shut down and powered off.

1. Open the Take Snapshot Dialog Box



1. Using vSphere Web Client, right-click the VM in the inventory list, and select **Snapshots**.
2. Select **Take Snapshot**.

2. Take the Snapshot



1. Provide a descriptive name; for example, the name might include the date of the snapshot.
2. Click **CREATE**.

Create OUs and User Groups in Active Directory

Much of the initial configuration and ongoing management of virtual desktops, RDSH server farms, feature enablement, and end-user experience is performed by creating and applying group policies in Active Directory. Some standard Microsoft Group Policy Object settings are required to configure virtual desktops and applications, as described later in this guide.

If you use Horizon, you can also use VMware-provided GPO administrative templates for fine-grained control of access to features. See Using Horizon Group Policy Administrative Template Files.

OUs for VMs

You should create an organizational unit (OU) specifically for your virtual desktops and an OU for your RDSH server VMs. An OU is a subdivision in Active Directory that contains users, groups, computers, or other OUs.

To prevent group policy settings from being applied to other Windows servers or workstations in the same domain as your desktops or server farms, you can create a GPO for group policies and link it to the OU that contains your VMs.

You can also delegate control of the OU to subordinate groups, such as server operators or individual users.

User Groups

You should also create groups for different types of users in Active Directory. For example, you can create a group called End Users for your end users and another group called Horizon Administrators for users that will administer virtual desktops and applications.

Later in this guide, you will add a user group containing end users to the local Remote Desktop Users group in AD. Then members of the group will be able to connect to any VM that is joined to the domain.

Set Other Common Group Policies

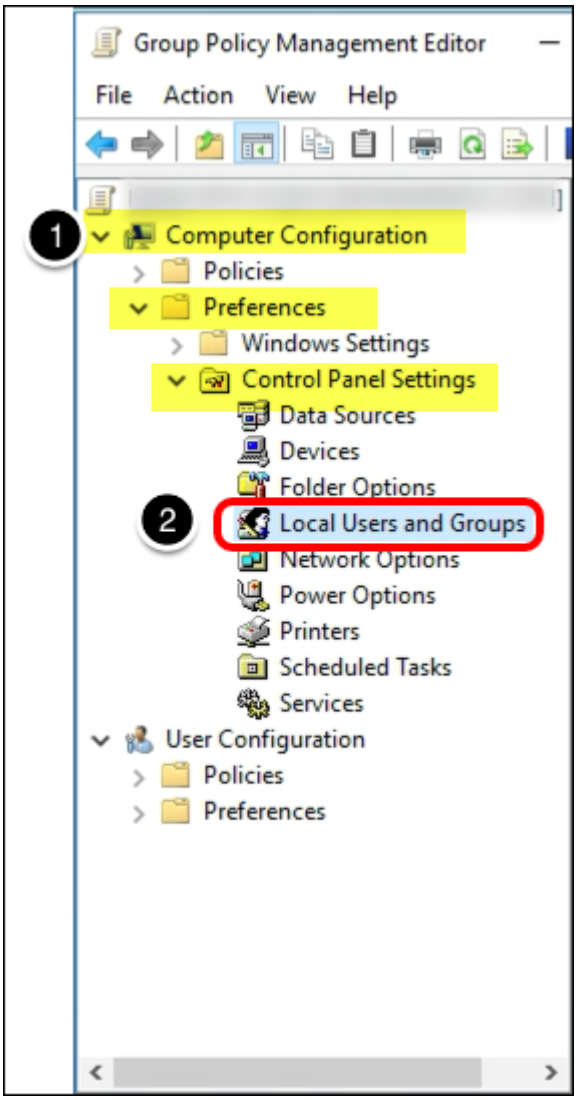
For both virtual desktop VMs and RDSH server VMs, create a GPO for the OU in Active Directory, and use the Group Policy Management Editor to apply the following GPO settings.

Setting	**Value**
Computer Configuration > **Policies** > **Administrative Templates** > **System** > **Group Policy**	
Configure user Group Policy loopback processing mode	Enabled Set **Mode** to **Replace**
Computer Configuration > **Policies** > **Administrative Templates** > **System** > **Logon**	
Always wait for the network at computer startup and logon	Enabled

Disable the Local Administrator User Account

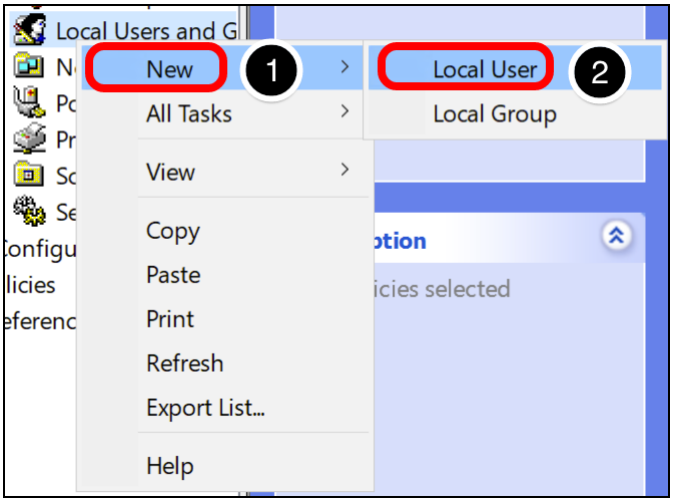
Next, edit the GPO to disable the local administrator account.

1. Navigate to Local Users and Groups



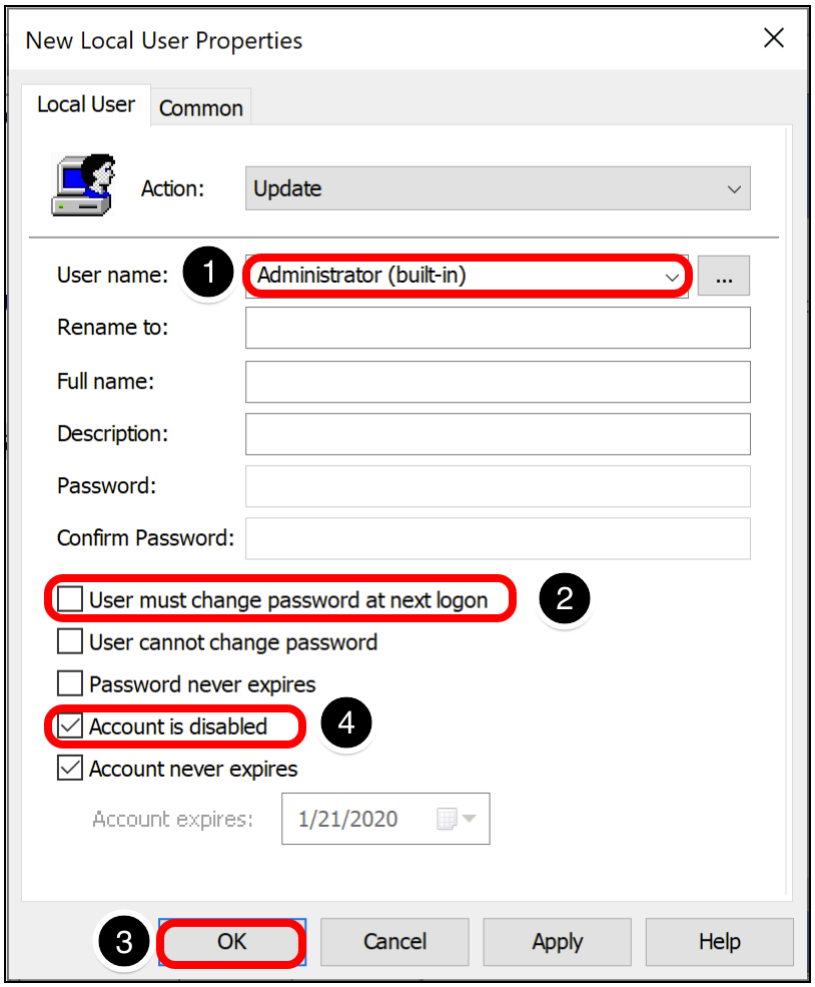
In Group Policy Management Editor, edit the GPO and navigate to **Computer Configuration** > **Preferences** > **Control Panel Settings** > **Local Users and Groups**.

2. Create a New Policy for a Local User Account



1. Click **New**.
2. Click **Local User**.

3. Specify New Properties for the Administrator Account



1. Select **Administrator (built-in)**.
2. De-select **User must change password at next logon**.
3. Select **Account is disabled**.
4. Click **OK**.

If you use Horizon, you can also use VMware-provided GPO administrative templates for fine-grained control of access to features. See Using Horizon Group Policy Administrative Template Files.

Set Policies for RDSH Server VMs

If you plan to use the image for creating RDSH server VMs, create a GPO for the RDSH server OU in Active Directory, and use the Group Policy Management Editor to apply the following GPO settings.

Setting	Value
Computer Configuration > **Policies** > **AdministrativeTemplates** > **Windows Components** > **Remote Desktop Services** > **Remote Desktop Session Host** > **Licensing**	
Use the specified Remote Desktop license server	Enabled (Comma-separated list of license servers to use)
Set the Remote Desktop license mode	Enabled (Choose the correct **Per Device** or **Per User** mode for your CALs)
Computer Configuration > **Policies** > **Administrative Templates** > **System** > **User Profiles**	
Delete cached copies of roaming profiles	Enabled

If you use Horizon 8, review the settings listed in the RDSH Server OU-Level Settings section of the "Horizon Configuration" chapter in the *VMware Workspace ONE and VMware Horizon Reference Architecture*.

If you use Horizon 7, be sure to review the VMware-provided administrative templates for RDSH server management. See Using Remote Desktop Services Group Policies.

Add Users to the Local Remote Desktop Users Group

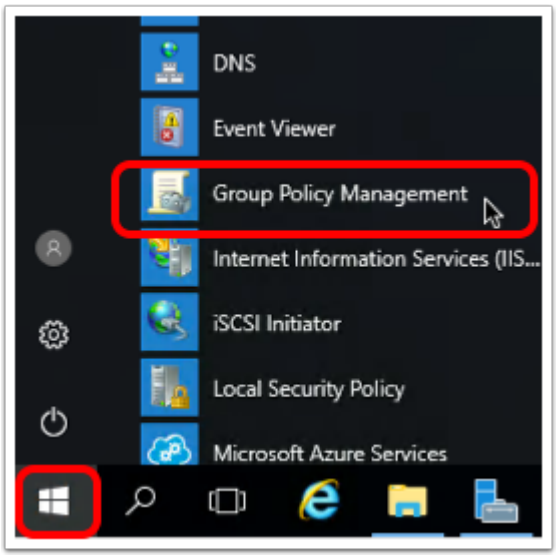
To connect to a remote desktop or RDSH server, users must belong to the local Remote Desktop Users group of the virtual desktop or RDSH server. You can use the Restricted Groups policy in Active Directory to add users or groups to the Remote Desktop Users group.

The members of the Remote Desktop Users group are always added to the *local* Remote Desktop Users group of every virtual desktop or RDSH server that is joined to your domain. When adding new users, you need only add them to the Remote Desktop Users group.

Prerequisites for Adding Users to the Restricted Groups Policy

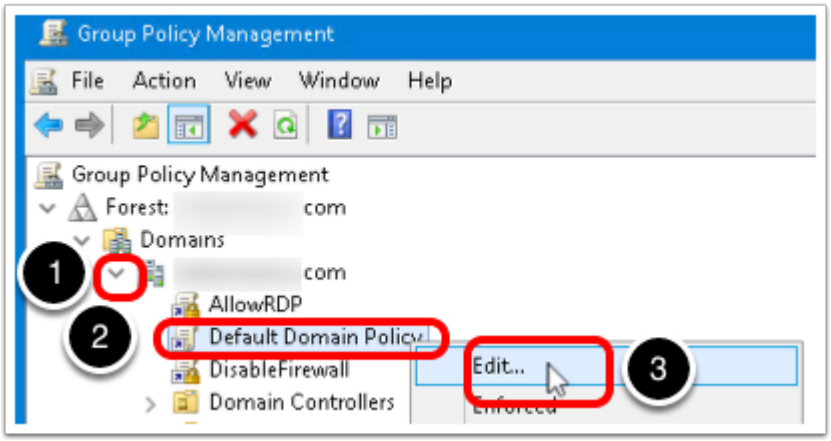
Before you can perform the procedure in this article, you must have created one or more user groups in Active Directory that contain the end users who will connect to the virtual desktops and RDSH servers.

1. Open Group Policy Management



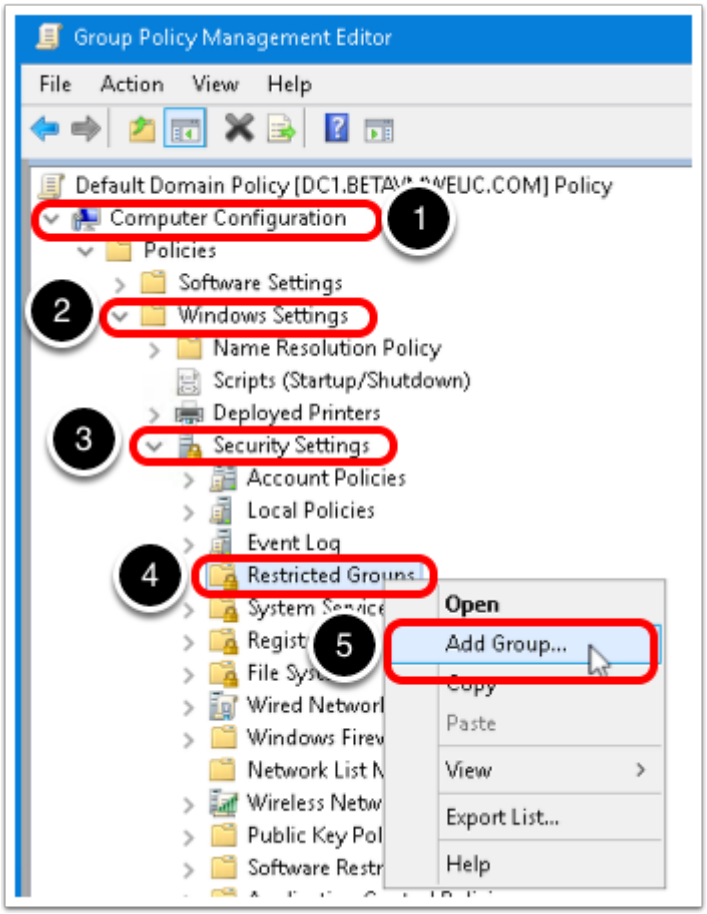
On the domain controller (AD machine), click the Start button, and navigate to **Windows Administrative Tools** > **Group Policy Management**.

2. Edit the Default Domain Policy



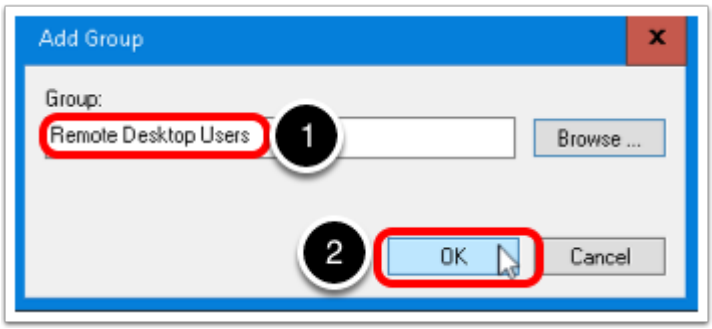
1. Expand your domain.
2. Right-click **Default Domain Policy**.
3. Select **Edit**.

3. Open the Add Group Dialog Box



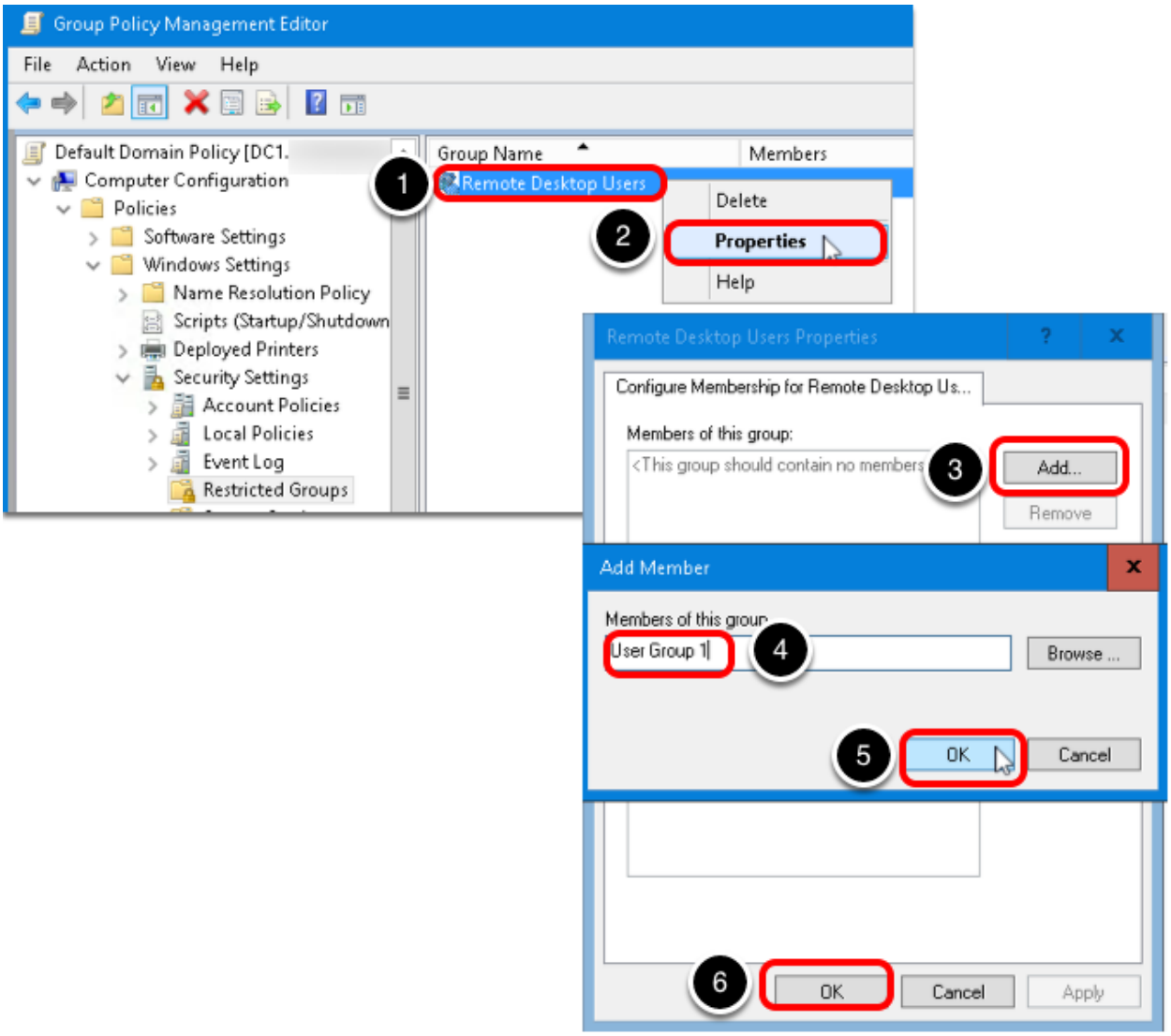
1. In the Group Policy Management Editor, expand **Computer Configuration**.
2. Expand **Windows Settings**.
3. Expand **Security Settings**.
4. Right-click **Restricted Groups**.
5. Select **Add Group**.

4. Add the Remote Desktop Users Group



1. In the Add Group dialog box, enter `Remote Desktop Users`.
2. Click **OK**.

5. Add User Groups to the Remote Desktop Users Group



1. Right-click the **Remote Desktop Users** group that you just added to **Restricted Groups**.
2. Select **Properties**.
3. Click **Add.**
4. Add a group of end users.

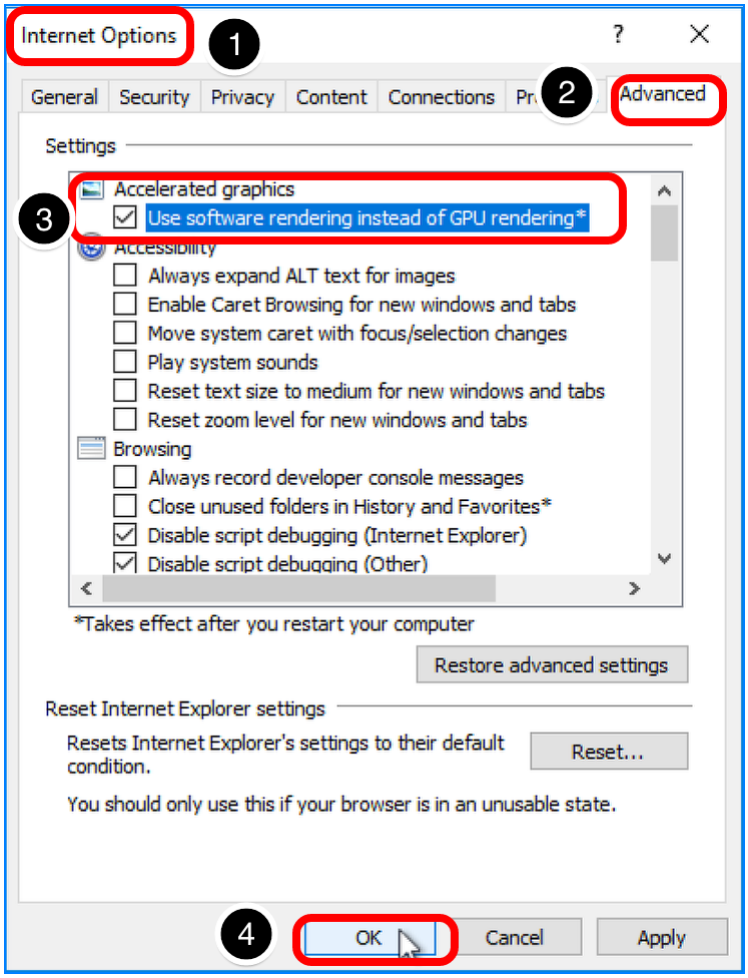
5. Click **OK** in the Add Member dialog box.
6. Click **OK** in the Remote Desktop Users Properties dialog box.

Turn Off Hardware Graphics Acceleration in Commonly Used Applications

If the VMs are not using a physical GPU in the ESXi hosts, you can reduce CPU usage by not emulating hardware graphics in applications. We recommend using Dynamic Environment Manager configuration files to control these application settings. Office, Internet Explorer and Adobe Reader are already done by OSOT, unless you deselected them.

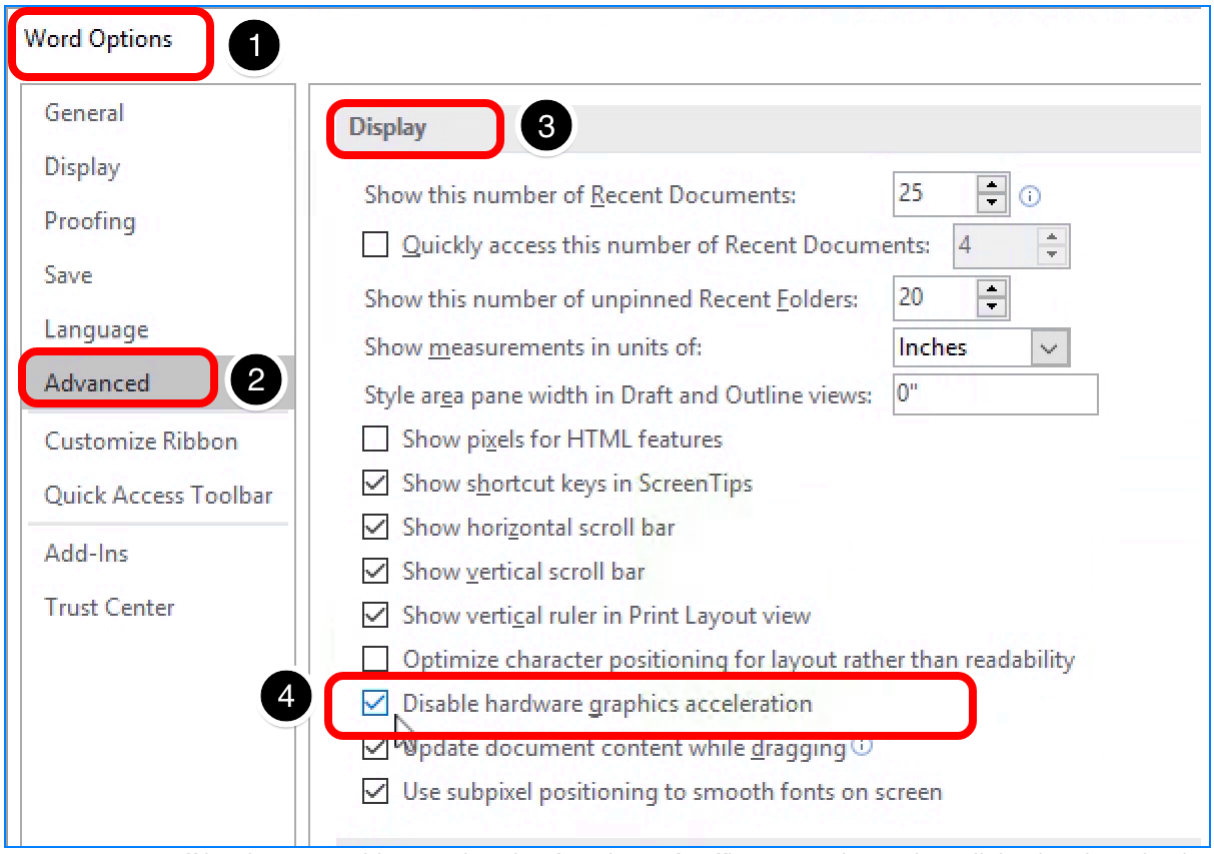
For more information about having VMs use physical GPUs, see Deploying Hardware-Accelerated Graphics with VMware Horizon.

1. Internet Explorer



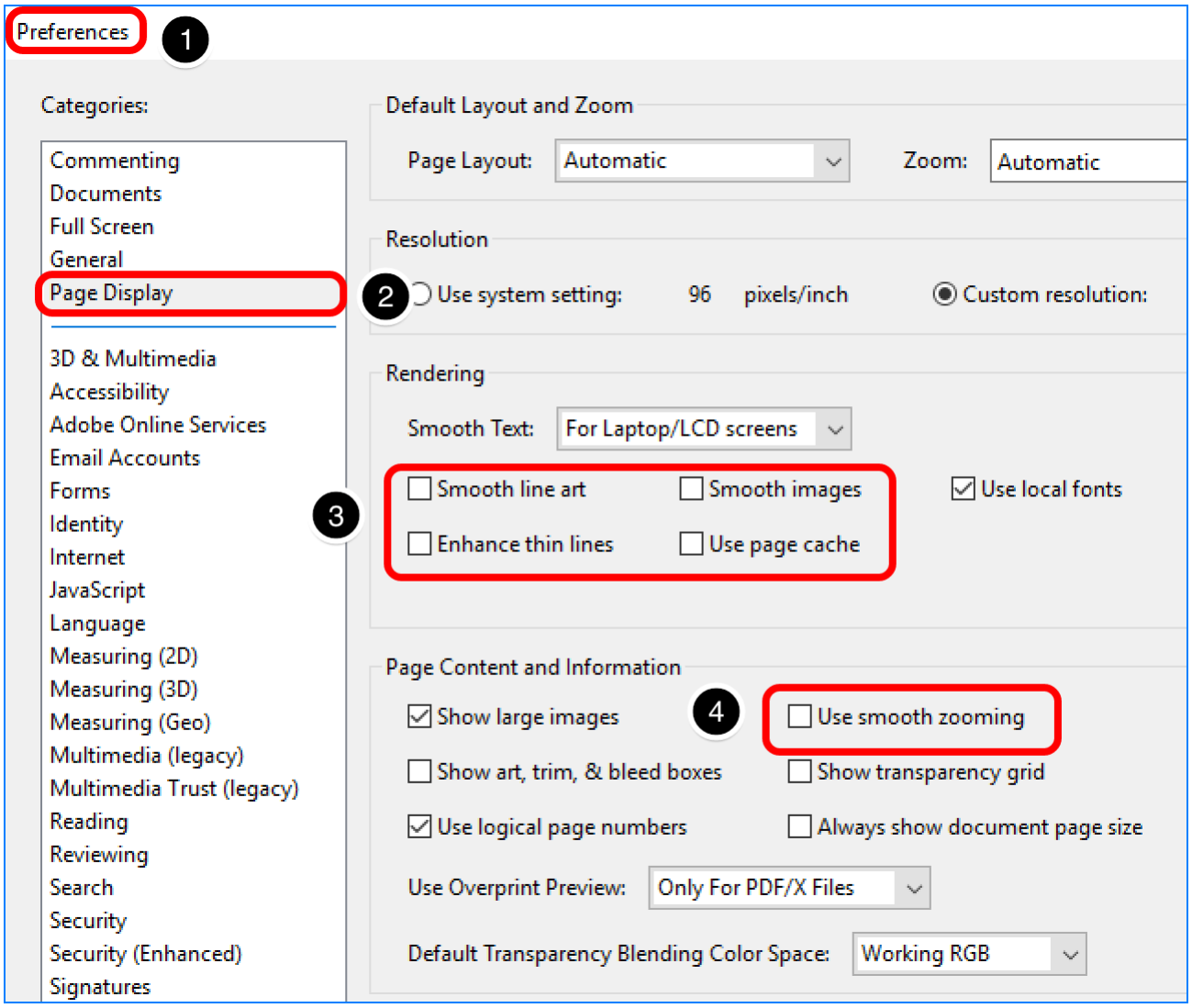
1. To turn off hardware graphics acceleration for Internet Explorer, open the Internet Options dialog box by clicking the Tools icon and selecting **Internet Options**.
2. Click the **Advanced** tab.
3. From the **Accelerated graphics** list, select **Use software rendering instead of GPU rendering**.
4. Click **OK**.

2. Microsoft Office



1. To turn off hardware graphics acceleration for Microsoft Office, open the Options dialog box by selecting **File > Options** in the application (in this example, Microsoft Word).
2. Select **Advanced**.
3. Scroll down to the Display section.
4. Select **Disable hardware graphics acceleration**.

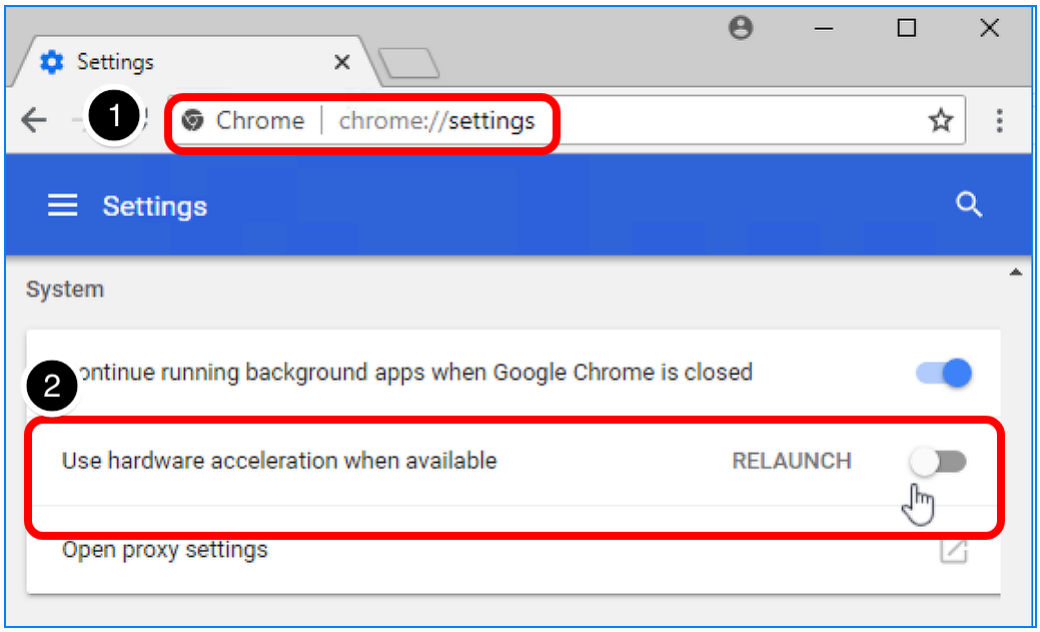
3. Adobe Reader



1. To turn off hardware graphics acceleration and disable other CPU-intensive display options for Adobe Reader, open the Preferences dialog box by selecting **Edit** > **Preferences**.
2. Select **Page Display**.
3. In the Rendering section, deselect the following options:
    - **Smooth imaging**
    - **Smooth line art**
    - **Use page cache**
    - **Enhance thin lines**
4. In the Page Content and Information section, deselect **Use smooth zooming**.

For more information, see the Adobe documentation about General Application Settings in the Windows Registry.

4. Google Chrome



1. To turn off hardware graphics acceleration for Chrome, navigate to `chrome://settings`.
2. Scroll down to the System section, in the Advanced settings, and turn off **Use hardware acceleration when available**.

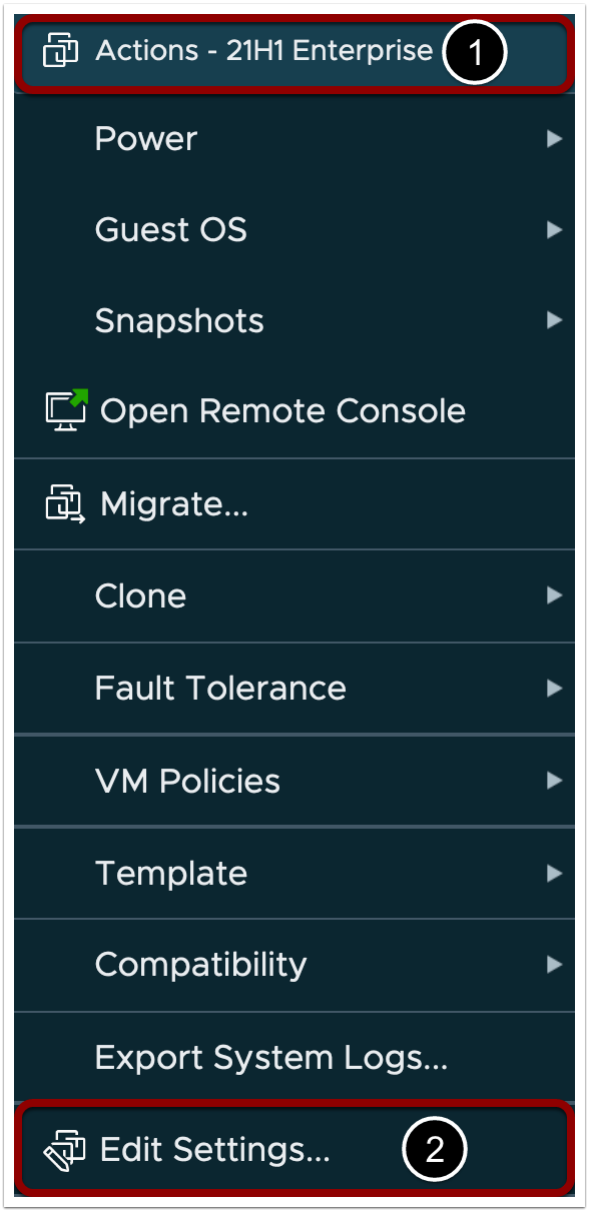
Day-2 Updates

Update VMware Tools

When new versions of VMware Tools are released, use this procedure to update VMware Tools in the golden image.

Note: If you are using Horizon Cloud on Microsoft Azure, you can skip this procedure.

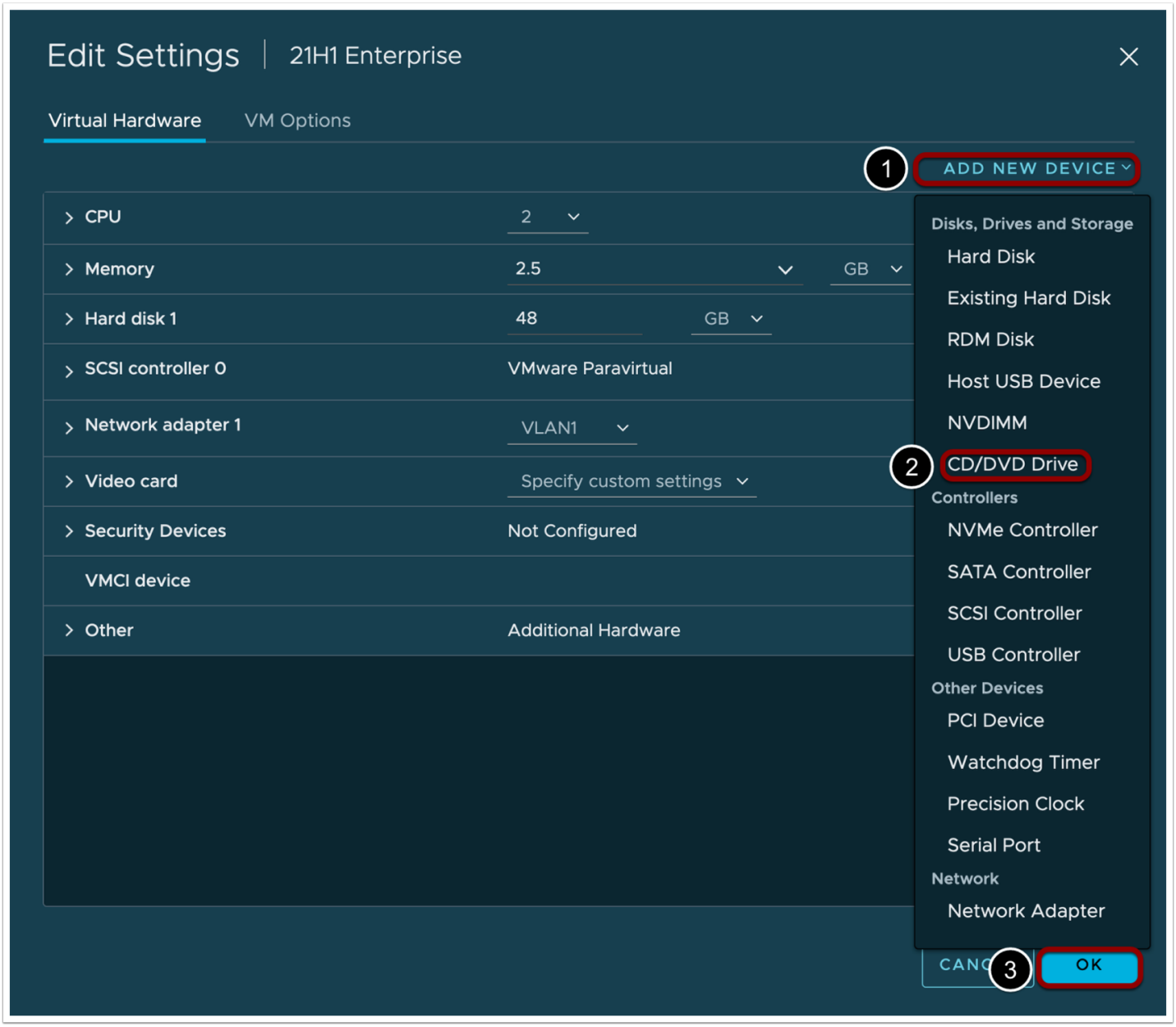
1. Open the Edit VM Settings Dialog Box



Make sure the VM is powered off and then use vSphere Web Client to:

1. Right-click the VM.
2. Select **Edit Settings**.

2. Add a Virtual CD/DVD Drive Back to the VM

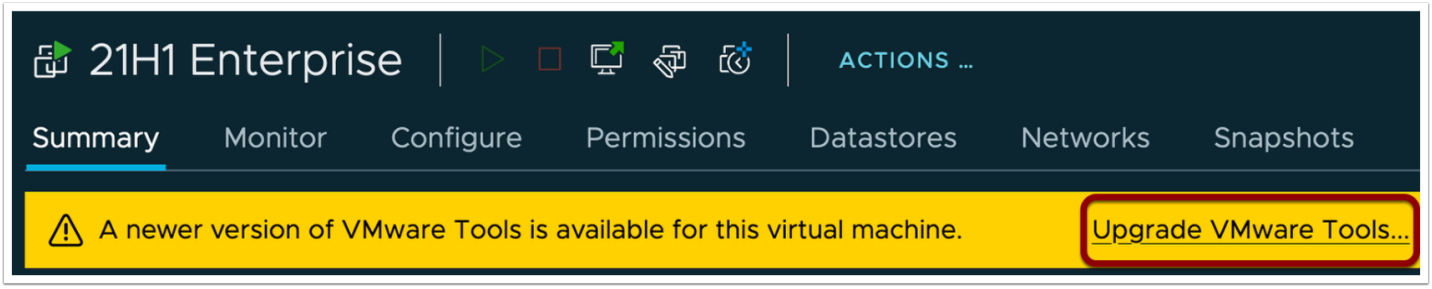


1. Click **ADD NEW DEVICE**.
2. Select **CD/DVD Drive**.
3. Click **OK**.

3. Power On the VM

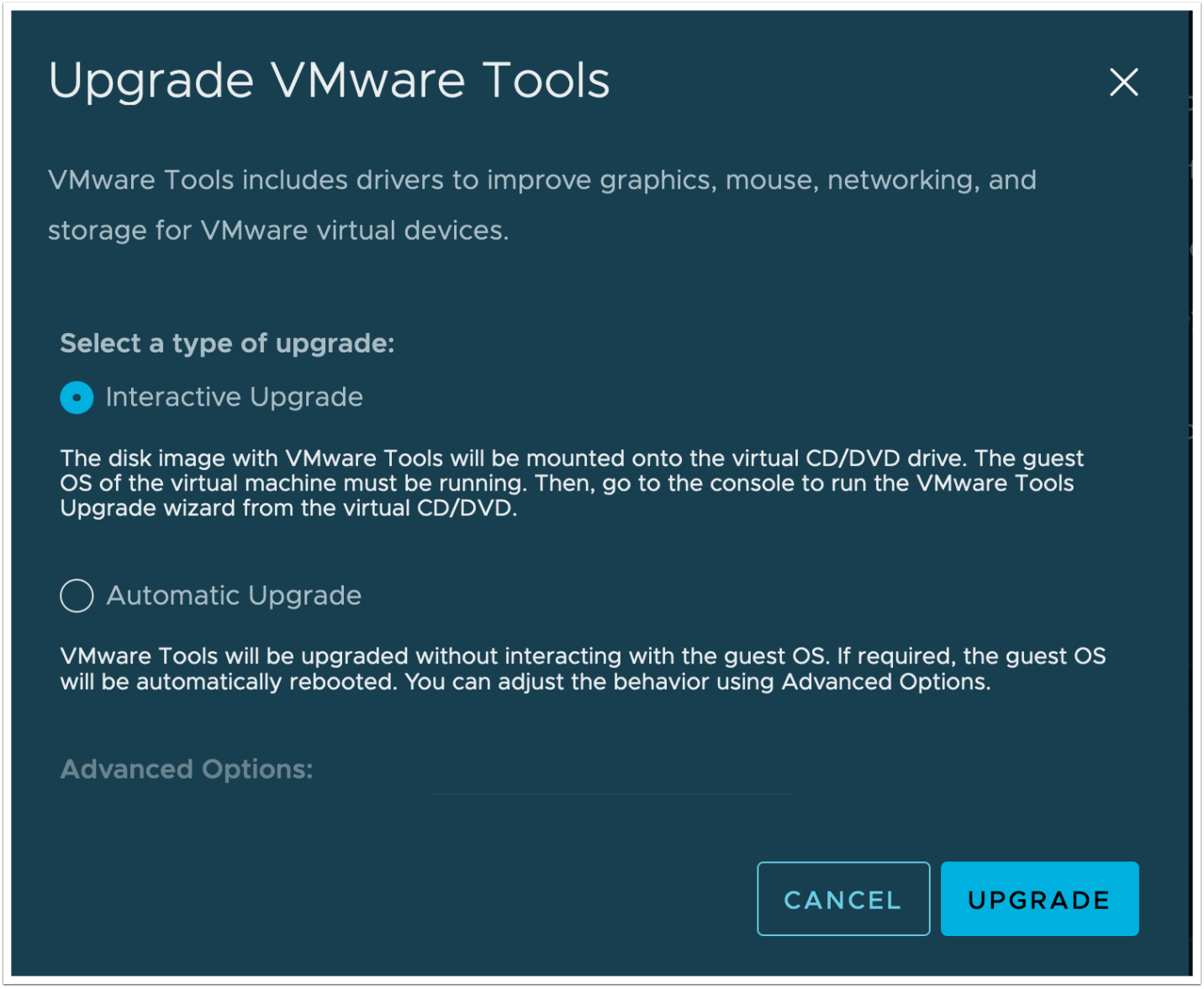
1. Right-click the VM.
2. Select **Power**.
3. Select **Power On**.

4. Click Upgrade VMware Tools on the Summary Tab



On the **Summary** tab for the VM, click **Upgrade VMware Tools**.

5. Use the Interactive Upgrade



1. Select **Interactive Upgrade**.
2. Click **UPGRADE**.

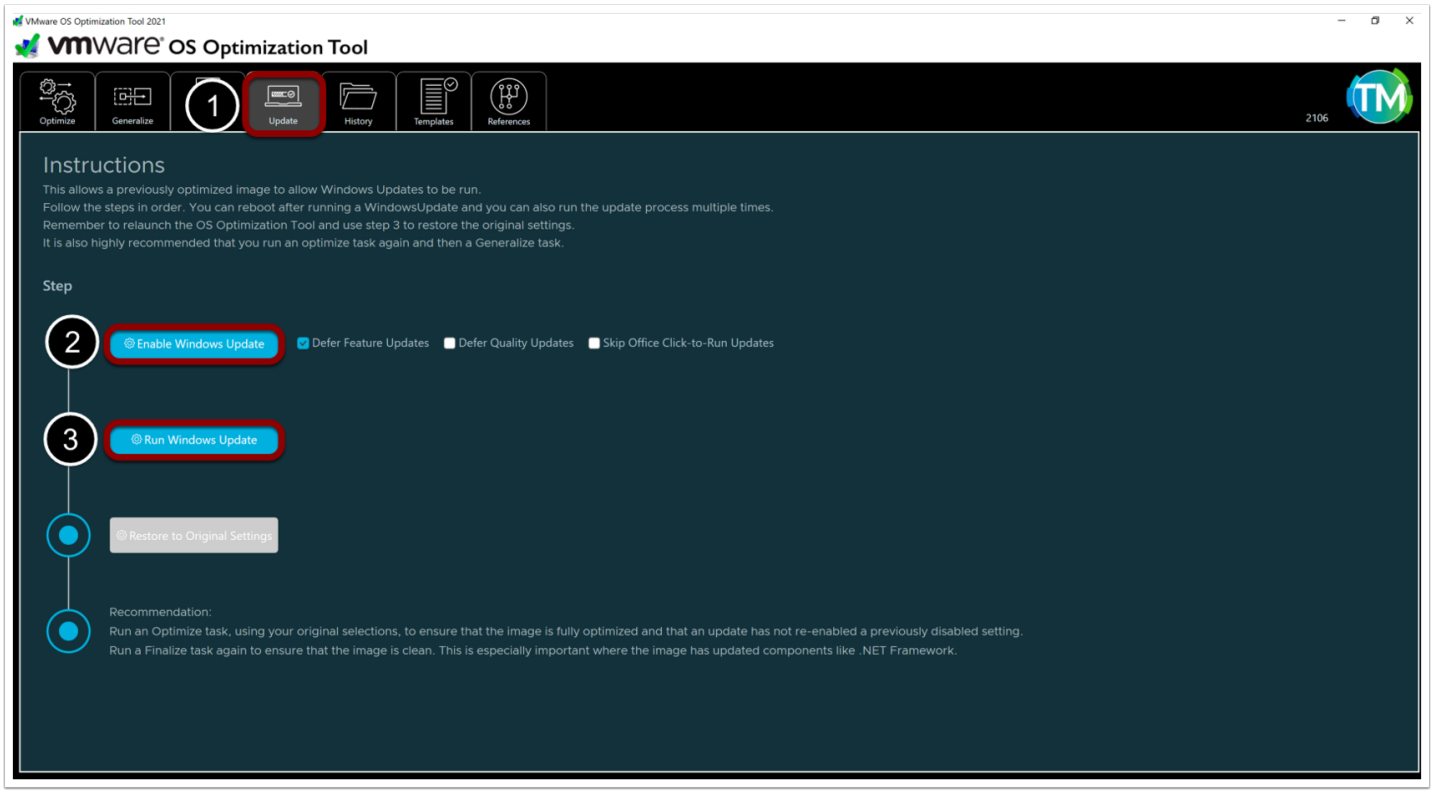
Now repeat the steps from Install VMware Tools.

Update Windows as Part of Day-2 Operations

Important: Updating Windows in the VM image is not recommended. Rather, it is better to generate a new image. An alternative to manually creating a new VM image each time you want to update Windows is to use automation. For step-by-step instructions, see the companion to this guide, titled **Using Automation to Create Optimized Windows Images for VMware Horizon VMs**.

If, however, you want to update Windows in the VM image, you can do so. If you have followed the instructions in this guide and used the OSOT as directed, some of the Windows Update facilities have been disabled. Before you can update Windows, you must re-enable Windows Update. After you update Windows, the best practice is to run the OSOT again.

1. Re-enable Windows Update



1. Run OSOT again and click on the **Update** tab.
    - If you are using a vSphere-based VM, run the OSOT on the VM you used to create the golden image.
    - If you are using Horizon Cloud on Microsoft Azure, use the Horizon Universal Console to duplicate the image, which creates a new VM with the same configuration, and run the OSOT on that VM.
2. Click **Enable Windows Update**.
3. Click **Run Windows Update**.

2. Update Windows

To update Windows, follow the instructions from the earlier Update Windows procedure in this guide.

3. Run the OSOT Again to Optimize and Finalize

Follow the instructions for the following tasks from the chapter Running the OS Optimization Tool to Optimize, Generalize, and Finalize the OS:

- Analyze and Optimize the OS Using Customizable Templates
- Use the OSOT Finalize Tab to Perform Final Cleanup Tasks if you are using a vSphere-based VM

Conclusion

In Conclusion

With the image optimization procedures in this guide, you are able to achieve a significant reduction in the amount disk space, CPU, and memory used by virtual desktop and RDSH server VMs and their vSphere hosts. The result is a corresponding savings in initial deployment time, user logon times, and IOPS.

Image optimization techniques included:

- Disabling unneeded Windows services and features
- Deleting unnecessary files and folders, such as event logs and temporary files
- Compressing OS files
- Zeroing out free disk space and shrinking the disk

Using the VMware OS Optimization Tool fling greatly simplifies many of these tasks.

This guide also provided step-by-step instructions for configuring the Windows image to perform optimally in a virtual environment, where CPU cores are shared among many VMs, and where users might be accessing a new VM every time they log in, though they probably will not realize it.

Seventeen discreet versions of the Windows OS were tested using the procedures in this guide, including thirteen versions of Windows 10.

The procedures in this guide help you create an optimized Windows image that you can use in a VMware Horizon implementation or in other types of deployments. End users will have a great experience, whether they access their personalized virtual desktops or remote applications from company laptops, their home PCs, thin-client devices, Macs, tablets, or smartphones.

Additional Resources

For more information about the VMware products mentioned in this guide, you can explore the following resources:

- Using Automation to Create Optimized Windows Images for VMware Horizon VMs
- Evaluate VMware Products
- Horizon Support Center
- Horizon 7 Documentation
- Horizon 8 Documentation
- Dynamic Environment Manager Documentation
- App Volumes Documentation
- VMware Product Guide
- VMware Product Interoperability Matrices
- VMware Professional Services
- VMware vSphere documentation

Changelog

The following updates were made to this guide.

Date	Description of Changes
2021-07-01	• Added links to Using Automation to Create Optimized Windows Images for VMware Horizon VMs. • Changed storage controller to PVSCSI for future compatibility. • Removed SVGA driver deselection from VMware Tools install, as it is no longer order dependent with the Horizon Agent with latest VMware Tools. • Added Windows 21H1 Education/Enterprise/Professional to the list of tested operating systems. • Removed all Windows 10 1709/1803/1809 (besides LTSC)/1903 editions and 1909 Pro from the list of tested operating systems as they are no longer supported. • Retested all supported operating systems with 2021-06-08 updates. • Updated for vSphere 7.0 U2. • Updated for OSOT 2106 and higher. • Updated links to product documentation topics.
2020-09-10	• Added Horizon Cloud on Azure. • Added Windows 2004/20H2 Education/Enterprise/Professional to the list of tested operating systems. • Retested all operating systems with 2020-09-08 updates. • Updated for vSphere 7. • Updated for OSOT 1170 and higher. • Updated for Horizon/AppVolumes/Dynamic Environment Manager 2006.
2020-01-30	• Removed Windows 7/8.1, Server 2012R2, Windows 10 1709/1803 Pro from the list of tested operating systems. • Added Windows Server 2019 and .NET Framework 3.5. • Retested all operating systems with 2020-01-14 updates. • Added a new chapter for day-2 updates for VMware Tools and Windows Update. • Added new sections that correspond to the Generalize and Finalize tabs of the OS Optimization Tool (January 2020 release), and removed the procedures that told how to do these tasks manually.
2019-10-10	• Removed mention of Windows mandatory profiles because this feature does not work reliably when used with Windows 10 version 1809 and later. Also, we found that login times are nearly equivalent if you use default user profiles instead of mandatory user profiles. • Removed the section "Configure Local Group Policies" because this task is now done by the OS Optimization Tool (as of the September 2019 release). • Renamed User Environment Manager to Dynamic Environment Manager. • Updated links to product documentation topics.

Authors and Contributors

Hilko Lantinga is a Staff End-User Computing (EUC) Architect in VMware Technical Marketing, with a focus on 3D, Horizon Windows Desktops and RDSH, Linux, and Applications. Previously, he was a Senior Consultant in VMware Professional Services, leading large-scale EUC deployments in EMEA and has over 20 years of experience in end-user computing.

Caroline Arakelian is a Senior Technical Marketing Manager, EUC Technical Marketing, VMware.

The following people contributed to the review of this paper:

- Graeme Gordon, Senior Staff EUC Architect, EUC Technical Marketing, VMware
- Jim Yanik, Senior Manager, EUC Technical Marketing, VMware
- Darren Hirons, Lead Solution Engineer in Digital Workspace UK, VMware

To comment on this paper, contact VMware EUC Technical Marketing at euc_tech_content_feedback@vmware.com.

VMware, Inc. 3401 Hillview Avenue Palo Alto CA 94304 USA Tel 877-486-9273 Fax 650-427-5001 www.vmware.com