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IBM Power Systems Private Cloud with Shared Utility Capacity

Featuring Power Enterprise Pools 2.0

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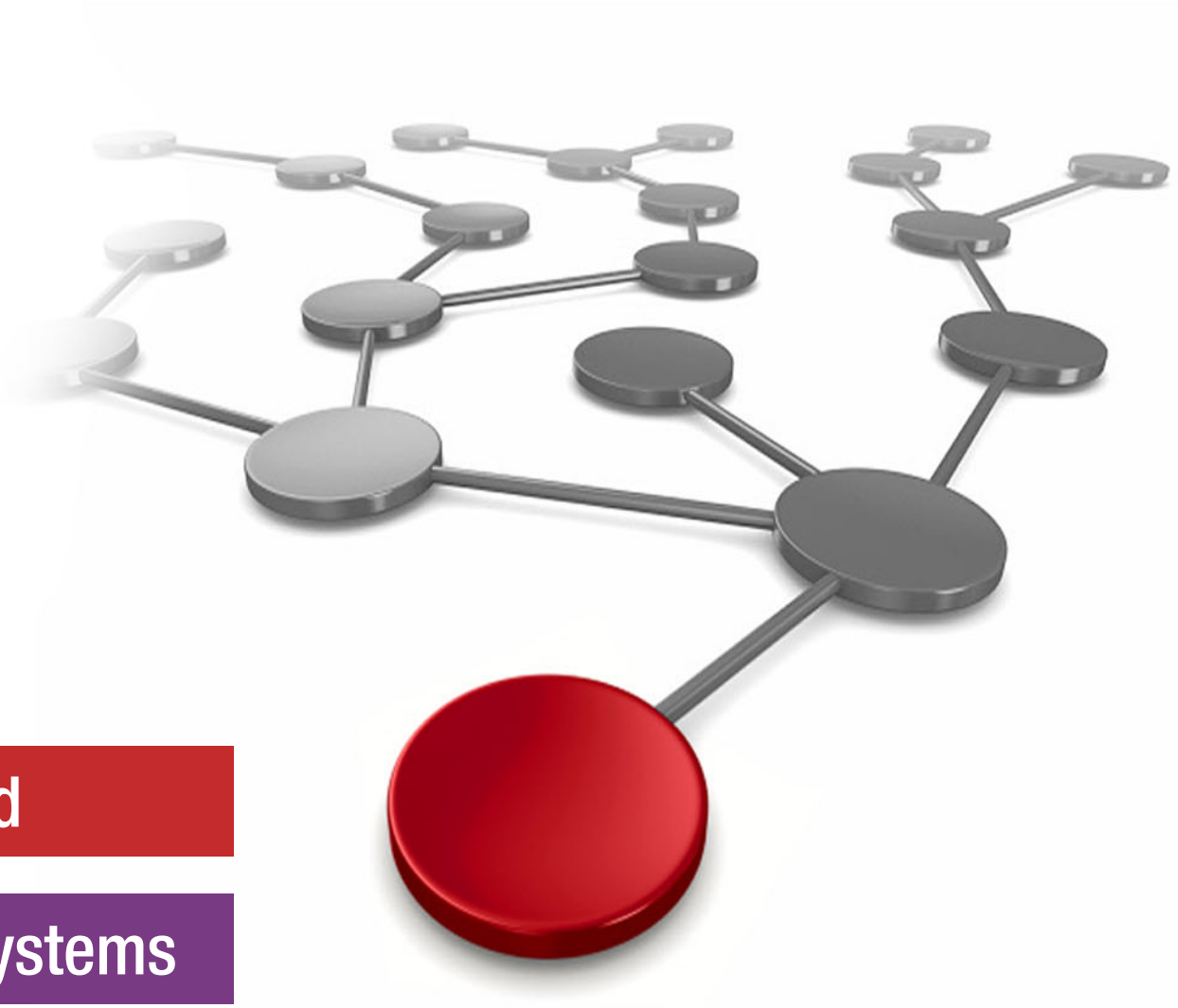

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IBM Power Systems Private Cloud with Shared Utility Capacity: Featuring Power Enterprise Pools 2.0

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Second Edition (September 2021)

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Preface

This IBM® Redbooks® publication is a guide to IBM Power Systems Private Cloud with Shared Utility Capacity featuring Power Enterprise Pools (PEP) 2.0.

This technology enables multiple servers in an *enterprise pool* to share base processor and memory resources and draw on pre-paid credits when the base is exceeded. Previously, the Shared Utility Capacity feature supported IBM Power E950 (9040-MR9) and IBM Power E980 (9080-M9S). The feature was extended in August 2020 to include the scale-out IBM Power servers that were announced on 14 July 2020, and it received dedicated processor support later in the year.

The IBM Power S922 (9009-22G), and IBM Power S924 (9009-42G) servers, which use the latest IBM POWER9™ processor-based technology and support the IBM AIX®, IBM i, and Linux operating systems (OSs), are now supported.

The previous scale-out models of Power S922 (9009-22A), and Power S924 (9009-42A) servers cannot be added to an enterprise pool.

With the availability of the IBM Power E1080 (9080-HEX) in September 2021, support for this system as part of a Shared Utility Pool has become available.

The goal of this book is to provide an overview of the solution's environment and guidance for planning a deployment of it. The book also covers how to configure IBM Power Systems Private Cloud with Shared Utility Capacity. There are also chapters about migrating from PEP 1.0 to PEP 2.0 and various use cases.

This publication is for professionals who want to acquire a better understanding of IBM Power Systems Private Cloud, and Shared Utility Capacity. The intended audience includes:

- Clients
- Sales and marketing professionals
- Technical support professionals
- IBM Business Partners

This book expands the set of IBM Power documentation by providing a desktop reference that offers a detailed technical description of IBM Power Systems Private Cloud with Shared Utility Capacity.

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1

Overview

This chapter provides a high-level overview of IBM Power Systems Private Cloud with Shared Utility Capacity.

This chapter provides a value proposition of moving to a pay-as-you-go model and positions this new offering in comparison to other Capacity on Demand (CoD) offerings that are available on IBM Power servers. In addition, this chapter introduces IBM Cloud Management Console (IBM CMC), which is used to manage a Shared Utility Capacity installation.

Note: Power Enterprise Pools (PEP) 2.0 was renamed to IBM Power Systems Private Cloud with Shared Utility Capacity. Within this publication, we are using the new name.

1.1 Value proposition

As more enterprises look at ways to reduce costs while maintaining the scalability that is required to stay competitive in today's fast-paced business environment, pay-as-you-go or consumption-based infrastructure models have grown increasingly popular. These purchase models enable clients to quickly scale up or down their IT infrastructure to optimize costs while quickly adapting to dynamic business environments. To maintain a competitive advantage, use an IT model that helps you adapt rapidly to the changing tech landscape.

A consumption-based IT model thrives in this environment because it has the following characteristics:

- Balances the flexibility of a cloud infrastructure with the control, security, and reliability that you expect from on-premises data centers.
- Pays for IT resources when they are actually consumed, which reduces the up-front capital expense and other costs that are associated with traditional procurement processes.
- Enables rapid infrastructure expansion to quickly accommodate the needs of new projects and workloads.

All these benefits contribute to a greater alignment between business and IT leaders, and when both sides of an organization are aligned, you are better prepared to deliver innovative products and services to your clients. Regardless of industry or company size, the shift to consumption-based IT is clear.

Flexible consumption offerings provide many of the attributes that clients like about public cloud in an on-premises, private cloud with better control and security.

IBM Power Systems Private Cloud Solution provides greater flexibility and scalability within your data centers. This new end-to-end solution enables you to take advantage of cloud agility and economics while getting the same business continuity and security that you are used to from IBM Power. There are three core components that make up the IBM Power Systems Private Cloud Solution:

- Dynamic cost optimization with pay-as-you-go pricing
- Automated, consistent enterprise IT management
- Increased flexibility for hybrid cloud

IBM Power Systems Private Cloud Solution expands the breadth and availability of Shared Utility Capacity to enable a wider range of IBM Power servers to take advantage of cloud agility and economics that were first provided with PEP 2.0 on the flagship IBM Power E980. With Shared Utility Capacity, the concept of PEP 2.0 is expanded to the IBM Power E950 server, and IBM Power S922 (9009-22G) and IBM Power S924 (9009-42G) servers. The newly announced IBM Power E1080 can also be part of a Shared Utility Capacity pool. In addition, the minimum activation requirements were lowered to 1 Base Processor Activation and 256 GB of Base Memory Activation when moving systems into a pool. These new requirements can substantially lower the initial system acquisition price for clients who want to minimize their short-term capital expenses or tailor their system configuration to their specific deployment plans.

The cloud-like agility and resilience that is offered with the IBM Power Systems Private Cloud Solution on-premises can ensure the business continuity and security that you look for and always count on from IBM Power servers with new economics around the ability to pay per use, by the minute, for compute resources to optimize your costs. IBM CMC provides robust monitoring and drill-down of resource consumption in real time and historically for systems within a pool.

Shared Utility Capacity delivers enhanced multisystem resource sharing and by-the-minute consumption of on-premises compute resources for clients deploying and managing a private cloud infrastructure. This flexibility combined with IBM Power security, reliability, and scalability provides clients with the consumption-based IT solution that is required in today's dynamic, hyper-competitive market. Shared Utility Capacity simplifies system management, so clients can focus on optimizing their business results instead of moving resources and applications around within their data center. Resources are easily tracked and monitored by IBM CMC, which automatically tracks usage by the minute and debits against Capacity Credits, which are based on actual usage. With Shared Utility Capacity, you no longer need to worry about over-provisioning capacity to support growth because all resources are activated on all systems in a pool. Purchased Base Activations can be seamlessly shared between systems in a pool, and all unpurchased capacity can be used on a pay-per-use basis.

All usage under the base capacity across the pool is not charged. All usage that is above the base capacity is metered by the minute and charged on a *pay-as-you-go* basis. Memory usage is tracked by assignment to active virtual machines (VMs), and it is not based on actual operating system (OS) usage of the memory. Core usage is tracked by the actual usage of VMs in the pool.

1.2 Implementation introduction

A single pool can contain up to 48 IBM Power servers. These servers must be in the same enterprise and country. Up to 1000 VMs can be supported by a single Hardware Management Console (HMC). A single IBM CMC instance can support up to 2000 VMs either in one large pool or in several smaller pools. Each HMC managing a system in the pool must have the Domain Name System (DNS) and the Network Time Protocol (NTP) enabled, and Performance and Capacity Monitoring (PCM) must be enabled for each managed system in the pool. A connection to IBM CMC is also required. Finally, clients can purchase prepaid Capacity Credits, which are used to cover metered usage charges (usage above the base capacity of the pool).

This section describes a few basic examples of how pools work. For example, if we have a two-system pool in which system A has five base cores and system B has five base cores, then if the total usage of both systems is less than or equal to 10 cores at any time, no charges are accrued. However, if usage exceeds 10 cores, then there are metered usage charges.

Figure 1-1 shows a pool with three systems. The pool has a total of 384 cores, of which 132 cores are base cores. System A exceeds its base capacity for the entire time interval, and the other two systems do not. But because the usage on system B and C is rather low, the overall base capacity of the pool is not exceeded, so no metered capacity is accrued and no Capacity Credits are consumed.

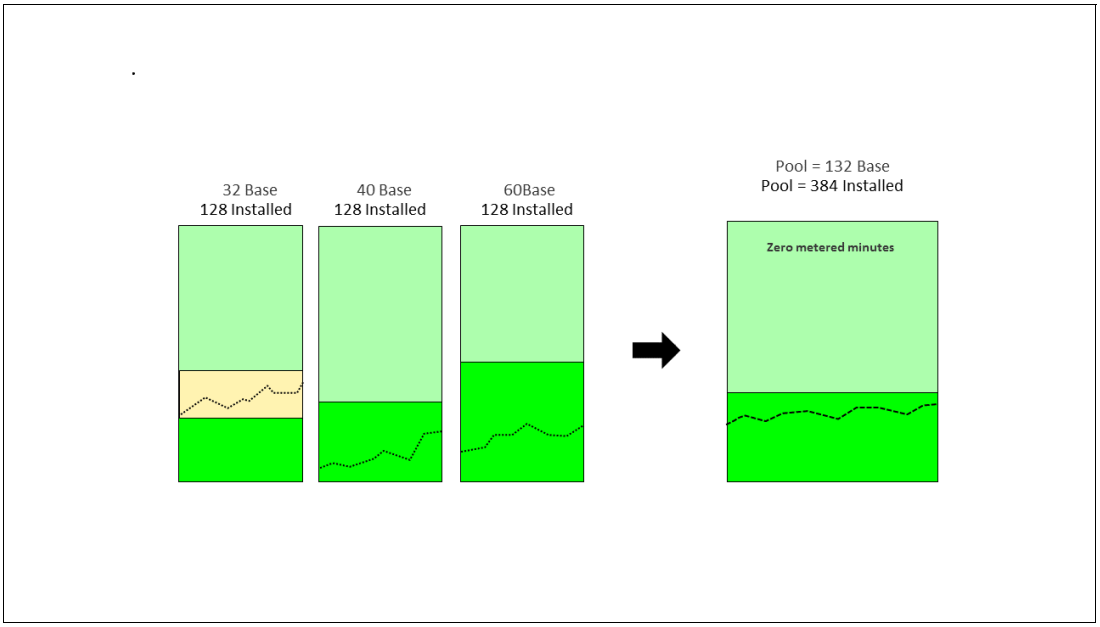

Figure 1-1 Pool usage with no metered charges

Figure 1-2 displays the same three-system pool at a different time. System A still exceeds its base capacity for the entire time interval and the other two systems do not. In aggregate, the usage exceeds the pool's base capacity, so metered usage charges are accrued because system A exceeded its base capacity enough to take the pool's total consumption above the pool's total base capacity, and systems B's and C's usage was not low enough to offset system A's usage.

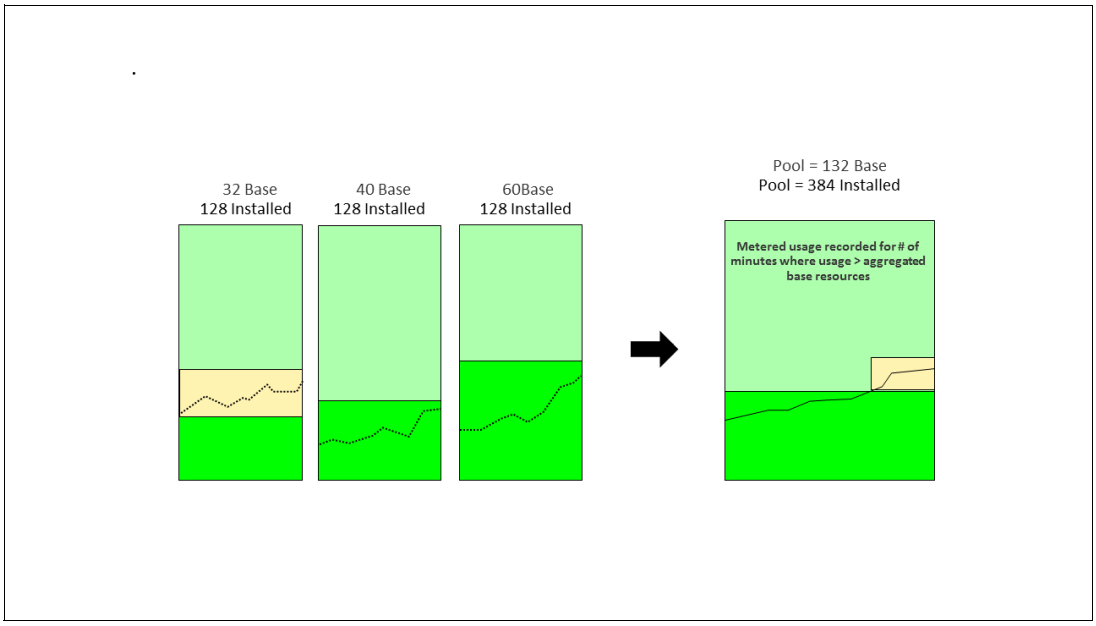

Figure 1-2 Pool usage with metered charges

Highlights of using IBM Power Systems Private Cloud with Shared Utility Capacity include:

- All installed processors and memory on the servers in a Shared Utility Capacity pool are activated and made available for immediate use when a pool is started. There is no need to reallocate mobile resources from server to server.
- System capacity is seamlessly made available when it is needed without requiring human awareness or intervention.
- Permanent processor and memory activations (base capacity) and corresponding license entitlements are purchased on each Power E1080, Power E980, or Power E950 server. These Base Processor and Memory Activation resources are then aggregated across a pool.
- Permanent processor activations (base capacity) and corresponding license entitlements are purchased on each Power S922 or Power S924 server. The Base Processor Activation resources are then aggregated across a pool.
- All unpurchased (inactive upon shipment) processor and memory capacity in the pool is activated when a system is added to a pool. Then, the capacity can be used on a pay-as-you-go basis (metered capacity) by using Capacity Credits that you purchase from IBM or an authorized IBM Business Partner.
- Processor resources within a pool are tracked by the minute, and they are based on the assignment of dedicated processors to active VMs and actual consumption of dedicated-donating VMs and shared processor VMs. The average consumption in any given minute is tracked, not the peak consumption.
- Memory resources within a pool are tracked by the minute, and they are based on the assignment of resources to active VMs, not on the OS usage of the memory. Again, average consumption is tracked, and the memory that is assigned to inactive VMs is not tracked.
- Metered capacity consumption on one system may be offset by idle base capacity elsewhere in the pool during the same period.
- Each Shared Utility Capacity pool is monitored and managed from an IBM CMC in IBM Cloud®.
- A single Shared Utility Capacity pool can support up to 2,000 shared processor VMs across up to 48 IBM Power servers with a maximum of 1000 VMs per HMC within a single enterprise within a single country. There can be multiple HMCs concurrently connected to an IBM CMC per IBM Power server.
- Capacity Credits can be purchased from IBM, an authorized IBM Business Partner, or online through the IBM Entitled Systems Support website, where available.
- You can more easily identify capacity usage and trends across your IBM Power servers in a pool by viewing web-accessible aggregated data without spreadsheets or custom analysis tools.

1.3 Comparing Capacity on Demand offerings

With CoD offerings, you can dynamically activate one or more resources on your server to meet your business requirements. Some servers include some active and inactive processor cores and memory units. Active processor cores and active memory units are resources that are available for use on your server. Inactive processor cores and inactive memory units are resources that are included with your server, but are not available for use until you activate them by using CoD. These activations can be on a temporary or permanent basis.

Here are the CoD offerings and details:

- Capacity Upgrade on Demand (CUoD)

  You can permanently activate inactive processor cores and memory units by purchasing an activation feature and entering the provided activation code on the HMC. You can do this task without restarting your server or interrupting your business.

- Elastic CoD

  You can activate processor cores or memory units for a number of days by using the HMC to activate resources on a temporary basis. Activations are available in 24-hour increments.

- Utility CoD

  Utility CoD is used when you have unpredictable, short workload spikes. You can automatically provide extra processor capacity on a temporary basis within the shared processor pool of a single system. Usage is measured in processor minute increments.

- Trial CoD

  You can evaluate the use of inactive processor cores, memory, or both, at no charge by using Trial CoD. After it starts, the trial period is available for 30 contiguous power-on days.

- Power Enterprise Pool 1.0

  A Power Enterprise Pool 1.0 is a group of systems that can share Mobile CoD processor resources and memory resources. Mobile resources can be assigned to individual servers in the pool from the HMC.

- IBM Power Systems Private Cloud with Shared Utility Capacity

  In a Shared Utility Capacity Pool, all systems in a pool share their activated base capacity without any requirement for user intervention. The pool's usage is tracked by the minute on IBM CMC. Capacity above the pool's base capacity can be automatically used and is metered and charged by the minute.

1.3.1 Power Enterprise Pools 1.0

PEP 1.0 can move mobile processor and memory activations between servers in a defined pool by using the HMC. There are four different types of pools:

- The IBM Power 770+, IBM Power E870, IBM Power E870C, and IBM Power E880C pools
- The IBM Power 780+, IBM Power 795, IBM Power E880, IBM Power E870C, and Power E880C pools
- The Power E870, Power E880, Power E870C, Power E880C, and Power E980 pools
- The Power E980 and Power E1080 pools

Each system contains static core and memory resources and can contain mobile core and memory activations. After you create your PEP, all mobile processor resources and mobile memory resources are allocated to the pool. You must use the HMC to allocate mobile resources to the servers in the pool. You do not have to notify IBM when you allocate resources.

You can assign mobile resources to partitions in the same manner as you assign permanent resources to partitions. Mobile resources remain on a server until you remove them from that server. Mobile resources do not expire in the same manner as Elastic CoD resources or Trial CoD resources. Movement of mobile resources is instant, dynamic, and non-disruptive.

Figure 1-3 shows an example where multiple HMCs are used for managing a PEP 1.0 consisting of three servers.

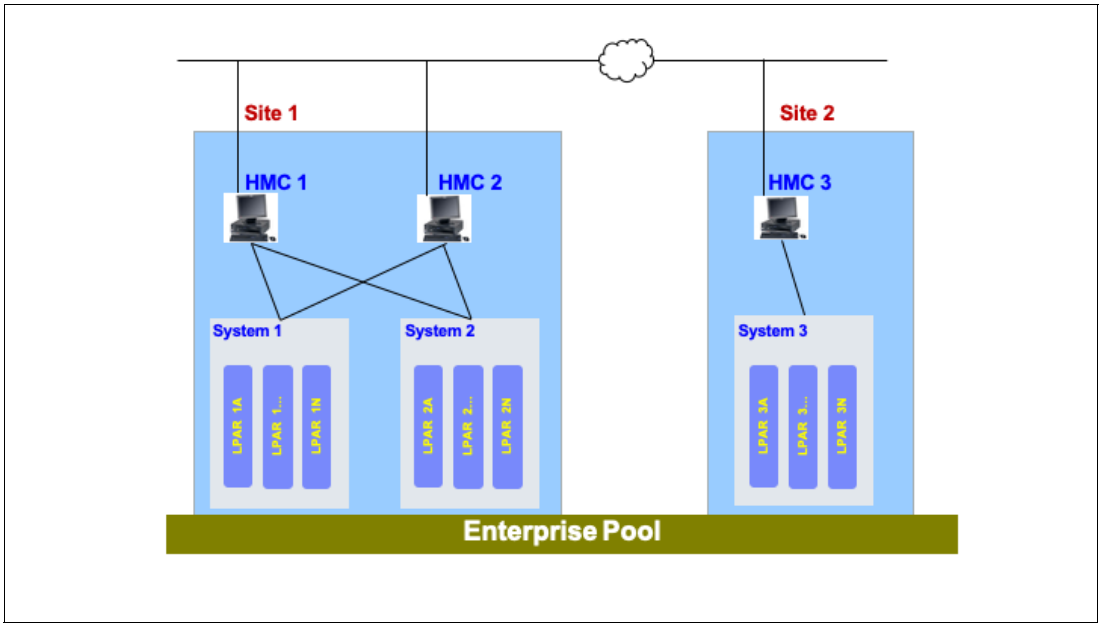

Figure 1-3 Power Enterprise Pools 1.0

1.3.2 Power Enterprise Pools 2.0

Starting with PEP 2.0 (later renamed to IBM Power Systems Private Cloud with Shared Utility Capacity), you do not need to move resources manually. All installed processors and memory on systems in a IBM Power Systems Private Cloud with Shared Utility Capacity pool are activated and made available for immediate use when a pool is started. Processor and memory usage on each server are tracked by the minute and aggregated across the pool.

From an Enterprise Pool 2.0 point of view, there are three groups of systems:

- Power E1080 and Power E980
- Power E950
- Power S924 (9009-42G) and Power S922 (9009-22G)

Note: Servers from different groups cannot coexist in the same pool.

Base processor and memory activations, and the corresponding software license entitlements, are purchased for each server in PEP 2.0. The base resources are aggregated and shared across the pool without having to move them from server to server. The unpurchased capacity in the pool can be used on a pay-as-you-go basis. Resource usage that exceeds the pool's aggregated base resources is charged as metered capacity by the minute, and is debited against purchased Capacity Credits on a real-time basis. Capacity Credits can be purchased from IBM, an authorized IBM Business Partner, or online through the IBM Entitled Systems Support website, where available.

Note: On scale-out servers (9009-22G and 9009-42G), base memory activations and metered memory are not available. All installed memory is activated by default.

Processor usage is tracked based on the assignment of dedicated processors to active partitions and actual consumption by dedicated-donating partitions and shared processor partitions. Memory usage is tracked based on the assignment of memory to active partitions, and is not based on the OS usage of the memory. Both processor and memory usage are tracked and charged by the minute. Both processor and memory usage are based on the average usage for 1 minute and not the peak usage during the minute.

- Processor usage is tracked and charged by the OS. Processor activations and software license entitlements are monitored and metered independently. There are six different types of processor-related metered capacity charges:Any OS core (A core that can run any OS that is supported on IBM Power servers.)
- Linux or Virtual I/O Server (VIOS) core (A core that can run only Linux or VIOS.)
- IBM AIX software (licensed per core)
- IBM i software (licensed per core)
- SUSE Linux Enterprise Server for Power (subscription per socket)
- Red Hat Enterprise Linux (RHEL)

There is no software charge for a VIOS partition.

A monthly budget for metered capacity consumption can be set. Both dedicated and shared processor partitions are allowed in PEP 2.0.

PEP 2.0 is monitored and managed from the IBM CMC. The IBM CMC Enterprise Pools 2.0 application provides monitoring of base and metered capacity across a IBM Power Systems Private Cloud with Shared Utility Capacity pool, with summary and sophisticated drill-down views of real-time and historical resource consumption by a VM.

1.4 Power E1080, Power E980, Power E950, and Power S922 and Power S924 server variations

This section compares the IBM Power Systems Private Cloud Solution on different supported IBM Power Systems Private Cloud with Shared Utility Capacity configurations.

Depending on the hardware, there are three types of IBM Power Systems Private Cloud with Shared Utility Capacity pools that you can create:

- A pool with Power E1080 or Power E980 servers
- A pool with Power E950 servers
- A pool with Power S924 (9009-42G) or Power S922 (9009-22G) servers.

All three of these pools support Shared Utility Capacity, but there are a few differences based on the associated Machine Type Model and what is supported on those IBM Power servers.

You can see the list of differences in Table 1-1.

Table 1-1 Power Systems Private Cloud scope: Scale-out versus scale-up

Item	Scale-up (Power E1080 and Power E980)	Scale-up (Power E950)	Scale-out (Power S924 and Power S922)
Shared Utility Capacity	Yes	Yes	Yes
Processor core metering	Yes	Yes	Yes
AIX entitlement metering	Yes	Yes	Yes
IBM i entitlement metering	Yes	N/A	Yes
RHEL metering	Yes	Yes	Yes
SUSE Enterprise Linux metering	Yes	Yes	No
Memory metering	Yes	Yes	No
Base activations by OS	One for any OS and another for Linux / VIOS	One for any OS and another for Linux / VIOS	One for any OS
Intermix of systems in same pool	Yes	No	Yes
Managed through IBM CMC	Yes	Yes	Yes
Try before you buy: Lab Services Private Cloud Capacity Assessment (#EP2X)	Yes	Yes	No, quote directly with Lab Services
Buy Capacity Credits in the IBM Entitled Systems Support portal	Yes	Yes	Yes

Note: There are different feature codes for different types of IBM Power servers for the same type of base activations. Make sure to use correct feature codes in the order process. For more information, see 2.6, “Ordering process” on page 59.

The base memory activation and metering are not enabled for Power S924 (9009-42G) or Power S922 (9009-22G) systems. When configuring a scale-out pool, the systems are configured with standard memory features that always include the activation of all installed memory.

Note: For the scale-out systems, IBM CMC considers all installed memory as base memory.

Another significant differentiator is the supported OSs. IBM i is not supported on Power E950 systems, so it is not supported by IBM Power Systems Private Cloud with Shared Utility Capacity pools on Power E950 systems. It is supported on Power E1080, Power E980 systems, and scale-out systems, so IBM i workloads can be part of PEP 2.0 on Power E1080 systems, Power E980 systems, or on scale-out systems.

Power E1080, Power E980, and Power E950 servers can be configured with two sets of base hardware activations:

- One core activation for any OS
- One core activation for Linux or VIOS only

The “one core activation for Linux or VIOS only” type of base activation is not available on scale-out systems. All types of workload (AIX, IBM i, Linux, or VIOS) are charged against the “one core activation for any OS” type of base activation.

There are also differences in metered Capacity Credits and their value in minutes on different type of pools. A detailed comparison of the provided metered minutes for a credit can be seen in 1.7.3, “Credits” on page 23.

At the time of writing, it is possible to include Feature Code #EP2X in a Power E1080, Power E980, or Power E950 system order, but the feature code is not available on scale-out systems. A Private Cloud Capacity Assessment and Implementation service from IBM Systems Lab Services is offered as part of the Power to Cloud Rewards Program when the engagement is preselected though Feature Code #EP2X or requested for a system with PEP enablement Feature Code #EP20 on a qualifying IBM Power server.

In addition, systems that are ordered with Feature Code #EP2X are eligible as part of the Private Cloud Capacity Assessment to be configured with as few as 1 core and 256 GB of Static Activation and receive up to 60 days of Trial Capacity. This Feature Code provides the maximum range of compute resources to clients who want to evaluate and project the benefits of using Elastic or Utility Capacity on IBM Power servers as part of their infrastructure. A similar engagement with IBM Systems Lab Services can be separately requested directly from Lab Services. For more information about the provided analysis, see 5.2, “IBM Systems Lab Services sizing support” on page 145.

1.5 Introducing IBM Cloud Management Console

IBM CMC for IBM Power servers provides a consolidated view of the IBM Power servers in your enterprise. It runs as a service that is hosted in IBM Cloud, and you can access it securely anytime and anywhere to monitor and gain insights about your IBM Power servers. IBM CMC can be deployed based on the client input to different IBM Cloud regions. Supported regions are US South (Dallas), Germany (Frankfurt), UK (London), and Australia (Sydney).

IBM CMC provides the following features to clients:

- Inventory
- Capacity Monitoring
- Logging
- Patch Planning
- Support to manage app links of the following on-premises software: IBM PowerVS, IBM PowerVC, PowerHA, IBM PowerSC, IBM PowerSC MFA, and VM Recovery Manager for High Availability (HA)
- IBM Power Systems Private Cloud with Shared Utility Capacity

You can start any of the above applications from the IBM CMC dashboard or from the navigation menu.

To enable IBM CMC to monitor the servers in your enterprise, it needs data that is uploaded by the HMCs in your data center. Secure Cloud Connector is the HMC component that uploads data to the IBM CMC cloud. Secure Cloud Connector verifies the identity of your IBM CMC instance and provides end-to-end encryption between the instance and the HMC in your data center.

IBM CMC is supported for any IBM POWER8® or later processor-based servers.

The solution is built for mobile devices, tablets, and desktop browsers to provide convenient access to the application.

Note: Before starting the cloud connector in the HMC, ensure that the systems that are connected to the HMC meet the minimal required firmware (FW) level, which is described in “Hardware Management Console requirements” on page 34.

Figure 1-4 shows the IBM CMC dashboard.

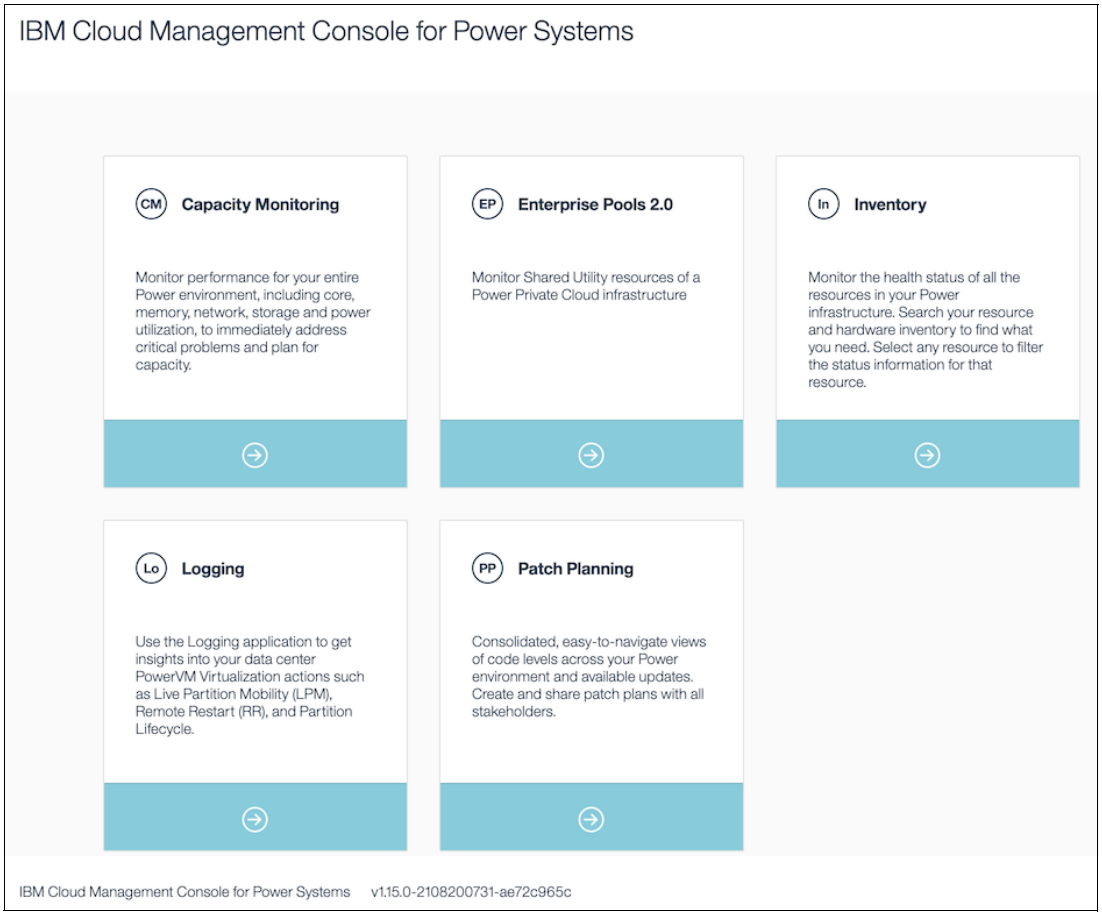

Figure 1-4 IBM Cloud Management Console

1.5.1 Activating IBM Cloud Management Console

IBM CMC is an online SaaS solution which must be set up.

To activate your CMC instance, you need to fill in the CMC activation form and email it to `support@ibmcmc.zendesk.com`

This activation form can be found at the IBM Entitled Systems Support website in the Help section.

You can view existing software entitlements by logging in to IBM Entitled Systems Support and selecting **Inventory explorer** → **Software maintenance** → **Active/Shipped**, as shown in Figure 1-5 on page 12.

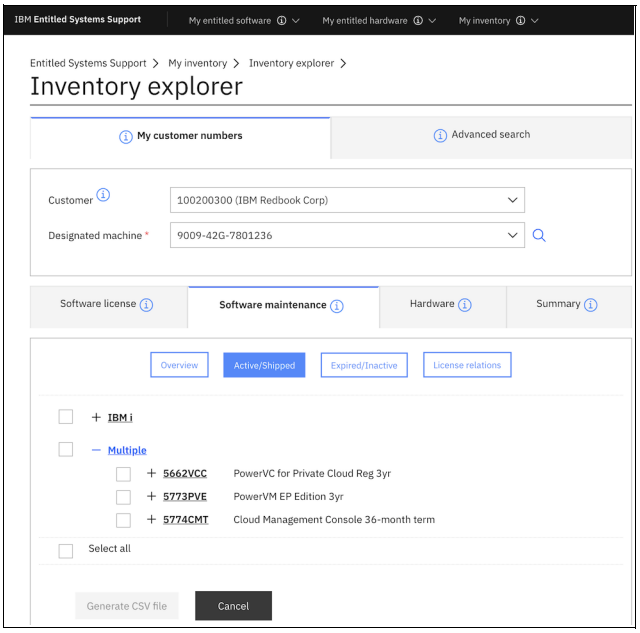

Figure 1-5 ESS Inventory explorer

The following active service contracts entitle you to obtain a CMC instance:

- 5771-CMT - Cloud Management Console 3-month term
- 5772-CMT - Cloud Management Console 6-month term
- 5773-CMT - Cloud Management Console 12-month term
- 5774-CMT - Cloud Management Console 36-month term
- 5775-CMT - Cloud Management Console 48-month term
- 5776-CMT - Cloud Management Console 60-month term

After the form is processed, the CMC help desk team will provide you with your CMC instance's link.

1.5.2 Accessing IBM Cloud Management Console

To access IBM CMC, you need the unique subdomain *<my_subdomain>*, which you provided during the ordering process.

To access IBM CMC, complete the following steps:

1. Enter the following URLs into a browser window:
   - `http://<my_subdomain>-powercloud.mybluemix.net/` for the IBM CMC Dallas location
   - `http://<my_subdomain>-powercloud.eu-de.mybluemix.net/` for the IBM CMC Frankfurt, Germany location
   - `http://<my_subdomain>-powercloud.eu-gb.mybluemix.net/` for the IBM CMC London, UK location
   - `http://<my_subdomain>-powercloud.au-syd.mybluemix.net/` for the IBM CMC Sydney, Australia location
2. Log in to the portal by using the admin ID that you provided when you ordered the IBM CMC.

With the admin ID, you can view all the applications that are enabled for your organization in the IBM CMC dashboard.

Managing users

The Manage Users function is available only for the administrator login that you registered with IBM CMC. You can use the Settings window to manage users and applications for your organization.

To access the Settings window, select **Navigation menu** → **Settings icon**.

You can create, modify, provide access permissions to, or delete users by using the administrator login.

1.5.3 IBM Cloud Management Console features

With IBM CMC, you can securely view information and gain insights about the IBM Power servers in your enterprise. This section gives an overview of the IBM CMC functions.

Table 1-2 shows the summary of the IBM CMC features and their benefits.

Table 1-2 Summary of IBM Cloud Management Console features

Feature	Benefits
Offered as a service in the IBM Cloud	► Clients do not have to install and maintain the software. ► Clients can use the solution function faster, and IBM can deliver new functions faster.
Inventory	► Enterprise-wide views of IBM Power servers, HMCs, logical partitions (LPARs), and resources that are associated with these components. ► View the state of the resources of your IBM Power servers. ► Provides the hardware inventory. ► Simplified views with grouping of resources by using client-supplied tags.
Capacity Monitoring	► Aggregated performance views that provide resource consumption and performance data for IBM Power servers, LPARs, and I/O components. ► Energy monitoring.
Logging	► System log aggregation across the IBM Power servers in your enterprise. ► Gain insights into virtualization operations, which include Live Partition Mobility (LPM), remote restart (RR), and other partition activities.
Patch Planning	View patch planning needs across all the IBM Power server resources in your environment. The resources include FW, VIOSs, OSs, adapters, and HMCs. ► View the code levels and available updates. ► Create and share patch plans with all stakeholders.
PEP 2.0	Manage and monitor IBM Power Systems Private Cloud with Shared Utility Capacity.
Software launch capability	Start IBM Power software, such as PowerVC, IBM PowerSC, and PowerHA.

Inventory

The Inventory application displays an aggregated view of all the data centers and the resources in your environment.

If you click **Inventory** and then click the **Dashboard** tab, you can view the state summary of managed systems, LPARs, and VIOSs in the data center. There are good states and bad states for each resource type. Examples of good states are operating or initializing for a managed system, and examples of bad states are no connection or failed authentication for a managed system.

Figure 1-6 shows the Inventory dashboard view in IBM CMC.

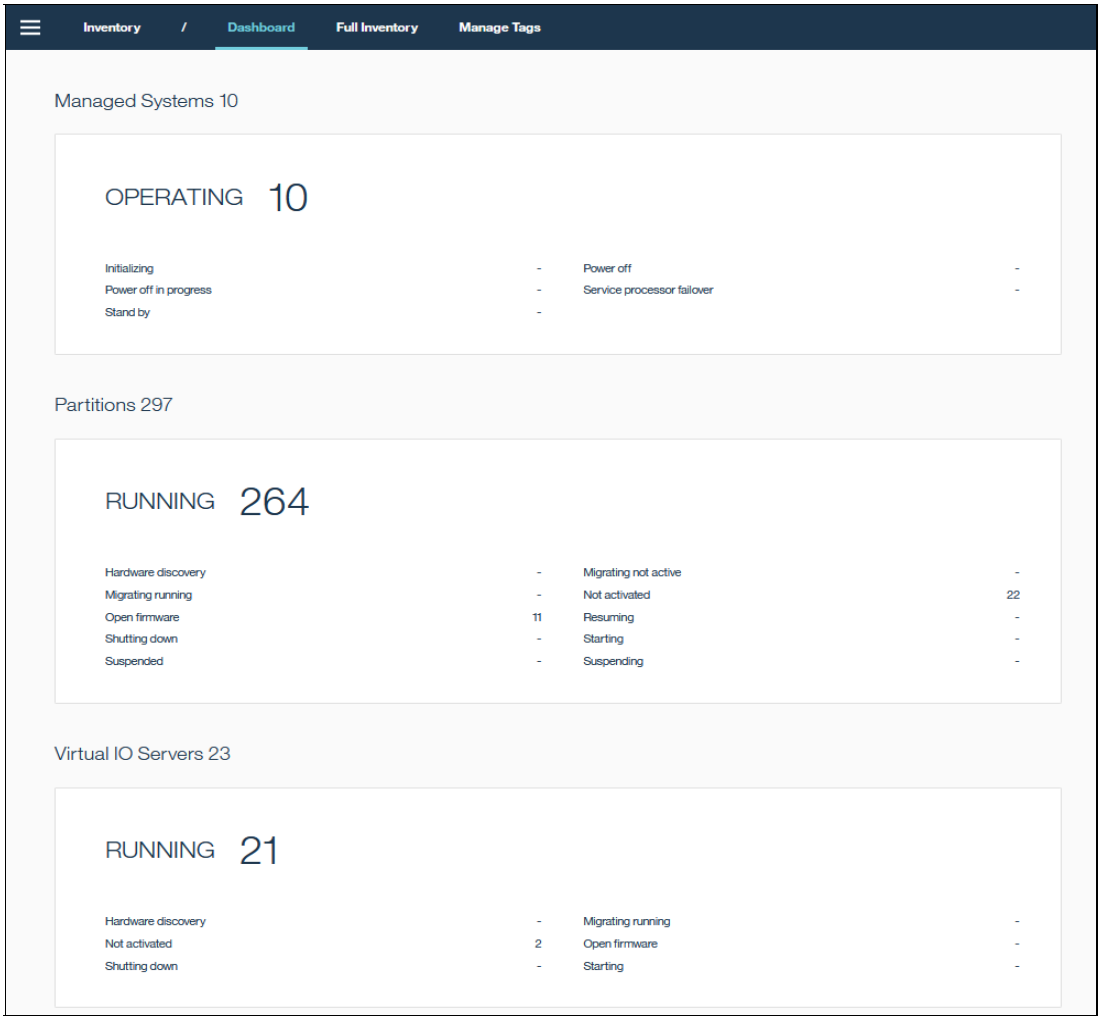

Figure 1-6 Inventory dashboard view in IBM Cloud Management Console

On the **Full Inventory** tab, you can view the detailed inventory information of the resources in your IBM Power server environment, including managed systems and HMCs, partitions and VIOSs, and shared storage pool clusters.

Figure 1-7 shows the Full Inventory view in IBM CMC.

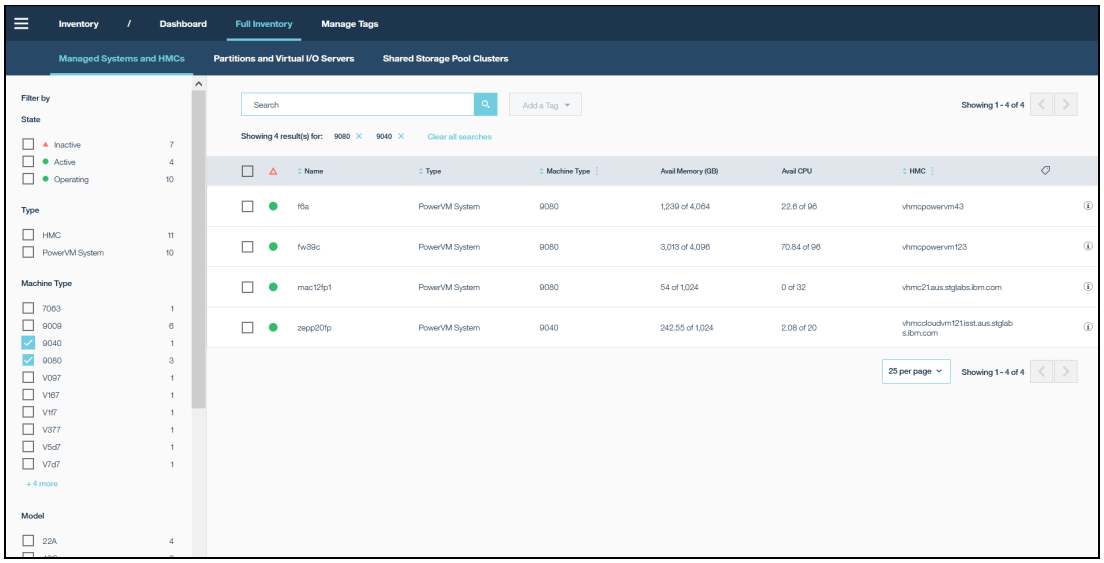

Figure 1-7 Full Inventory view in IBM Cloud Management Console

Capacity Monitoring

This feature provides aggregated performance views for your entire IBM Power environment. It displays core, memory, network, storage, and power utilization data. You can view real-time and historical performance data, which can help you to identify bottlenecks, analyze critical problems, and plan for capacity.

To view the performance data of a resource, go to the navigation menu, click **Capacity Monitoring**, and select the resource that you want to view in the content area. The resources are:

- Systems
- Partitions
- Shared Processor Pools
- Shared Storage Pool Clusters

Figure 1-8 shows the core usage of a managed system for the week as shown by the Capacity Monitoring feature.

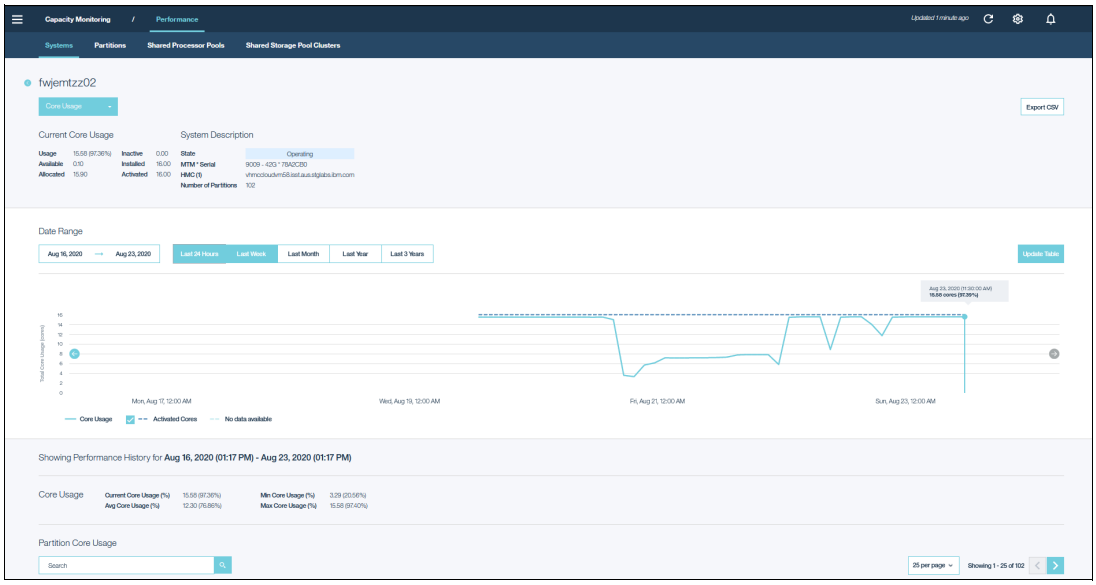

Figure 1-8 Capacity Monitoring view in IBM Cloud Management Console

Enterprise Pools 2.0

The Enterprise Pools 2.0 application in IBM CMC monitors and manages PEP 2.0.

To access IBM Power Systems Private Cloud with Shared Utility Capacity, complete the following steps:

1. Click the navigation menu, and then click **Enterprise Pools 2.0**.
2. In the contents area, click any of the available pools to manage or monitor it. You can select **Inventory**, **Core Usage**, **Memory Usage**, **Budget**, **Usage Statement**, and **Events** for a pool.

Figure 1-9 shows the resource summary that is displayed by the Enterprise Pools 2.0 application Inventory window.

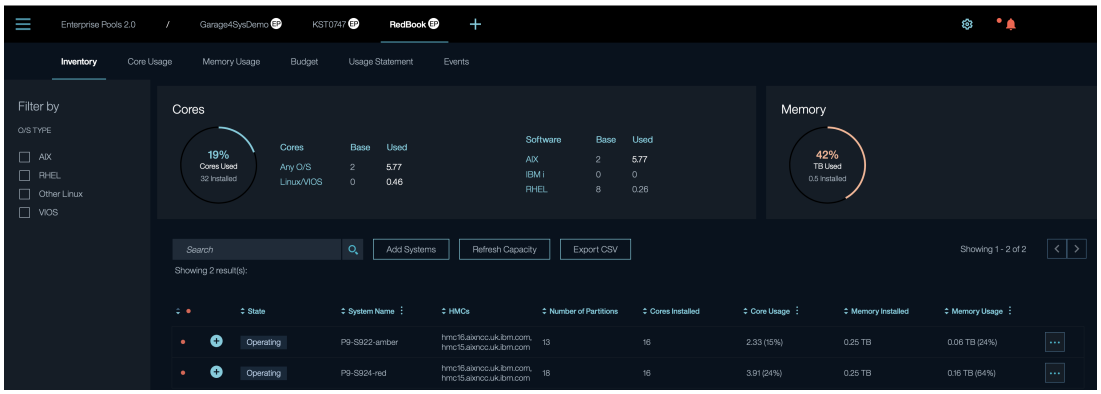

Figure 1-9 Enterprise Pools 2.0 Inventory window

The following functions are available for pool management:

- Create Pool

  This function is used to create an Enterprise Pool 2.0. To create a pool, click the **(+)** icon at the top of the window next to PEP 2.0 / available pools.

- Inventory

  You can view the resource usage for the pool. The resource usage that is shown is the usage as of approximately 3 minutes before the time the Inventory window was loaded.

- Pool Settings

  To manage the pool and threshold settings, click the **Settings** icon (the gear icon next to bell icon) at the upper right of the window. One of the settings is to have the monthly usage statement emailed to you.

- View Notifications

  You can view the notifications for a pool, which are generated by IBM CMC, by clicking the **Notifications** (the bell) icon. The Notification icon is next to the Settings icon at the upper right of the window.

- Budget

  In the Budget window, you can view and set monthly budgets for the metered capacity usage in a pool. You can also use the Budget window to view the metered capacity usage in credits, for the current month and for all previous months.

- Core Usage

  When you click **Core Usage** for an Enterprise Pool 2.0, you can view and analyze the current and historical core usage for a pool, and for systems and partitions in a pool. Core usage is tracked in minutes.

- Memory Usage

  You can view and analyze the current and historical memory usage for a pool, and for the systems and the partitions in a pool. Memory usage is tracked and charged by the minute. It is tracked based on the assignment of memory. Virtual persistent memory (PMEM) is always tracked even when the partitions are not activated.

- Usage Statement

  This window shows the metered capacity usage of a pool. You can view the monthly metered capacity usage by resource type in minutes and in credits. This window also shows you the remaining credit balance for the pool and remaining budget for the month.

- Events

  This window shows the events that occurred for the pool. The date and time the event occurred, the user ID that performed the event, and a description of the event are displayed.

Logging

The Logging application displays the different LPM and RR operations that are performed on the LPARs in your inventory.

Figure 1-10 shows all the LPM and RR operations that are filtered by operation type Active LPM.

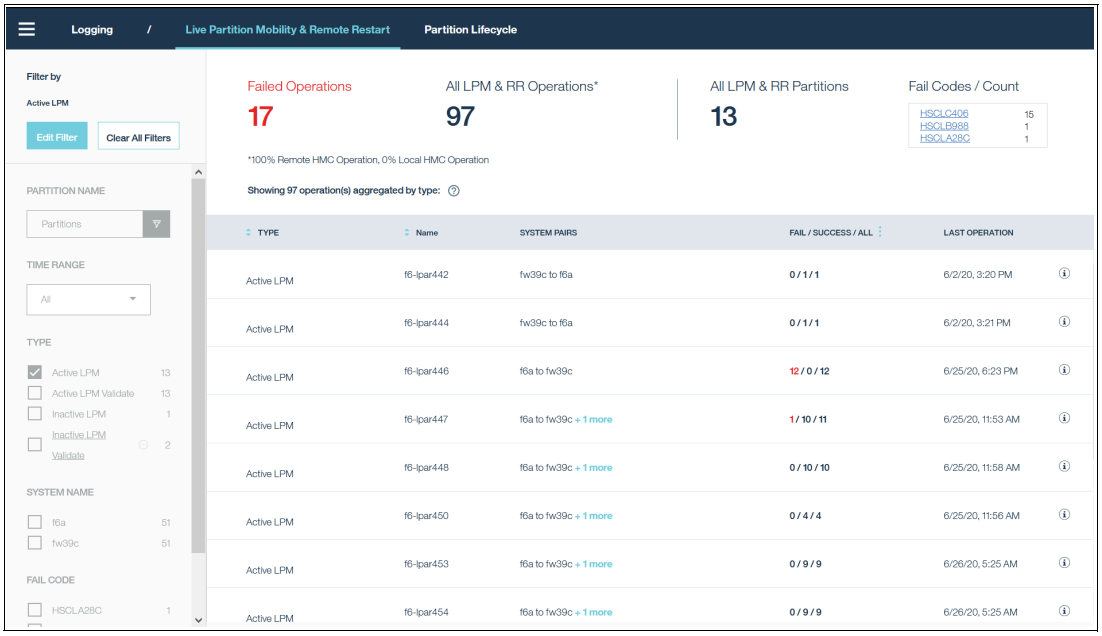

Figure 1-10 Table of Active LPM operations that are displayed by the Logging application in IBM CMC

As shown in Figure 1-10, the logging application provides details of all active LPM operations:

- Name of the partition and the operation type.
- Number of times the active LPM operation is performed on the partition, and the number of successful and failed operations.
- Average duration that is taken for a successful operation on the LPAR.
- Date and time the operation was last performed.
- Managed systems that are frequently used for the operation.

The **Partition Lifecycle** tab provides a view of the following operations on LPARs in your inventory:

- Create
- Activate or Apply Configuration
- Shut down
- Delete

Figure 1-11 shows the **Partition Lifecycle** tab in the logging application.

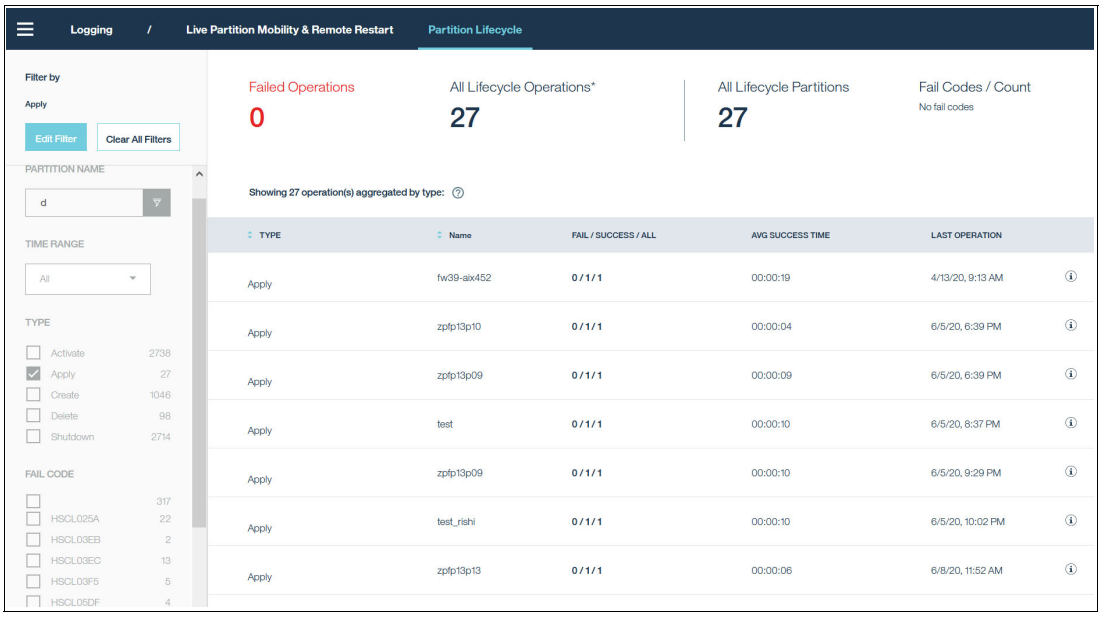

Figure 1-11 Partition Lifecycle tab in the Logging application

Patch Planning

The Patch Planning application provides a comprehensive view of the current and latest patch levels for the resources in your inventory. You can use this feature to do the following actions:

- View the current patch level and latest patch update or latest patch upgrade that are available for a resource. The resources can have the following views:
  - List of all resources patch information
  - List of resources that need a patch update
  - List of resources that are up to date on their patch levels

  The resources include OSs, FW, VIOSs, adapters, and HMCs.
- Create and share patch plans with all stakeholders.

Figure 1-12 shows the list of AIX OS and FW resources that need a patch level update.

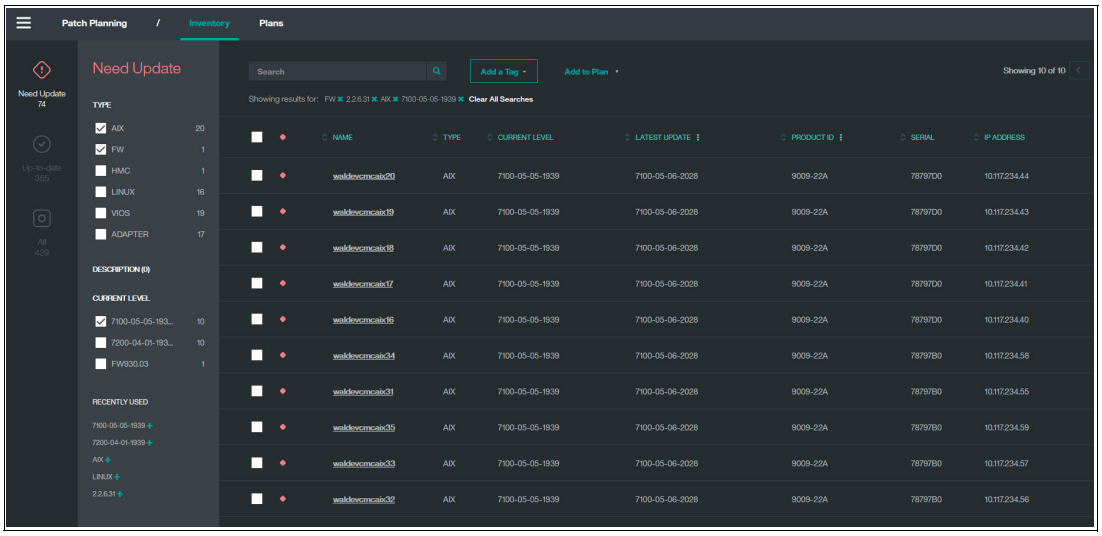

Figure 1-12 Patch Planning application view in IBM Cloud Management Console

Software launch capability

IBM CMC provides a software launch capability for IBM Power software, such as PowerVC, IBM PowerSC, and PowerHA, and IBM PowerSC MFA and VM Recovery Manager for HA. Users can add links for this software. Multiple links can be added for each application. A unique name must be given for each link. You can access the links from the IBM CMC dashboard or from the navigation menu.

1.6 Connection requirements

All IBM Power servers that are participating in a PEP 2.0 must be connected to IBM CMC through an HMC. The HMC must be configured to run the HMC Cloud Connector service.

HMC Cloud Connector is a service that runs on the HMC and pushes the system resource usage data on a continuous basis to the IBM CMC database and also pulls the configuration file from the IBM CMC Cloud Database. HMC Cloud Connector supports either a direct outbound connection or a connection through a proxy server to IBM CMC. In addition to a basic authentication process, HMC V9.1.941.1 and later supports different authentication protocols, such as Kerberos, LDAP, and Digest-MD5 when using an authenticated proxy server.

Cloud Connector comes preinstalled in HMC, and it can be started by using the steps in 3.1.3, “Connecting an HMC to IBM CMC” on page 88.

The HMC Cloud Connector service pushes certain information that is related to the system that is participating in the PEP to the IBM CMC database. The information that is pushed to the cloud falls under three main categories:

- Inventory attributes
- Performance metrics attributes
- Logging application attributes

For a detailed list of attributes that are pushed to the IBM CMC database, see the *Cloud Connector Security* white paper.

Figure 1-13 provides an overview of the PEP 2.0 connection.

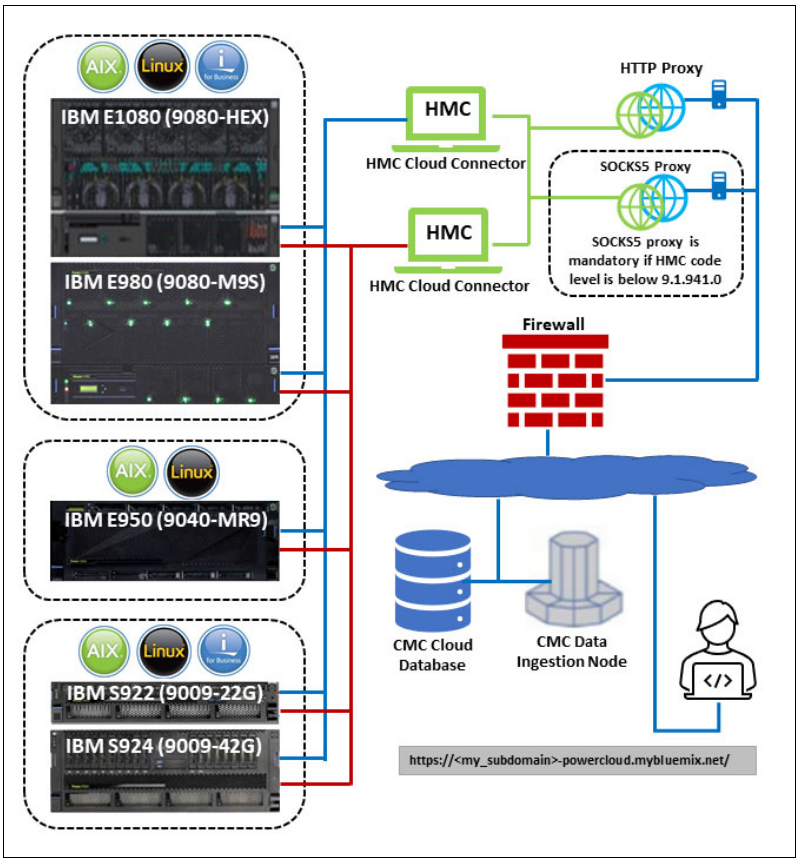

Figure 1-13 Power Enterprise Pools 2.0 Connection overview

For more information about the requirements regarding hardware, software, and FW, and the connection to IBM CMC, see 2.1, “Requirements for Power Enterprise Pools 2.0” on page 32.

1.7 Shared Utility Capacity terminology

This section introduces the basic terminology that is used in an IBM Power Systems Private Cloud with Shared Utility Capacity environment. After reading this section, you will understand the concept of base capacity, metered capacity, budgeting, and more.

1.7.1 Base capacity

Base processor or base memory activations and the corresponding software licenses are purchased for each server in a pool. The base capacity of the pool consists of the aggregated base activations of all servers in the pool. Figure 1-14 shows a pool consisting of three Power E980 servers with a total base capacity of 192 cores.

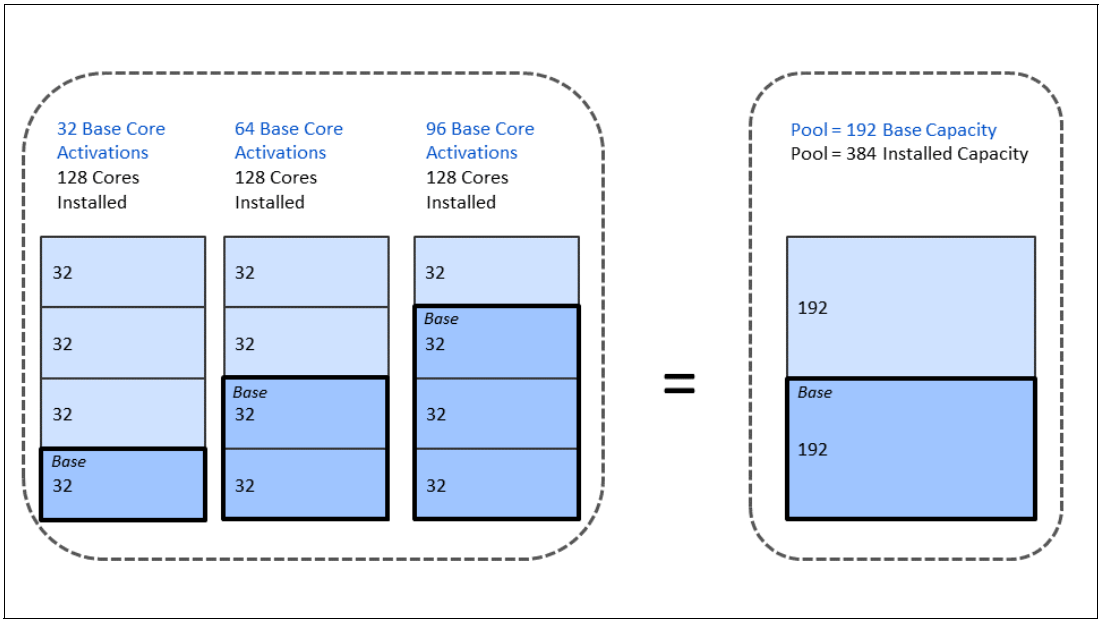

Figure 1-14 Base capacity

1.7.2 Metered capacity

In a pool, all installed cores and memory of all servers in the pool are activated. These cores and memory are independent of the base capacity for cores and memory in the pool. If a pool consists of Power S922 (9009-22G) or Power S924 (9009-42G) servers, then you do not purchase base memory for these servers, but all installed (and therefore active) memory is considered base memory in an Enterprise Pool 2.0. Unpurchased capacity in the pool (everything that is not base capacity) can be used as metered capacity on a pay-as-you-go basis.

Processor and memory usage of each server in the pool is tracked by the minute and aggregated for the whole pool. If during a given minute the average usage of processor or memory resources exceeds the base capacity of the pool, then the consumption above base capacity of the pool is recorded as metered capacity for this specific minute.

There are six types of core charges for metered usage, as shown in Table 1-3.

Table 1-3 Types of core charging

Types of core charging	Power E1080 and Power E980	Power E950	Power S924 and Power S922
Any OS hardware core	Yes	Yes	Yes
Linux / VIOS only hardware core	Yes	Yes	N/A
AIX software	Yes	Yes	Yes

Types of core charging	Power E1080 and Power E980	Power E950	Power S924 and Power S922
IBM i software	Yes	N/A	Yes
RHEL Software	Yes	Yes	Yes
SUSE Linux Enterprise Serve Software	Yes	Yes	N/A

IBM CMC applies AIX and IBM i core usage to the “any OS core” base activations first. If there are any OS base activations that are left over, they are applied against any Linux or VIOS usage if the base Linux/VIOS core activations are not enough to cover that usage. Any excess Linux/VIOS usage is then charged as metered usage at the Linux/VIOS core rate.

There is a single memory charge.

Processor usage is tracked based on the assignment of dedicated not-donating processors to active VMs and actual consumption by dedicated-donating partitions and shared processor partitions, but memory usage is tracked only based on memory assignment to active VMs.

1.7.3 Credits

To pay for metered capacity, you use prepaid Capacity Credits that can either be acquired through IBM or IBM Business Partner sales channels or through the IBM Entitled Systems Support website. Rate tables for the different systems that can be part of a pool determine how many minutes of usage can be paid for by one credit, as shown in Table 1-4.

Table 1-4 Usage ratio (minutes: one credit)

Setup	Power E1080 / Power E980	Power E950	Power S922 / Power S924
One core any OS	20,000	60,000	130,000
One core Linux or VIOS	40,000	90,000	N/A
AIX software	30,000	50,000	50,000
IBM i software	1,500	N/A	2,000
RHEL Linux Software	70,000	90,000	90,000
SUSE Linux Enterprise Server software	70,000	90,000	N/A
1 GB of memory	1,500,000	5,000,000	N/A

Here are some examples of how the rate calculation is done:

- Assume that you have a pool of five Power E980 servers with 128 cores that are installed per server. Together, they have a base capacity of 60 cores for any OS and 60 AIX licenses, and 10 TB of base memory. If for 10 hours (600 minutes) you use 100 cores with AIX above that base capacity (a total of 160 cores every minute), the rate adds up to five credits being used: Three credits for the core usage itself (60,000 minutes) and two credits for the AIX usage (60,000 minutes).

- In the same example, assume that the base activations are evenly distributed across five servers. Each IBM Power server would have 12 base capacity. If utilization is also evenly distributed, then in each system 32 cores are used for AIX for 10 hours. The system utilization is 32/128 cores = 25% for every system. Twelve out of those 32 utilized cores are enabled by base capacity, and the remaining 20 cores are covered by Capacity Credits in each system.

  There are five systems that use 32 cores each (five systems x 20 cores = a total of 100 extra cores above the base capacity) for 10 hours (600 minutes), and the required Capacity Credits are calculated as 20 cores per system per minute x five systems x 600 minutes = 60,000 core minutes. A single credit provides 20,000 minutes of “one core any OS” in Power E980 systems, so you would need three Capacity Credits to cover the core usage. A credit provides 30,000 minutes for AIX software licensing, so you would need two credits to cover AIX usage for 60,000 core minutes.

Attention: Even after the remaining credit balance reaches 0, usage continues as-is, and as metered usage accrues, your remaining credit balance will go negative. If your balance is not replenished after 30 days, processor throttling is initiated on the servers in the pool.

Figure 1-15 shows an example from IBM CMC where you can observe the number of minutes of metered capacity that were used in several months and how they are converted to credits.

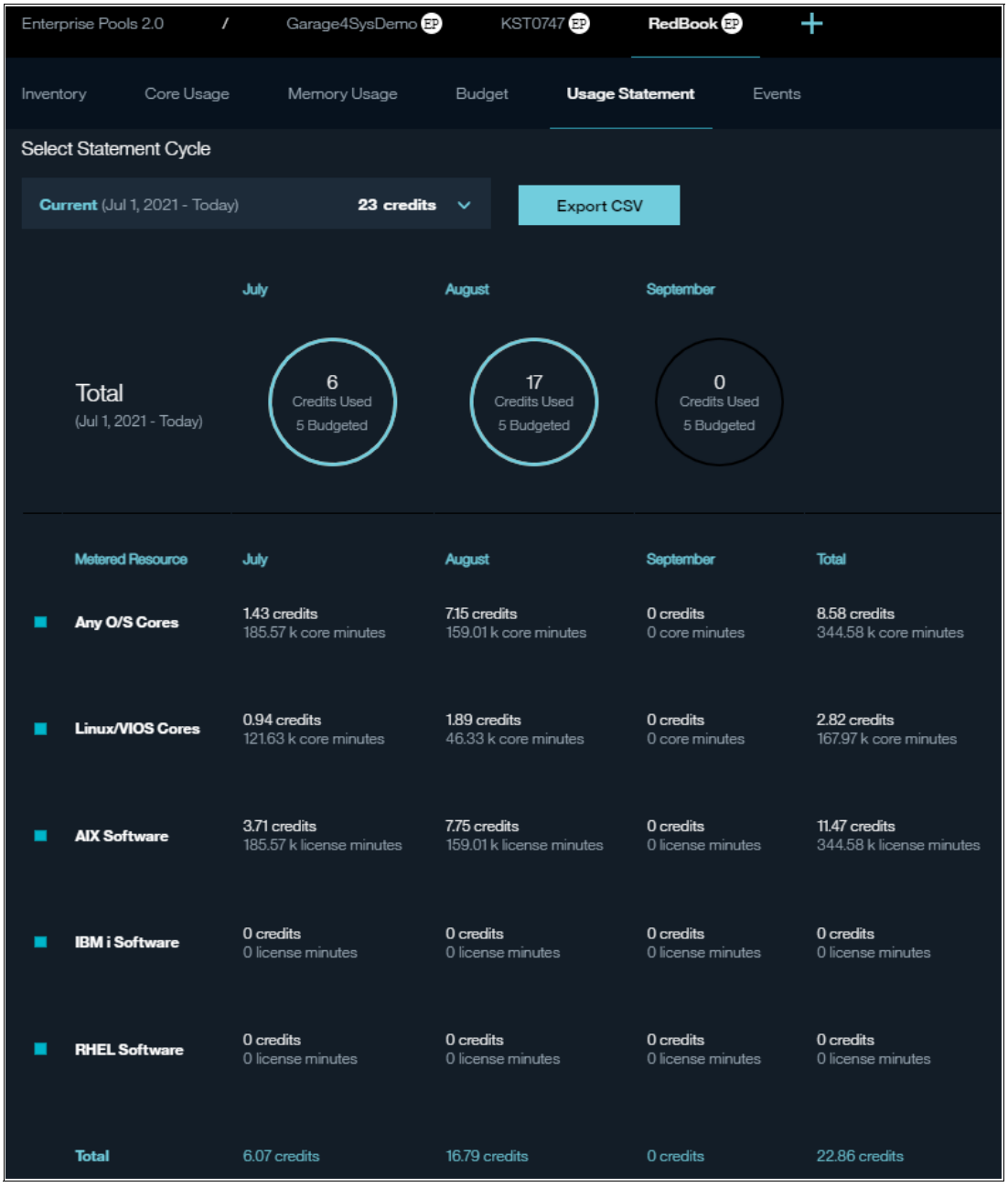

Figure 1-15 Usage Information on IBM Cloud Management Console

1.7.4 Budgeting

As metered usage accrues, client accounts are debited in real time. To alleviate concerns of runaway metered usage, a budget can be put in place to cap metered usage charges. You can set monthly budget limits. This budget determines the maximum number of credits that a pool can consume within a specific calendar month, as shown in Figure 1-16.

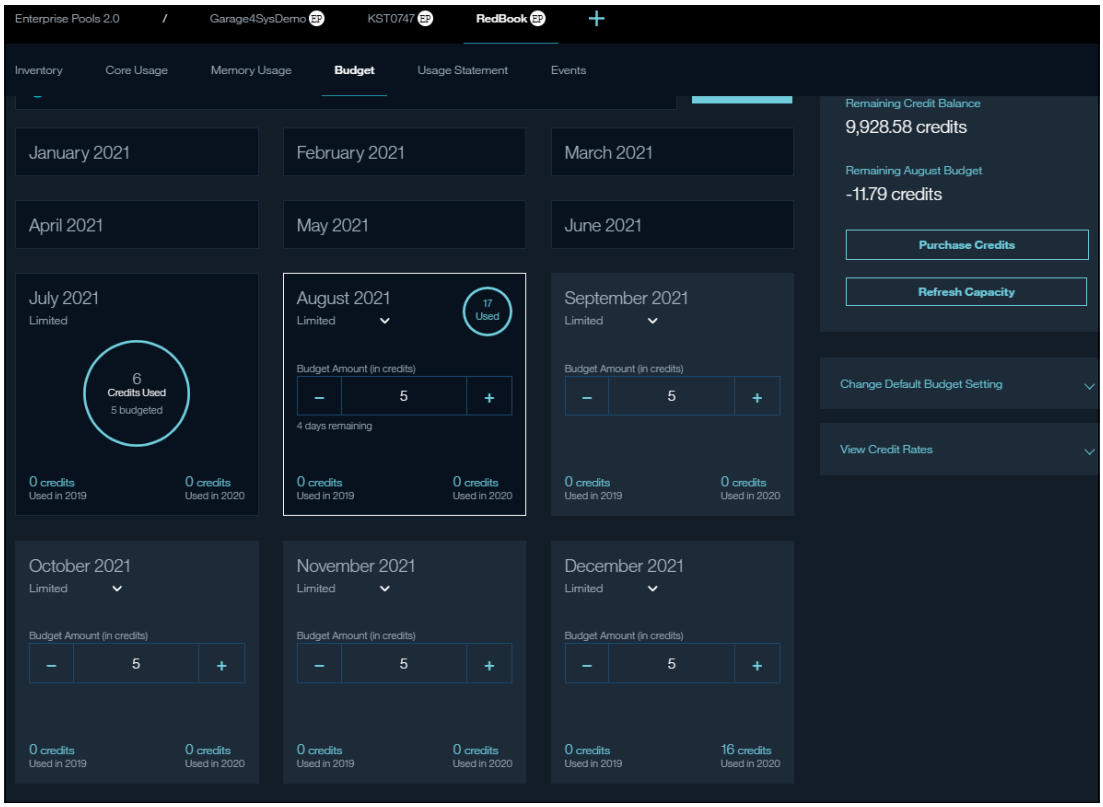

Figure 1-16 Budgeting information window

Different budget limits can be set for each month. You can also change a budget if you determine in the course of a month that you need to adjust your planning because of unexpected changes in workload requirements. In addition, you can also decide to set no budget for a month and let the pool consume an unlimited number of credits during this month.

Budgeting is available in addition to the mechanisms that shared processor pool and VM configurations provide:

- Limit the number of cores that are available for a specific shared processor pool.
- Limit the number of virtual or dedicated cores for a VM.

Note: IBM Power Systems Private Cloud with Shared Utility Capacity has no effect on shared processor pools, and shared processor pools remain an important tool in managing software licensing.

IBM Power Systems Private Cloud with Shared Utility Capacity does not limit the number of cores that are available for use on a server in a pool, but you can configure shared processor pools and the maximum number of cores each partition can use to provide limits.

You can set alerts that send notifications when the rate of consumption is threatening to exceed the budget. Alerts can be set for rate of consumption, remaining budget balance, and remaining Capacity Credit balance.

Attention: In a pool that allows the use of dedicated VMs, budgeting is not enforced. You can still define a budget, but you are charged for metered usage above the set budget.

Note: For Shared Processor VM only pools, IBM ensures that no charges are paid above a budget level that is set for a specific month.

1.7.5 Throttling

If budgeting is enforced and no charges occur above a limit that is defined by a client, there must be a mechanism in place to prevent continued use of resources above the base capacity after the budget limit is reached. This mechanism is *throttling*. When a budget is used up, IBM CMC through the HMCs sends requests to servers in the pool to limit the consumption of CPU.

Throttling uses a gradual model to limit the rate of consumption of each system in a pool. The goal is to throttle each server back to its base resources over four days. CPU consumption is reduced every 24 hours. Each system in the pool is throttled based on its average core usage over the last 7 days when throttling starts. For example, if a system has 10 base cores and is using 20 cores in average over the last 7 days when throttling is initiated, that core usage value is used throughout the throttling period by the throttling algorithm.

The first reduction in consumption rate that is applied by the throttling algorithm limits metered core usage by 10 percent of the metered core usage at the start of throttling. After 24 hours, the metered core usage is limited by 30 percent. After 48 hours, the metered core usage is limited by 60 percent. After 72 hours, core usage is limited to the sum of the number of base “any OS cores” and base Linux/VIOS cores on that system.

For example, assume that a system has 10 base cores and is averaging 20 cores in the last 7 days at the time throttling is started. There will be four rounds of throttling:

1. In round one, the algorithm limits the system’s core usage by 10 percent of its metered usage. Because the metered usage is 10 cores, the algorithm limits the total usage by one core to provide a throttled upper bound of 19 cores for that system for the first 24 hours.
2. The next throttling round throttles the metered usage by 30 percent, which is three cores. Thus, for the next 24 hours, usage is capped at 17 cores.
3. The third round throttles the system’s metered usage by 60 percent to provide an upper bound of 14 cores for the next 24 hours.
4. The final round of throttling limits the core usage to the system’s base core capacity of 10 cores.

Figure 1-17 provides a graphical representation of this behavior.

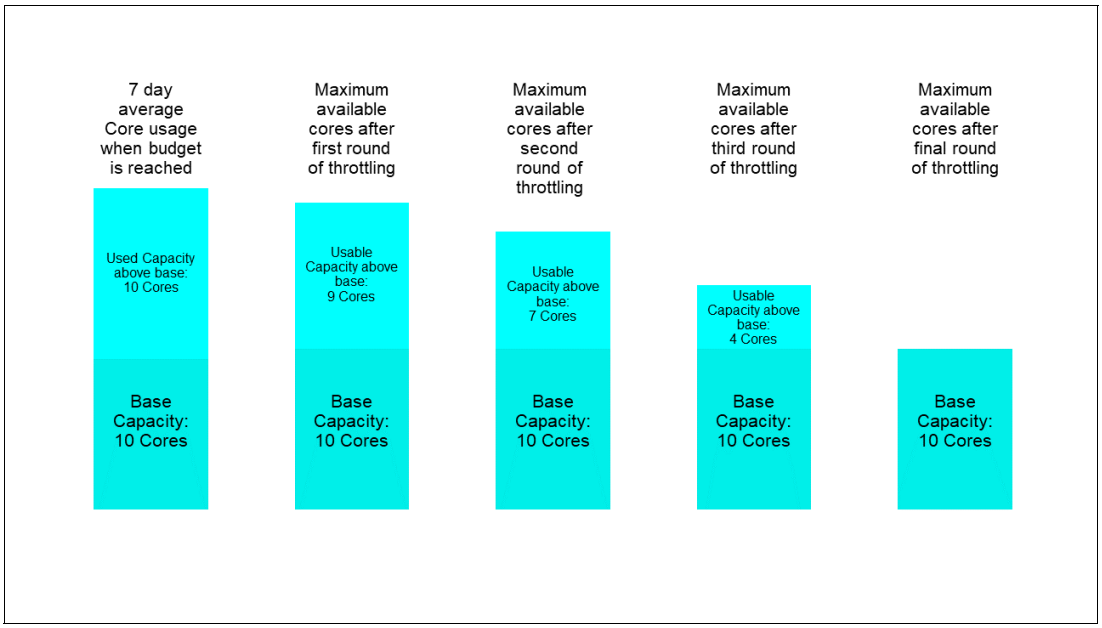

Figure 1-17 Throttling

Throttling never limits consumption to less than base capacity.

When throttling is started or stopped, notifications appear in the IBM CMC GUI and the HMC GUI. Furthermore, the Enterprise Pool 2.0 event log and the system's CoD history log contain throttling start and stop messages to provide start and stop times.

If throttling is initiated for budget enforcement, it is stopped as soon as the budget for the month is increased or the end of the month is reached.

Besides reaching a set budget, there are three other events that cause throttling:

- A client bought credits through the IBM Entitled Systems Support website and the bill for these credits is past due.
- All credits in a pool are used up and not replenished within 30 days.
- The CoD codes that activate all resources of the servers in a pool become invalid, which happens every 90 days, and might not be automatically or manually renewed through IBM CMC.

Note: In the last case, throttling is initiated by the PowerVM hypervisor and does not use a gradual approach. All servers are immediately throttled back to their base capacity.

If the billing status is resolved or more Capacity Credits are purchased, it might take up to 24 hours for IBM CMC to automatically update this information and stop throttling. It is possible to manually refresh capacity to stop throttling in these cases.

On a VM level, if there is sufficient base capacity to satisfy the entitled capacity of all partitions on a server, then only uncapped consumption is affected. If the total entitled capacity of all partitions exceeds the throttle limit, then every partition on the server has their entitled capacity proportionally scaled.

For example, if due to throttling there are only 25 cores that are available but the total entitled capacity is 50 cores, each partition would have only 50 percent of its entitled capacity guaranteed. If other partitions do not use all their entitled capacity, then this unused capacity can be shared among other partitions on the system. If there are partitions with low entitled capacity and there is a large overcommitment of entitled capacity, the low-entitled capacity partitions might be starved for CPU, which causes them to become unresponsive.

1.7.6 Capacity on Demand codes

All CoD codes are managed automatically by IBM CMC and IBM Entitled Systems Support. There are no XML files and no CoD codes that must be downloaded and applied. CoD codes are used to add systems to a pool; provide a system's PowerVM hypervisor with purchased base capacity information for throttling when pool membership CoD codes expire; continue a system's membership in a pool; and remove a system from a pool.

Pool membership codes expire after 90 days. IBM CMC automatically starts the CoD code renewal process 10 days before expiration. If a CoD code is not successfully renewed, IBM CMC retries daily and notifies the user when there are 7 or fewer days that are left until expiration. The Update CoD code task in the Enterprise Pool 2.0 application can be used to attempt CoD code renewal at any time when there are 10 or fewer days that are left until expiration.

1.7.7 Single hybrid cloud currency

IBM Power Systems Private Cloud deployments use a prepaid model for establishing credits that can be debited for compute resource usage in those on-premises, pooled environments. IBM also offers a robust Power Virtual Server solution in the cloud for clients that want to run their workloads off-premises. However, clients expect the same reliability, flexibility, and operational processes that they are using with their IBM Power servers on-premises today in the cloud.

To that end, IBM is making a statement of direction around the implementation of Hybrid Capacity Credits on top of what is offered today for IBM Power Systems Private Cloud solutions. Hybrid Capacity Credits will allow clients to prepay for a set of capacity, on a project basis, with flexibility in how it is allocated. It can be allocated on-premises with one or more IBM Power Systems Private Cloud with Dynamic Capacity environments, paying for the minutes of processor or memory time, or OS use above the base capacity of the pool. The other way that these Hybrid Capacity Credits can be used is by allocating them to a subscription for Power Virtual Servers in the cloud. Credits can be used across either one of these environments or both.

Figure 1-18 shows a statement of direction for how a single Hybrid Cloud Currency would work.

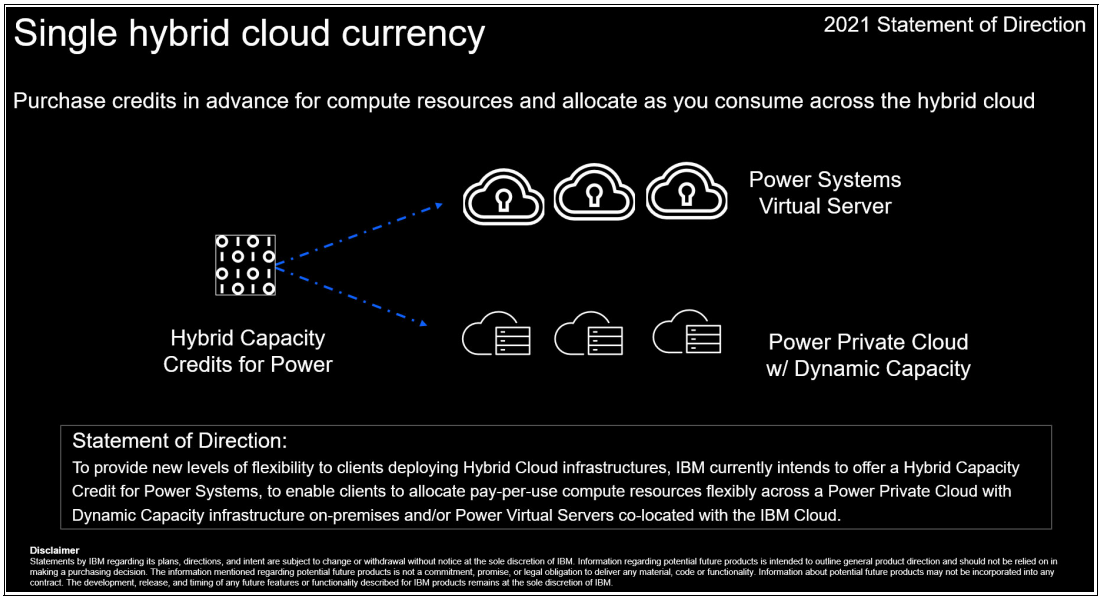

Figure 1-18 Single Hybrid Cloud Currency

This offer benefits clients greatly by providing them with more flexibility around the deployment of pay-per-use environments and giving them options for combining on-premises and off-premises infrastructures in a hybrid cloud environment.

1.8 Dedicated processor support

Starting with IBM Power FW level FW950 and HMC V9.2.950, dedicated processor VMs are allowed in an IBM Power Systems Private Cloud with Shared Utility Capacity environment. The support for dedicated processor VMs is specified during the initial configuration of the pool in the **Select Pool Configuration Option** menu. After the pool is created, this setting cannot be changed later. If you want to change the use of dedicated processors in an existing pool, you must delete the pool and create another pool.

Processor resources within a pool are tracked based on the assignment of dedicated processors to active VMs. Unless the cores are in dedicated-donating mode, the whole core is marked as consumed. If the processor is set to dedicated-donating mode, then actual consumption is reported like shared processor VMs.

If a pool is configured to support dedicated processor VMs, budgeting is not enforced. You can still define a budget, but you are charged for metered usage above the set budget.

2

Planning

This chapter describes technical and legal requirements for using IBM Power Systems Private Cloud with Shared Utility Capacity. These requirements include:

- Hardware and hardware configuration requirements
- Firmware (FW) and Hardware Management Console (HMC) requirements
- Connection requirements
- Contracts and terms and conditions

In addition, this chapter provides information about scaling and functional implications of different FW levels regarding IBM Power Systems Private Cloud with Shared Utility Capacity.

2.1 Requirements for Power Enterprise Pools 2.0

This section describes the requirements for IBM Power Systems Private Cloud with Shared Utility Capacity. There are hardware requirements, FW requirements, software requirements, and contractual requirements for implementing IBM Power Systems Private Cloud with Shared Utility Capacity.

2.1.1 System and hardware configuration requirements

This section details the hardware requirements, which include system and configuration requirements:

- Supported or qualified systems.

  The following systems are supported for Power Enterprise Pools (PEP) 2.0 at the time of writing:

  - IBM Power E1080 (9080-HEX)
  - IBM Power E980 (9080-M9S)
  - IBM Power E950 (9040-MR9)
  - IBM Power S922 (9009-22G) and IBM Power S924 (9009-42G)
- Each supported system can be assigned only to one pool.
- One machine type is supported per pool. So, a pool can consist of the following servers:
  - One or more Power E1080 or Power E980 servers.
  - One or more Power E950 servers. The Power E950 Enterprise Pool 2.0 can have only Power E950 servers.
  - One or more scale-out servers. The scale-out pool can have a mix of Power S922 (9009-22G) and Power S924 (9009-24G) servers.
- Each system in the pool must be in the same country and be part of the same enterprise.
- Each server in the pool needs a minimum base processor activation of one core and a minimum base memory activation of 256 GB. The scale-out servers require only base processor activations. All processor cores that are activated by base processor activation features must be licensed for a supported operating system (OS) and must be registered for the associated software subscription and support.
- Each server in the pool needs the PEP 2.0 enablement Feature Code #EP20.
- All systems in a pool must be under hardware and software maintenance and should be at the same service level.
- The systems in a pool can have shared processor partitions or dedicated processor partitions. Dedicated processor partitions are supported in IBM Power Systems Private Cloud with Shared Utility Capacity. Dedicated partition support in a PEP 2.0 requires:
  - Power Systems FW level FW950 or higher and Hardware Management Console (HMC) V9.2.950 or higher
  - Power Systems FW level FW1010 or higher and Hardware Management Console (HMC) V10.1.1010 or higher

- An Enterprise Pool 2.0 can have up to 48 servers and a maximum of 2000 partitions across the servers, with up to 1000 partitions supported per HMC.
- Clients must purchase Capacity Credits for the pool. Credits are automatically decremented by IBM Cloud Management Console (IBM CMC) based on the consumption of metered capacity. Clients must ensure that they do not run out of Capacity Credits. Clients can purchase the Capacity Credits from IBM, an IBM Business Partner, or through the IBM Entitled Systems Support website in countries where this purchase option is available.

2.1.2 System firmware and console requirements

Here are the software requirements for IBM Power Systems Private Cloud with Shared Utility Capacity:

- IBM Power FW requirements
- IBM CMC
- HMC requirements

There are no specific OS requirements for running a Shared Utility Capacity Pool. For OS requirements of the specific server models that can be part of a Shared Utility Capacity Pool, see System Software Maps.

IBM Power firmware requirements

This section describes the IBM Power FW requirements for IBM Power Systems Private Cloud with Shared Utility Capacity.

At the time of writing, the levels of FW that are supported are shown in Table 2-1 to Table 2-5 on page 34. You should take the following FW restrictions into consideration when planning your Enterprise Pool.

Table 2-1 Power E1080 firmware level requirements

Machine Type and Model	Firmware version	Supported level
Power E1080 / 9080-HEX	1010.xx	FW1010 or later

Table 2-2 Power E980 firmware level requirements

Machine Type and Model	Firmware version	Supported level
Power E980 / 9080-M9S	930.xx	FW930.02 or later
	940.xx	FW940.10 or later

Table 2-3 Power E950 firmware level requirements

Machine Type and Model	Firmware version	Minimum level
Power E950 / 9040-MR9	940.xx	FW940.10 or later

Table 2-4 Power S922 firmware level requirements

Machine Type and Model	Firmware version	Supported level
Power S922 /9009-22G	941.xx	FW941.00

Table 2-5 Power S924 firmware level requirements

Machine Type and Model	Firmware version	Supported level
Power S924 / 9009-42G	941.xx	FW941.00

Note: The above FW levels are the requirements for PEP 2.0. The OS of the logical partitions (LPARs) (virtual machines (VMs)) that your workload runs on might require a different or higher level of FW. Follow the guidelines for your specific environment from the OS perspective by going to IBM Fix Level Recommendation Tool (FLRT).

Before starting the Cloud Connector in the HMC, the IBM Power server should be at the supported FW level, and the HMC should be at the required code level.

IBM Cloud Management Console

You must have access to an IBM CMC portal to create and manage IBM Power Systems Private Cloud with Shared Utility Capacity.

To implement IBM Power Systems Private Cloud with Shared Utility Capacity for a system, you must meet the following requirements:

- The system should have an IBM CMC subscription.
- At least one of the HMCs, which is connected to the system, should have a connection to IBM CMC.

Hardware Management Console requirements

IBM Power servers can be managed by using different types of HMCs. An HMC is available as a hardware appliance or virtual appliance (virtual Hardware Management Console (vHMC)) and categorized as follows:

- x86 based HMCs: 7042-CR7, CR8, CR9, OE1, or OE2
- IBM POWER® processor-based HMC: 7063-CR1 or 7063-CR2
- vHMC on x86 or IBM Power server

IBM Power servers support attachment to one or two HMCs or vHMCs. You may also use one x86-based HMC and one IBM POWER processor-based HMC if the HMC software is at the same level on the two HMCs.

Each system in a PEP 2.0 must be connected to one or two HMCs, at least one of which is connected to IBM CMC. Cloud Connector is the HMC component that uploads data to the IBM CMC cloud.

The HMC must have the following configuration:

- All HMCs managing servers within a pool require the Network Time Protocol (NTP) to be enabled.
- All HMCs managing servers within a pool require the Domain Name System (DNS) to be enabled.
- Performance and Capacity Monitoring (PCM) must be enabled through the HMC for each server in the pool.
- Cloud Connector is set up to connect the HMC to IBM CMC.

Implications of server firmware levels and the HMC code level

The FW level on the servers and HMCs defines which systems can be part of a pool, and how many VMs and servers and what functions are supported.

Table 2-6 shows the FW, systems, and supported limits.

Table 2-6 Firmware, systems, and supported limits

System	Minimum firmware (FW) level	Minimum HMC version[a]	LPARs per pool	LPARs per HMC	Systems per pool
Power E1080 / 9080-HEX	FW1010	1010	2000	1000	48
Power E980 / 9080-M9S	FW930.02	930 + PTF MH01825 / MH01826	500	500	16
	FW940	940	1500	500	48
		950 + PTF MH01883 / MH01884[b]	2000	1000	
	FW940.10	940 SP1	1500	500	48
		950 + PTF MH01883 / MH01884[b]	2000	1000	
Power E950 / 9040-MR9	FW940.10	940 SP1	1500	500	48
		950 + PTF MH01883 / MH01884[b]	2000	1000	
Power S922 / 9009-22G Power S924 / 9009-42G	FW941	940 SP1	1500	500	48
		950 + PTF MH01883 / MH01884[b]	2000	1000	

a. The minimum recommended HMC 940 version is 940 SP2 + PTF MH01879 (x86_64) or MH01880 (ppc64le), and the minimum recommended HMC 950 version is 950 + PTF MH01883 (x86_64) or MH01884 (ppc64le) when HMC to IBM CMC connections are across significant distance, such as across continents.

b. If you are migrating LPARs to servers in a PEP 2.0, HMC Version 950 + PTF MH01883 (x86_64) or MH01884 (ppc64le) is not recommended. Instead, the recommended version is HMC Version 950 SP1 + PTF MH01889 (x86_64) or MH01890 (ppc64le).

Table 2-7 shows additional product support.

Table 2-7 Additional product support

Additional support	Minimum FW level	Minimum HMC version[a]
Dedicated LPAR support	FW950	950
Ability to identify Linux LPAR running Red Hat Enterprise Linux (RHEL) or SUSE Linux Enterprise Server and meter eligible SUSE Linux Enterprise Server LPARs (requires active Remote Management and Control (RMC) connection from HMCs to Linux LPARs)	FW950	950

a. The minimum recommended HMC 940 version is 940 SP2 + PTF MH01879 (x86_64) or MH01880 (ppc64le), and the minimum recommended HMC 950 version is 950 + PTF MH01883 (x86_64) or MH01884 (ppc64le) when HMC to IBM CMC connections are across significant distance, such as across continents.

Important: At the time of writing, the maximum number of partitions that is supported by IBM CMC per POWER9 system is 750, and per IBM Power10™ system, it is 500.

2.1.3 Linux metering considerations

Metering for SUSE Linux Enterprise Server and for RHEL is available. HMC Version 950 and an active RMC connection from the HMC to the Linux LPAR are required.

SUSE Linux Enterprise Server metering

Starting with HMC Version 950, metering for SUSE Linux Enterprise Server has become available. It requires one of the following subscriptions:

- SUSE Linux Enterprise Server for Power with Base1 - 2 Socket, Unlimited LPAR and Priority Subscription (5639-15S or 5639-12S)
- SUSE Linux Enterprise Server for SAP Applications for Power with Base1 - 2 Socket, Unlimited LPAR and Priority Subscription (5639-SAP)

All systems that are expected to share Base SUSE Linux Enterprise Server subscription entitlement resources within a pool must have the same subscription product and add-on features.

The SUSE Linux Enterprise Server Base subscription entitlement for each system will be set to the number of cores that is available in the quantity of sockets that is entitled by the current, valid subscription for that system (the number of cores per chip multiplied by the quantity of sockets that are acquired in the current subscription).

Red Hat Enterprise Linux metering

The following RHEL subscriptions that are procured from IBM, with required features included, will be monitored by IBM CMC, and are eligible to be shared as Base Capacity and available as pay-per-use Metered Capacity resources when a Power Enterprise Pool (2.0) starts:

- 5639-RH8: RHEL 8 for Power with Smart Management, Premium (up to four cores and four LPARs) Subscription or Subscription/RH Support, including Extended Update Support and High Availability for Power features (required)
- 5639-RLE: RHEL 7 for Power with Smart Management, Premium (up to four cores and four LPARs) Subscription or Subscription/RH Support, including Extended Update Support features (required)
- 5639-RHS: RHEL for SAP Solutions for Power, Premium (up to four cores and four LPARs) Subscription or Subscription/RH Support

Base Capacity resources may be shared across systems within a pool. RHEL Base subscription entitlement for each system is set to the number of cores that is entitled by the current, valid subscription for that system.

Metered Capacity resources above the Base Capacity of a pool are activated, available for use, and charged by the minute when used.

All systems that are expected to share Base RHEL subscription entitlement resources within a pool must have the same Red Hat subscription product and add-on features.

To enable a client's Red Hat subscriptions as Base and Metered Capacity resources within a Power Enterprise Pool (2.0) environment, IBM or Business Partner Sales teams must order 5799-RP2 Red Hat Enablement for Power Private Cloud/Pools 2.0 and include i-listed PRPQ P91342. The following information must be included in the request for PRPQ P91342 approval:

- Company name
- Address
- Contact name and email of the primary administrator of the RHEL server
- Red Hat network account number
- Initial quantity of Base RHEL or RHEL for SAP on Power 4-core/4-LPAR entitlements being ordered or enabled on IBM Power servers within the pool

Linux subscription entitlement is monitored and metered independently of processor activations. Metered Capacity charges for minutes of RHEL use that exceeds a pool's Base. The respective subscription entitlement will be charged by the minute and debited, like AIX or IBM i operating system minutes, against the pool's Power Capacity Credit balance.

For more information, see IBM Sales Support Information.

2.1.4 Connection requirements

All IBM Power servers participating in PEP 2.0 must be connected to IBM CMC through an HMC. The HMC must be configured to run the Cloud Connector service.

HMC Cloud Connector is a service that runs on the HMC and pushes the system resource usage data on a continuous basis to the IBM CMC database and also pulls the configuration file from the IBM CMC Cloud Database. Cloud Connector supports either a direct outbound connection or a connection through a proxy server to IBM CMC.

In addition to the basic authentication process, HMC Code V9.1.941.1 and later support different authentication protocols, such as Kerberos, LDAP, and Digest-MD5 when using an authenticated proxy server.

Cloud Connector pushes data for all systems that are connected to the HMC unless users explicitly exclude systems from being monitoring by IBM CMC. The information that is pushed to the cloud falls under three main categories:

- Inventory attributes
- Performance metrics attributes
- Logging application attributes

Connectivity details

This section describes the connectivity details that are required to be set up before starting Cloud Connector on the HMC and creating IBM Power Systems Private Cloud with Shared Utility Capacity pools:

- The HMC needs internet connectivity to access IBM CMC. To view the IP addresses and ports that allow traffic through your firewall, open IBM CMC and select **Settings** → **Cloud Connector**.
- Connectivity from the HMC connector to IBM CMC is secured by default by using the Transport Layer Security Version 1.2 protocol (TLSv1.2) and the `SSL_ECDHE_RSA_WITH_AES_256_GCM_SHA384` cipher suite.
- Cloud Connector requires outbound connectivity to three endpoints, with one endpoint connection to port 5044, and the other two to port 443.
- The connection to IBM CMC can be with or without a proxy.
- Before HMC V9 R1 M941, when setting up a connection to IBM CMC from Cloud Connector through a proxy server, both the SOCKS5 proxy and HTTP proxy are required. In this case, the HTTP proxy creates connections to fetch configurations, and the SOCKS proxy creates connections for the main data flow.
- Starting with HMC V9 R1 M941, when setting up a connection to IBM CMC from Cloud Connector through a proxy server, you can choose between using HTTP only or both the SOCKS5 proxy and the HTTP proxy.
- When you set up a SOCKS5 proxy in a stand-alone configuration, SOCKS5 fetches configurations directly with no proxy. The main data flow happens through the SOCKS5 proxy.
- The supported types of authentication with HTTP proxy are Basic Authentication, Digest, Kerberos, LDAP, and No Authentication. A SOCKS5 proxy must be configured without authentication.

2.1.5 Configuration steps

To configure IBM Power Systems Private Cloud with Shared Utility Capacity, complete the following steps:

1. Order one or more supported or eligible IBM Power servers that satisfy the requirements in 2.1.1, “System and hardware configuration requirements” on page 32.
2. Make sure that the requirements that are specified under “Hardware Management Console requirements” on page 34 are met.
3. All the software requirements in 2.1.2, “System firmware and console requirements” on page 33 should be met.

4. Request to activate your IBM CMC instance by completing the IBM CMC activation form and sending it to `support@ibmcmc.zendesk.com`. In the form, you must provide the following information:
   - The primary administrator email address
   - The primary administrator IBM ID
   - The preferred subdomain name for your IBM CMC portal
   - Which IBM CMC subscription that you purchased
   - Which IBM CMC location that you want to choose (Dallas or Frankfurt)
   - Which systems should be managed by IBM CMC (type and model, serial number, customer number, IBM country code, and start/order date)

   The IBM CMC activation form can be obtained from IBM.
5. Log in to the IBM Entitled Systems Support portal and establish a Pool ID. You can start a new pool by either buying credits or by using an order number and system serial number.
6. Use the Pool ID from step 5 to create an Enterprise Pool 2.0 through IBM CMC. You can select which available qualified systems that you want to add to the pool during the initial pool creation or at a later point.
7. IBM CMC starts monitoring the processor, memory, and software entitlement resource usage of systems in the pool.
8. Metered resource usage that is above the pool's aggregate base capacity is tracked by the minute and debited against the Capacity Credits that are available for the pool in real time.

The IBM CMC activation form can be found on the IBM Entitled Systems Support website in the Help section under User guidelines. Go to IBM Entitled Systems Support, click **Help** in the left pane, and then scroll until you find the PDF.

2.2 Cloud licensing models

In the IBM Power Systems Private Cloud with Shared Utility Capacity solution, the charge for license entitlement resources is included in the metered capacity consumption (used resources above the base capacity). Clients pay for metered capacity consumption by purchasing Capacity Credits, which are then debited in real time as processor, memory, or license entitlement resources above the pool's base are consumed by the minute. Therefore, one of the prerequisites to establish IBM Power Systems Private Cloud with Shared Utility Capacity is all cores that are activated by Base Processor Activations must be licensed for the supported OS and registered for the associated Software Subscription and Support.

Also, each machine in Enterprise Pool 2.0 must be covered by the same level of IBM (Hardware and Software) warranty or maintenance support. All Base Processor Activations must be licensed for AIX, IBM i, or Linux and the included associated Software Subscriptions and Support.

Core usage is tracked and charged by OS. IBM Power Systems Private Cloud with Shared Utility Capacity has two different types of Base Processor Activation resources, and software license entitlement is monitored and metered independently of processor activations, so there are six different types of core-related metered capacity charges:

- A core that may run any OS that is supported on an IBM Power server.
- A core that may run on only a Linux/Virtual I/O Server (VIOS) server.
- IBM AIX software (licensed per core).
- IBM i software (licensed per core).
- RHEL Software (subscription per four cores and four LPARs).
- SUSE Linux Enterprise Server for Power (subscription per socket).

2.3 Contracts, terms, and conditions

Using IBM Power Systems Private Cloud with Shared Utility Capacity requires that you sign a license supplement. This contract can be obtained through IBM. The license supplement defines the specific terms and conditions for using Shared Utility Capacity:

- All machines must be in the same enterprise and country.
- All machines must be connected to one or two HMCs with at least one HMC that is connected to an IBM CMC.
- NTP must be enabled on the HMCs to provide time-synchronized reporting of resource usage.
- DNS must be enabled on the HMCs to enable Cloud Connector to IBM CMC communications.
- All machines must be serviced by IBM either under a warranty or under a post-warranty maintenance service agreement.

In addition, the license supplement defines:

- You agree that any minutes of metered capacity usage are decremented from the credits that you purchased.
- You may continue to use metered capacity for up to 30 days after your remaining balance of credits reaches zero.
- After 30 days with a remaining balance of zero credits and no replenishment, access to metered capacity is restricted.
- The way that tracking metered resources works, and the consumption rates for different resource types.

Table 2-8 shows the IBM programs that are licensed as part of metered capacity in a pool.

Table 2-8 List of eligible programs

IBM program number	Description
5765-G62	AIX V6.1 Standard Edition
5765-AEZ	AIX V6.1 Enterprise Edition
5765-G98	AIX V7.1 and V7.2 Standard Edition
5765-CD1	AIX V7.1 Enterprise Edition
5765-CD3	AIX V7.2 Enterprise Edition
5765-CBA	IBM Power Systems Enterprise Cloud Edition with AIX V7
5765-ECB	IBM Power Systems Enterprise Cloud Edition
5770-SS1	IBM i V7.2, V7.3, and V7.4
5765-PSE	IBM PowerSC Standard
5764-PVE	PowerVM Enterprise
5765-VE3	PowerVM Enterprise Edition V3
5770-HAS	PowerHA SystemMirror for i
5765-H23	PowerHA for AIX V6 Standard

IBM program number	Description
5765-H24	PowerHA for AIX V6 Enterprise
5765-H39	PowerHA for AIX V7 Standard
5765-VCS	PowerVC Standard Edition V1.4
5765-VCD	Cloud PowerVC Manager V1.4

When removing a system from a pool, all metered processor core and metered memory activation resources exceeding the base processor and memory activation capacity are deactivated on the removed system. Using Trial Capacity on Demand (CoD), all core and memory resources are activated for 30 days to provide time for migration. Running VMs are not affected and continue to have access to all of the installed resources made available through Trial CoD. Base resources are statically activated.

When transferring a system that was part of a pool to another party (including return to a leasing company), only base capacity transfers with the system. The conditions of the license supplement are not transferable and can be granted to another party only by IBM.

2.4 System management tasks

The IBM Power Systems Private Cloud with Shared Utility Capacity application provides features to perform the following tasks:

- Create or start a pool.
- Add systems to a pool.
- View the pool inventory, including systems and partitions in a pool.
- Set a monthly budget for metered capacity consumption.
- Analyze the total or metered minutes, Capacity Credits, core, memory, or OS resource usage.
- Monitor the base and metered capacity that is used within a pool over time.
- Analyze trends within a pool and adjust the time scale to review by minutes, hours, days, weeks, or months.
- Drill down within a selected period to see more detailed usage by VM.
- Show the Capacity Credits that are consumed, and break down usage by resource within a pool.
- Display the Capacity Credit balance, budget status, metered resource rate table, and Capacity Credit purchase history.
- Set alerts and thresholds for a pool based on budget and resource consumption.
- Remove a system from a pool.
- Delete a pool.

2.4.1 Creating a pool

This function is used to create and start an Enterprise Pool 2.0. To create the pool, you need the Pool ID, which you obtained from the IBM Entitled Systems Support website. After entering the Pool ID and pool name, you must set a default monthly budget for the pool. You can choose unlimited budget or specify a quantity of credits as the default monthly budget and this setting can be changed whenever it is needed. On the same page, you must also decide whether you want to allow dedicated processor partitions in your pool. When dedicated processor partitions are allowed, budgeting cannot be enforced for the pool. Also, once set, this setting cannot be changed on IBM CMC. The client can either delete the pool and re-create it or can submit an IBM Support ticket and request a change for their pool. After selecting these options, you can select the systems to be added to the pool.

After you create the pool successfully, the pool name appears in the upper section of the IBM Power Systems Private Cloud with Shared Utility Capacity launch window. Click the pool name to view the options to monitor and manage the pool. The options are Inventory, Core Usage, Memory Usage, Budget, Usage Statement, and Events. For more information about the Create Pool function, see 3.1.2, “Starting a new pool” on page 77.

2.4.2 Adding systems to a pool

IBM CMC enables the user to select the systems to be added to a pool during initial pool creation wizard. It also allows adding systems to an existing pool by clicking **Add Systems** in the Inventory page, as shown in Figure 2-1.

2.4.3 Inventory

In the Inventory window, you can view the current resource usage summary for the pool. Select the pool that you want to view from the available pool names that are shown in the upper part of the window, as shown in Figure 2-1.

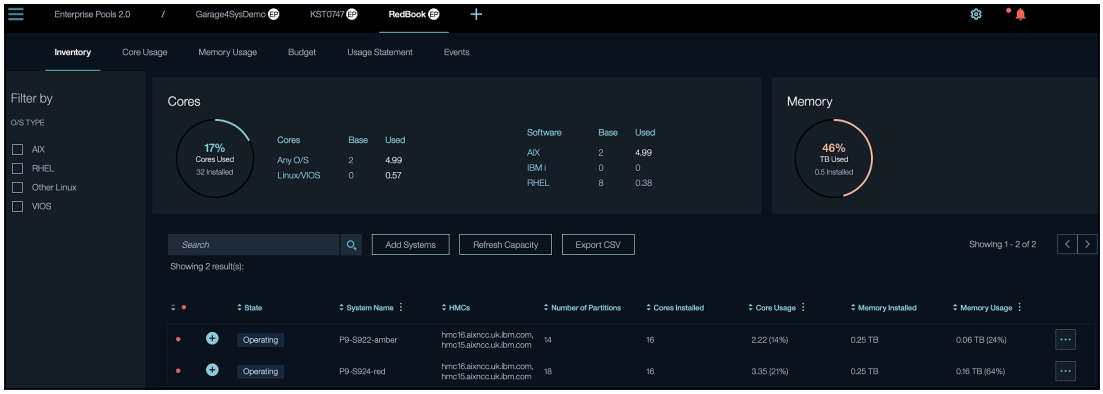

Figure 2-1 Enterprise Pools 2.0: Inventory

The Inventory page for a pool has the following features:

- A view of the total installed cores and memory of the systems in the pool and its current usage.
- A view of the total base resources in the pool and its current usage. The base resources are:
  - Any OS cores.
  - Linux/VIOS cores. For the scale-out servers Power S922 (9009-22G) and Power S924 (9009-42G) servers, the base Linux OS or VIOS is shown as 0 because you cannot purchase Linux/VIOS base activations for these servers. Also, the rates for Any OS Core and Linux/VIOS core are identical on scale-out servers.
  - AIX software.
  - IBM i software.
  - SUSE Linux Enterprise Server software.
  - RHEL software
  - Memory. This feature is not supported for scale-out systems. For scale-out servers, IBM CMC shows installed memory as the base capacity.
- List of systems and partitions in the pool with core and memory usage summary.
- An **Add Systems** button to add new systems to the pool.
- After you purchase more base capacity or credits for your pool, they automatically are reflected on the IBM CMC within 24 hours. If you want to reflect the new capacity immediately, click **Refresh Capacity** on the Inventory page to update the base capacity and credits for the pool.
- The **Export CSV** button exports the pool inventory, partition inventory, and system inventory in `.csv` format.
- Remove a system from a pool.

  You can remove a system from a pool by clicking the three small dots (...) at the right of the Inventory window, as shown in Figure 2-2 and Figure 2-3.

Figure 2-2 System summary in Enterprise Pools 2.0: Inventory window

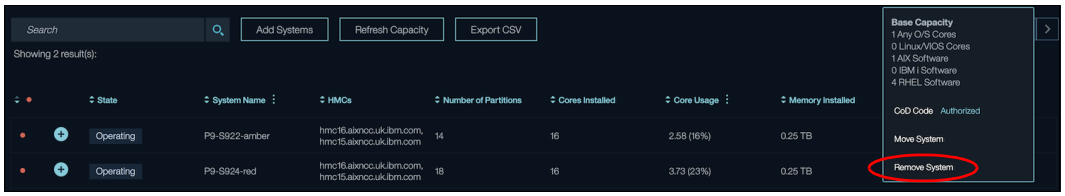

Figure 2-3 Remove System from Pool

Click the (**...**) icon that is at the right of the system table, as shown in Figure 2-2 on page 43 to see the status of the pool membership CoD code for a system. Pool membership CoD codes expire every 90 days. If the CoD code has more than 10 days remaining in its authorization period, the status that is shown is *Authorized*. If the CoD code has 10 or fewer days remaining in its authorization period, the status that is shown is the number of days remaining. If the CoD code is expired, the status that is shown is *EXPIRED*. IBM CMC automatically renews the pool membership CoD code for a system after the days remaining in the authorization period reaches 10. IBM CMC tries once every 24 hours to renew a CoD code. If the renewal of a CoD code fails when there are 7 or fewer days remaining in the authorization period, a notification is generated. If you click the **CoD code status** field, a window opens that shows any system in the pool that has 10 or fewer days remaining in its authorization period or that has an expired pool membership CoD code. You can view why the automatic CoD code update failed for each system. You can select systems and update their CoD codes immediately.

- Move System.

  Click the (**...**) icon that is at the right of the system table to open a menu, and then click **Move System** to move the system to another, existing Enterprise Pool 2.0, as shown in Figure 2-4. IBM CMC contacts IBM Entitled Systems Support to get the pool membership CoD code and pool resource CoD code for the system in the destination pool. A managing HMC for the system retrieves the CoD codes and enters them into the system. When the pool membership CoD code is successfully entered into the system, the system is removed from its pool and added to the destination pool. IBM CMC removes the system's base resources from the current pool and adds them to the destination pool. If the system that was moved was the only system in the current pool, the pool is permanently deleted. All unused credits for the pool are forfeited.

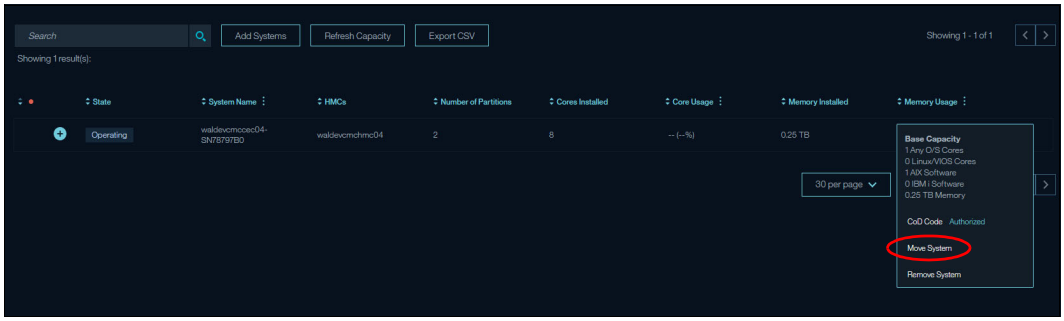

Figure 2-4 Enterprise Pools 2.0 Inventory: Move System

2.4.4 Core Usage

When you click **Core Usage** for Enterprise Pool 2.0, you can view and analyze the current and historical core usage for a pool, and for systems and partitions in a pool. The core usage is tracked and charged in minutes. It is based on the average core usage, not the peak core usage, for the minute.

The bar graph in the Core Usage window, as shown in Figure 2-5, shows the core usage for the pool. You can change the view to show the usage by minutes, hours, days, weeks, and months, and you can view Total Usage (Core Minutes), Metered Usage (Core Minutes), and Metered Usage (Credits).

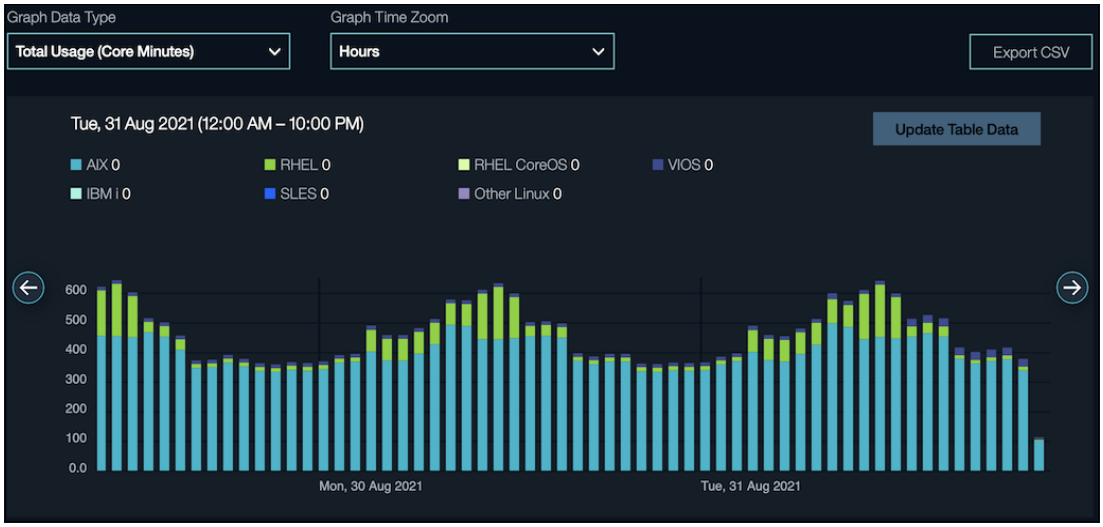

Figure 2-5 Core Usage graph

You can select a period in the core usage graph to view the detailed usage by system or partition, as shown in Figure 2-6, Figure 2-7 on page 46, and Figure 2-8 on page 46.

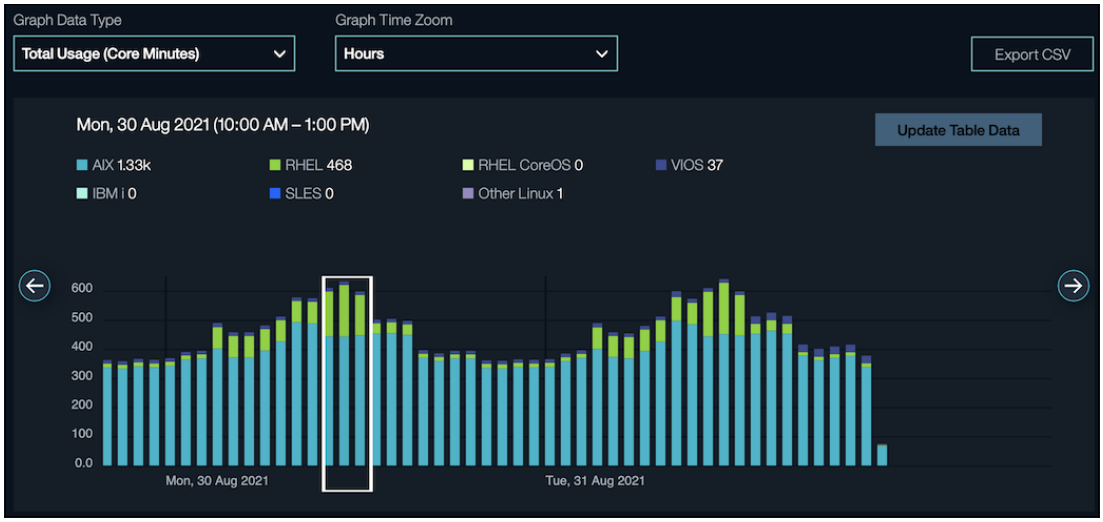

Figure 2-6 Selecting the period in the Core Usage bar graph

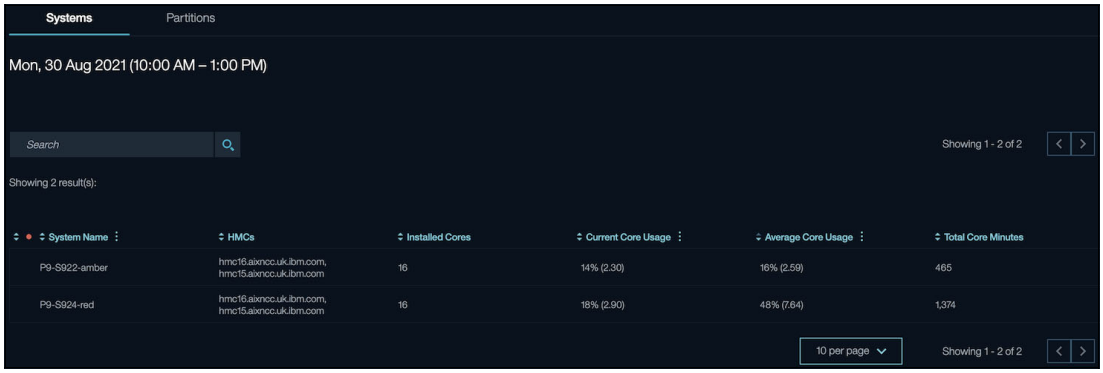

Figure 2-7 Core Usage details for systems in a pool for the selected period

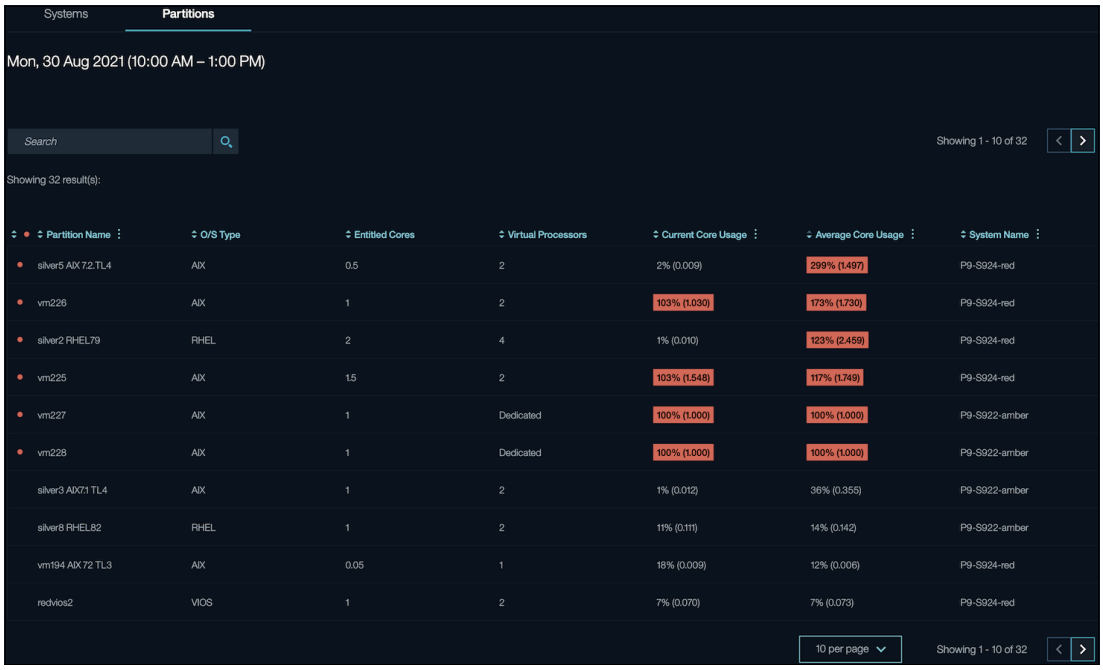

Figure 2-8 Core Usage details for partitions in a pool for the selected period

There are filters that you can set that determine which partitions in the pool are displayed. The filter affects the pool usage and system usage that are displayed. You can filter by the following OS types, as shown in Figure 2-9:

- AIX
- IBM i
- RHEL
- RHEL CoreOS
- SUSE Linux Enterprise Server
- Other Linux
- VIOS

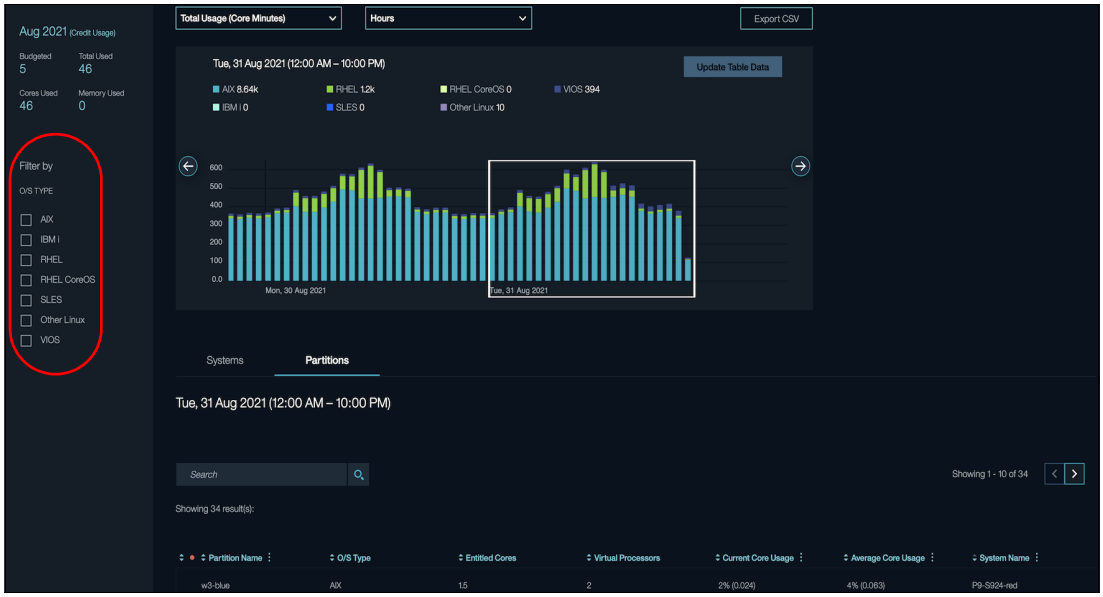

Figure 2-9 Core Usage graph with filter

2.4.5 Memory Usage

You can view and analyze the current and historical memory usage for a pool and for the systems and the partitions in the pool. Memory usage is tracked and charged by the minute.

Memory usage is tracked based on the assignment of memory and virtual persistent memory (PMEM) to the partitions in the pool. Virtual PMEM that is assigned to both active and inactive partitions is tracked and charged because it is always in use. Other memory that is assigned to inactive partitions is not tracked or charged. System FW memory usage is tracked and charged.

For the bar graph, different views of memory usage are available in minutes, hours, days, weeks, and months.

The Memory Usage bar graph, the selected period for detailed view, and the system and partition views for the selected period are shown in Figure 2-10, Figure 2-11, and Figure 2-12 on page 49.

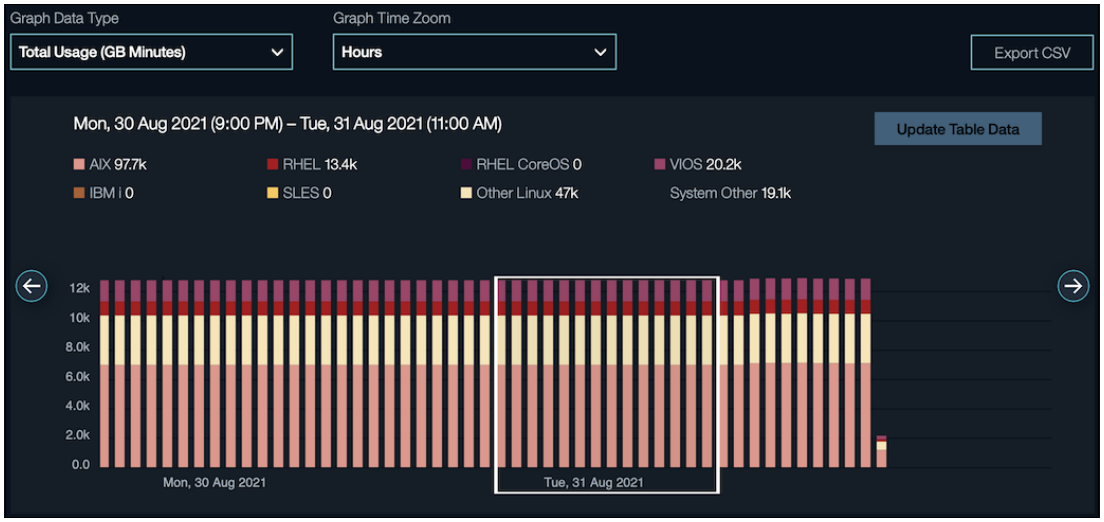

Figure 2-10 Memory Usage bar graph in Enterprise Pools 2.0 with a selected period

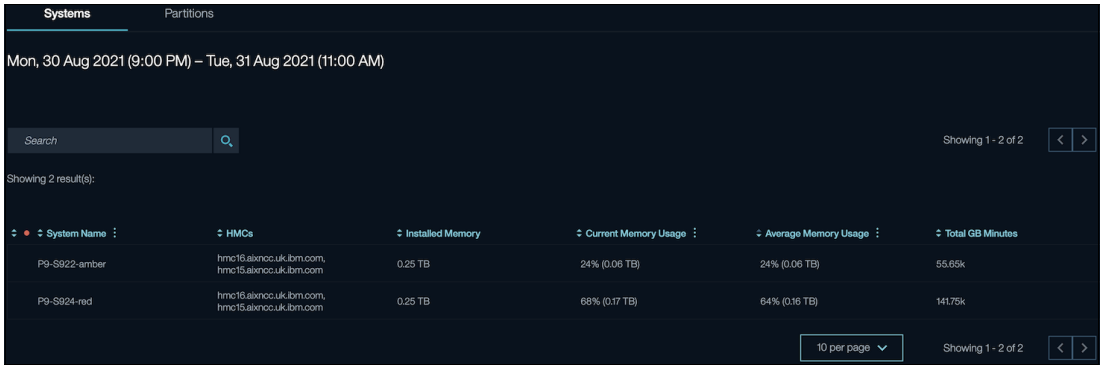

Figure 2-11 Detailed Memory Usage for systems in a pool for the selected period

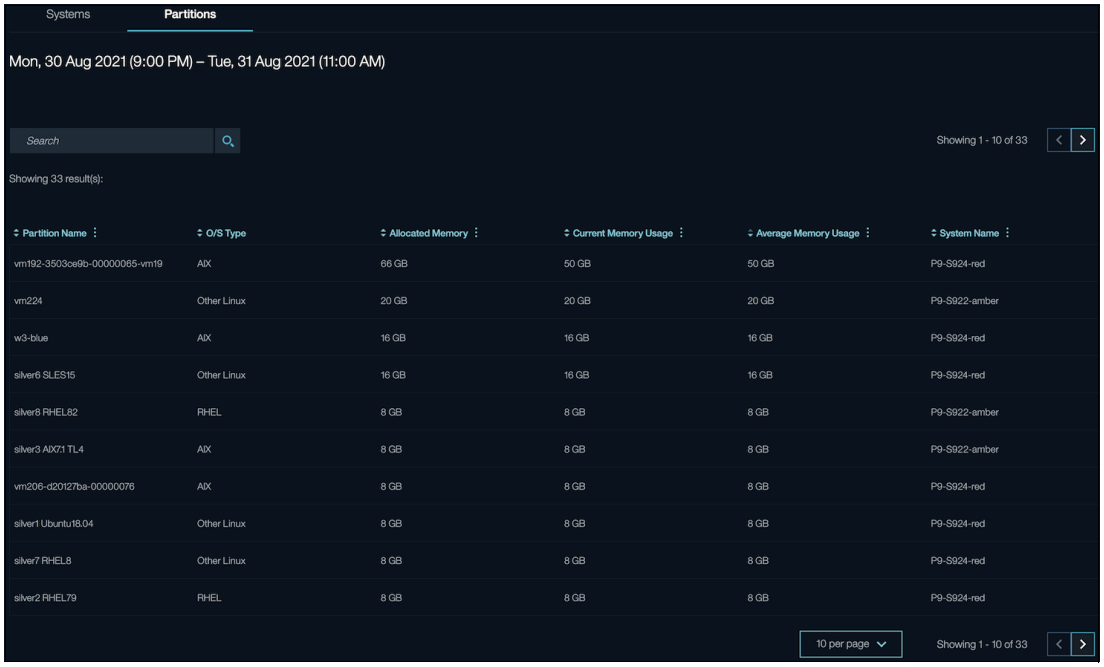

Figure 2-12 Detailed Memory Usage for partitions in a pool for the selected period

There are filters that you can set that determine which partitions in the pool are displayed. The filter affects the pool usage and system usage that are displayed. You can filter by the following OS types, as shown in Figure 2-13:

- AIX
- IBM i
- RHEL
- RHEL CoreOS
- SUSE Linux Enterprise Server
- Other Linux
- VIOS

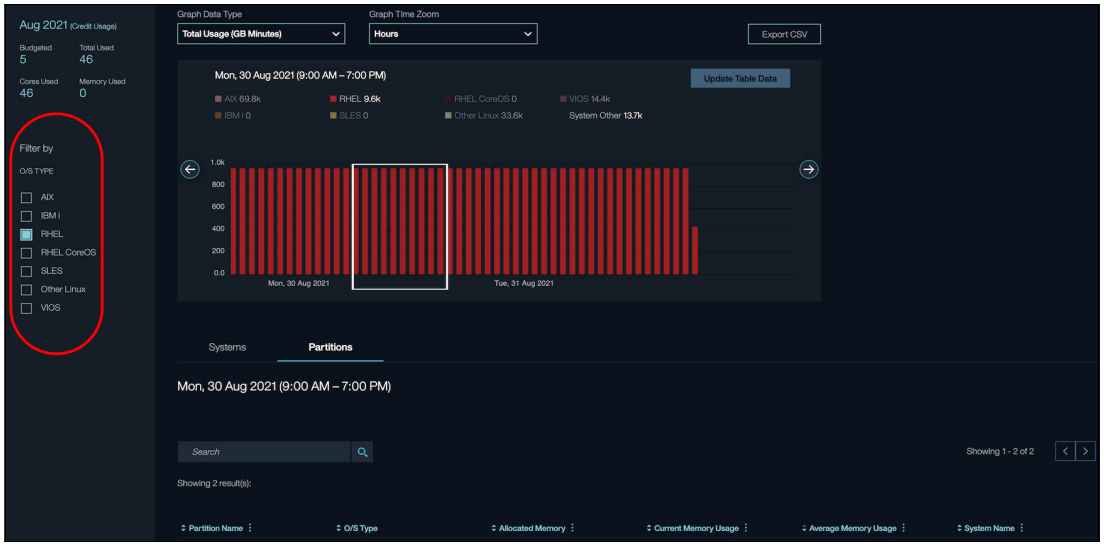

Figure 2-13 Memory usage graph with filter

2.4.6 Budget

In the Budget window, you can view and set monthly budgets for the metered capacity usage in a pool.

A monthly budget puts a limit on the amount that can be spent each month on metered capacity, which cannot be exceeded. If you do not want to limit the amount that can be spent in a month on metered capacity, you can set the monthly budget to **Unlimited**.

Note: Budgeting is not enforced for pools that allow dedicated processor partitions.

If budgeting is enforced for a pool and a monthly budget is reached, then processor throttling starts on all of the systems in the pool and each system will be gradually limited to its purchased base capacity.

If budgeting is not enforced for a pool, a monthly budget can be exceeded. Therefore, when a monthly budget is reached, processor throttling is not started to limit metered capacity consumption and metered capacity charges continue to accrue. (The remaining current month's budget is shown as negative.)

Even when budgeting is not enforced for a pool, budget notifications are still functional.

You can also use the Budget window to view the metered capacity usage in credits for the current month and all previous months.

Figure 2-14 shows the Budget window. Because the example pool in this window allows dedicated partitions, budgeting is not enforced for this pool.

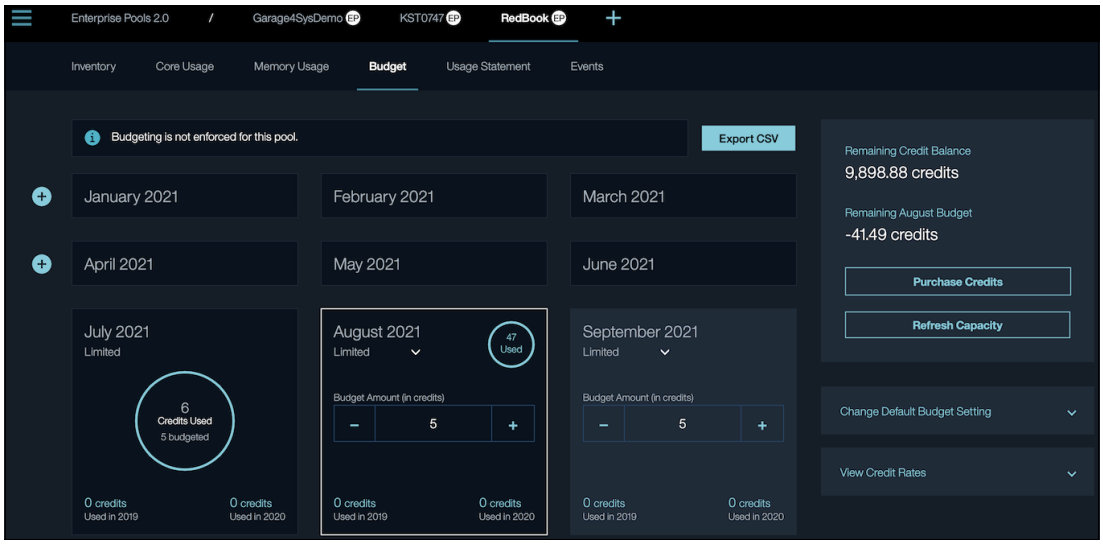

Figure 2-14 Budget window in the Enterprise Pools 2.0 application

The Budget window also displays the following information, as shown in Figure 2-15:

- Credit Balance: Shows the amount of Capacity Credits that remain in the pool.
- Remaining budget for the month: Shows the credit balance that remains for the month.
- Refresh Capacity: You can click **Refresh Capacity** when you add base capacity or credits to a pool so that the application shows the updated capacity.
- View Credit Rates: Expand this view to display the credit rates for the metered resource types.
- Change Default Budget Setting: Use this view to change the default budget setting to unlimited or to a credit limit amount for future months.
- Purchase Credits: Opens the IBM Entitled Systems Support website in a new tab.

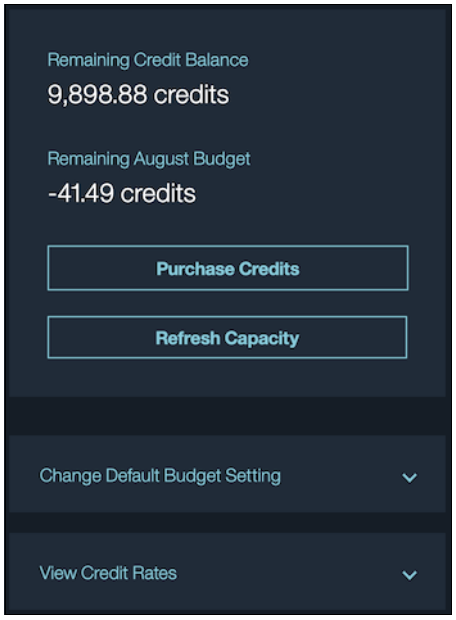

Figure 2-15 Credit summary that is displayed in Budget and Usage Statement

2.4.7 Usage Statement

You can view the metered capacity usage for the pool by resource type for the statement cycle that is selected.

Figure 2-16 shows the Usage Statement view in the IBM Power Systems Private Cloud with Shared Utility Capacity application.

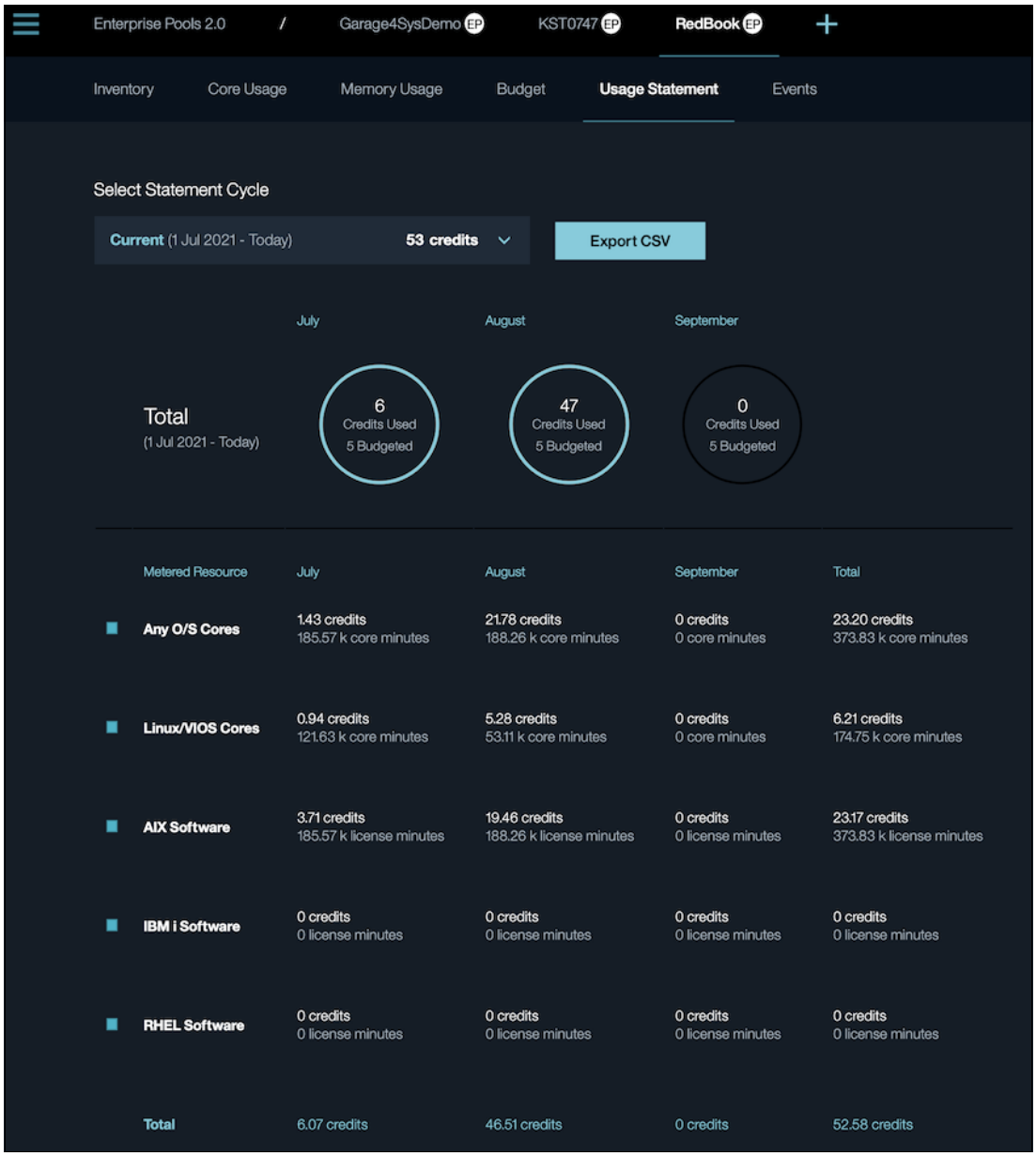

Figure 2-16 Usage Statement in the Enterprise Pools 2.0 application

The Usage Statement also displays the credit summary, as shown in Figure 2-15 on page 51. To enable the monthly usage report to be emailed to you (a best practice), go to the Settings page.

2.4.8 Events

Use the Events page to view the events that occurred for the pool. The date and time that the event occurred, the user ID that performed the event, and a description of the event are displayed. If the event was performed by IBM CMC, the user ID is `system`.

An example event is shown in Figure 2-17.

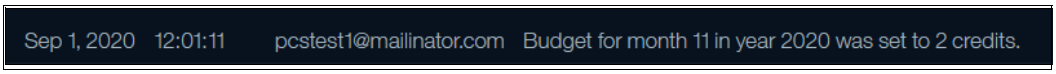

Figure 2-17 An event in Enterprise Pools 2.0

The events list can be exported in `.csv` format.

2.4.9 Pool Settings

Click the **Settings** icon in the upper right of the PEP 2.0 window to manage the pool and threshold settings, as shown in Figure 2-18.

Figure 2-18 Changing the Pool Settings

You can select the value (entitled cores or virtual processor cores) on which partition core usage percentages and thresholds are based.

Set alerts and thresholds for a pool based on budget and resource consumption. An example of a threshold setting is `when metered usage reaches a % of the current month's budget`.

The Pool Settings window also provides Usage Statement Email option. When this option is enabled, a credit usage statement for the pool is sent to the listed emails monthly.

Lastly, the Delete Pool function is also available on the Pool Settings window.

2.4.10 View Notifications

You can view the notifications for a pool, which are generated by the IBM CMC applications, by clicking the **Notifications** icon. The Notifications icon is next to the Settings icon in the upper right of the PEP 2.0 application window, as shown in Figure 2-19.

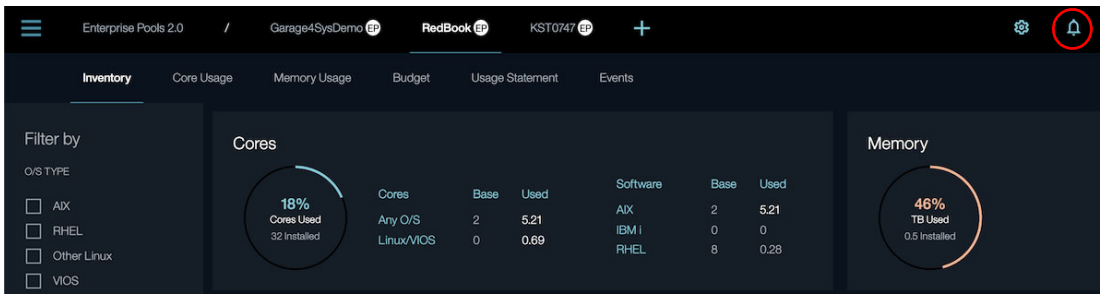

Figure 2-19 View Notifications

You can also modify the notification settings. You can enter one email address and one phone number to receive each notification when it occurs.

An example of a pool notification is `Monthly budget for pool 1006 has been reached`.

2.5 Sizing: How to figure out base capacity

This section describes the sizing guidelines for IBM Power Systems Private Cloud with Shared Utility Capacity.

2.5.1 Overview

Using IBM Power Systems Private Cloud with Shared Utility Capacity can substantially lower the initial system acquisition price for clients who want to minimize their short-term capital expenses or tailor their system configuration to their specific deployment plans.

2.5.2 Dynamic Capacity options

On POWER9 and Power10 processor–based systems, there are two options for Dynamic Capacity: Elastic Capacity (formerly On/Off CoD) and Shared Utility Capacity (IBM Power Systems Private Cloud with Shared Utility Capacity).

Elastic Capacity offers processor or memory by the day, which are purchased as features for a particular machine type and deployed across one or more systems in an enterprise by the client, who allocates the days to a particular system for use and generates a key to enable them (self-service) for use on that system some time in the future. You must manually assign resources to VMs. Also, resources are considered as used at the moment that they are assigned to a VM independent of their actual usage in the VM. Resource granularity is in days, so it is not possible to activate resources for shorter terms than 24 hours.

Shared Utility Capacity offers processor and memory resources by the minute. It enables purchased base activation resources within a defined pool of systems of the same machine type to be shared. More unpurchased hardware resources on all systems in the pool are activated for use by the client. If these resources are used, they are debited in real time by the minute against pre-purchased Capacity Credits based on published resource rates for each machine type. These additional minutes are billed only if there are no idle purchased resources of the same type available at that moment.

A graphical comparison of these two Dynamic Capacity options is shown in Figure 2-20.

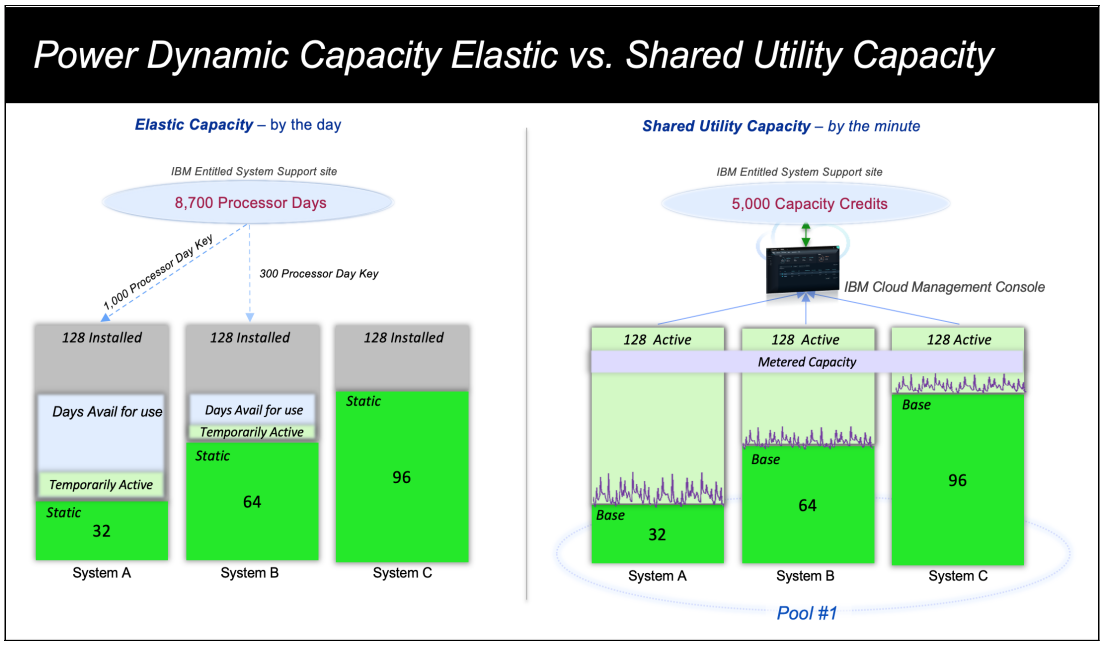

Figure 2-20 Power10 processor-based systems: Dynamic Capacity options

2.5.3 Shared Utility Capacity fundamentals

IBM Power Systems Private Cloud with Shared Utility Capacity delivers enhanced multisystem resource sharing and by-the-minute consumption of on-premises compute resources for clients deploying and managing a private cloud infrastructure. All installed processors and memory on servers in an IBM Power Systems Private Cloud with Shared Utility Capacity are activated and made available for immediate use when a pool is started. There is no need to reallocate mobile resources from server to server as with PEP 1.0, or activate and deactivate temporary resources on servers as with Elastic CoD.

IBM Power Systems Private Cloud with Shared Utility Capacity simplifies system management, so clients can focus on optimizing their business results instead of activating and deactivating resources within their data center. Resources are easily tracked and monitored by IBM CMC with HMC, which automatically tracks usage by the minute and debits against Capacity Credits based on actual usage. With IBM Power Systems Private Cloud with Shared Utility Capacity, clients no longer need to worry about over-provisioning capacity to support growth.

2.5.4 Total cost of ownership versus total cost of acquisition

To start sizing the pools, you must determine the client objectives and approach to optimize the total cost of ownership (TCO) or total cost of acquisition (TCA). Here is a brief high-level guideline for TCO/TCA sizing:

1. Identify capacity requirements and projections with a deeper understanding of utilization across a pool of resources:
   - Tools for capacity assessment
   - Systems Lab Services optimization services
2. Determine the client objectives and approach to optimize TCO or TCA.

3. Configure the system based on the TCO/TCA objectives.
4. Determine metered capacity requirements for the initial purchase of credits.
5. Iterate to optimize the sizing for both the client and IBM.

Identifying requirements and capacity projections

To identify the requirements and capacity projections, you must perform the following tasks:

- Identify physical system configurations and compute requirements to satisfy peak physical usage over time.
- Configure each system and identify the target price objective that is required to support average and peak workload requirements if all capacity is purchased at the time of initial system acquisition.
- Determine the project capacity that is required on each system and the average utilization over a period:
  - Determine the average and peaks for processor activations, memory activations, and license entitlements.
  - Include any patterns of growth and the level of volatility of average/peak utilization.
  - Create assumptions about aggregate base capacity versus what might potentially be metered resources.

Optimizing TCO versus pay-per-use

Determine the primary value that Shared Utility Capacity should deliver to the client and propose the correct mix of base versus planned metered capacity to meet that objective, as illustrated in Figure 2-21.

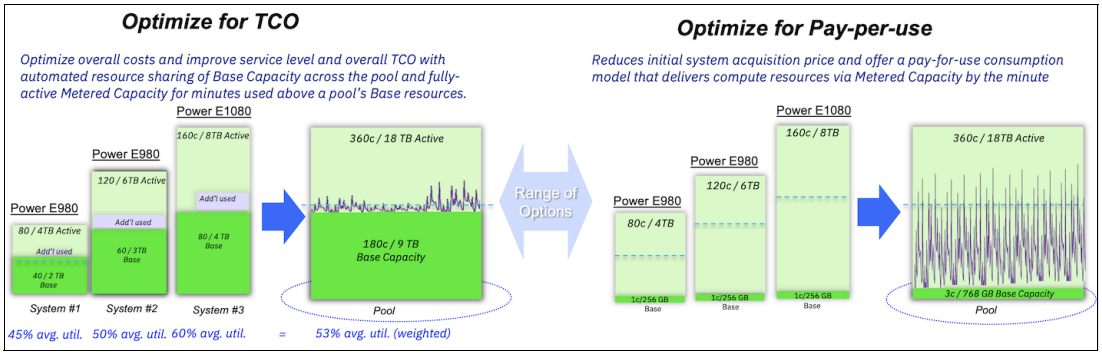

Figure 2-21 Optimizing for TCO versus pay-per-use

2.5.5 Getting the utilization right

To provide the average utilization data for systems that go into the pool, you must complete the following steps:

1. Provide the size budgeting for the current system capacity.

   You should know or be able to gather these statistics from your existing operations team for peak periods or average over the last quarter or year. For example, you might use **`nmon`**, LPAR2RRD, BMC Patrol, or a 3-month IBM CMC package to gather this information.

2. Start with the processor and memory capacity that is sized for the rPerf/commercial processing workload (CPW) from Proc/Mem activations in the initial “buy-all up-front” configurations:
   – Add extra capacity (20 - 25%) that you might need to handle growth, but only if the growth is projected in the “buy-all upfront” case.
   – If you are not sure how much extra capacity is needed, use 70% of the active resources for production systems as a robust average.
3. Adjust the percentage to reflect 100% active resources per system in a pool versus what you might have installed versus the active capacity on the measured systems. For example, if the data is from systems with 80% average utilization of a 75% active system, the new utilization is 100% of resources that are not active => 60%.
4. Reduce or adjust the average and peak percentage utilization projections over a 3-year period to reflect any impacts from the following items:
   – Phased growth over time. Consider reducing the base capacity initially and Miscellaneous Equipment Specification (MES) later for sustained workloads that will not be deployed in the near term, for example, a client migrating from an existing 80% active POWER8 processor-based system to a Power10 processor-based system with a forecast of 20% growth per year over 3 years.
   – Volatile workloads with a wide range of peaks and valleys. Project peaks over each year, and average more carefully per system for a more refined view of a pool.
   – Time of day/week/month/year. Adjust the percentage average to reflect the period of projection to account for fluctuations and averaging to account for up/down volatility over 3 years. For example:
     • A 9x5 Monday - Friday schedule versus a 24x7 schedule.
     • A 3-year period of growth of system capacity. Is it 80% initially upon deployment versus 2.5 years from now based on the capacity that is proposed in the “buy-all up-front case”?
     • Holidays, vacation periods, and other seasonal peaks or valleys.

2.5.6 Shared Utility Capacity detailed sizing

There is only one type of charge for memory resources, and there are multiple types of charges for metered capacity utilization based on OS types that are offered by IBM:

- Any OS hardware core
- Linux/VIOS only hardware core
- AIX software
- IBM i software
- SUSE Linux Enterprise Server software
- RHEL software

Memory sizing

Because memory resources are tracked based on the assignment of resources and not based on the OS usage of the memory, sum up the memory sizes of all the planned workloads and purchase enough memory activations to cover the planned workloads. It is possible to order more memory activations when they are needed, and also it is possible to burn metered Capacity Credits for extra memory capacity for high demand periods.

Processor sizing

The total pool core consumption for 1 minute is computed by looking at each active partition in the pool, determining its OS type, computing its average core usage for that minute, and summing it with the average usage for every other active partition of the same OS type in that minute. This summary generates multiple values for pool core usage in that minute: AIX, IBM i, RHEL, RHEL CoreOS, SUSE Linux Enterprise Server, other Linux, and VIOS. These calculated values are compared against purchased base activations in the relevant category, and excess usage is charged against Capacity Credits. Due to various supported OS types, estimating the necessary number of base activations for each category can be challenging:

- IBM CMC compares the total processor consumption of AIX and IBM i workloads against “any OS hardware core” activations and their corresponding software activations (AIX or IBM i software activations). If there are not enough activations in any segment (hardware or software), excess usage is charged against metered Capacity Credits.
- If there are enough “any OS hardware core” base activations to satisfy both AIX and IBM i workloads, the remaining capacity is marked as *spare* for Linux/VIOS workloads if needed.
- The processor consumption for Linux and VIOS workloads is first compared against “Linux/VIOS only hardware core” activations if there are any. If there are enough activations, no metered charges are generated. If there are not enough “Linux/VIOS only hardware core” base activations for that minute, then the deficit is compared against any “any OS hardware core” activations that are marked as spare from AIX and IBM i workloads. If there are enough “any OS hardware core” activations remaining to satisfy the remaining Linux/VIOS workloads, no metered charges are generated. If not, any spare “any OS hardware core” activations are deducted from the deficit, and the remaining Linux/VIOS processor usage is charged against Capacity Credits.
- The processor consumption for VIOS workloads is compared against only hardware core activations. There are no software charges for VIOS workloads in the Shared Utility Capacity metering model.
- If there are any SUSE Linux Enterprise Server and RHEL subscriptions, the IBM CMC compares actual utilization against base capacity for these OSs. Above the base usage is charged against Capacity Credits.

> **Important:** IBM offers RHEL and SUSE Linux Enterprise Server metering in the IBM Power Systems Private Cloud with Shared Utility capacity.

Metered Capacity Credits cover all seven types of metered capacity utilization: Any OS hardware core, Linux/VIOS only hardware core, AIX software, IBM i software, 1 GB Memory, and if there are any subscriptions, SUSE Linux Enterprise Server software and RHEL software. If constantly used, metered Capacity Credits might cost more than base activations. Because base activations and Capacity Credits have different costs, estimating an optimal number of base activations for IBM Power Systems Private Cloud with Shared Utility Capacity is important for maximizing the cost efficiency of resource sharing.

To calculate the optimal number of base activations, clients should collect processor utilization information of 1-minute intervals from every candidate workload. Then, all the collected data must be aligned, and processor consumption must be aggregated together for every minute, followed by a rPerf/CPW value conversion from existing systems to the target Power10 or POWER9 processor-based system.

This data enables understanding of the aggregated processor consumption characteristics of the selected workloads. Starting with this minute-based, aggregated, and rPerf/CPW scaled processor utilization matrix, and incorporating available pricing information, it might be possible to estimate an optimal number of base activations for a set of workloads.

Note: It is important to start the analysis by using a long range of data (the longer the better) because this data sets the baseline for the pool. Consider looking at a few months of data (ideally a whole year) with a minimum of 2 months to cover some peaks.

It is possible to add more base activations to the pool as needed so that you do not need to buy extra capacity at the start of the sizing process. If the procurement model is “buy-all upfront”, only then make a projection for the expected number of years and add extra capacity for expected future growth.

Attention: Clients also must determine the number of Capacity Credits that is needed to keep their pool running.

IBM Systems Lab Services developed a set of capacity planning tools (CPTs) and a study to analyze workload utilization characteristics. IBM Private Cloud Capacity Assessment (PCCA) is a study that uses the Capacity Planning Tool - Metered Capacity Modeling (CPT-MCM), which is designed for an IBM Power Systems Private Cloud with Shared Utility Capacity analysis. This study analyzes provided utilization data and calculates an optimal number of base activations and required number of Capacity Credits for a set of parameters and candidate workloads for a IBM Power Systems Private Cloud with Shared Utility Capacity configuration.

Tip: For more information, see 5.2, “IBM Systems Lab Services sizing support” on page 145.

2.6 Ordering process

There are new feature codes that are available for IBM Power Systems Private Cloud with Shared Utility Capacity. The ordering process consists of the following steps:

1. Clients purchase one or more IBM Power servers with the following features:
   a. PEP 2.0 enablement Feature Code #EP20
   b. Base activations
   c. Corresponding software license entitlements for the base activations
2. Clients purchase an initial quantity of Capacity Credits from IBM Sales, an IBM Business Partner, or where available, on the IBM Entitled Systems Support website to pay for potential metered capacity consumption.
3. Clients purchase an IBM CMC (5765-CMT) subscription to create and manage IBM Power Systems Private Cloud with Shared Utility Capacity.

2.6.1 Base activations

IBM Power Systems Private Cloud with Shared Utility Capacity requires the following base activation feature codes:

- Base processor activations
- Base memory activations

Table 2-9 shows the feature codes for the Power E1080 (9080-HEX) server.

Table 2-9 Power E1080 feature codes

Feature Code	Description
#EP20	PEP 2.0 Enablement
#EPDC	1 core Base Processor Activation (Pools 2.0) for EDP2 any OS
#EPDD	1 core Base Processor Activation (Pools 2.0) for EDP3 any OS
#EPDS	1 core Base Processor Activation (Pools 2.0) for EDP4 any OS
#EPDU	1 core Base Processor Activation (Pools 2.0) for EDP2 Linux only
#EPDW	1 core Base Processor Activation (Pools 2.0) for EDP3 Linux only
#EPDX	1 core Base Processor Activation (Pools 2.0) for EDP4 Linux only
#EDAG	256 GB Base Memory Activation (Pools 2.0)
#EDAH	512 GB Base Memory Activation (Pools 2.0)
#EDAL	256 GB Base Memory Activation Linux only
#EDAM	512 GB Base Memory Activation Linux only
#EDAP	1 GB Base Memory activation (Pools 2.0) from Static
#EDAQ	100 GB Base Memory activation (Pools 2.0) from Static
#EDAR	512 GB Base Memory activation (Pools 2.0) from Static
#EDAS	500 GB Base Memory activation (Pools 2.0) from Static
#EDAT	1 GB Base Memory activation (Pools 2.0) MES only
#EDAU	100 GB Base Memory activation (Pools 2.0) MES only
#EDAV	100 GB Base Memory Activation (Pools 2.0) from Mobile
#EDAW	500 GB Base Memory Activation (Pools 2.0) from Mobile
#EDAX	512 GB Base Memory Activation Linux only - Conversion
#EPS0	1 core Base Proc Act (Pools 2.0) for #EDP2 any OS (from Static)
#EPS1	1 core Base Proc Act (Pools 2.0) for #EDP3 any OS (from Static)
#EPS2	1 core Base Proc Act (Pools 2.0) for #EDP4 any OS (from Static)
#EPS5	1 core Base Proc Act (Pools 2.0) for #EDP2 Linux (from Static)
#EPS6	1 core Base Proc Act (Pools 2.0) for #EDP3 Linux (from Static)
#EPS7	1 core Base Proc Act (Pools 2.0) for #EDP4 Linux (from Static)
#EPSK	1 core Base Proc Act (Pools 2.0) for #EDP2 any OS (from Mobile Prev)

Feature Code	Description
#EPSL	1 core Base Proc Act (Pools 2.0) for #EDP3 any OS (from Mobile Prev)
#EPSM	1 core Base Proc Act (Pools 2.0) for #EDP4 any OS (from Mobile Prev)

For more information about the Power E1080 server, see *IBM Power E1080 Technical Overview and Introduction*, REDP-5649.

Table 2-10 shows the feature codes for the Power E980 (9080-M9S) server.

Table 2-10 Power E980 feature codes

Feature Code	Description
#EP20	PEP 2.0 Enablement
#EP90	1 core Base Processor Activation (Pools 2.0) for EFP1 - Any OS
#EP91	1 core Base Processor Activation (Pools 2.0) for EFP2 - Any OS
#EP92	1 core Base Processor Activation (Pools 2.0) for EFP3 - Any OS
#EP93	1 core Base Processor Activation (Pools 2.0) for EFP4 - Any OS
#EP94	1 core Base Processor Activation (Pools 2.0) for EFP0 Linux only
#EP96	1 core Base Processor Activation (Pools 2.0) for EFP1 – Linux/VIOS only
#EP97	1 core Base Processor Activation (Pools 2.0) for EFP2 – Linux/VIOS only
#EP98	1 core Base Processor Activation (Pools 2.0) for EFP3 – Linux/VIOS only
#EP99	1 core Base Processor Activation (Pools 2.0) for EFP4 – Linux/VIOS only
#EP9Z	1 core Base Processor Activation (Pools 2.0) for EFP0 any OS
#EP9S	256 GB Base Memory Activation (Pools 2.0)
#EP9U	512 GB Base Memory Activation (Pools 2.0)
#EPP0	1 core Base Proc Act (Pools 2.0) for #EFP0 (from Static/Mobile-enabled)
#EPP1	1 core Base Proc Act (Pools 2.0) for #EFP1 (from Static/Mobile-enabled)
#EPP2	1 core Base Proc Act (Pools 2.0) for #EFP2 (from Static/Mobile-enabled)
#EPP3	1 core Base Proc Act (Pools 2.0) for #EFP3 (from Static/Mobile-enabled)
#EPP4	1 core Base Proc Act (Pools 2.0) for #EFP4 (from Static/Mobile-enabled)
#EPP5	1 core Base Proc Act (Pools 2.0) for #EFP0 Linux (from Static/Mobile-enabled)
#EPP6	1 core Base Proc Act (Pools 2.0) for #EFP1 Linux (from Static/Mobile-enabled)
#EPP7	1 core Base Proc Act (Pools 2.0) for #EFP2 Linux (from Static/Mobile-enabled)
#EPP8	1 core Base Proc Act (Pools 2.0) for #EFP3 Linux (from Static/Mobile-enabled)
#EPP9	1 core Base Proc Act (Pools 2.0) for #EFP4 Linux (from Static/Mobile-enabled)
#EPPK	1 core Base Proc Act (Pools 2.0) for #EFP0 (from Prev)
#EPPL	1 core Base Proc Act (Pools 2.0) for #EFP1 (from Prev)
#EPPM	1 core Base Proc Act (Pools 2.0) for #EFP2 (from Prev)

Feature Code	Description
#EPPN	1 core Base Proc Act (Pools 2.0) for #EFP3 (from Prev)
#EPPP	1 core Base Proc Act (Pools 2.0) for #EFP4 (from Prev)
#EPPQ	1 GB Base Memory activation (Pools 2.0) from Static/ Mobile-enabled
#EPPR	100 GB Base Memory activation (Pools 2.0) from Static/ Mobile-enabled
#EPPS	512 GB Base Memory activation (Pools 2.0) from Static/ Mobile-enabled
#EPPT	500 GB Base Memory activation (Pools 2.0) from Static/ Mobile-enabled
#EPPU	1 GB Base Memory activation (Pools 2.0) MES only
#EPPV	100 GB Base Memory activation (Pools 2.0) MES only
#EPPW	100 GB Base Memory Activation (Pools 2.0) from Mobile
#EPPX	500 GB Base Memory Activation (Pools 2.0) from Mobile

For more information about the Power E980 server, see *IBM Power System E980: Technical Overview and Introduction*, REDP-5510.

Table 2-11 shows the activation feature codes for the Power E950 server.

Table 2-11 Power E950 feature codes

Feature Code	Description
#EP20	PEP 2.0 Enablement
#EPQ0	1 core Base Processor Activation (Pools 2.0) for EPWR
#EPQ1	1 core Base Processor Activation (Pools 2.0) for EPWS
#EPQ2	1 core Base Processor Activation (Pools 2.0) for EPWT
#EPQ3	1 core Base Processor Activation (Pools 2.0) for EPWY
#EPQ4	1 core Base Linux Processor Activation (Pools 2.0) for EPWR
#EPQ5	1 core Base Linux Processor Activation (Pools 2.0) for EPWS
#EPQ6	1 core Base Linux Processor Activation (Pools 2.0) for EPWT
#EPQ7	1 core Base Linux Processor Activation (Pools 2.0) for EPWY
#EPQ8	1 GB Base Memory Activation (Pools 2.0)
#EPQ9	100 GB Base Memory Activation (Pools 2.0)
#EPQA	256 GB Base Memory Activation (Pools 2.0)
#EPQB	1 core Base Proc Act (Pools 2.0) for #EPWR (from Static)
#EPQC	1 core Base Proc Act (Pools 2.0) for #EPWS (from Static)
#EPQD	1 core Base Proc Act (Pools 2.0) for #EPWT (from Static)
#EPQE	1 core Base Proc Act (Pools 2.0) for #EPWY (from Static)
#EPQF	1 core Base Proc Act (Pools 2.0) for #EPWR Linux (from Static)
#EPQG	1 core Base Proc Act (Pools 2.0) for #EPWS Linux (from Static)

Feature Code	Description
#EPQH	1 core Base Proc Act (Pools 2.0) for #EPWT Linux (from Static)
#EPQJ	1 core Base Proc Act (Pools 2.0) for #EPWY Linux (from Static)
#EPQK	1 GB Base Memory activation (Pools 2.0) from Static
#EPQL	100 GB Base Memory activation (Pools 2.0) from Static
#EPQM	512 GB Base Memory activation (Pools 2.0) convert from Linux only
#EPQN	256 GB Base Memory Activation for Pools 2.0 - Linux only

For more information about the Power E950 server, see *IBM Power System E950: Technical Overview and Introduction*, REDP-5509.

Table 2-12 and Table 2-13 shows the feature codes for the Power S922 (9009-22G) and Power S924 (9009-42G) servers.

Table 2-12 Power S922 (9009-22G) feature codes

Feature Code	Description
#EP20	PEP 2.0 Enablement
#EUA7	8-core Base Processor for (Pools 2.0) Typical 3.4 to 3.9 Ghz (max) POWER9
#EUA8	10-core Base Processor for (Pools 2.0) Typical 2.9 to 3.8 Ghz (max) POWER9
#EUA9	11-core Base Processor for (Pools 2.0) Typical 2.8 to 3.8 Ghz (max) POWER9
#EUAB	1 core Base Processor Activation (Pools 2.0) for EUA7 - Any OS
#EUAC	1 core Base Processor Activation (Pools 2.0) for EUA8 - Any OS
#EUAD	1 core Base Processor Activation (Pools 2.0) for EUA9 - Any OS
#EUAK	8-core Base Processor Pools 2.0 (Conv from #EP58)
#EUAL	10-core Base Processor Pools 2.0 (Conv from #EP59)
#EUAM	11-core Base Processor Pools 2.0 (Conv from #EP5B)
#EUAP	1 core Base Processor Activation (Pools 2.0) for #EUAK - Any OS (Conv from #EP68)
#EUAQ	1 core Base Processor Activation (Pools 2.0) for #EUAL - Any OS (Conv from #EP69)
#EUAR	1 core Base Processor Activation (Pools 2.0) for #EUAM - Any OS (Conv from #EP6B)

Table 2-13 Power S924 (9009-42G) feature codes

Feature Code	Description
#EP20	PEP 2.0 Enablement
#EUB6	8-core Base Processor for (Pools 2.0)
#EUB7	10-core Base Processor for (Pools 2.0)
#EUB8	11-core Base Processor for (Pools 2.0)

Feature Code	Description
#EUB9	12-core Base Processor for (Pools 2.0)
#EUBA	1 core Base Processor Activation (Pools 2.0) for EUB6 - Any OS
#EUBB	1 core Base Processor Activation (Pools 2.0) for EUB7 - Any OS
#EUBC	1 core Base Processor Activation (Pools 2.0) for EUB8 - Any OS
#EUBD	1 core Base Processor Activation (Pools 2.0) for EUB9 - Any OS
#EUBJ	8-core Base Processor Pools 2.0 (Conv from #EP5E)
#EUBK	10-core Base Processor Pools 2.0 (Conv from #EP5F)
#EUBL	11-core Base Processor Pools 2.0 (Conv from #EP5H)
#EUBM	12-core Base Processor Pools 2.0 (Conv from #EP5G)
#EUBN	1 core Base Processor Activation (Pools 2.0) for #EUBJ - Any OS (Conv from #EP6E)
#EUBP	1 core Base Processor Activation (Pools 2.0) for #EUBK - Any OS (Conv from #EP6F)
#EUBQ	1 core Base Processor Activation (Pools 2.0) for #EUBL - Any OS (Conv from #EP6H)
#EUBR	1 core Base Processor Activation (Pools 2.0) for #EUBM - Any OS (Conv from #EP6G)

2.6.2 Capacity Credits

Clients pay for metered capacity consumption by pre-purchasing Capacity Credits.

Capacity Credits can be purchased from IBM, an authorized IBM Business Partner, or online through the IBM Entitled Systems Support website, where available.

5819-CRD is the model and type for ordering Capacity Credits.

IBM CMC tracks the metered capacity usage by the minute and debits against the Capacity Credits based on actual usage.

Table 2-14 shows the Capacity Credit feature codes for model 5819-CRD.

Table 2-14 Capacity Credit features

Feature Code	Description
#EP9B	1 Capacity Credit (Pools 2.0)
#EP9C	10 Capacity Credits (Pools 2.0)
#EP9D	100 Capacity Credits (Pools 2.0)
#EP9E	1,000 Capacity Credits (Pools 2.0)
#EP9F	10,000 Capacity Credit (Pools 2.0)
#EP9J	1 Capacity Credit (Pools 2.0) - Digital
#EP9K	10 Capacity Credits (Pools 2.0) - Digital

Feature Code	Description
#EP9L	100 Capacity Credits (Pools 2.0) - Digital
#EP9M	1,000 Capacity Credits (Pools 2.0) - Digital
#EP9N	10,000 Capacity Credits (Pools 2.0) - Digital

The last five feature codes in Table 2-14 on page 64 are available only for orders through the IBM Entitled Systems Support website.

Ordering Capacity Credits from IBM Entitled Systems Support

Clients can purchase Capacity Credits on the IBM Entitled Systems Support website in countries where this option is available. To purchase credits from IBM Entitled Systems Support, complete the following steps:

1. Log in to the IBM Entitled Systems Support portal by using your IBM ID.
2. Register your customer number by selecting **My profile** → **Register customer number** from the IBM Entitled Systems Support main page.
3. Add credits by selecting **Enterprise Pools 2.0 - Add credits to pool** in the **My entitled hardware** menu.

   There are two options to add credits to a pool: You can buy new credits for your existing Pool ID, or you can use an existing 5819-CRD order to assign credits to your Pool ID if you have unassigned credit orders. The **Use an existing 5899-HYB order** option might be visible on IBM Entitled Systems Support, which is planned to be made available later in the future.

   a. To buy new credits, complete the following steps:

      i. In the **Buy new credits** tab, select the customer number and the Pool ID from the drop-down list and click **Continue**, as shown in Figure 2-22.

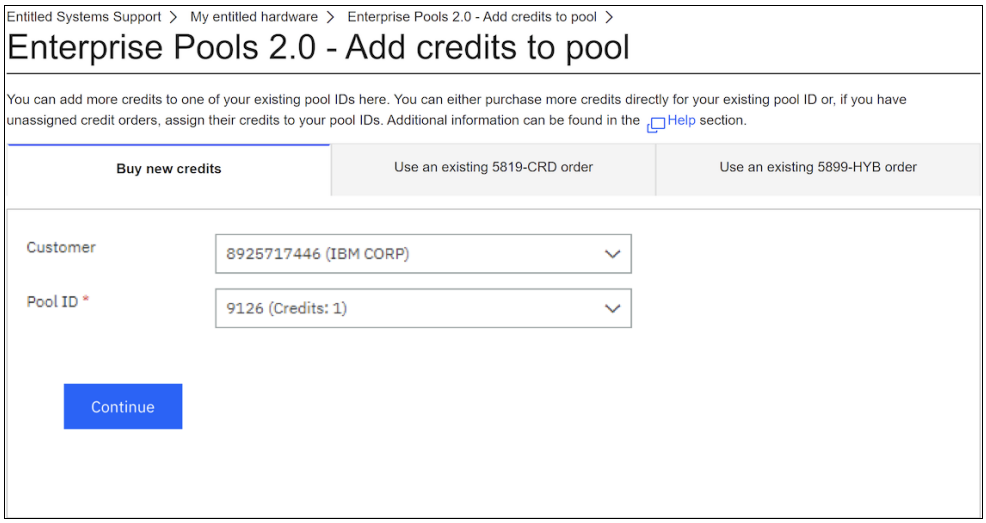

Figure 2-22 Add credits to pool window: Buy new credits

ii. Add the number of credits to purchase and click **Continue**, as shown in Figure 2-23.

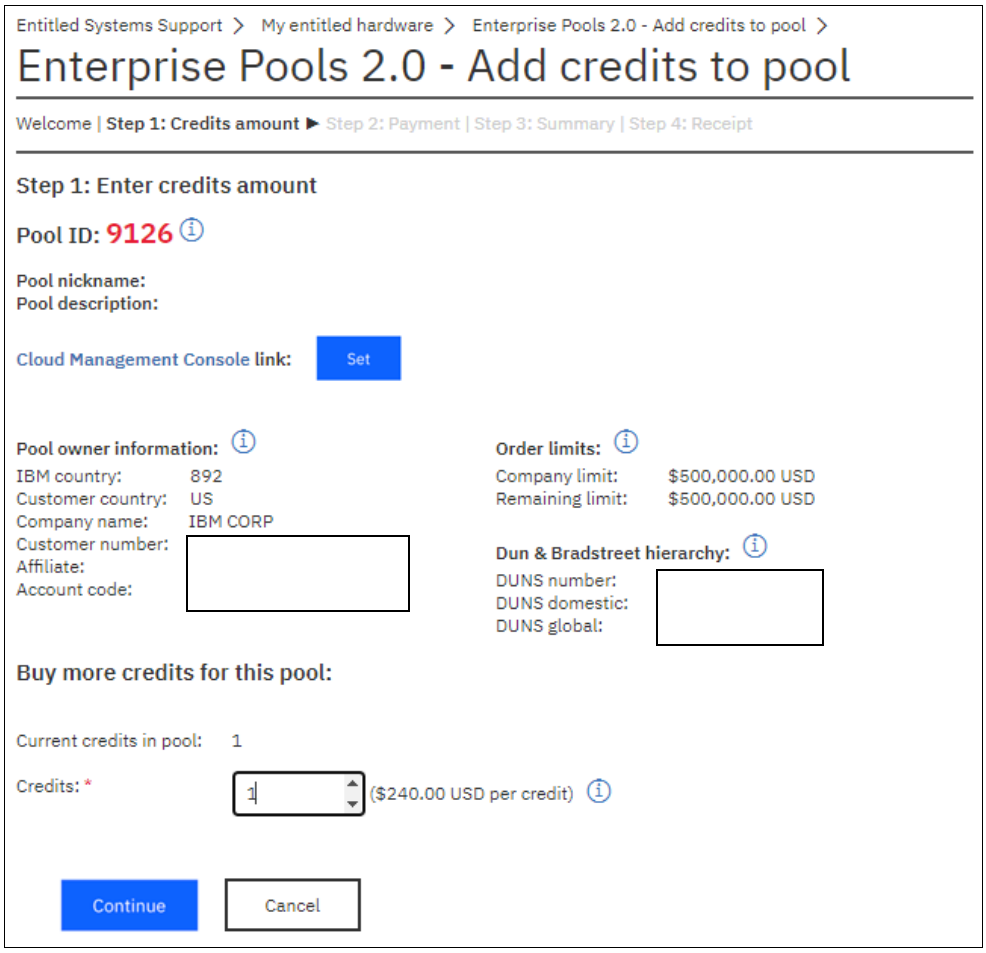

Figure 2-23 Add credits to pool: Enter credits amount

iii. Add the Purchase order number and Billing address, and click **Continue**, as shown in Figure 2-24.

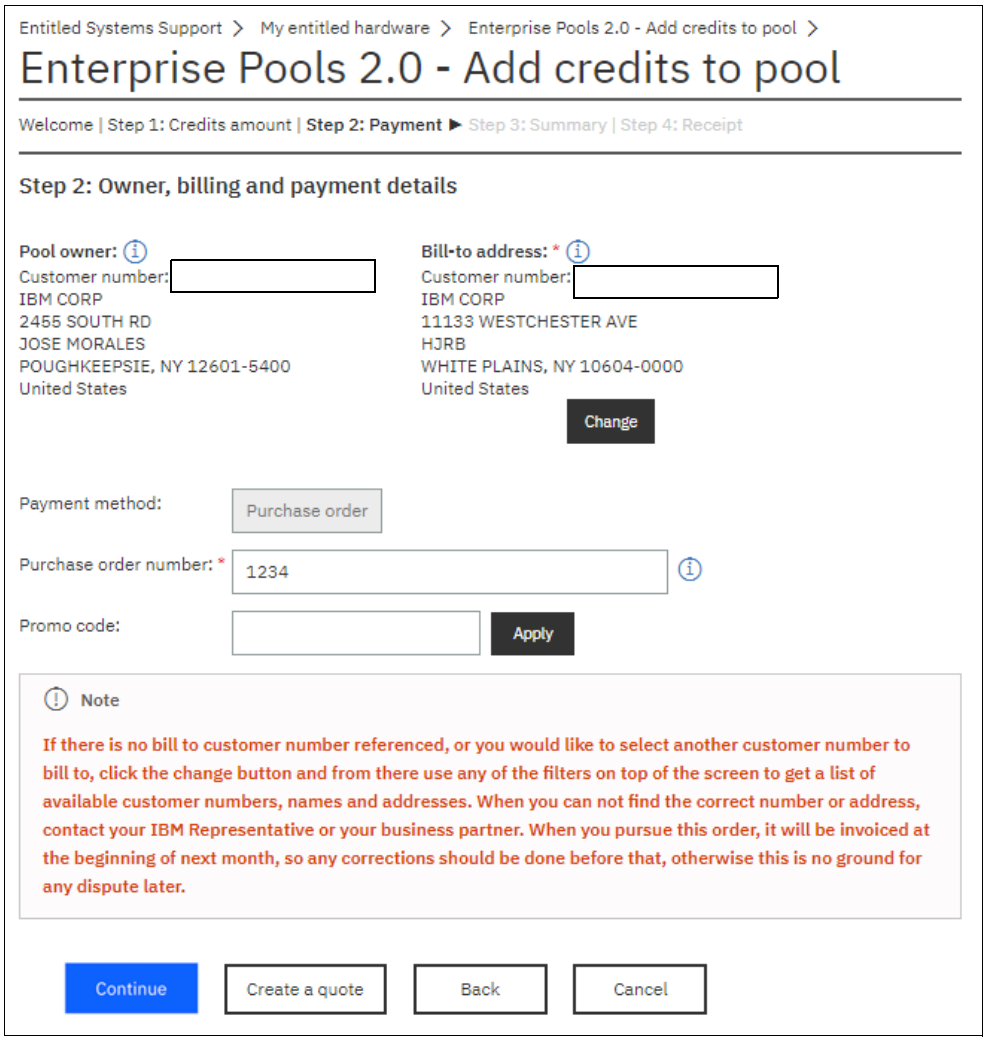

Figure 2-24 Add credits to pool window: Owner, billing, and payment details pane

iv. Review the summary, accept the terms and conditions, and click **Submit Order**, as shown Figure 2-25.

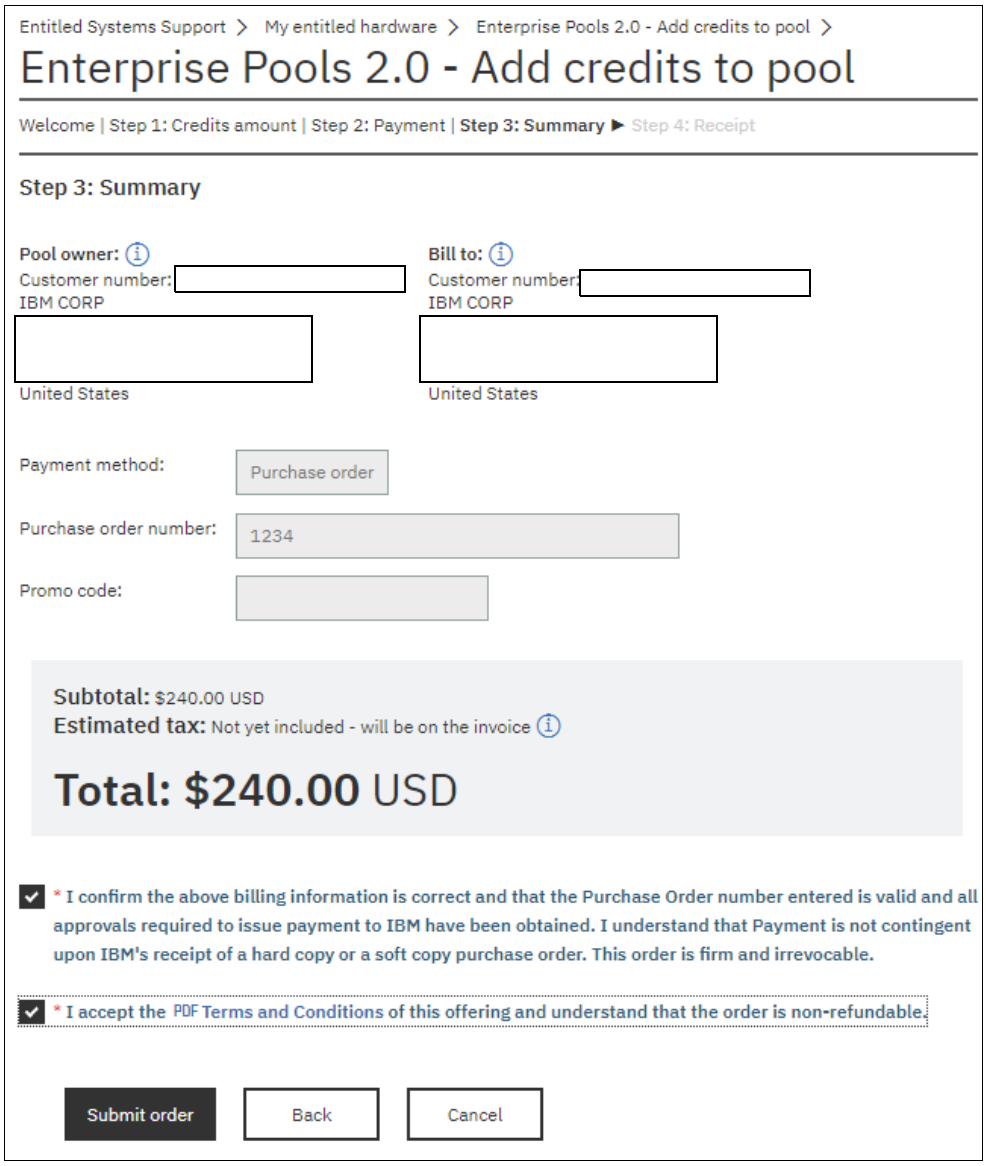

Figure 2-25 Add credits to pool: Summary

v. The Receipt window shows the pool ID, as shown in Figure 2-26.

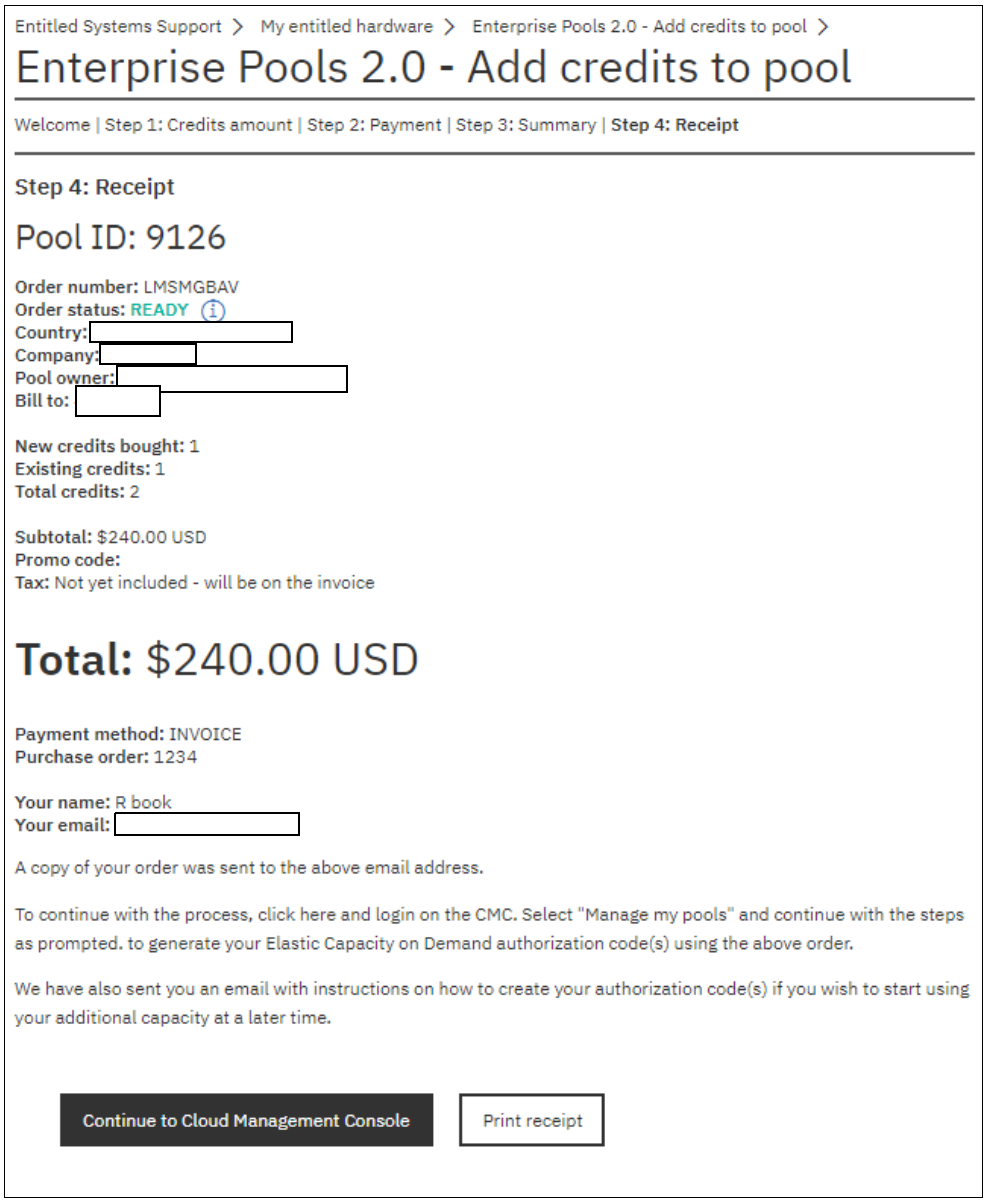

Figure 2-26 Add credits to pool window: Receipt

b. To use an existing 5819-CRD order to add credits to a pool, complete the following steps:

   i. In the **Use an existing 5819-CRD order** tab, select your order details from the **Order details** drop-down menu, and click **Find Pools**.

ii. Select the Pool ID from the **Pool ID** drop-down list, as shown in Figure 2-27, and then click **Continue**.

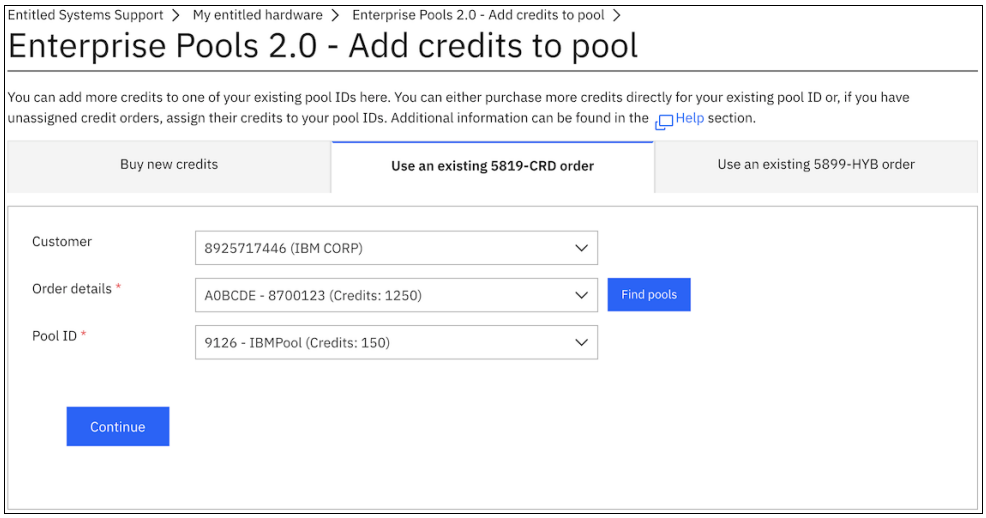

Figure 2-27 Add credits to pool window: Select order details and Pool ID

iii. Review the Pool ID updates and click **Continue**, as shown in Figure 2-28.

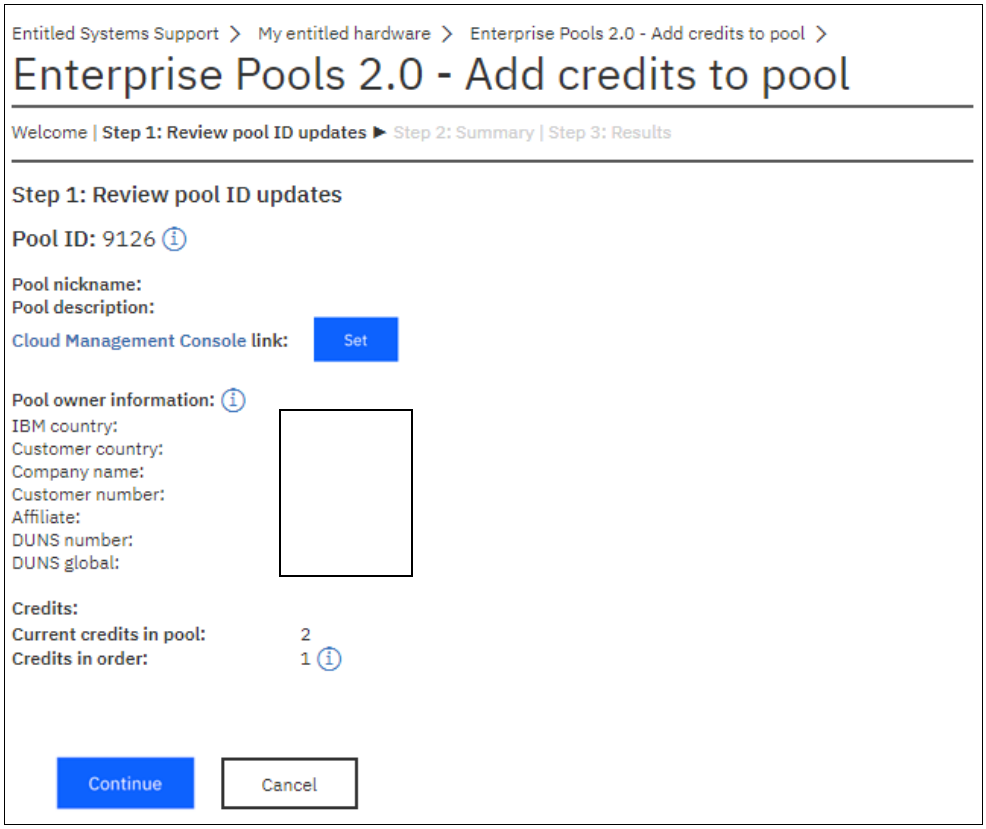

Figure 2-28 Add credits to pool window: Review pool ID updates

iv. View the Summary, accept the terms and conditions, and click **Update Pool**, as shown in Figure 2-29.

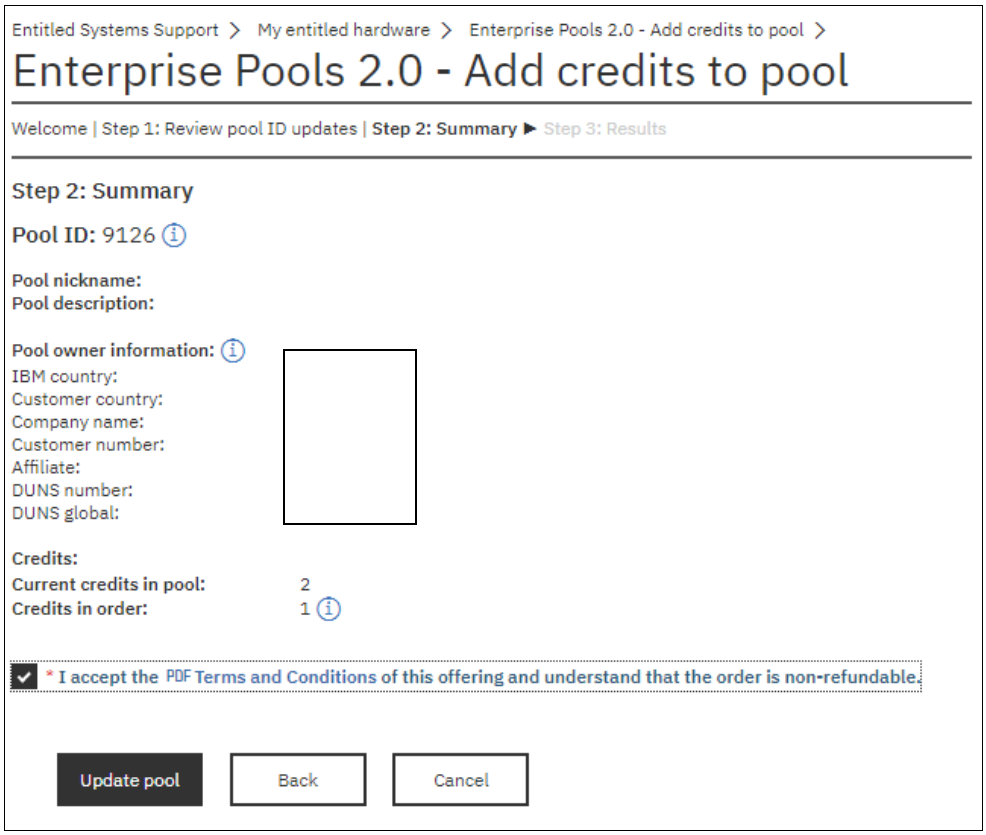

Figure 2-29 Add credits to pool window: Summary

v. View the total credits in the pool after the pool update, as shown in Figure 2-30.

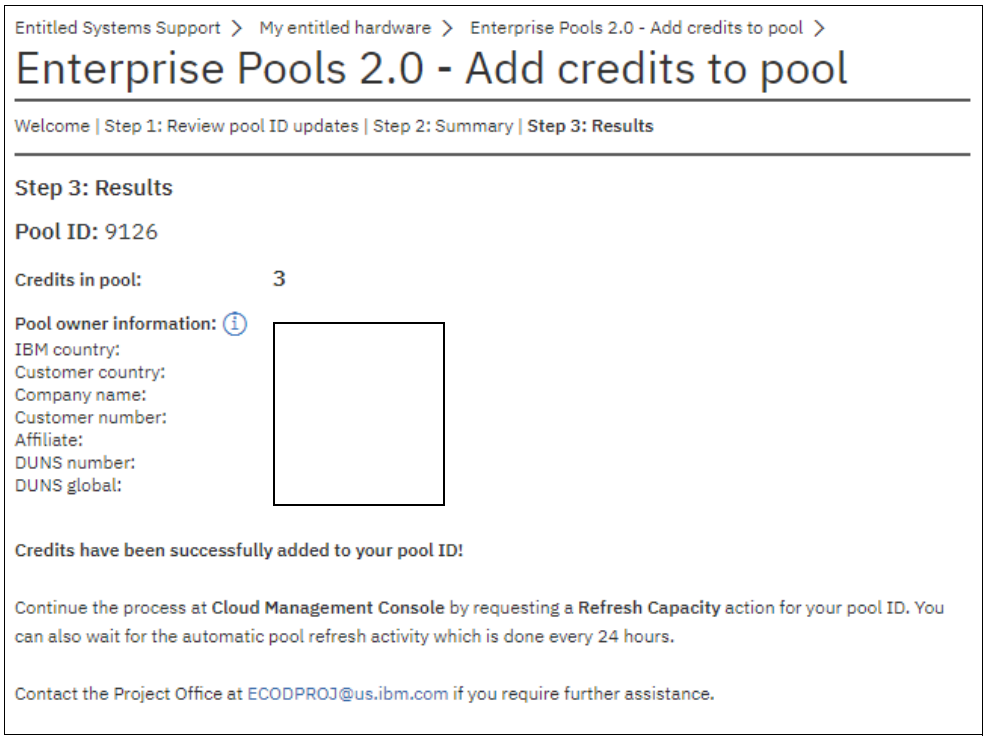

Figure 2-30 Viewing the total credits after an update

2.6.3 IBM Cloud Management Console

The IBM CMC Monthly Term offering is a cloud-delivered monitoring service that connects to multiple HMCs and gives administrators an aggregate view of their entire IBM Power infrastructure.

IBM CMC can be ordered by using the program number 5765-CMT or by using the IBM Power Systems Enterprise Cloud Edition (5765-ECB or 5765-CBA).

This offering is sold through monthly subscription packages on a per-socket basis.

The 5765-CMT can be ordered for a 3-year/36-month, 1-year/12-month, 6-month, or 3-month period.

The IBM CMC subscription is included as part of IBM Power Systems Enterprise Cloud Edition (5765-ECB) or IBM Power Systems Enterprise Cloud Edition with AIX (5765-CBA). The IBM CMC offering in these editions has a limit of 36 months of usage. To continue to use IBM CMC beyond that timeframe, clients must purchase a new package of offering 5765-CMT for either a 3-month, 6-month, 12-month, or 36-month period.

3

Configuration and management

This chapter describes how to set up a Shared Utility Capacity Pool and how to manage an existing pool by using IBM Cloud Management Console (IBM CMC).

3.1 Configuration

This section describes how to configure Power Enterprise Pools (PEP) 2.0. We go through the different steps that are involved in the configuration of IBM Power Systems Private Cloud with Shared Utility Capacity. This section covers the following items:

- Register a customer number on the IBM Entitled Systems Support website.
- Create a Pool ID and start a new pool in IBM Entitled Systems Support.
- Connect the Hardware Management Console (HMC) to IBM CMC.
- Create a pool on IBM CMC.
- Set up multi-data-center connectivity by using the HMC to connect to IBM CMC.

3.1.1 Registering a customer number on IBM Entitled Systems Support

To start IBM Power Systems Private Cloud with Shared Utility Capacity, first you must enroll your customer number at the IBM Entitled Systems Support website, which has your IBM Power server details, but these details must be linked to your customer number. The customer number is important for PEP 2.0 and for opening support tickets; placing new orders; purchasing new software licenses, hardware, and Capacity on Demand (CoD); and working with your software and hardware maintenance agreements (SWMAs and HWMAs). If you have more than one customer number, contact your IBM sales representative or IBM Business Partner to find the active number, or use the number that you used to place your hardware/software order for IBM Power Systems Private Cloud with Shared Utility Capacity. You must have the correct customer number to create a Pool ID for IBM Power Systems Private Cloud with Shared Utility Capacity in the IBM Entitled Systems Support portal.

The IBM Entitled Systems Support website is where you go to access and manage any IBM Power (IBM i, IBM AIX, and Linux on Power) and IBM Storage software. The IBM Power servers that are offered by IBM Systems are purchased through IBM Sales representatives or IBM Business Partners, and they can be accessed at the IBM Entitled Systems Support website. Several IBM products can also be directly purchased from this website. For more information, see IBM Entitled Systems Support.

Note: If you do not have your customer number, contact your IBM Sales representative or IBM Business Partner.

To register a customer number, complete the following steps:

1. Go to IBM Entitled Systems Support and sign in by using your IBM ID.

Note: If you do not have an IBM ID, you can create one at Create your IBM account.

After you are logged in, you see the window that is shown in Figure 3-1.

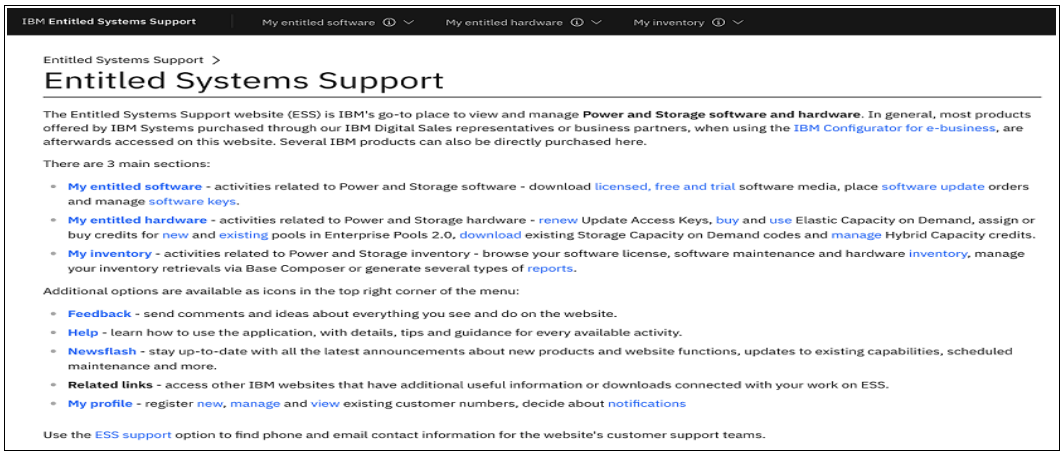

Figure 3-1 IBM Entitled Systems Support login

2. You see three main sections (My entitled software, My entitled hardware, and My inventory). You can click the required function for an overview and description for a function.
3. If you are using the IBM Entitled Systems Support website for the first time, you must register your customer number. Click **My profile**, as shown in Figure 3-2.

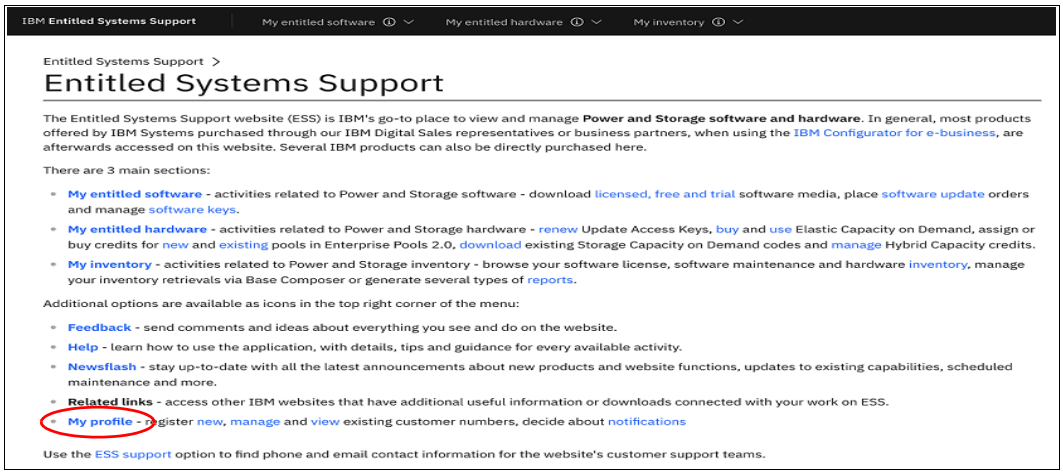

Figure 3-2 My profile

4. Click **Register customer number,** as shown in Figure 3-3. If your customer number is already registered, skip this step and go to 3.1.2, “Starting a new pool” on page 77.

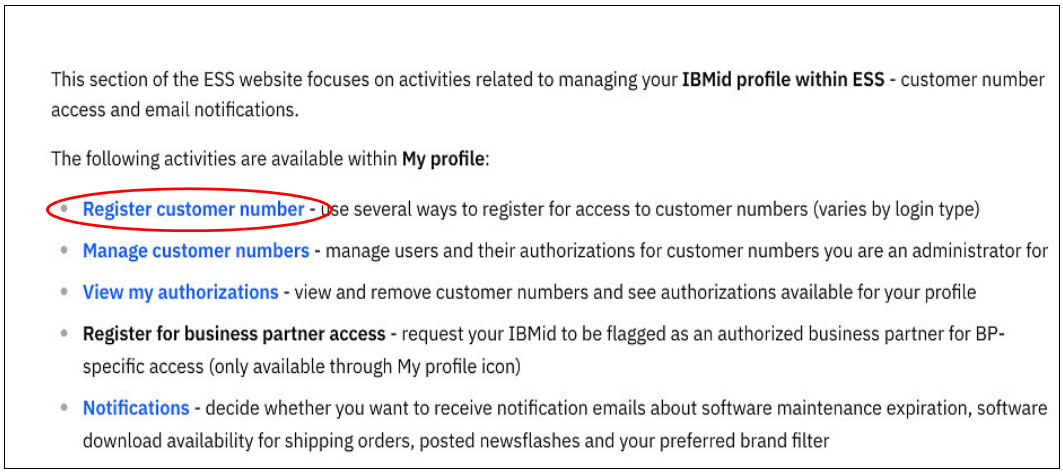

Figure 3-3 Register customer number

5. On the “Register customer number” window, select your country, input your customer number in the “Customer number” field, and click **Submit**, as shown in Figure 3-4.

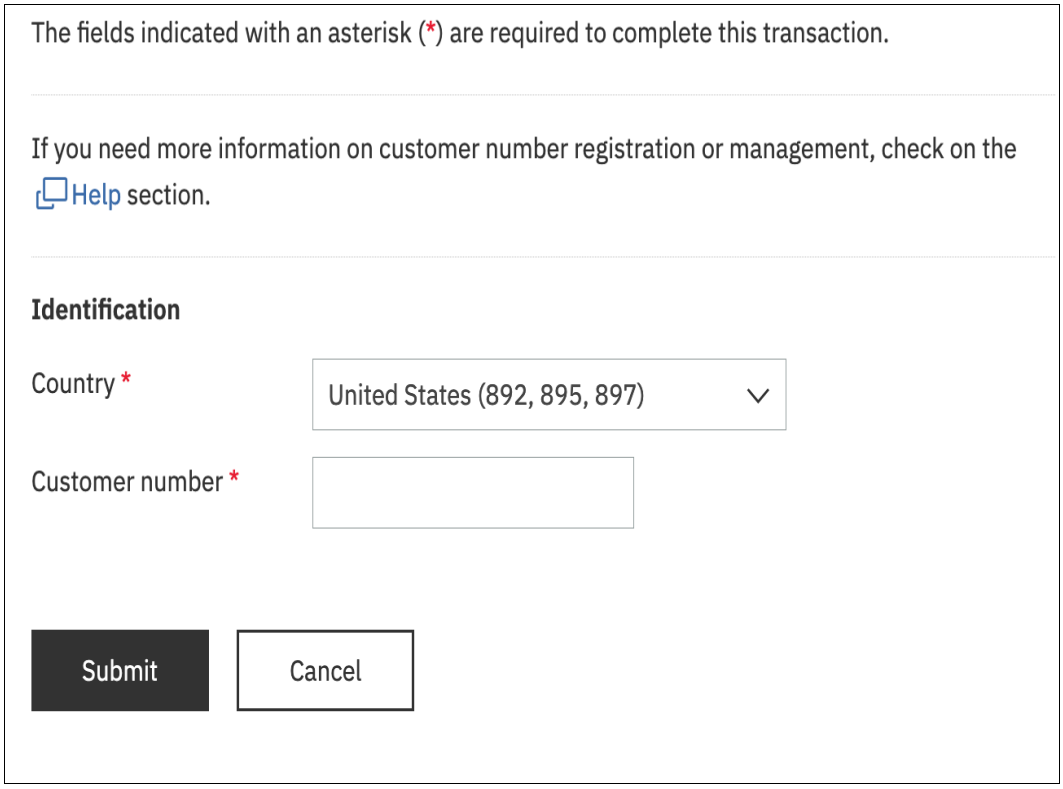

Figure 3-4 Customer registration details

Your customer number is registered. You can proceed to the next section.

3.1.2 Starting a new pool

After the customer number is registered, you can start a new pool. Capacity Credits are required to start a new pool. You can start a new pool or create a Pool ID in IBM Entitled Systems Support by selecting an existing order with credits or with buying new credits.

- Start a pool by buying new credits.

  Use this option when you start a new PEP 2.0 for systems that you order with Feature Code #EP20 and you want to add credits to the PEP 2.0. The serial number of the ordered systems appears in the “hardware type serial” list on the IBM Entitled Systems Support website when ordering credits. For more information about the ordering process, see 2.6, “Ordering process” on page 59.

- Start a pool by using an existing order (Capacity product IDs 5819-CRD and 5899-HYB).

  Use these options when you want to start a new pool by using existing credits that you purchased by using capacity product IDs 5819-CRD and 5899-HYB:

  – Use Power Capacity Credits from a 5819-CRD order that you purchased before for your on-premises pools.

  – Use Hybrid Capacity Credits from a 5899-HYB order that you purchased before for your hybrid cloud pools.

  The order number appears in the Order Details drop-down list on the IBM Entitled Systems Support website. Select the order number of new Capacity Credits from the list, which are ordered directly from IBM or through an IBM Business Partner.

Starting a pool by buying new credits

To buy new credits, complete the following steps:

1. On the IBM Entitled Systems Support navigation menu, click **My entitled hardware**, as shown in Figure 3-5.

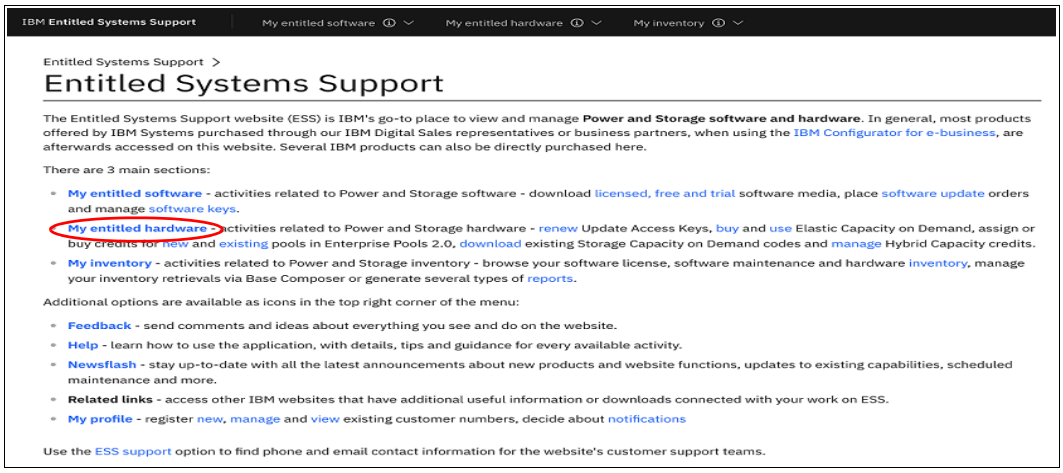

Figure 3-5 My entitled hardware

2. Under **My entitled hardware**, click **Enterprise Pool 2.0 - Start a new pool**, as shown in Figure 3-6.

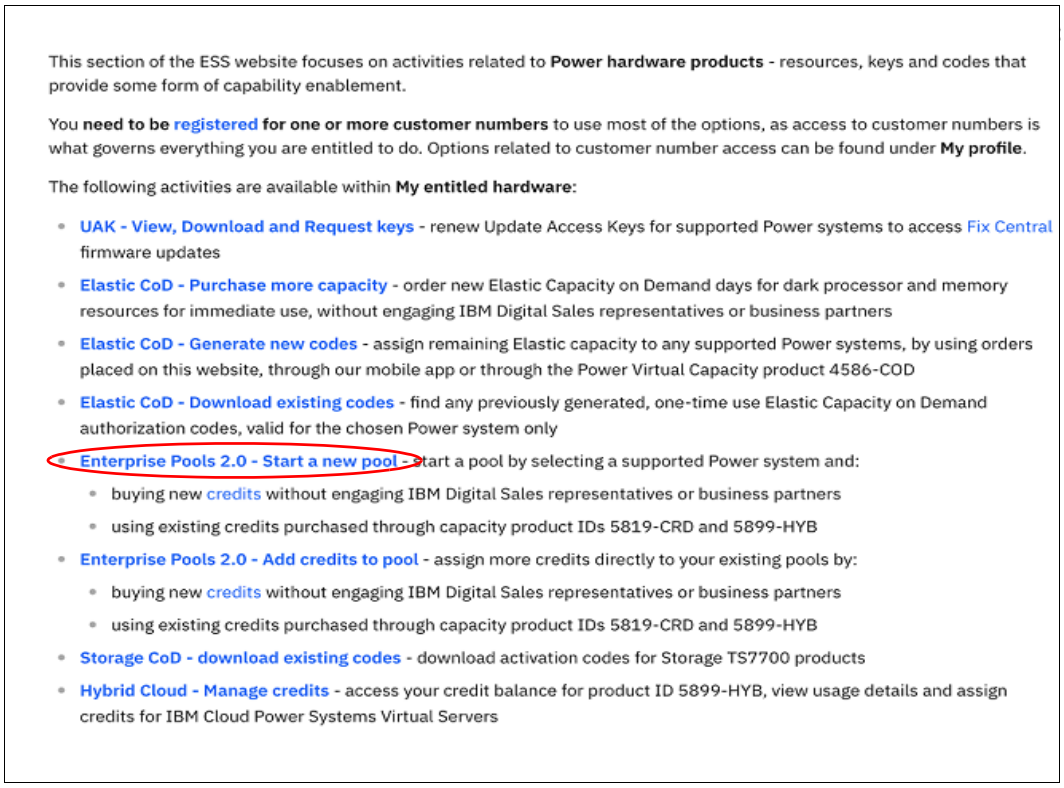

Figure 3-6 Enterprise Pools 2.0 - Start a new pool menu

3. The **Buy new credits** tab opens. Select **Enterprise Pool 2.0**, as shown in Figure 3-7.

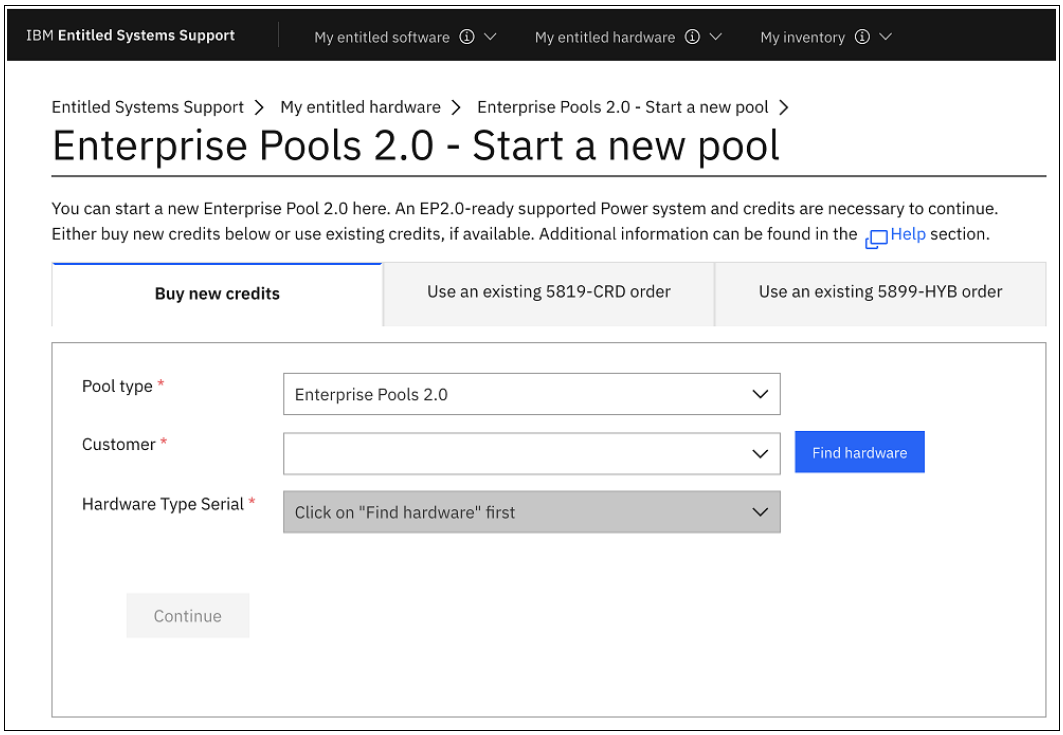

Figure 3-7 Buy new credits

a. Select **Enterprise Pool 2.0** from **Pool type**.

b. Select your customer number from **Customer** and click **Find hardware** to find your entitled hardware.

c. After the IBM Entitled Systems Support system finds all the new IBM Power servers with Feature Code #EP20, their types and serial numbers appear in the Hardware Type Serial field. Select your hardware serial number and click **Continue**.

4. The “Enter credits amount” window opens. It shows the “Pool Owner information”, “Order limits”, and “Cloud Management Console CMC link” fields, as shown in Figure 3-8.

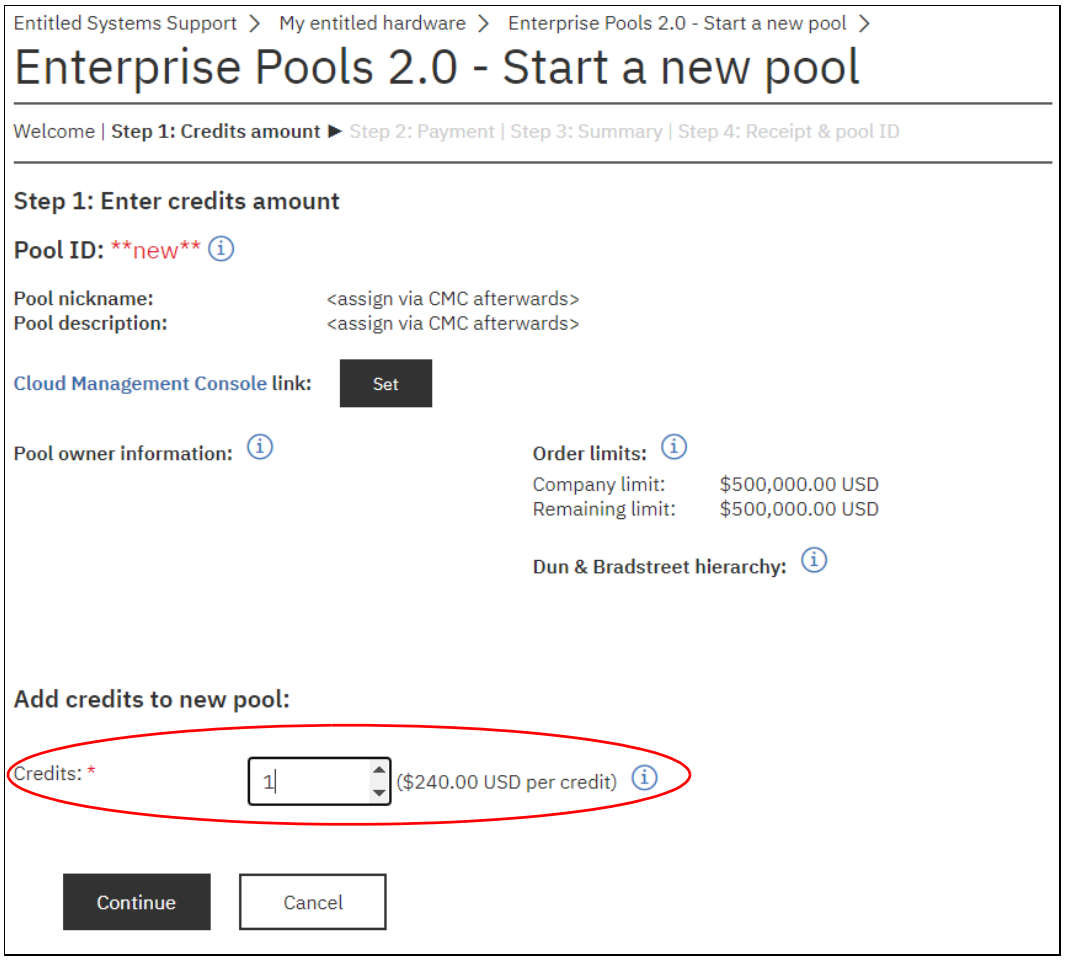

Figure 3-8 Enter credits amount

5. Click **Set** next to the “Cloud Management Console link” field to add the IBM CMC URL to your profile to easily return to IBM CMC after you finish your activity on the IBM Entitled Systems Support website.

   Figure 3-9, Figure 3-10, and Figure 3-11 show the steps to update the IBM CMC URL in IBM Entitled Systems Support. The “Cloud Management Console link” field is available during any pool creation or update activity.

Figure 3-9 Setting the IBM CMC link

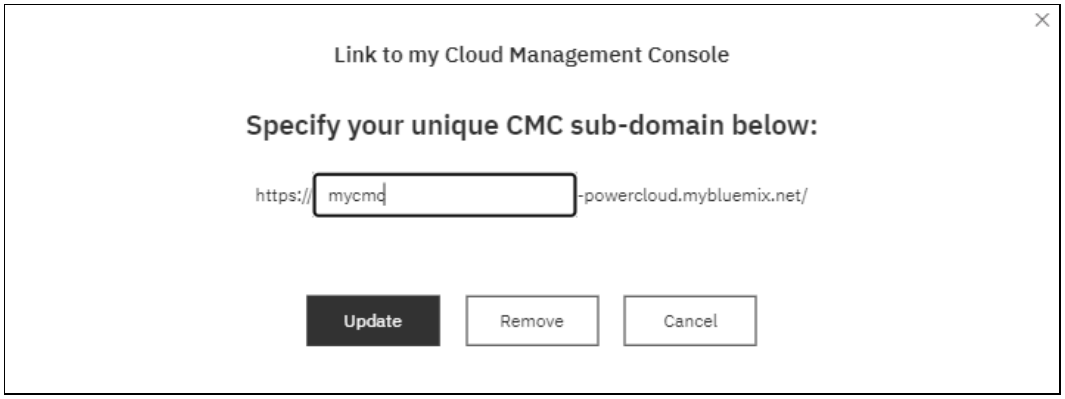

Figure 3-10 Entering the IBM CMC URL

Figure 3-11 IBM CMC URL updated

6. Return to the “Enter credit amounts” window.
7. Enter the number of credits to add to the new pool. The cost of each credit is shown in the window.
8. After entering the number of credits that you need and sizing, click **Continue**. (For more information about sizing, see 2.5, “Sizing: How to figure out base capacity” on page 54.)
9. The “Ownership, billing and payment details” window opens, where you input your purchase order number. If you do not have a purchase order number, click **Create a quote**, which generates a summary of your purchase. After you receive your purchase order number from this summary, input it into the “Purchase order number” field.
10. If you already have the purchase order number, enter the purchase order number into the “Purchase order number” field, and check and correct your billing address by clicking **Change**, as shown in Figure 3-12. Make what changes that you must and click **Continue**.

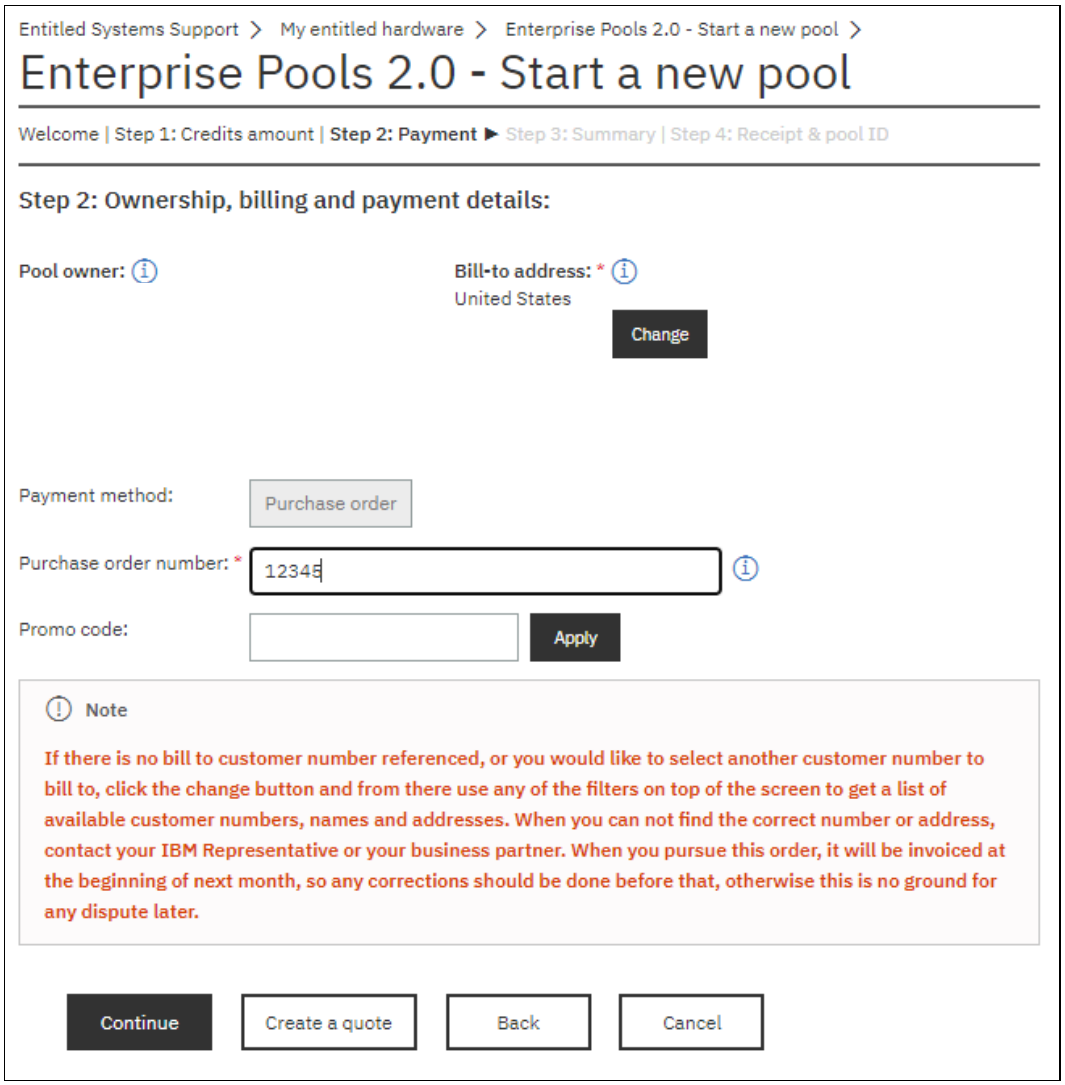

Figure 3-12 Ownership, billing, and payment details

11. The Summary window opens, as shown in Figure 3-13. Select the terms and billing information confirmation checkbox and click **Submit Order**.

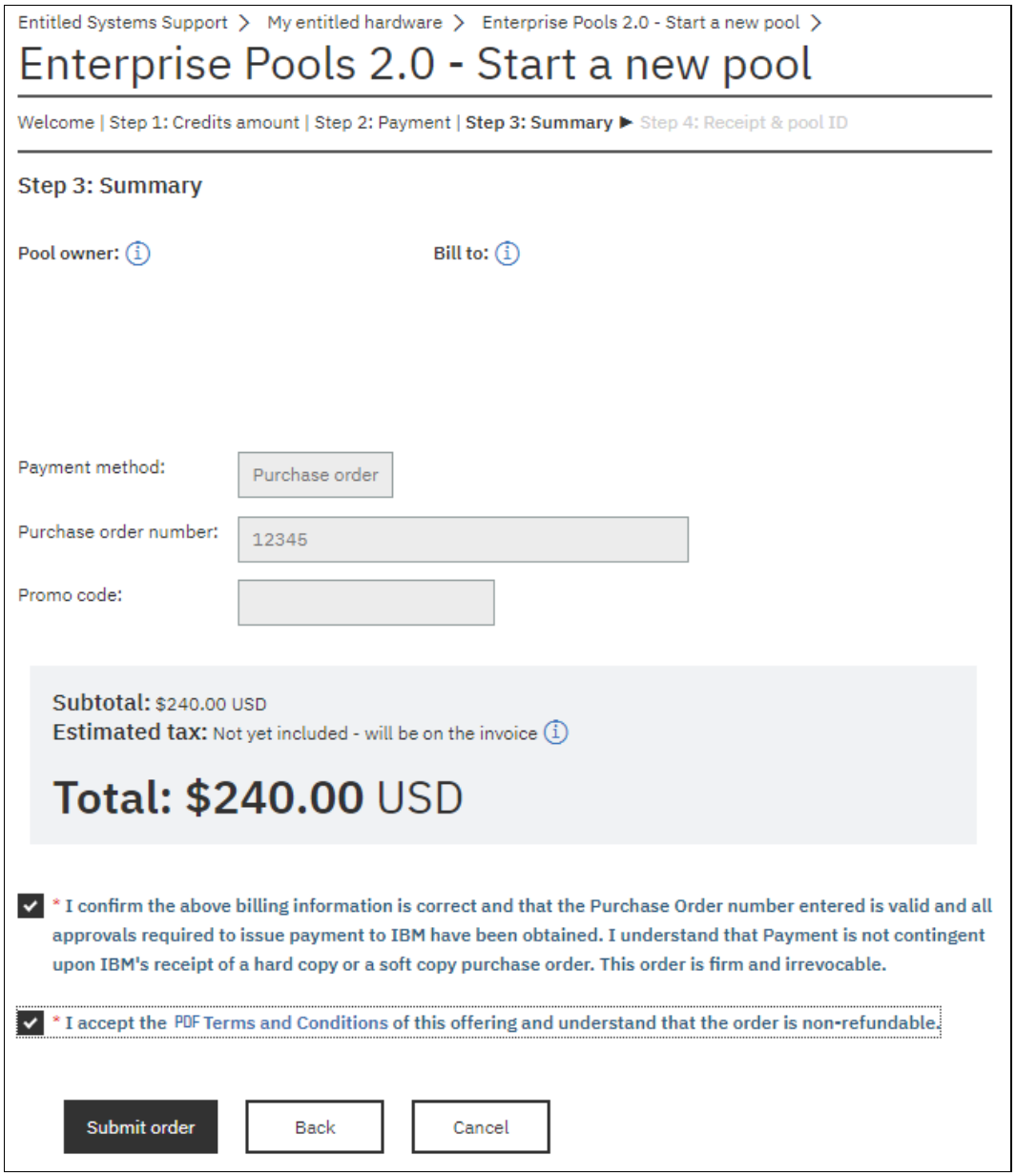

Figure 3-13 Summary window

You see the new Pool ID for PEP 2.0 and your order details summary, as shown in Figure 3-14.

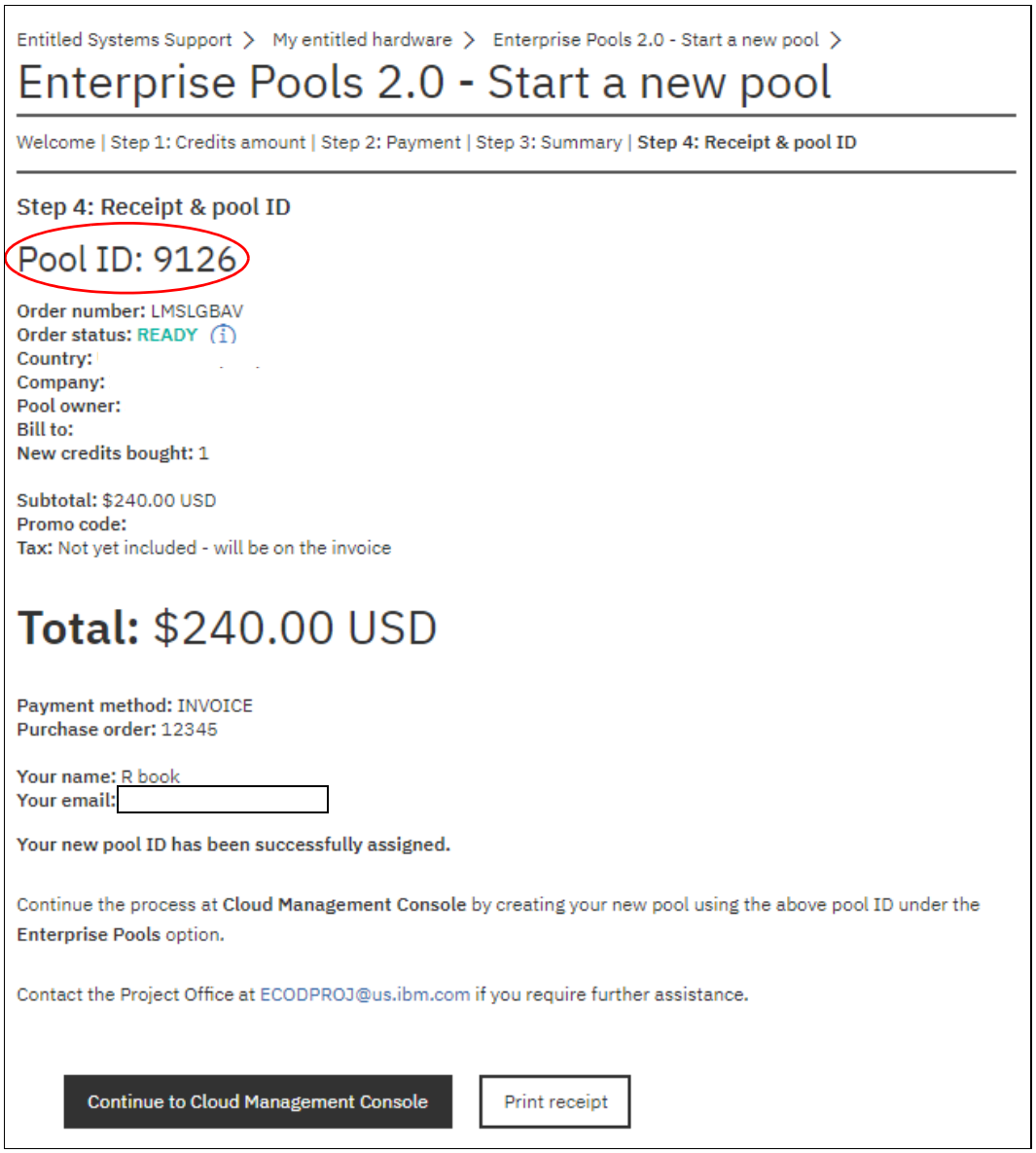

Figure 3-14 Receipt and Pool ID

12. Write down the pool ID because you need it when you create a pool. The order details also are sent to the email address that you used to create your IBM ID.

Starting a pool by using an existing 5819-CRD or 5899-HYB order

You can start a new pool by using the credits that you purchased through IBM or an IBM Business Partner:

- Use Power Capacity Credits from a 5819-CRD order that you purchased before for your on-premises pools.
- Use Hybrid Capacity Credits from a 5899-HYB order that you purchased before for your hybrid cloud pools.

To use an existing 5819-CRD order or 5899-HYB order and create your new pool ID or add new credits to your pool, complete the following steps:

1. Log in to IBM Entitled Systems Support by using your IBM ID.
2. Click **My entitled hardware** on the IBM Entitled Systems Support navigation menu, as shown in Figure 3-5 on page 77.
3. Under **My entitled hardware**, click **Enterprise Pools 2.0 - Start new pool**.
4. Click **Use an existing 5819-CDR order**, as shown in Figure 3-15.

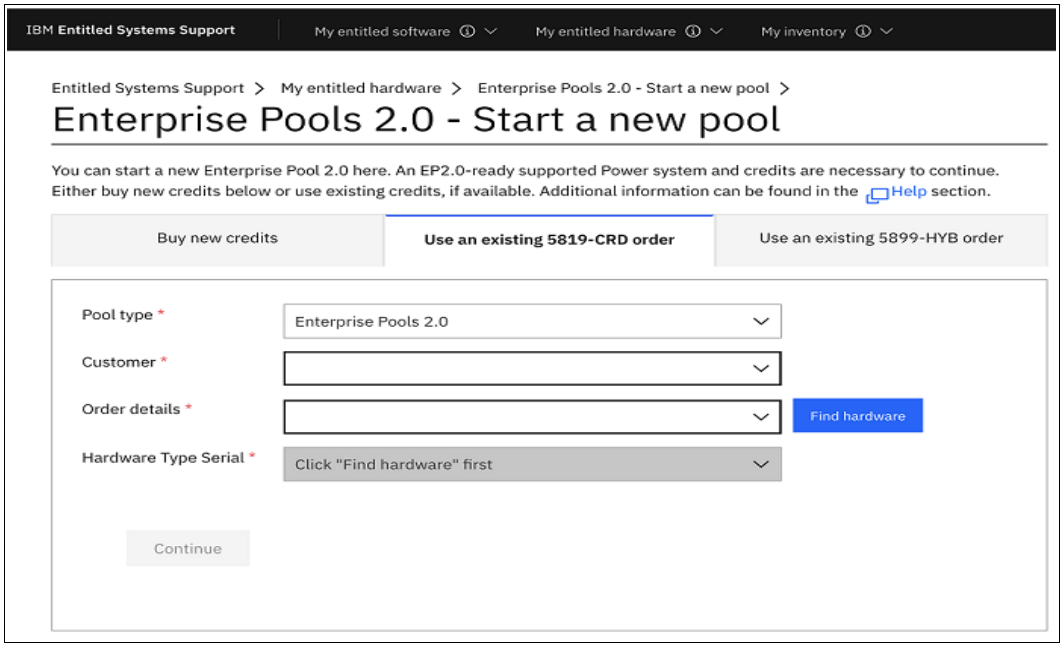

Figure 3-15 Using an existing 5819-CDR order

5. In the “Use existing 5819-CDR order” window complete the following steps to complete your order:
   a. In the “Pool type” field, select **Enterprise Pool 2.0**.
   b. In the “Customer” field, select your customer number from the ID that you used to place the order.

c. In “Order details” field, select your order for the purchased credits, and then click **Find hardware**, as shown in Figure 3-16.

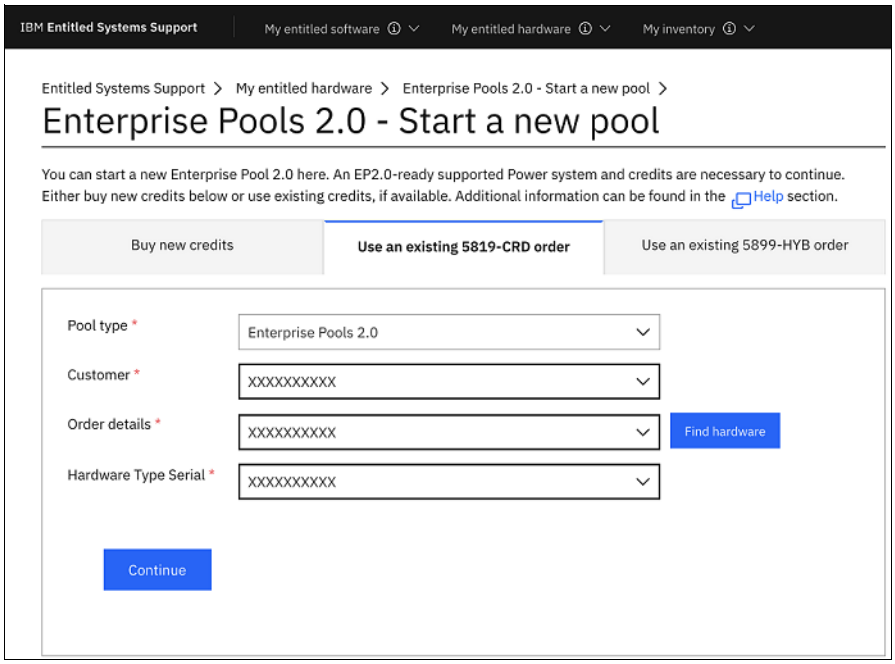

Figure 3-16 Entering the details

d. In the “Hardware Type Serial” field, select the IBM Power server that you want to use for PEP 2.0, and click **Continue**.

e. A window opens, as shown in Figure 3-17. You see the “Pool owner information” and “Credits in order” fields, which show the information for your order.

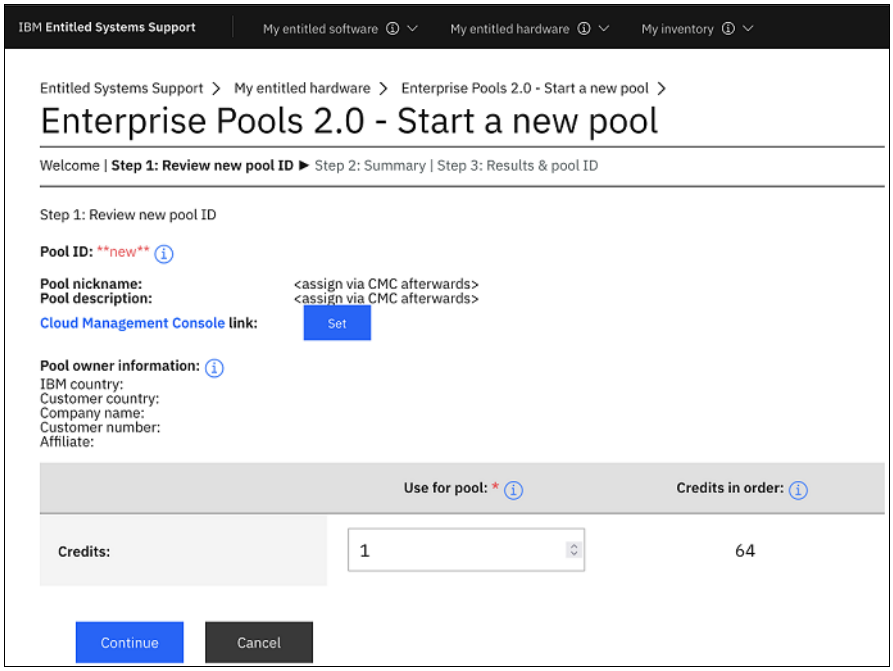

Figure 3-17 Reviewing the new pool ID

f. Click **Continue**. The window that is shown in Figure 3-18 opens and shows a summary of your order.

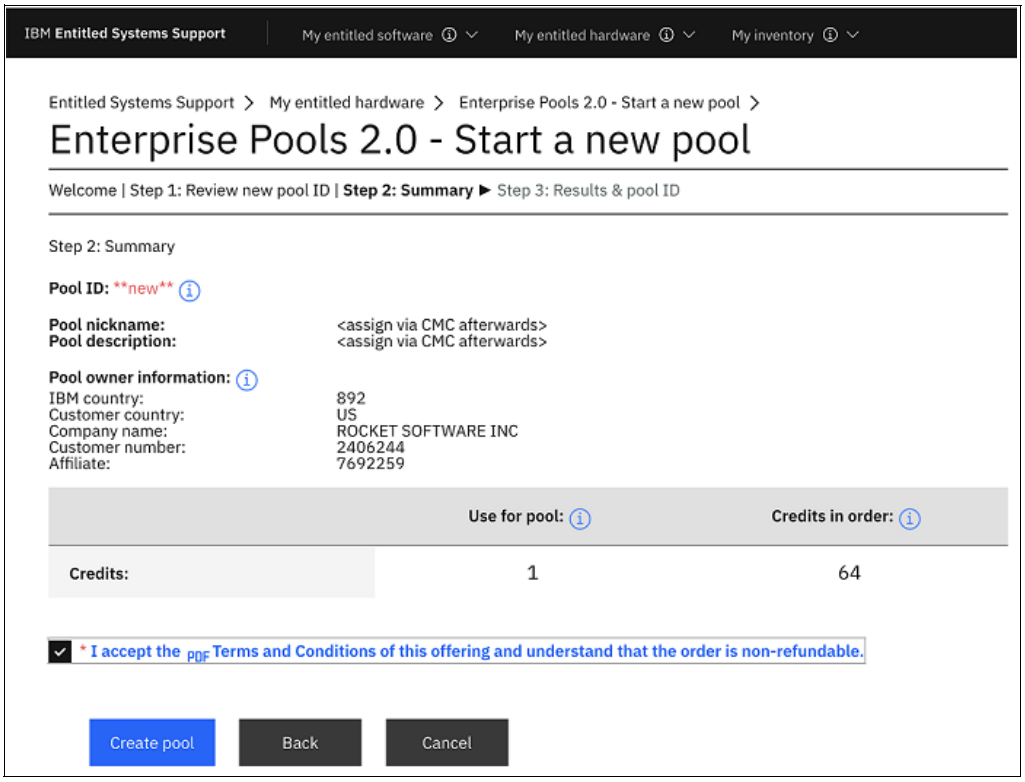

Figure 3-18 Summary

g. Click **Create pool**. The window that is shown in Figure 3-19 opens, and you see the Pool ID and other information.

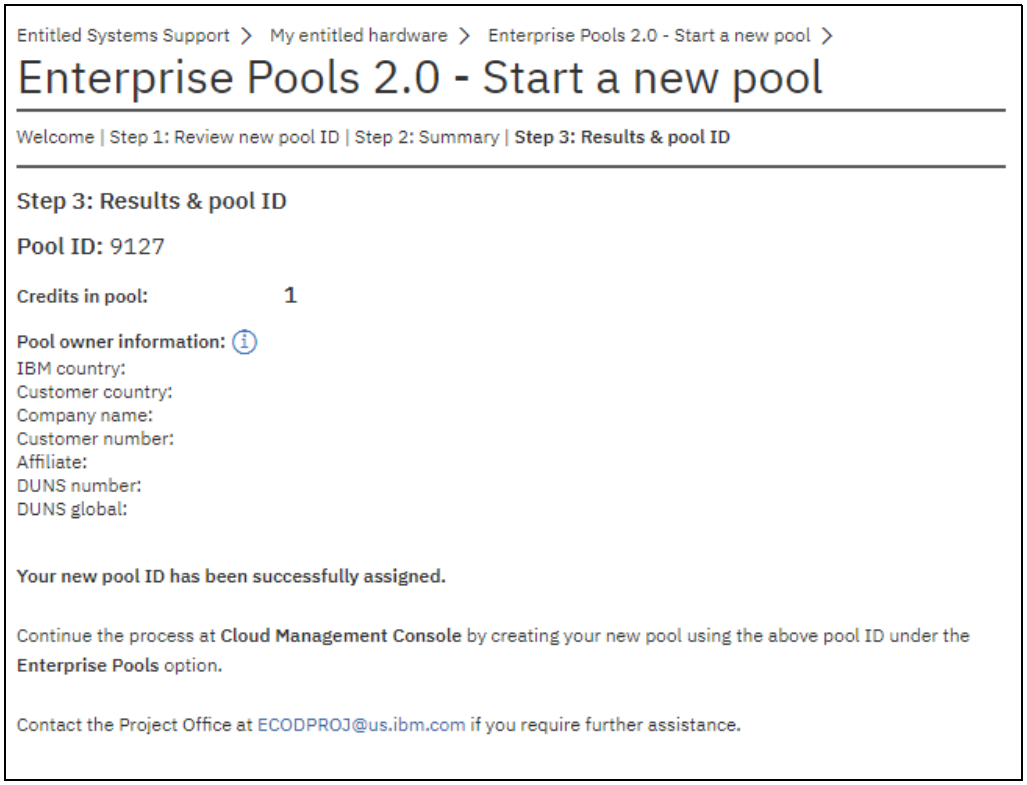

Figure 3-19 Results & Pool ID

6. Write down the Pool ID to use it to create a PEP 2.0 pool on IBM CMC. For more information, check the email address that you used to create the IBM ID.

3.1.3 Connecting an HMC to IBM CMC

This section explains how to connect your HMC to IBM CMC. This connection must be established on each HMC that manages a server that you want to add to the pool. If two HMCs manage the same server, as a best practice, connect both of them to IBM CMC.

For the steps that are required to activate your IBM CMC instance, see 1.5.1, “Activating IBM Cloud Management Console” on page 11.

To connect your HMC to IBM CMC, complete the following steps:

1. Log in to IBM CMC by using your IBM ID and password. The details for accessing IBM CMC are in 1.5.2, “Accessing IBM Cloud Management Console” on page 12.

2. In the IBM CMC launch window, click the hamburger menu (horizontal bars in the upper left of the window), as shown in Figure 3-20.

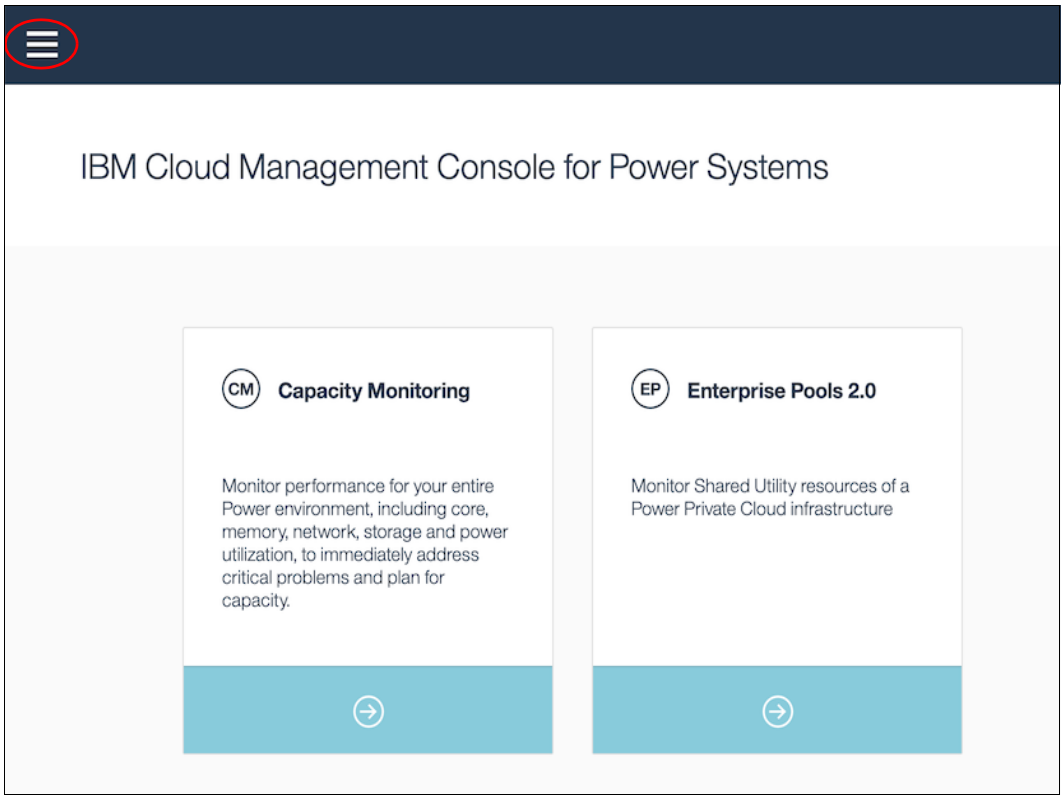

Figure 3-20 IBM CMC launch window: Access menu

3. At the bottom of this menu, you see a settings icon (small pinwheel), as shown in Figure 3-21. Click that settings icon.

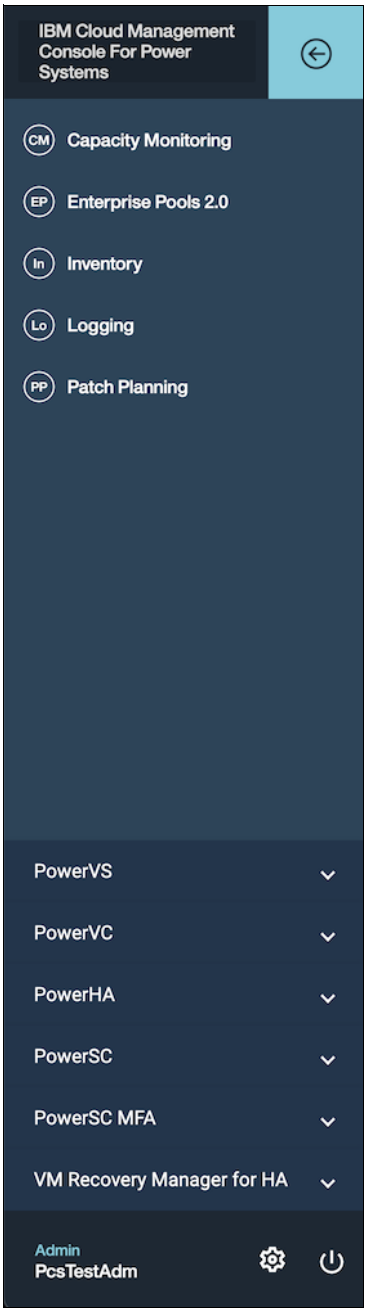

Figure 3-21 IBM CMC: Settings

4. The Settings window opens. Click **Cloud Connector**, as shown in Figure 3-22.

Figure 3-22 Cloud Connector tab in Settings

5. In the Cloud Connector window, scroll down to the bottom until you see the “Cloud Connector Startup Command”. Copy this command to a text editor. The command that is provided here creates a direct connection to IBM CMC. If you want to use a proxy, see “Creating a connection that uses a proxy” on page 91.
6. Start an SSH session to your HMC and log in to it.
7. Your HMC must be able to access the internet, as described in 2.1.3, “Linux metering considerations” on page 36.
8. In your SSH shell, paste the command that you copied from the “Cloud Connector Startup Command” menu and press Enter. Example 3-1 provides an example startup command.

Example 3-1 Cloud Connector startup command

```
HMC:~> chsvc -s cloudconn -o start -k
MWl6cExHZndscDM5cXB6OUxVeFRTZVpVSW9VWktFYWFtaEYxX2pzbndOaGRNRjNneWdIVUFaZTkwbXp
ibVNSUOFicUMwOFNCWXJoLVdwdTFCdkNhbW5pMWVDNzBIM1dTbFhzM3EzYOgzMFlFNkhPd2NWQV9rZF
NIV2hsSzE2TllLRl9zaU1zV3BMci1JelU4cGtMLURFd3JpTzVDbkFUZFNaVFFNM2RyaDhBZTYzQ2FjV
zRNNXAxLWIOdXVWMFFDR3ZKVEU5NTVDSVp2R3VkSkxPWMwOFNCWXJoLVdwdTFCdkNhTJiOVZHUjFBR1
MzSFhpZzBXRWhHejFXSHFMdHZKZnQzOWNDcUlzNlJLZXhNSXh1Mkc5ejEOdEc5VnVqXO5jblNscVJ3S
GUxTTBhMwOFNCWXJoLVdwdTFCdkNhbW5MkRXRUZOY3dOUkl3cVJaMC1UalRBOmNtY3Rlc3RzdnQxLXB
vd2VyY2xvdWQubXlibHVlbWl4Lm5ldB
```

9. After getting the prompt back on your SSH session, run **`lssvc -s cloudconn`** and press Enter.

   The **`lssvc`** command should return `state=active`, as shown in Figure 3-23. If you do not receive `state=active`, wait for a few minutes and rerun **`lssvc -s cloudconn`**.

```
redbook@hmc16:~> lssvc -s cloudconn
state=active,socks_proxy=,http_proxy=
redbook@hmc16:~>
```

Figure 3-23 Cloud Connector state

   If `state=active`, your HMC is connected to IBM CMC.

Tip: You can run the **`diagcloudconn`** command on the HMC for troubleshooting if the state does not change to `active`.

Creating a connection that uses a proxy

In addition to a direct connection, Cloud Connector also supports using a proxy. If you want to use a proxy connection, you have three choices:

- You can set up a stand-alone HTTP proxy. In this case, the HTTP proxy creates connections for both configurations and for the main data flow. If you use only an HTTP proxy, open port 5044 for outbound HTTP connections to allow the Cloud Connector to be able to successfully connect to IBM CMC.
- You can set up a SOCKS5 proxy and an HTTP proxy. In this case, the HTTP proxy creates connections to fetch configurations, and the SOCKS proxy creates connections for the main data flow.
- You can set up a stand-alone SOCKS5 proxy. In this case, Cloud Connector fetches configurations directly (no proxy). However, the main data flow happens through the SOCKS5 proxy.

To view the IP addresses and ports that allow traffic through your firewall, select **Settings** → **Cloud Connector** → **Cloud Connector Management** on IBM CMC. Figure 3-24 provides an example of the output.

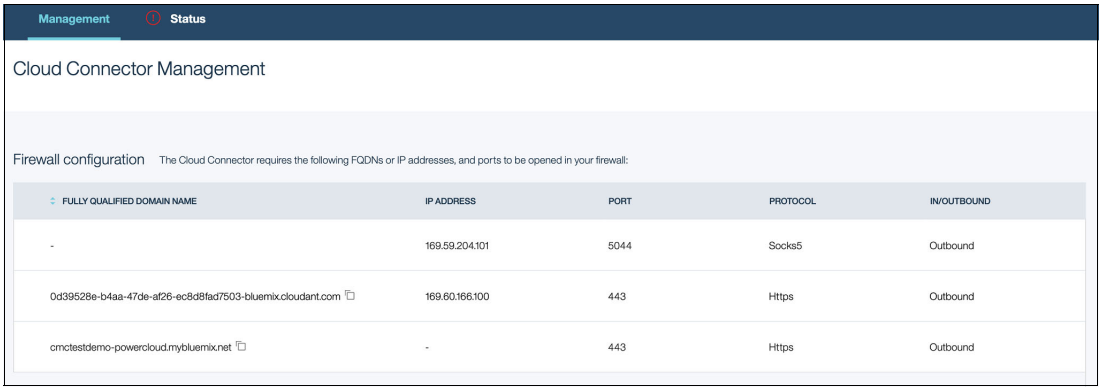

Figure 3-24 Cloud Connector Firewall configuration

To add a proxy connection, run the command that is shown in Example 3-2 on your HMC.

Example 3-2 Cloud Connector start command with proxy

```
chsvc -s cloudconn -o start -k <key> --socks/http
username:password@hostname[:port]
```

Note: You can add a SOCKS5 proxy, HTTP proxy, neither, or both connections. If you specify the username string starting with a `:` (colon) and you do not specify a password, you are prompted for the password. The port number is not required, but recommended. The hostname can also be a valid IP address.

If you stop the Secure Cloud Connector by running **`chsvc -s cloudconn -o stop`**, the proxies are cleared. You must reuse the same startup command if you want to use proxies the next time that you start the Secure Cloud Connector.

If the Secure Cloud Connector already was started without using a proxy configuration, it must be stopped by running **`chsvc -o stop`**, and then restarted by using a proxy configuration.

To view your proxy setup, run **`lssvc -s cloudconn`**. The password is displayed in an encrypted format.

To test the firewall configuration from the HMC, run **`ssh -vvv -p Port <IP or FQDN>`**. If the output of this command displays a `connection established` message, the specified address and port are reachable. The successful command might also generate spurious error messages, which you can ignore.

The SOCKS5 proxy must be configured without authentication. The Basic Authentication, Digest, Kerberos, LDAP, and No Authentication authentication types are supported by an HTTP proxy.

If the HTTP proxy uses authentication, specify an authentication choice by using the **--auth** option of the **chsvc** command. Setting the **auth** type is optional. The authentication type is `basic` if this option value is not specified. The **--auth** syntax is shown in Example 3-3.

Example 3-3 The --auth syntax

```
--auth ldap | digest-md5 | kerberos | basic
```

LDAP configuration

The LDAP configuration requires that you have a proxy server with LDAP authentication. To configure the proxy server for LDAP authentication, complete the following steps:

1. To test whether the proxy server is correctly configured, run the command that is shown in Example 3-4 from the HMC or from any other system that is correctly configured for LDAP.

   Example 3-4 LDAP configuration test

   ```
   $curl -v -x "<ldapUsername>:<password>@<proxyserver.domain.com>:3128"
   https://trial-powercloud.mybluemix.net/api/verifyApiKey
   ```

   The output should return `200 Connection established without any errors.`

2. Start the Cloud Connector with LDAP authentication. Use the **--http** option to provide the LDAP username and password with the portal key, as shown in Example 3-5. The portal key was truncated for readability.

   Example 3-5 LDAP configuration for Cloud Connector

   ```
   chsvc -s cloudconn -o start -k
   RUtPN2t5YW4wWUOxZDFQS2xOY2RYOUdoSEVWYVlEalVlb2s4ZnY3dVlhTWpTZFNiSOVZdOhfNHVW
   --http ldapUsername:password@proxyserver.domain.com --auth ldap
   ```

3. Verify that the Cloud Connector successfully connected to the portal by running **lssvc -s cloudconn**.

   The output for an HTTP proxy from this command should be similar to what is shown in Example 3-6.

   Example 3-6 Cloud Connector state for an HTTP proxy with LDAP

   ```
   state=active,socks_proxy=,http_proxy=ldapUsername:*******@proxyserver.domain.com
   ```

Kerberos configuration

You must satisfy the following requirements when using Kerberos authentication:

- Configuring the Kerberos Key Distribution Center (KDC) server with the HMC is required if the HTTP proxy uses Kerberos authentication.
- You must specify the realm and the principle if multiple KDC servers are configured on the HMC and the HTTP proxy does not use the default KDC server. Consider the example that is shown in Example 3-7. The portal key is truncated for readability.

  Example 3-7 Kerberos configuration for Cloud Connector

  ```
  chsvc -s cloudconn -o start -k
  RUtPN2t5YW4wWUOxZDFQS2xOY2RYOUdoSEVWYVlEalVlb2s4ZnY3dVlhTWpTZFNiSOVZdOhfNHVW --http
  principle@EXAMPLE.REALM.COM:password@proxyserver.domain.com --auth kerberos
  ```

3.1.4 More security configurations

The Cloud Connector also provides two more configuration options to determine which data flows from the HMC to IBM CMC.

System Blocklist

When you use the System Blocklist option, the HMC (where Cloud Connector is started) does not push data for specific servers to IBM CMC. This option is useful if an HMC manages both systems that are part of a PEP and other systems that are not part of a PEP 2.0.

To use the System Blocklist option, click **Blocklist**, as shown in Figure 3-25.

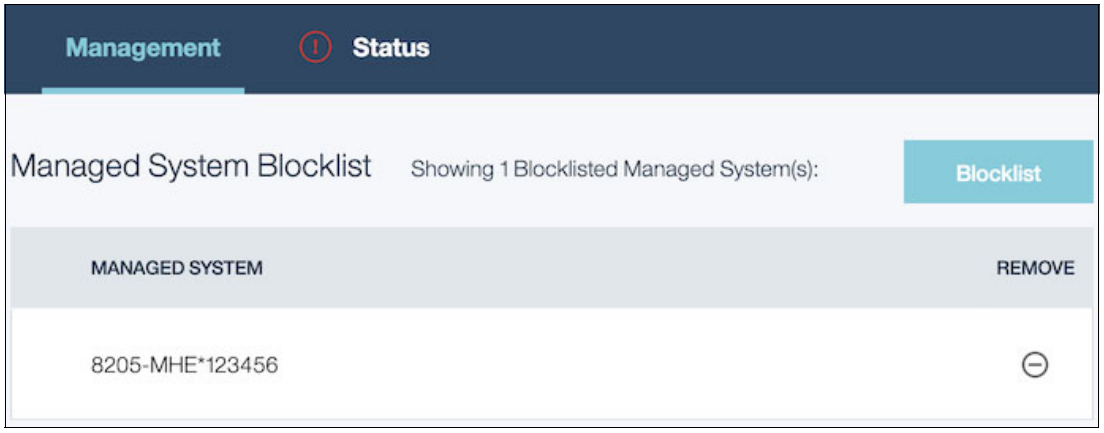

Figure 3-25 Cloud Connector: Managed System Blocklist

A window opens where you can either manually enter the machine type, model, and serial number of the server that you want to exclude, or you can upload a CSV file with the corresponding data, as shown in Figure 3-26.

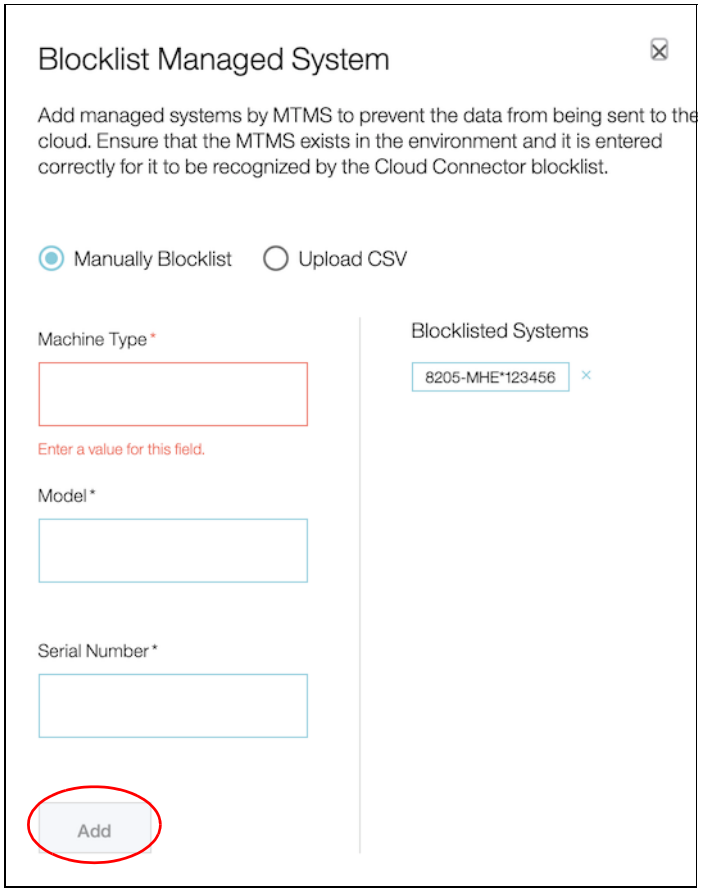

Figure 3-26 Cloud Connector: Add system to blocklist

Data Filter

By using the Data Filter option, you can exclude certain data types from being pushed to IBM CMC. Select the data types that you do not want to send, as shown in Figure 3-27.

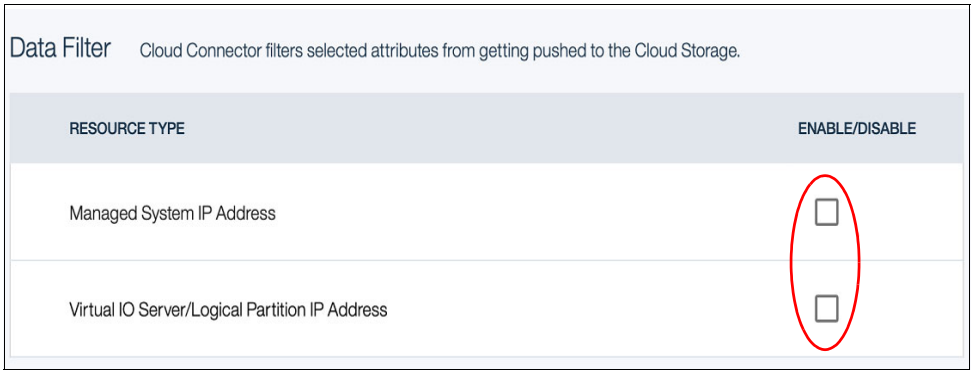

Figure 3-27 Cloud Connector: Data Filter

3.1.5 Creating a pool on IBM Cloud Management Console

This section describes the steps to create a Shared Utility Capacity pool on IBM CMC.

The following steps must be performed on each HMC managing a server that you want to add to a pool. If two HMCs manage the same server, you should perform the steps on both of them.

1. The Domain Name System (DNS) must be enabled on the HMC to resolve the IBM CMC portal address.

   The steps to enable DNS are:

   a. Select **HMC Management** → **Console Settings** → **Change Network Settings**.

   b. Go to the **Name Services** tab, select **DNS enabled**, and add the DNS servers to the input field.

2. Before creating the pool, enable the Network Time Protocol (NTP) on the HMC by selecting **HMC Management** → **Change date and time** → **NTP configuration**, and then select the **Enable NTP service for this HMC** checkbox.

3. Performance Data Collection (Performance and Capacity Monitoring (PCM)) must be enabled for all servers that you want to add to a pool. To enable PCM, select **HMC Management** → **Console settings** → **Change Performance Monitoring Settings**. In the window that is shown in Figure 3-28, specify the number of days to store performance data and activate performance collection where required.

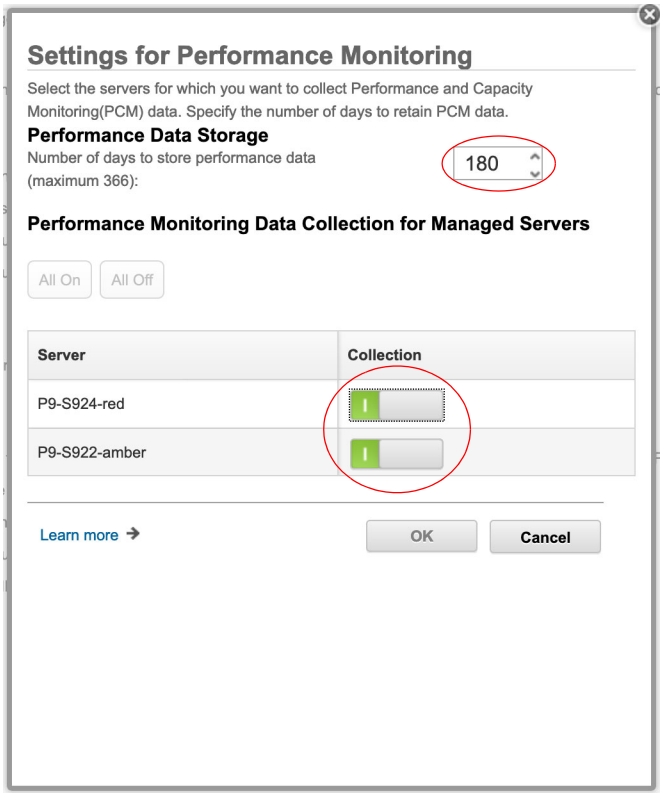

Figure 3-28 Enabling Performance Data Collection

After enabling DNS, NTP, and PCM, go to the IBM CMC portal and log in.

4. Click **Enterprise Pool 2.0** to start the application.

5. If you created a pool before in this IBM CMC instance, click the (+) icon in the top section of the window next to Enterprise Pools 2.0 to create a pool, as shown in Figure 3-29. If no pool exists, you are sent to the Pool Creation wizard, as shown in Figure 3-30.

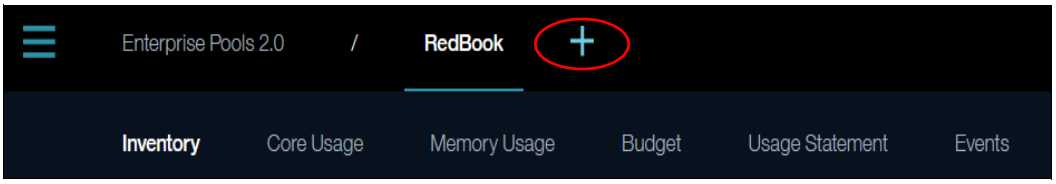

Figure 3-29 Create Pool icon

6. In the next window, enter the Pool ID that you obtained from IBM Entitled Systems Support, a pool name of your choice, and a description, as shown in Figure 3-30.

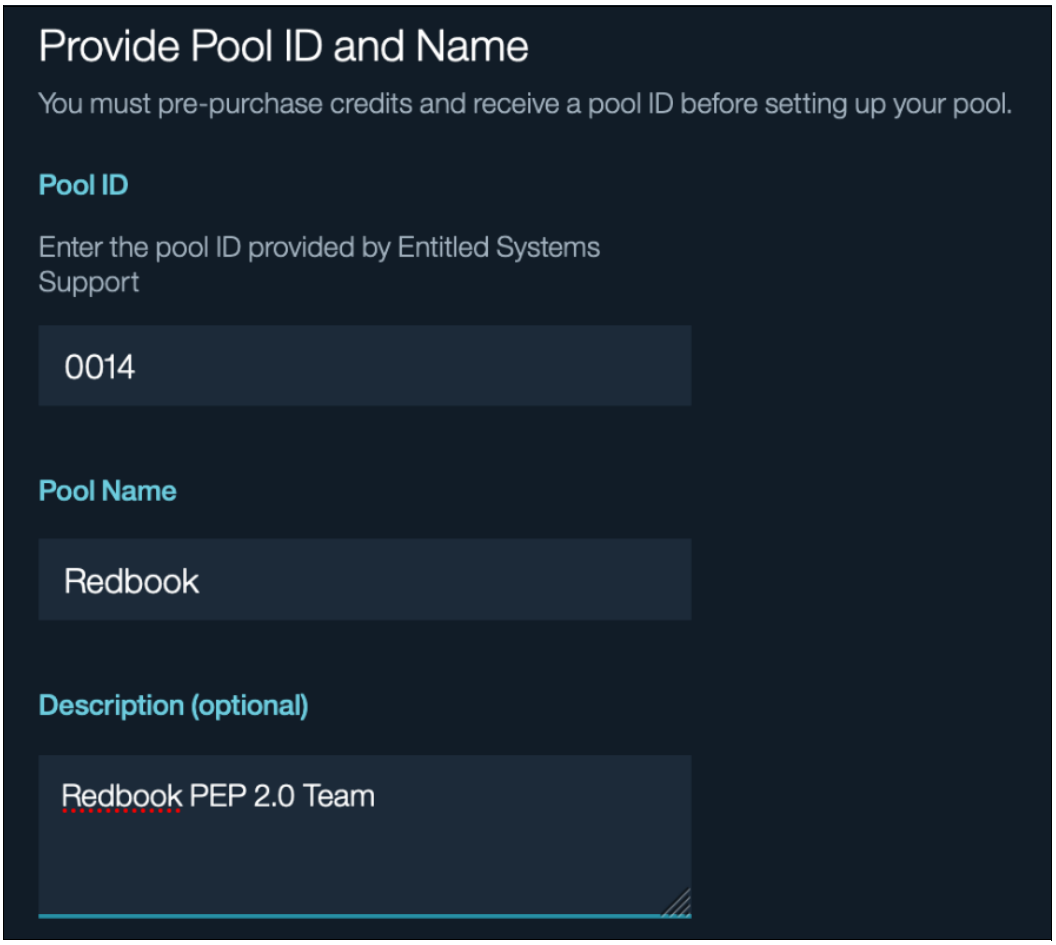

Figure 3-30 Creating a pool in Enterprise Pools 2.0

7. If the system that is used to create the Pool ID in the IBM Entitled Systems Support portal is not in the IBM CMC inventory, you are prompted to enter your customer number and country to proceed, as shown in Figure 3-31.

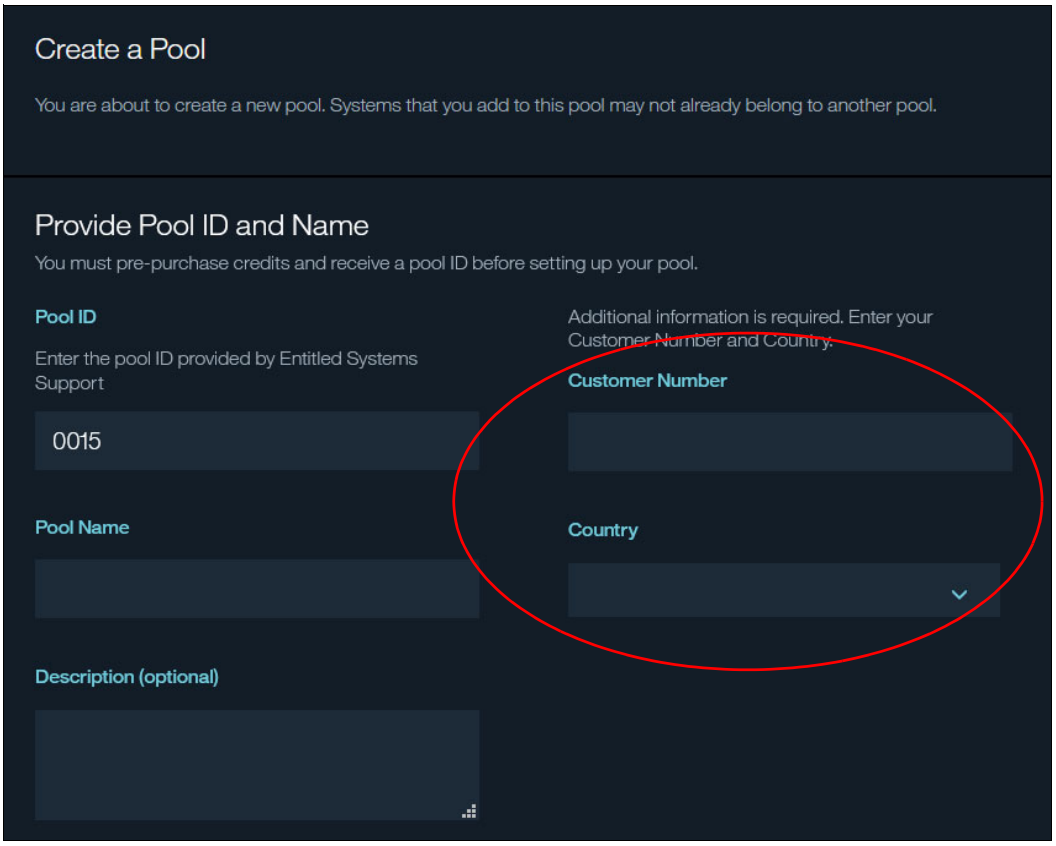

Figure 3-31 Create a Pool: More information

8. Set a default monthly budget for the new pool. In addition, you must decide whether you want to allow dedicated logical partitions (LPARs) in your pool. This setting *cannot* be changed for an existing pool. If you want to use dedicated LPARs in an existing pool, you must delete the pool and create a new one. Click the little twistie in the “Select Pool Configuration Option” section, as shown in Figure 3-32.

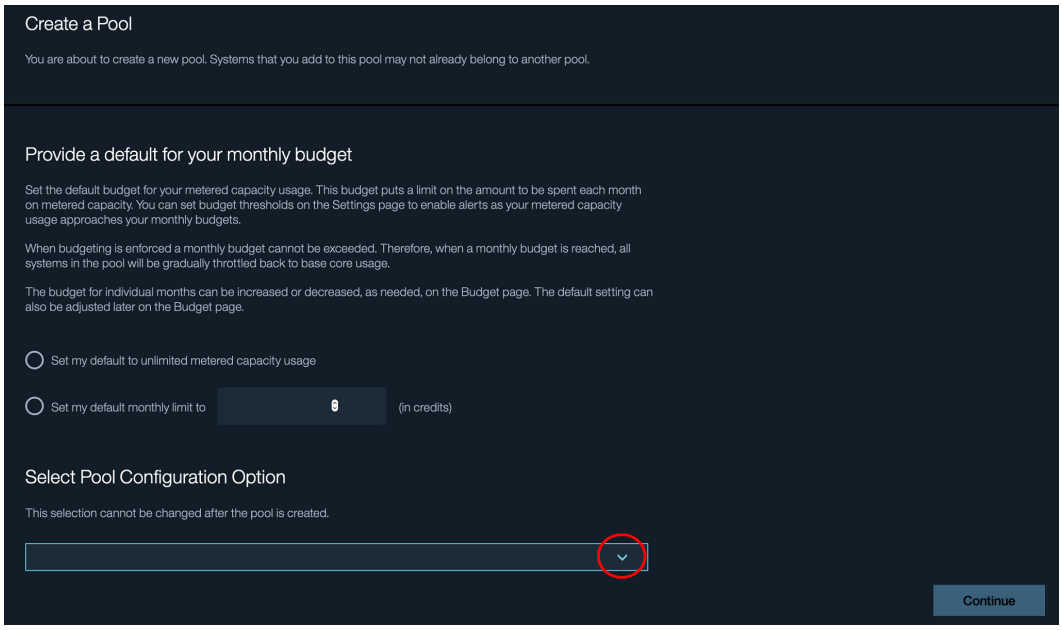

Figure 3-32 Create a Pool: Set the default budget

9. Choose whether you want to allow dedicated LPARs. In a pool that allows the use of dedicated LPARs, budgeting is not enforced. You can still define a budget, but you are charged for metered usage above the set budget. Figure 3-33 shows the available Pool Configuration Options.

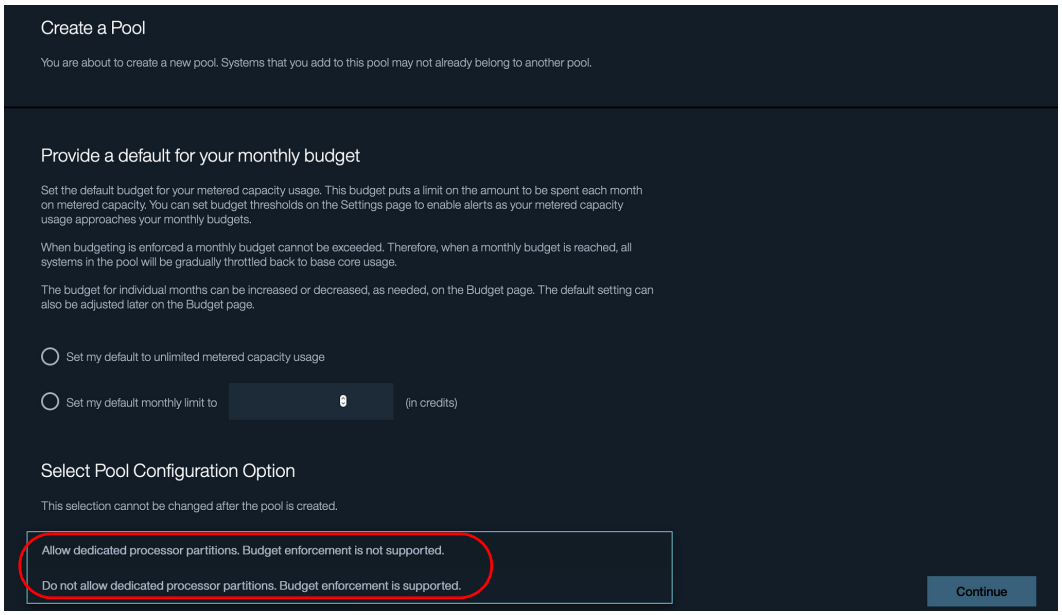

Figure 3-33 Create a Pool: Select Pool Configuration Option

10. You see a list of all systems that are managed by the HMCs that are connected to the IBM CMC that are the type and model that are allowed in the pool. If there are any issues preventing systems from being added to the pool, the reasons are also shown here. Select the systems that you want to add, as shown in Figure 3-34.

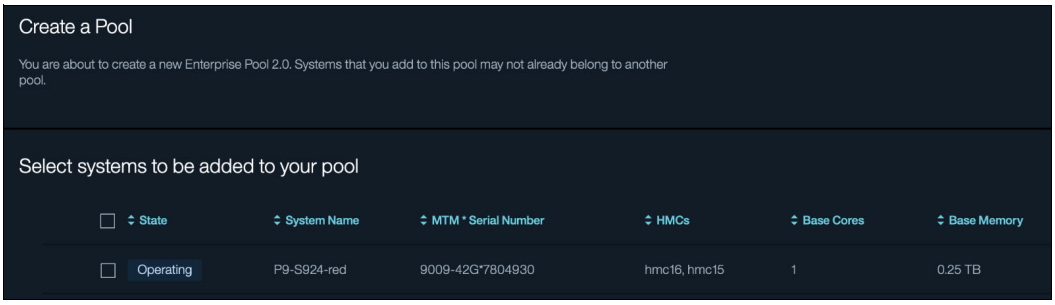

Figure 3-34 Create a Pool: Select systems to be added to your pool

Note: IBM CMC gets information about available systems from IBM Entitled Systems Support. A system must have a status of “installed” in IBM Entitled Systems Support.

11. If the Create a Pool operation is successful, you get the messages that are shown in Figure 3-35.

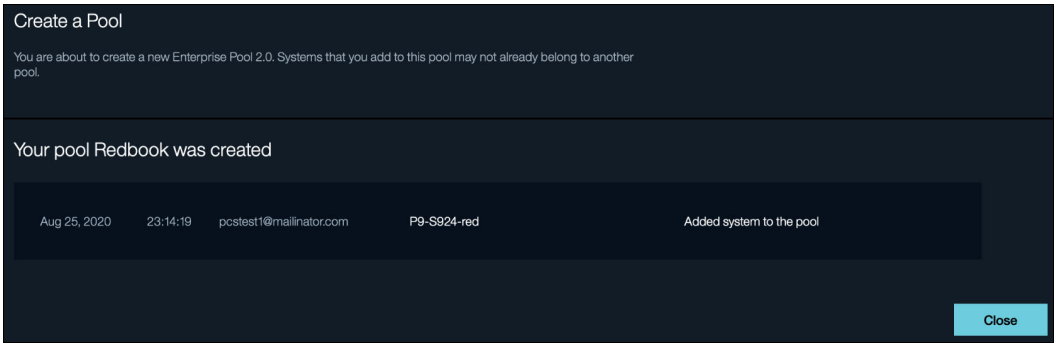

Figure 3-35 Create a Pool: Success

12. Your pool name appears at the top of the page, as shown in Figure 3-36.

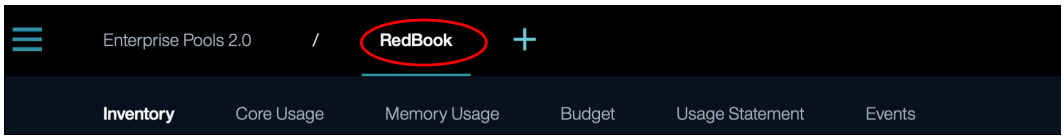

Figure 3-36 Create a Pool: Display new pool

13. You can add other systems to the pool by clicking **Add Systems**, as shown in Figure 3-37.

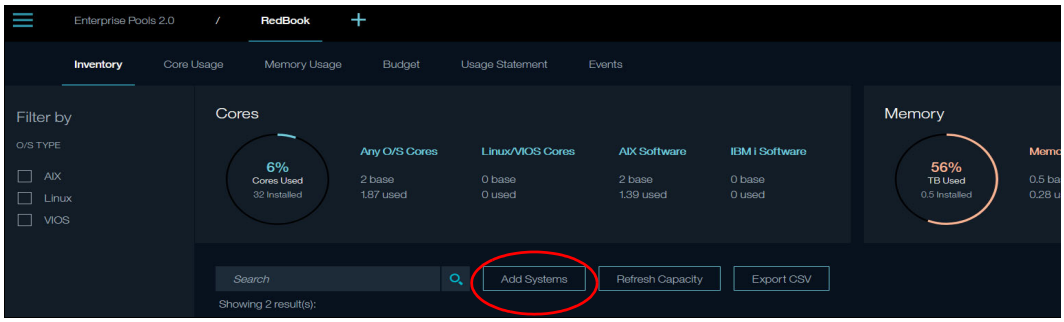

Figure 3-37 Add Systems to a pool

3.1.6 Multi-data-center connectivity by using an HMC to connect to IBM CMC

If you have multiple IBM Power servers in your enterprise that are managed by different HMCs at different sites within the same country, you can add them to the same pool. Ensure that all HMCs are connected to the same IBM CMC instance, as described in 3.1.3, “Connecting an HMC to IBM CMC” on page 88.

3.2 IBM Cloud Management Console operation

This section provides an overview of the different management operations that can be used on IBM CMC to manage your PEP 2.0 environment.

3.2.1 Inventory

The **Inventory** tab provides a general overview of your pool. The top part shows overall pool data, such as current core and memory usage; number of installed cores and memory in the pool; and overall base capacity in the pool. You can add more systems to the pool from here, or refresh the metered capacity to update the purchased base capacity or Capacity Credits in IBM CMC, as shown in Figure 3-38.

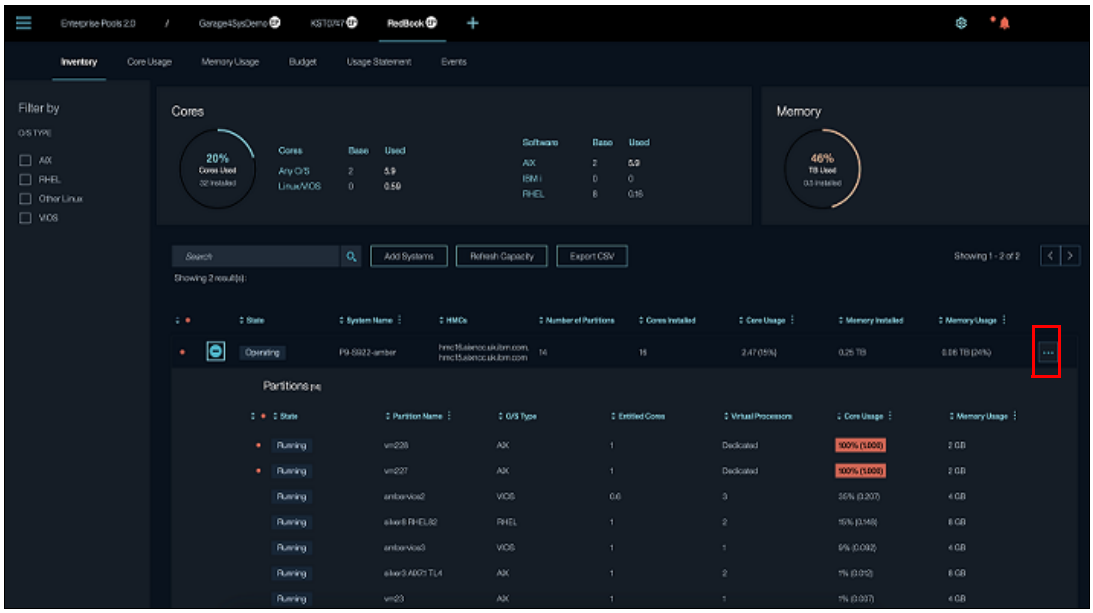

Figure 3-38 Inventory tab

Filtering by operating system (OS) type is available at the upper left of the Inventory window.

The lower part of the window provides an overview of the systems that are part of the pool and of the virtual machines (VMs) that are defined on those systems. For each system, the number of installed cores and memory and the current usage is shown. For each VM, the OS type, current core usage, and current memory usage are provided. The current core usage for a dedicated non-donating VM is always shown as 100%.

Clicking the three small dots at the right side of a system in the pool opens an information window with the base capacity and the CoD status of the system, as shown in Figure 3-39. From here, you can also remove a system from a pool or move it to another pool.

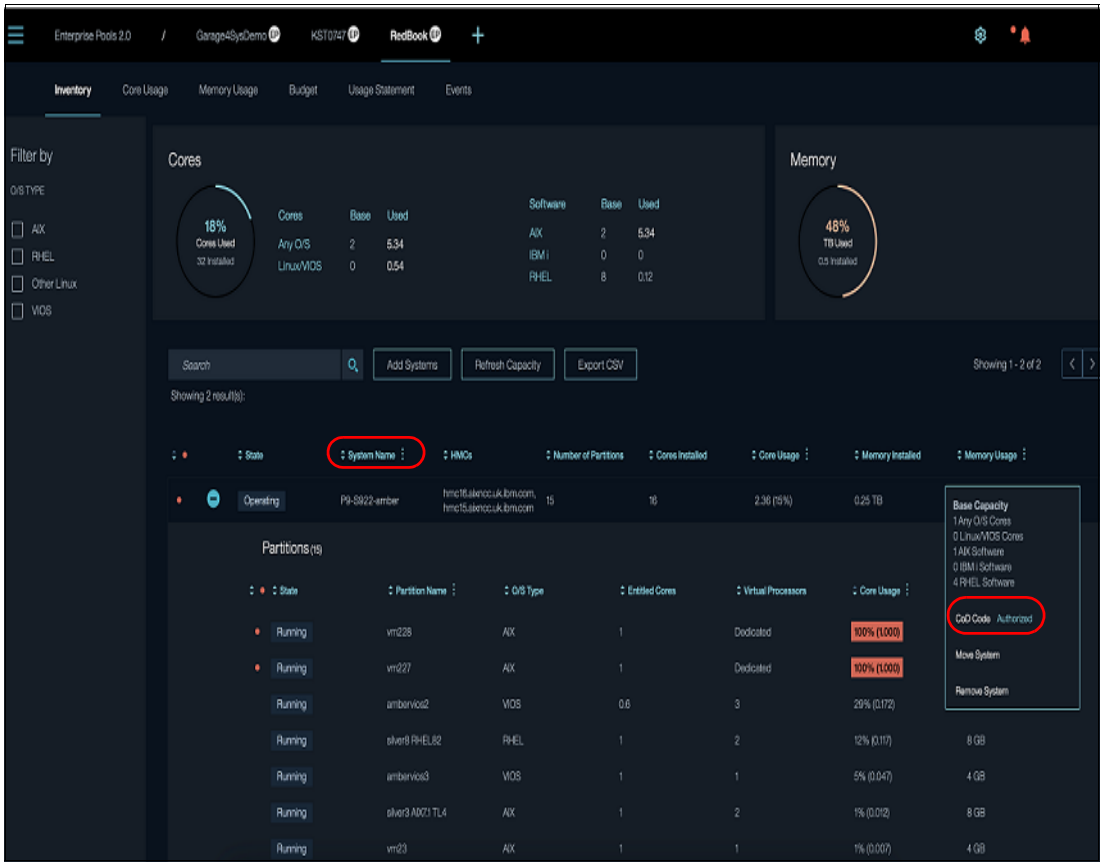

Figure 3-39 Inventory with information about the base capacity

The CoD status might be `Authorized`, `Expired`, or `x days left`. The `x days left` status is shown if there are 10 days or less left before the CoD code expires.

The headings at the bottom part of the window provide more possibilities to customize the different windows. Clicking the up and down arrows changes the order in which the information is presented. Clicking the three small dots next to a heading opens up another window where you can select which information that you want to see, as shown in Figure 3-40.

Figure 3-40 Inventory window: Customizing

For the systems in a pool, you can choose between the system name or the type/model and serial number. For core and memory usage, you can specify whether you want to see the absolute value or the percentage first.

3.2.2 Usage

The **Core Usage** and **Memory Usage** tabs provide detailed information about various usage metrics on a server level or VM level for your pool. You can look at the data in a graphical representation or in a table format. You can also look at historical data and export the available data in CSV format and then, for example, use it for further accounting.

Core Usage

Here you take a more detailed look at what data is available on core usage in a Shared Utility Capacity pool and how to navigate the available data.

The upper part of the Core Usage window shows a calendar and a graphical representation of usage data, as shown in Figure 3-41. The lower part of the window shows more detailed data in a table, as shown in Figure 3-42 on page 105.

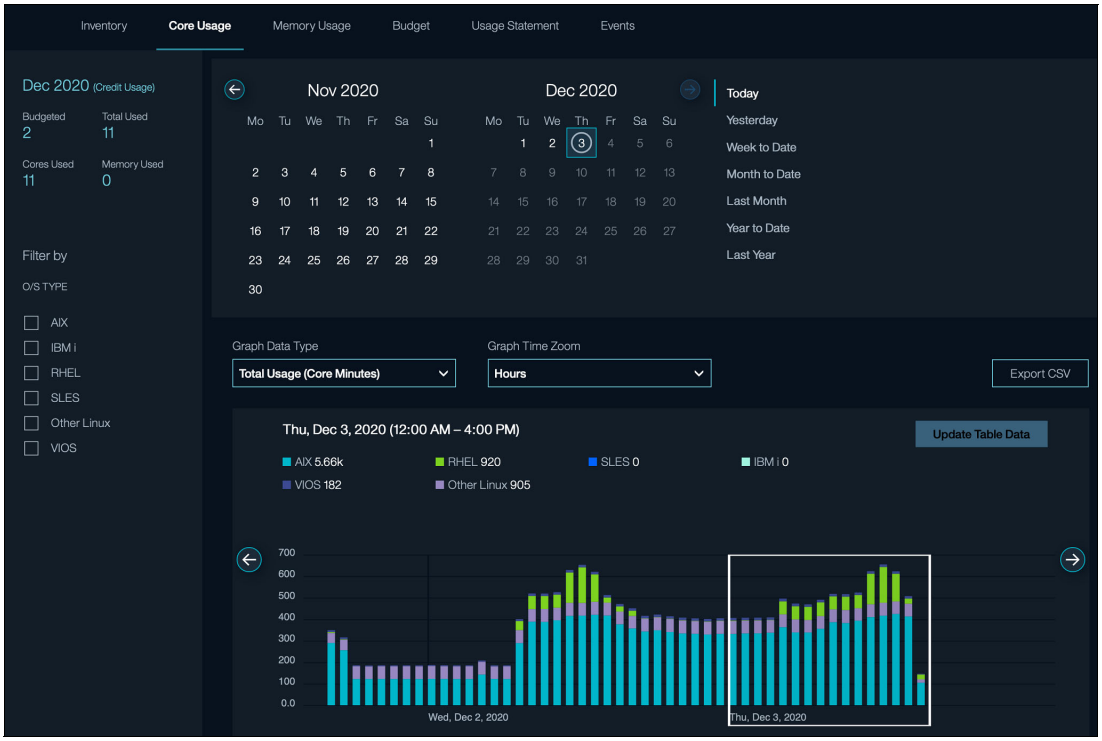

Figure 3-41 Core Usage: Graphical view

Figure 3-42 shows the lower part of the Core Usage window with the more detailed table view. VMs that exceed defined thresholds are marked with a red dot. Specific values that exceed the defined thresholds are also marked in red. You can choose whether you want to look at this data on a server level or even more detailed on a VM level.

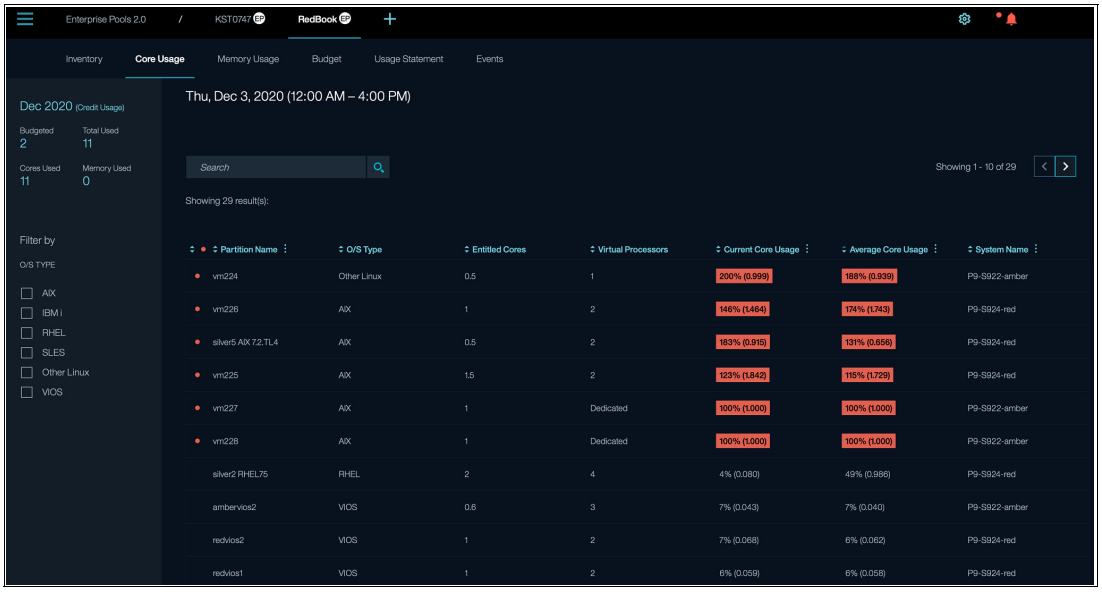

Figure 3-42 Core Usage: Table view

By using the calendar in the upper part of the usage window, you can look at a specific timeframe. As shown in Figure 3-43, you can either select a timeframe like “last month” or “year to date”, or you can either select a specific date by double-clicking that date or selecting a specific date range by clicking the start and end date. You can also change the timeframe by moving the white box in the graphical data representation.

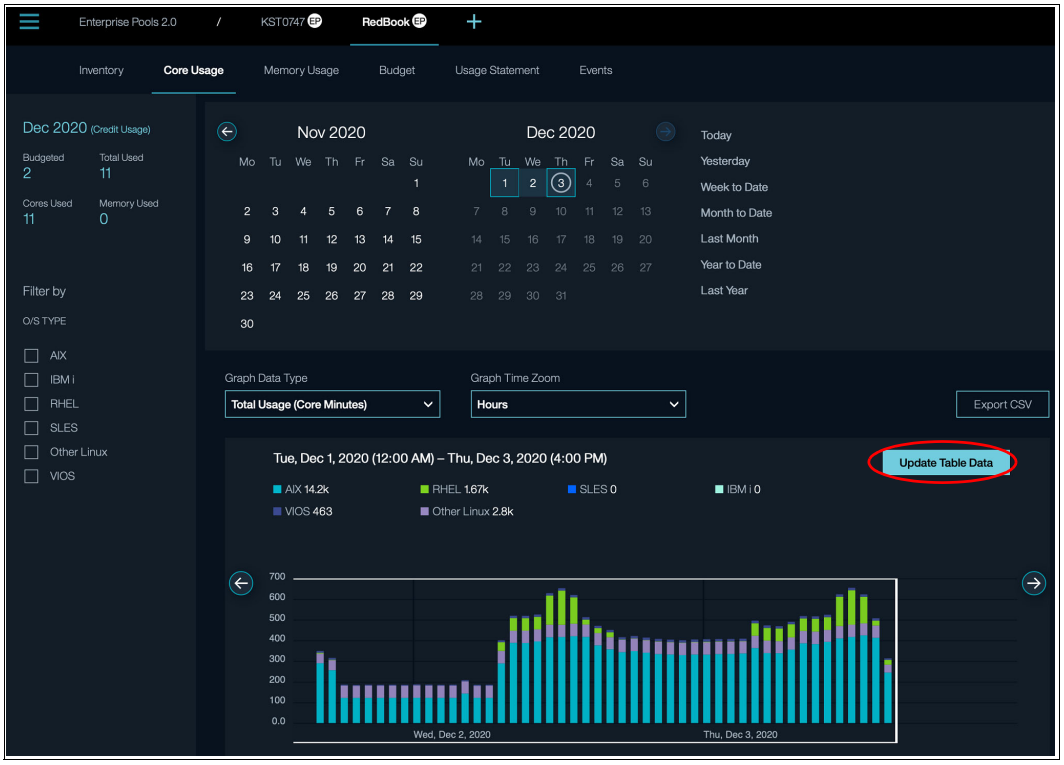

Figure 3-43 Core Usage: Calendar

The graphical view of data is updated immediately when changing the date range. To update the detailed table view, click **Update Table Data**.

The graph data type and the graph time zoom can be adjusted by opening the respective selection boxes, as shown in Figure 3-44.

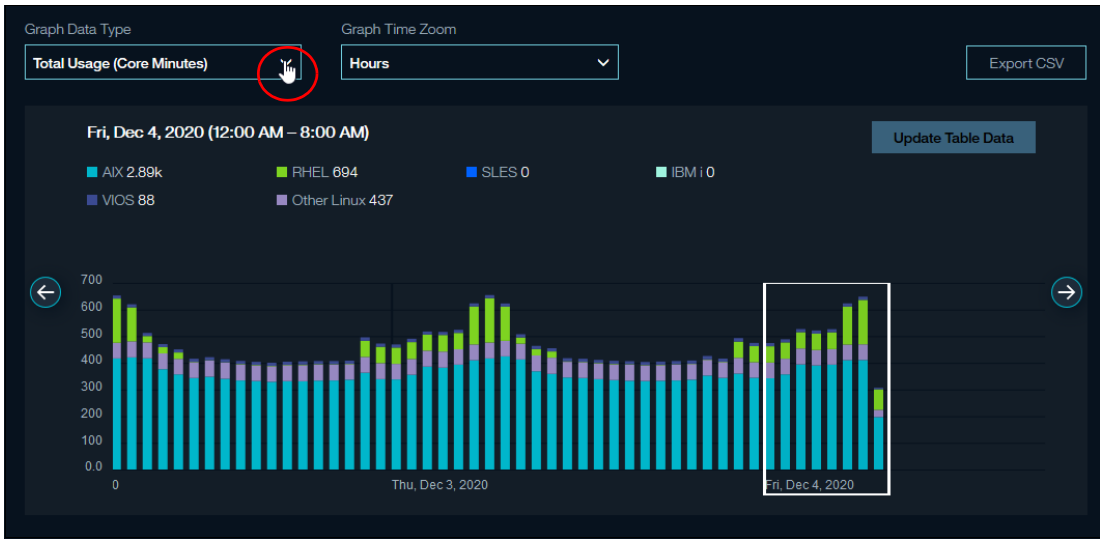

Figure 3-44 Core Usage: Change graph setting

As shown in Figure 3-45, metrics for core usage can be any one of the following items:

- Total core usage in minutes
- Metered core usage in minutes
- Metered core usage in credits

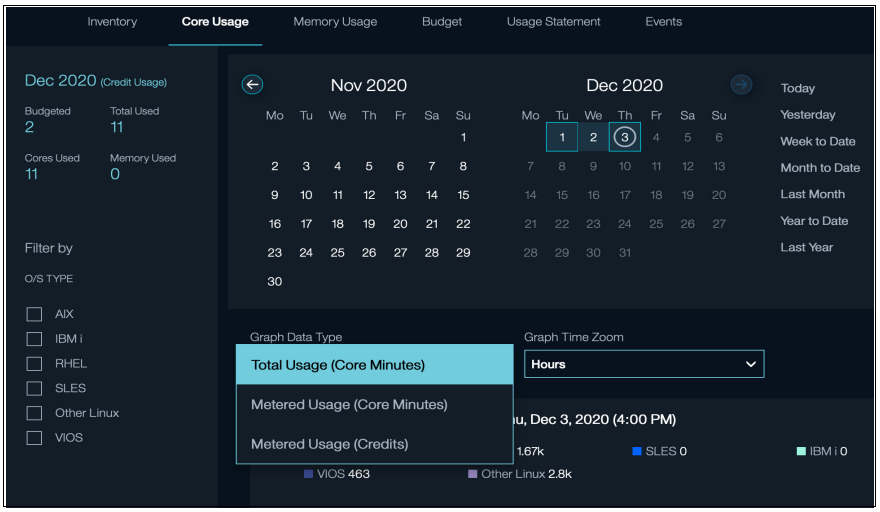

Figure 3-45 Core Usage: Change the graph data type

You can see data over minutes, hours, days, weeks, or months, as shown in Figure 3-46.

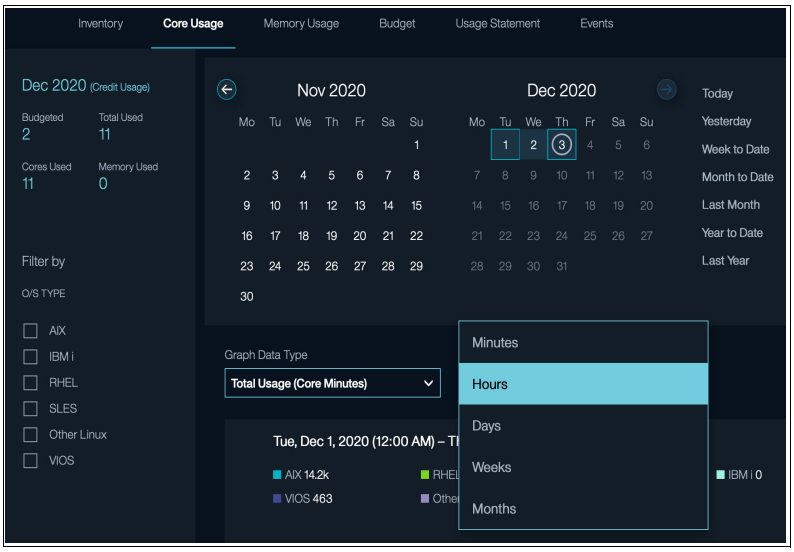

Figure 3-46 Core Usage: Change graph time view

Data in the table view can also be customized to your needs. Several column headings are followed by three small dots. Clicking these dots, as shown in Figure 3-47, shows a drop-down menu with the different presentation options that are available for this column.

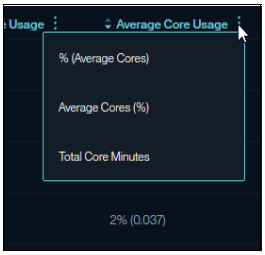

Figure 3-47 Core Usage: Change table view

The time values that are shown here are provided in your local time, which is taken from the browser that you use to access the IBM CMC portal. However, time aggregation is based on Coordinated Universal Time time for all systems in a pool. Therefore, when data is displayed at the day, week, or month level, the start time for a day is always shown as 0:00 am UTC time, which is converted to your local time.

Figure 3-48 was taken from a browser with a time setting of Coordinated Universal Time - 5 with automatic adjustment for Daylight Saving Time. Therefore, the day starts at 8:00 PM local time, which would be 0:00 am UTC time.

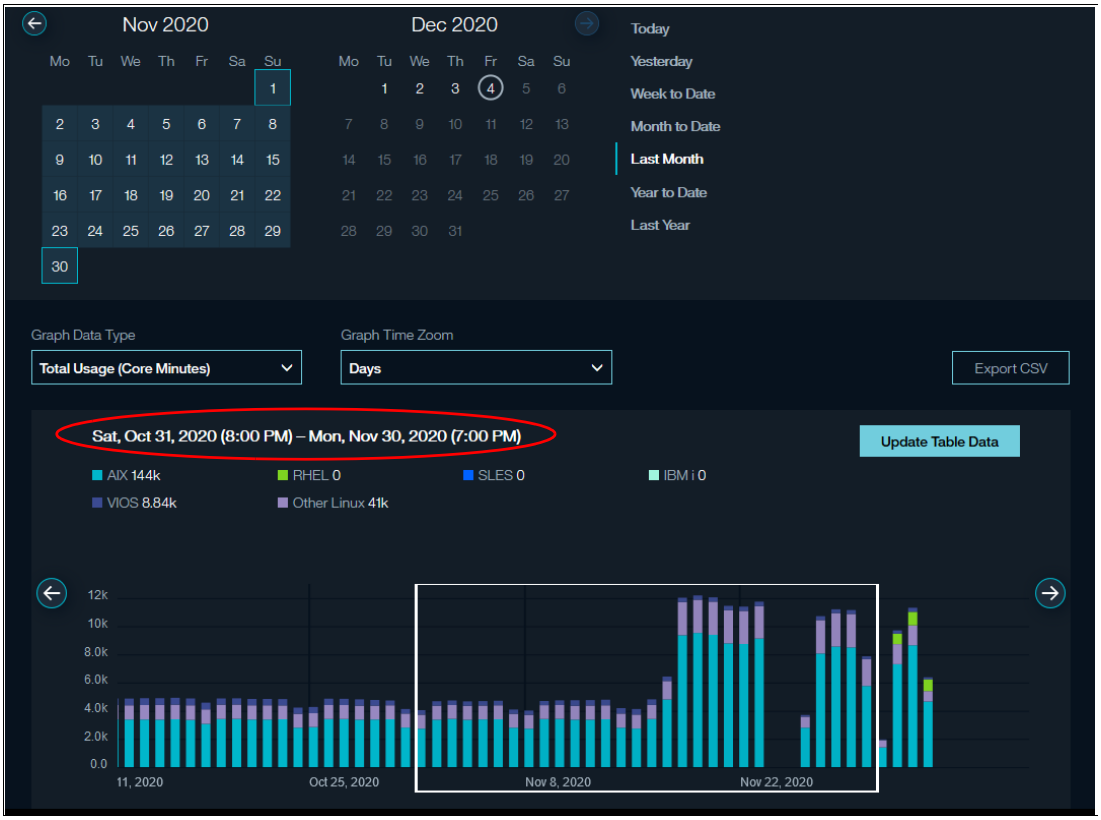

Figure 3-48 Time difference

Memory Usage tab

The handling in the **Memory Usage** tab is identical to the handling in the **Core Usage** tab. Figure 3-49 shows the graphical view of metered memory usage in credits.

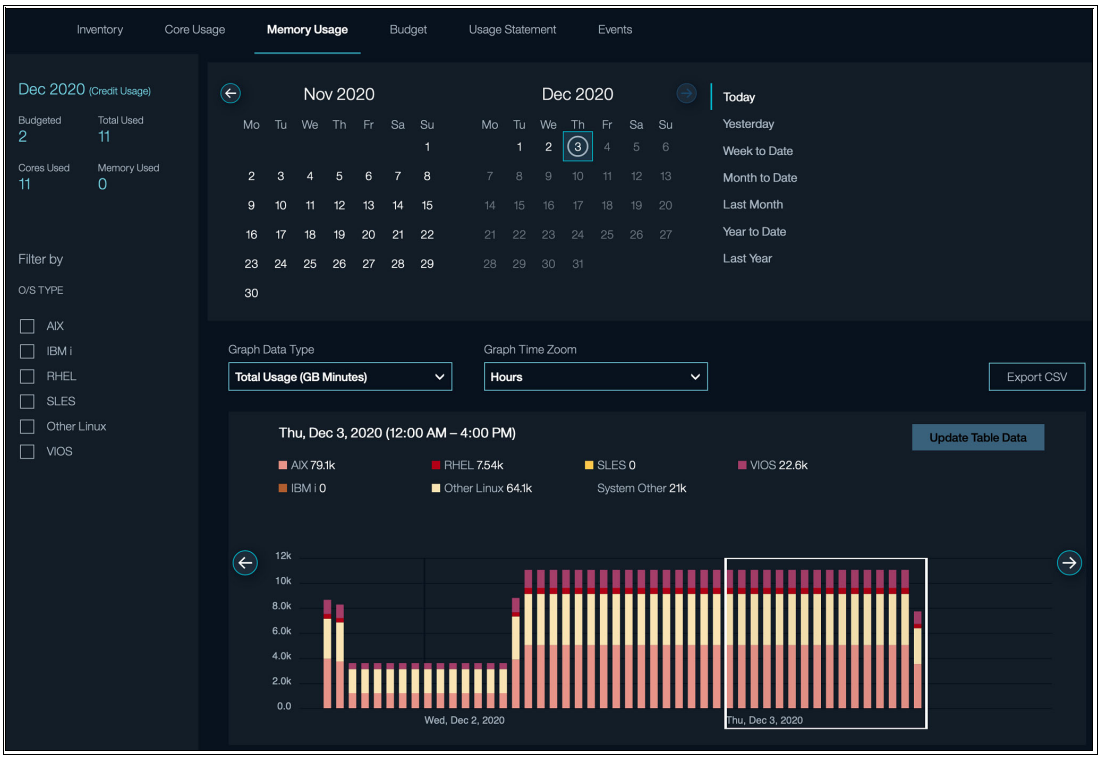

Figure 3-49 Memory Usage: Graphical view

3.2.3 Budget

When creating a pool, you set a default budget for all months. On the **Budget** tab, you can change this predefined value for individual months depending on your planned workload for those specific months. Overwrite the predefined values to change them, as shown in Figure 3-50.

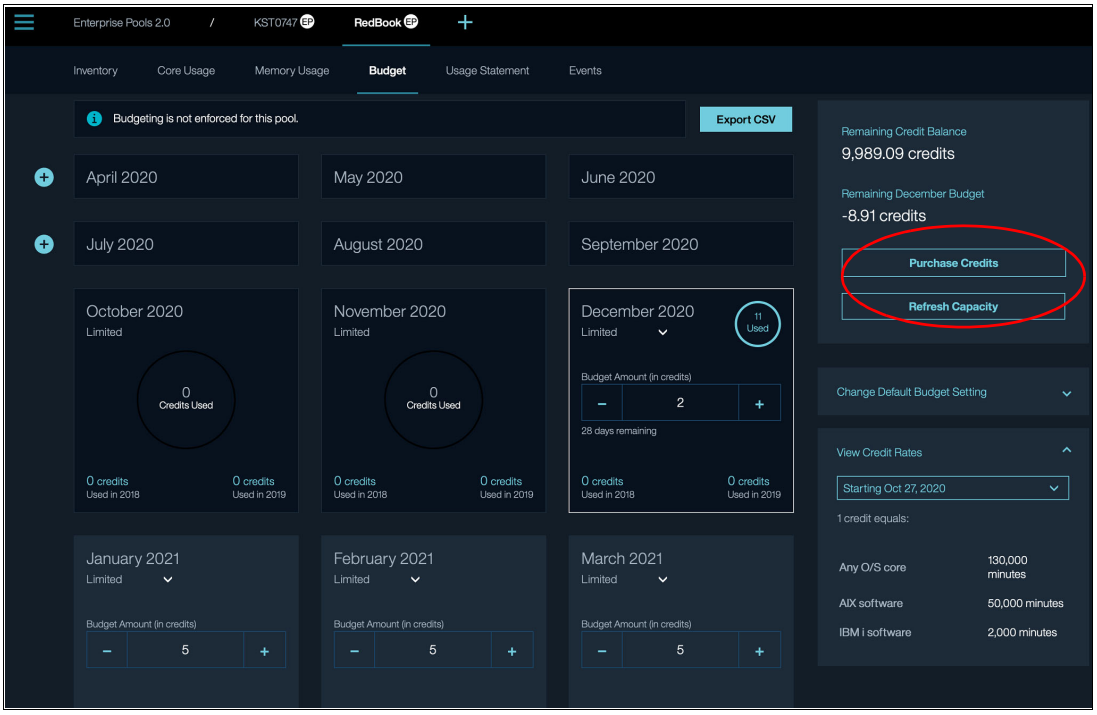

Figure 3-50 Budgeting information window

If your overall workload behavior changes, you can also change the default budget for all future months. This action changes only the defined budget for those months where you have not changed the default budget value to an individual value before. Budget settings that you provided for individual months stay in place even when changing the default budget setting.

The **Budget** tab also shows an overview of how many credits were used in previous months, a rate table for your pool, your remaining credit balance, and the remaining budget for the current month. The budget is set and used for a calendar month in Coordinated Universal Time time zone values. If you are in a different time zone, your actual month might start and end several hours earlier or later.

In addition, you can see whether budgeting is enforced on a pool (because the pool does not allow the use of dedicated LPARs) or is not enforced on a pool (because the pool *does* allow the use of dedicated LPARs).

The **Purchase Credit** button leads you to the IBM Entitled Systems Support website, where you can purchase more credits. If you purchased more credits either on the IBM Entitled Systems Support website or through your IBM or IBM Business Partner channel, click **Refresh Capacity** to load these new credits into IBM CMC.

Note: If the budget is set to zero, throttling does not start until metered resources in the pool start to be consumed.

3.2.4 Usage Statement

The Usage Statement window shows an overview of a pool's metered usage for a specific quarter of a year, as shown in Figure 3-51. IBM CMC shows detailed information about how many metered minutes were used for the different metered resources and how many credits to which this usage corresponds.

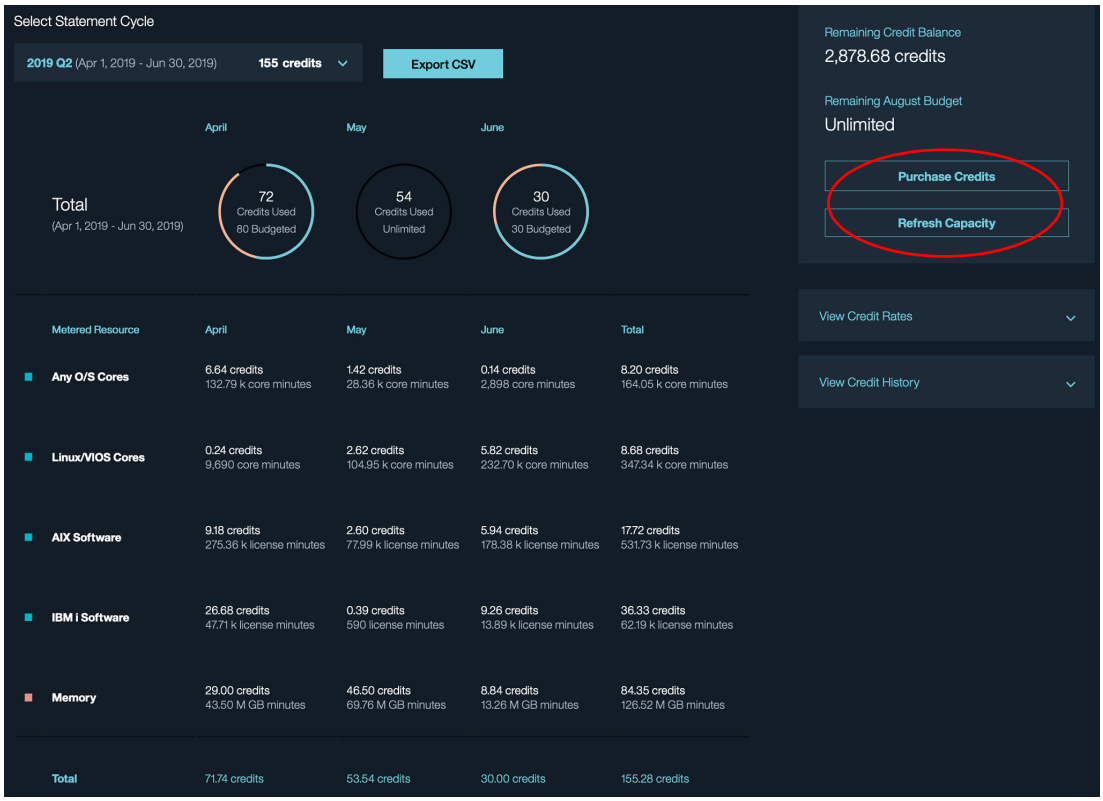

Figure 3-51 Usage Statement

On the right side of the window, you can see your current credit balance. You can purchase more credits through the IBM Entitled Systems Support website. If you purchased more credits, you can refresh the capacity to inform IBM CMC about these newly available Capacity Credits.

Data that is shown in this window can also be exported in the CSV format.

3.2.5 Usage Statement Email

The Pool settings page includes a Usage Statement Email feature. With this option enabled, you can receive a monthly credit usage statement for the pool at the listed email addresses.

To configure the Usage Statement Email feature, complete the following steps:

1. Log in to your IBM CMC portal.
2. Click **Enterprise Pools 2.0**.
3. Click the setting icon (upper right of the window).

4. Scroll down to the “Usage Statement Email” section and enter the email ID to be configured for receiving the monthly usage statement. If there are multiple addresses, they must be separated by commas, as show in Figure 3-52.

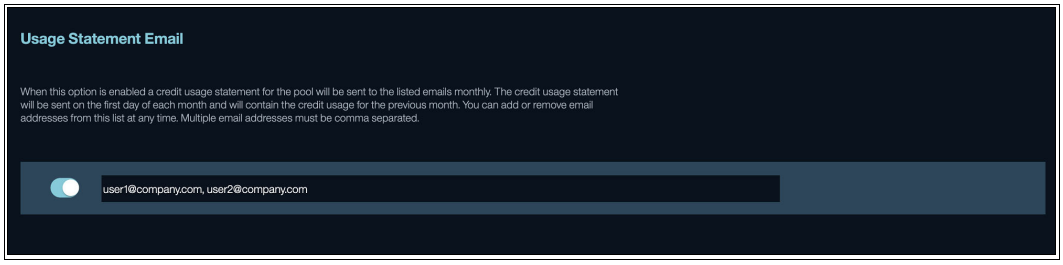

Figure 3-52 Usage Statement Email configuration

The credit usage statement, which is shown in Figure 3-53, is sent on the first day of each month and contains the credit usage for the previous month. A comma-separated version (CSV) of the usage statement is also attached to the email.

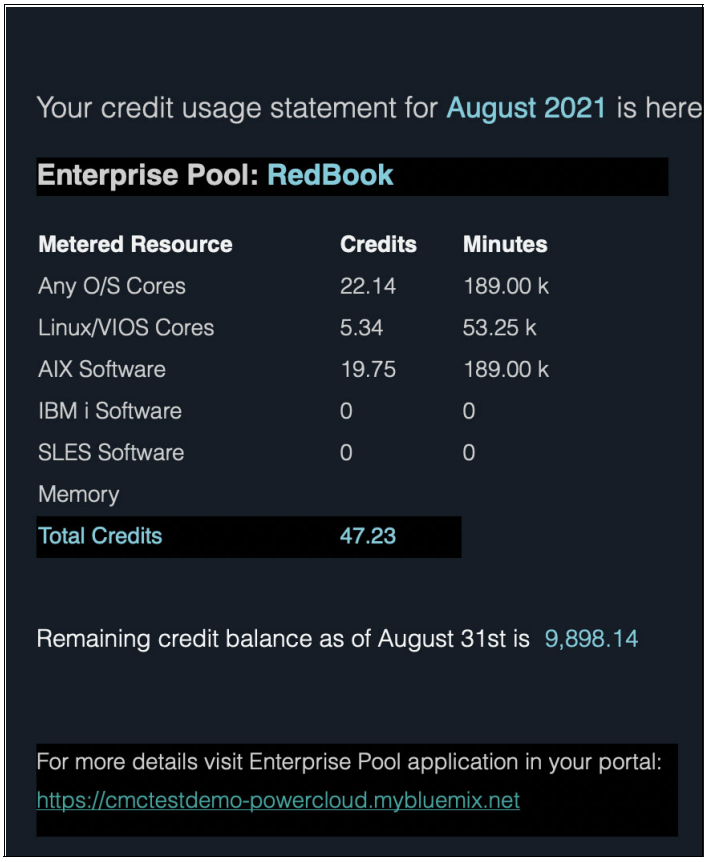

Figure 3-53 Credit usage statement email

3.2.6 Settings and thresholds

To define the pool settings and thresholds, click the settings icon in the upper right of the IBM CMC window, as shown in Figure 3-54.

Figure 3-54 Accessing the settings

In the **Settings** tab, details of enterprise pools and thresholds are displayed, as shown in Figure 3-55. You can delete a pool or restore threshold defaults from this window. You can also change the pool name and description by overwriting the current values.

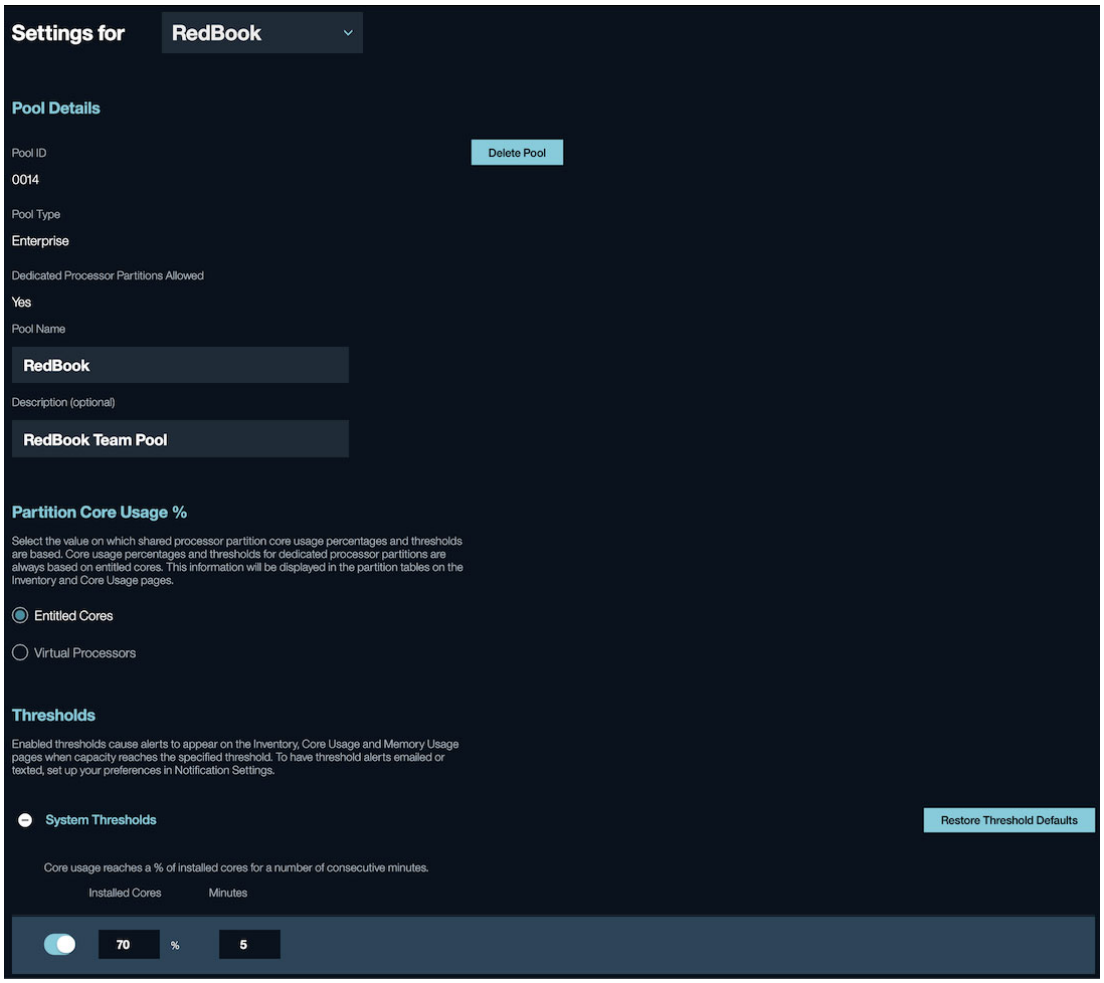

Figure 3-55 Settings window

System thresholds can generate warnings when the overall core usage of a server reaches a specific percentage of the installed cores on that server for a number of minutes or if the memory usage of a server reaches a specific percentage of the installed memory.

As shown in Figure 3-56, the percentage values and the number of minutes are configurable. You can also specify that VMs running over a certain percentage of cores for a number of minutes generate a warning.

Figure 3-56 System and partition thresholds

When setting monthly budgets, consider implementing thresholds that provide you with warning messages when certain limits are reached by using the Other Thresholds section:

- You can define that you want to receive a warning message after a configurable percentage of your monthly budget is reached.
- You can also set a relationship between the remaining budget for a month and the remaining timeframe within that month so that, for example, you receive a warning if more than 25% of your budget is used before 25% of a month is over, as shown in Figure 3-57.
- You can receive warning messages if your available credits fall below a specified number. You can define multiple rules for each category by clicking **Add** at the right of each threshold.

Even if you have not defined any thresholds, you still receive a warning when the budget for a month is met or the remaining balance reached zero.

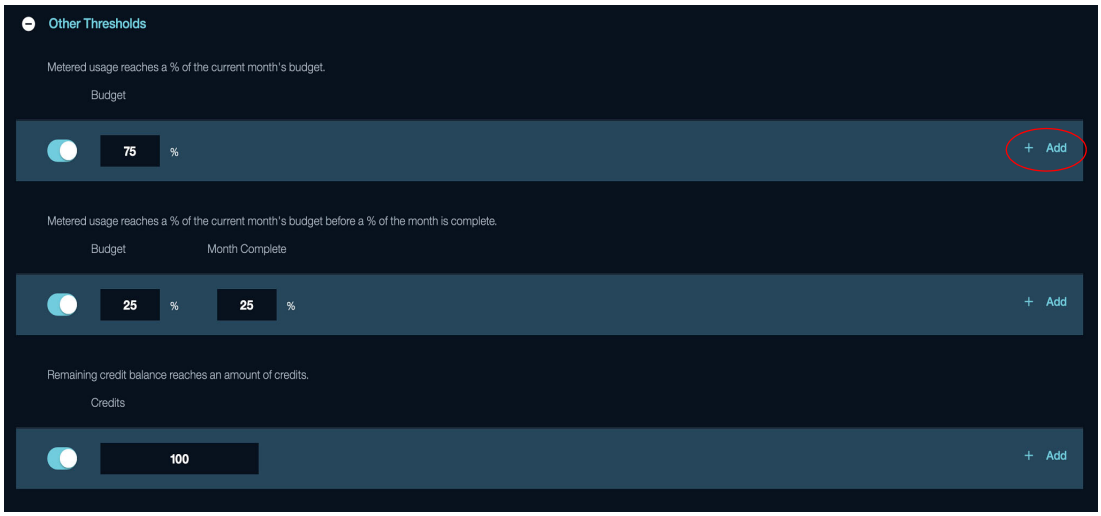

Figure 3-57 Other Thresholds

The system and partition thresholds define which systems and VMs show up with a warning indicator in the **Inventory**, **Core Usage**, and **Memory Usage** tabs. Figure 3-58 shows an example of the **Inventory** tab with warning indicators present.

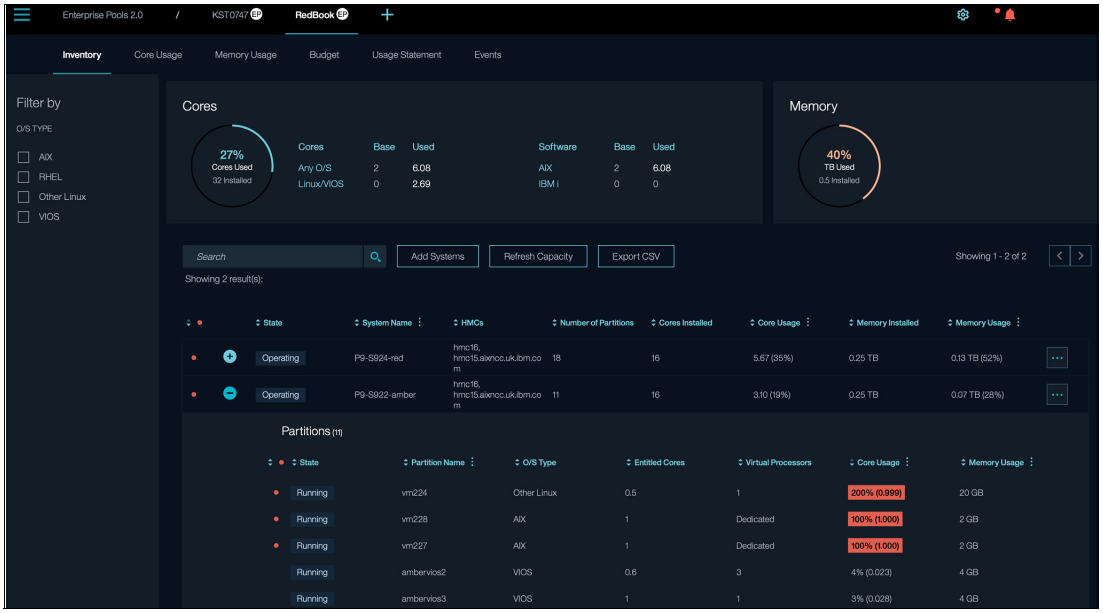

Figure 3-59 Inventory with warning indicators

In addition, you can configure IBM CMC to send email or SMS notifications when any of the thresholds are reached. To do so, open the Notifications window by clicking the small bell in the upper right of the IBM CMC window to open the window that is shown in Figure 3-59.

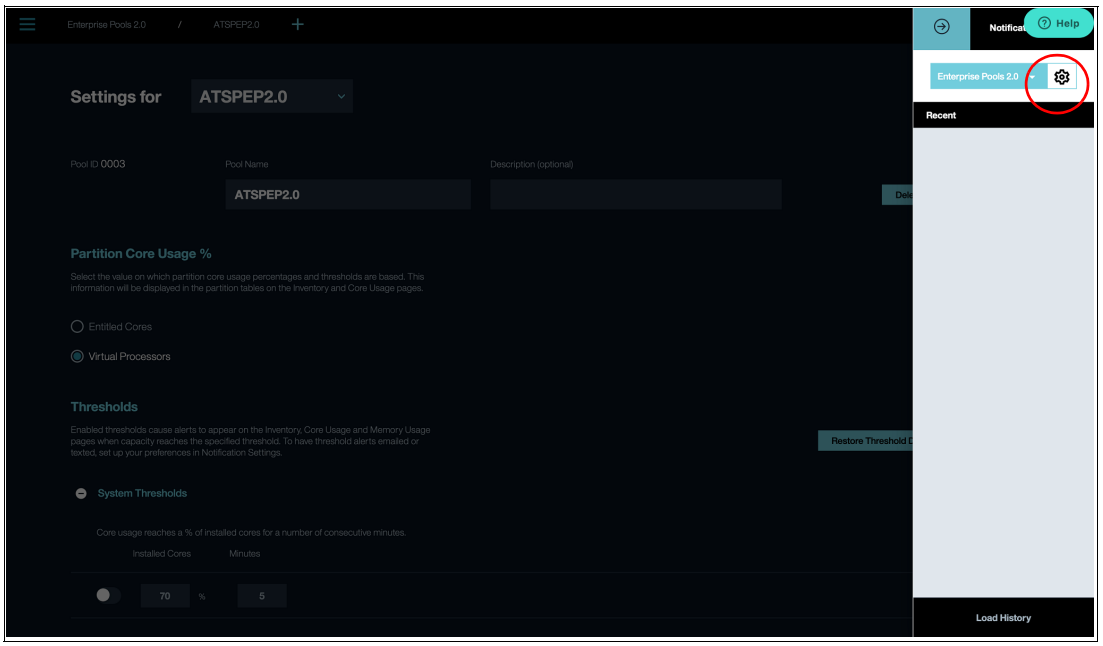

Figure 3-59 Notification window

Clicking the **Settings** icon opens the window that is shown in Figure 3-60. Here, you can configure the notification to send an email or enter a phone number to receive SMS warning messages when your defined thresholds are met. It is also possible to generate a test email or SMS notification after an email address or telephone number is provided.

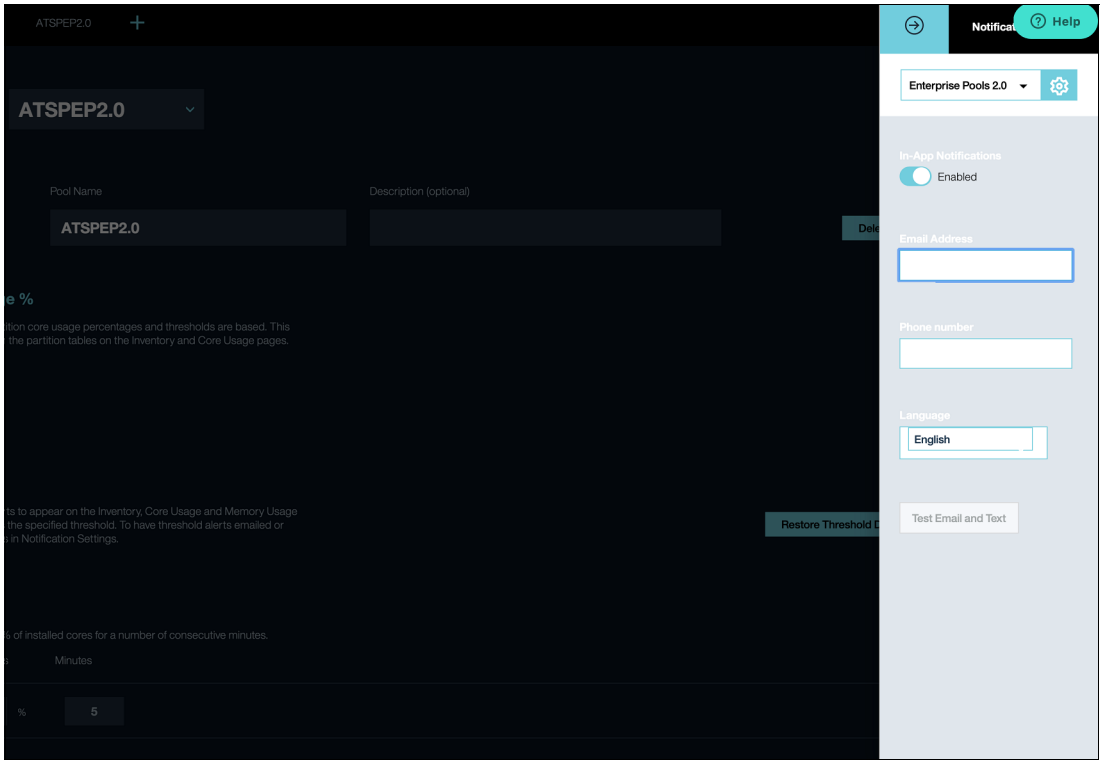

Figure 3-60 Configuring email / SMS notifications

Figure 3-61 shows an example of the email alert when the core usage exceeds the configured threshold value.

Figure 3-61 Sample email alert

3.2.7 Events

The **Events** tab provides a log of activities in your pool. Figure 3-62 shows log entries that were created when a new pool was set up.

Aug 26, 2020	11:17:50	pcstest1@mailinator.com	Budget for month 9 in year 2020 was set to 1 credits.
Aug 26, 2020	11:17:46	pcstest1@mailinator.com	Budget for month 9 in year 2020 was set to 2 credits.
Aug 25, 2020	21:15:49	pcstest1@mailinator.com	System 9009-22G*7804940 was added.
Aug 25, 2020	21:15:49	pcstest1@mailinator.com	Base memory is set to 0.25 TB for system 9009-22G*7804940.
Aug 25, 2020	21:15:49	pcstest1@mailinator.com	Base IBM i software is set to 0 for system 9009-22G*7804940.
Aug 25, 2020	21:15:49	pcstest1@mailinator.com	Base AIX software is set to 1 for system 9009-22G*7804940.
Aug 25, 2020	21:15:49	pcstest1@mailinator.com	Base Linux/VIOS cores is set to 0 for system 9009-22G*7804940.
Aug 25, 2020	21:15:49	pcstest1@mailinator.com	Base any O/S Cores is set to 1 for system 9009-22G*7804940.
Aug 25, 2020	21:15:47	pcstest1@mailinator.com	System 9009-22G*7804940 is authorized for 30 days.
Aug 25, 2020	20:14:18	pcstest1@mailinator.com	System 9009-42G*7804930 was added.
Aug 25, 2020	20:14:18	pcstest1@mailinator.com	Base memory is set to 0.25 TB for system 9009-42G*7804930.
Aug 25, 2020	20:14:17	pcstest1@mailinator.com	Base IBM i software is set to 0 for system 9009-42G*7804930.
Aug 25, 2020	20:14:17	pcstest1@mailinator.com	Base AIX software is set to 1 for system 9009-42G*7804930.
Aug 25, 2020	20:14:17	pcstest1@mailinator.com	Base Linux/VIOS cores is set to 0 for system 9009-42G*7804930.
Aug 25, 2020	20:14:17	pcstest1@mailinator.com	Base any O/S Cores is set to 1 for system 9009-42G*7804930.
Aug 25, 2020	20:14:17	pcstest1@mailinator.com	System 9009-42G*7804930 is authorized for 30 days.
Aug 25, 2020	20:14:16	pcstest1@mailinator.com	10000 credits were added to the pool: order 900T154.

Figure 3-62 Log showing messages for pool creation

The following sections describe some specific situations and how they appear in the IBM CMC interface.

3.2.8 Budget reached

When you reach your set budget for a month, several things happen:

- You receive a warning message in the Event log, as shown in Figure 3-63.

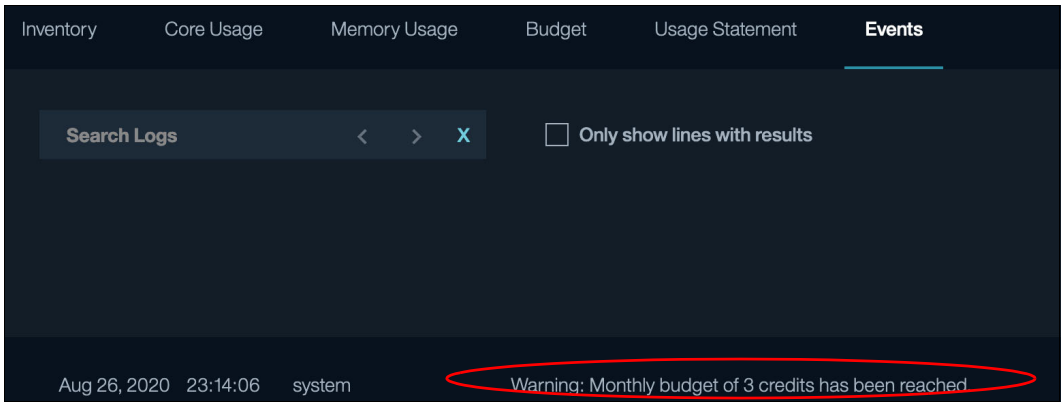

Figure 3-63 Warning message in Event log

- There is a new notification, as shown in Figure 3-64.

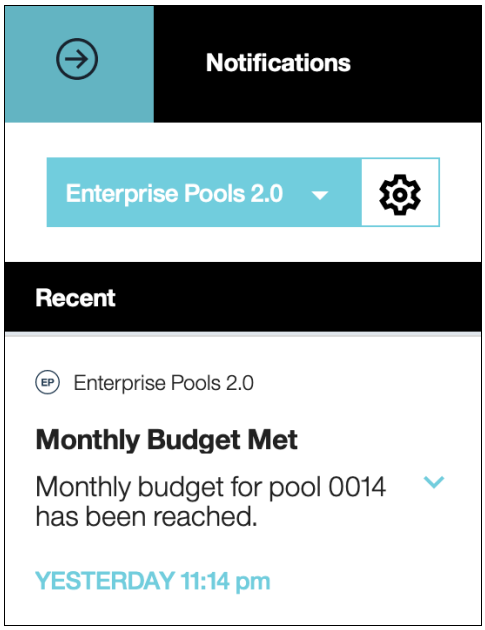

Figure 3-64 Notification that the budget was reached

- If you specified that you want to receive email or SMS notifications, an email or SMS is sent.
- If budgeting is not enforced because the pool allows the use of dedicated VMs, the pool continues to use metered capacity if the pool usage exceeds the base capacity. On the Budget window, you can see that the credit usage is higher than the set budgets, as shown in Figure 3-65.

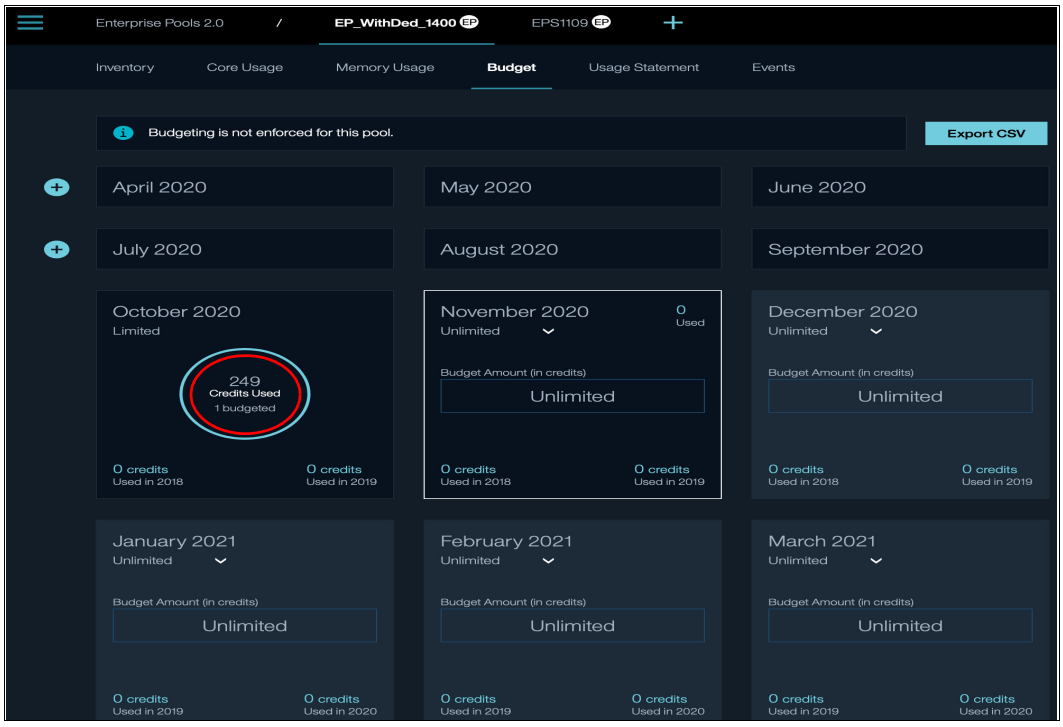

Figure 3-65 Budget overused

- If budgeting is enforced, IBM CMC initiates throttling, and the HMC shows messages and a graphical indication about throttling taking place, as shown in Figure 3-66.

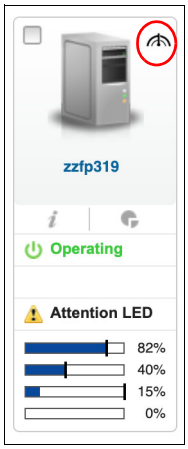

Figure 3-66 Throttling indicator on Hardware Management Console

- When throttling starts, the tracking of metered usage stops, but the pool might still be using capacity over the base capacity. This behavior is shown in Figure 3-67, where there is a gap in the metered capacity graph that starts immediately after the budget was met at 11:14 PM. The last bar on the right shows metered usage for the hour starting at 11:00 PM. Notice that the metered capacity is much lower than in the hours before because it is charged only until 11:14 PM and that there are no more bars in the timeslots after 11:00 PM.

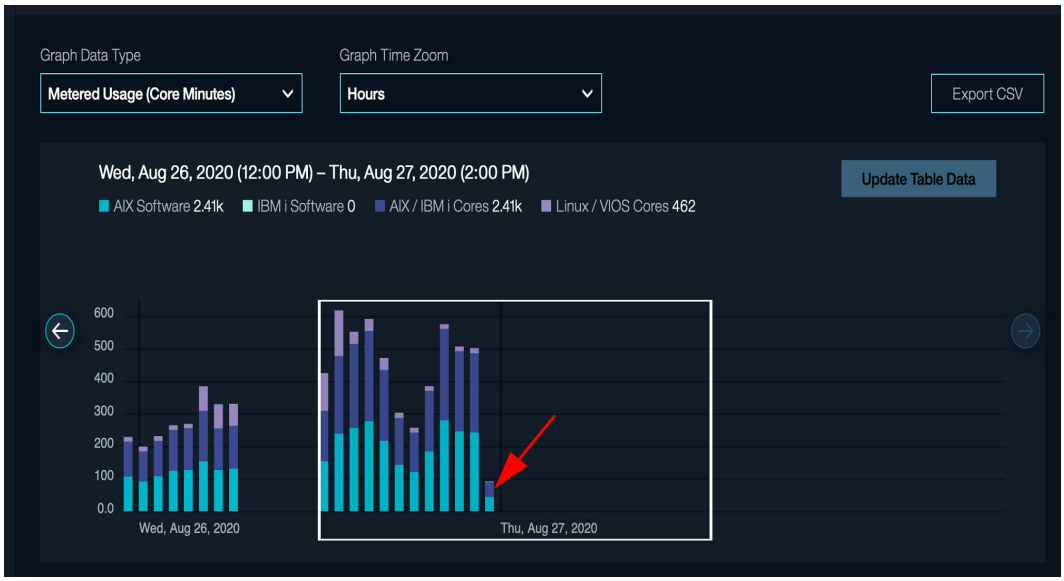

Figure 3-67 Metered usage after the budget is reached

3.2.9 Removing a system from a pool

You can remove a system from a pool by using the Inventory window. Complete the following steps:

1. Click the three small dots on the right of the row of the system that you want to remove. Another menu opens that shows the base capacity information for that system, the CoD code status, and an option to remove the system from the pool, as shown in Figure 3-68.

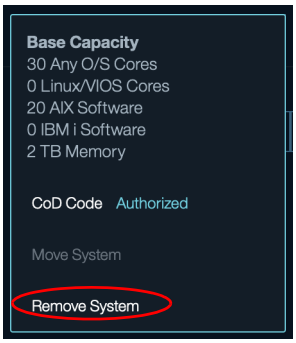

Figure 3-68 Remove System

A system that is removed from a pool takes its base activations out of the pool, which decreases the amount of base capacity that is available in the pool, as shown in Figure 3-69.

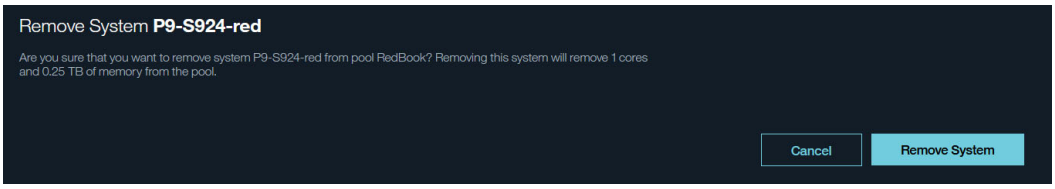

Figure 3-69 Removing a system from pool: Informational message

Base activations are converted to static activations on a system that leaves a pool. To ease migration and provide an option for removing a system from a pool without any downtime to applications running on that system, any system leaving a pool is provided with 30 days of Trial CoD that keeps all installed resources active for 30 days, as shown in the event login Figure 3-70.

Figure 3-70 Event log for Trial CoD

Removing the last system from a pool also deletes the whole pool, so you receive an extra warning when you try to delete the last system from a pool.

3.2.10 Deleting a pool

You can delete a pool from the Settings window. To open the Setting window, click the settings icon in the upper right of the PEP 2.0 window in IBM CMC. Make sure that the correct pool is selected and then click **Delete Pool**, as shown in Figure 3-71.

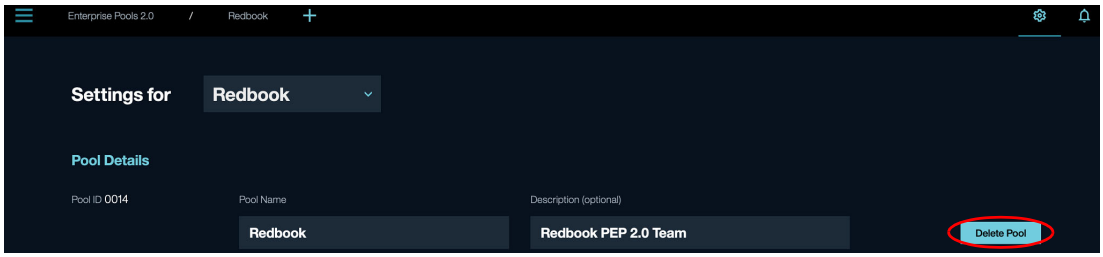

Figure 3-71 Deleting a pool

Deleting a pool cannot be undone. All systems are permanently removed from the pool and are provided with 30 days of Trial CoD to keep all installed resources active for 30 days.

Important: When deleting a pool, all unused credits that are associated with the pool are forfeited.

You must type in the name of the pool and confirm that you understand the consequences of deleting a pool before you can click **Continue**, as shown in Figure 3-72.

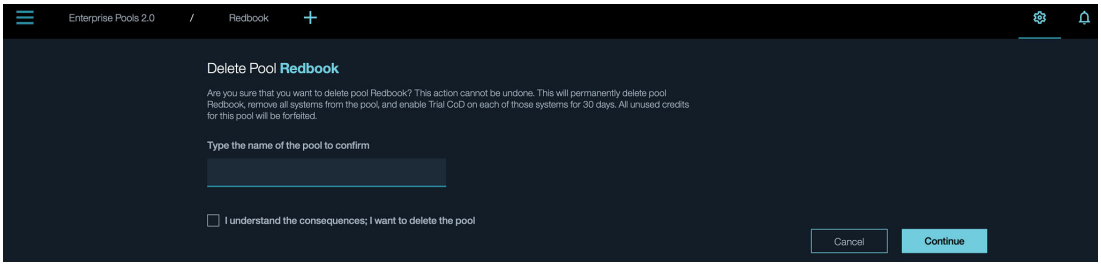

Figure 3-72 Delete Pool: Confirmation

3.2.11 Health Monitoring Service

The Health Monitoring service notifies you about potential issues concerning the connection between the HMC and IBM CMC or the reporting of performance data for systems being monitored by IBM CMC.

A notification appears in the notifications pane, and the service sends you a notification (phone call or email) based on your notification pane settings. All Health Monitoring Service notifications are repeated on 24-hour intervals until the issue is resolved.

The service notifies you of the following issues:

- Inactive HMCs. A list of all HMCs that have been inactive for more than 60 minutes.
- Disconnected Enterprise Pools 2.0 systems. The possible disconnected system states that are notified are as follows:
  - No connection
  - Pending authentication

- Failed authentication
- Version mismatch
- Disconnected (Enterprise Pools 2.0 state)

- Enterprise Pools 2.0 systems with PCM disabled.
- Systems in the inventory that stopped reporting performance data for more than 60 minutes.

3.3 IBM CMC Public APIs

IBM CMC provides the option to download data in the CSV file format, which then can be used as the basis for charge-back calculations for specific servers or LPARs. However, this function requires that a user logs in to IBM CMC and manually requests the download of a specific CSV file. To provide ways to automate this function, IBM CMC Public APIs are available. Public APIs generate data in JSON format that contains information about base capacity and usage for servers and LPARs in a pool.

3.3.1 Creating tags for API usage

The available APIs use tags to identify which servers or LPARs for which they should provide information. These tags must be set in the IBM CMC in the inventory app. To reach the inventory app, go to the main window of IBM CMC and select **Inventory**, as shown in Figure 3-73.

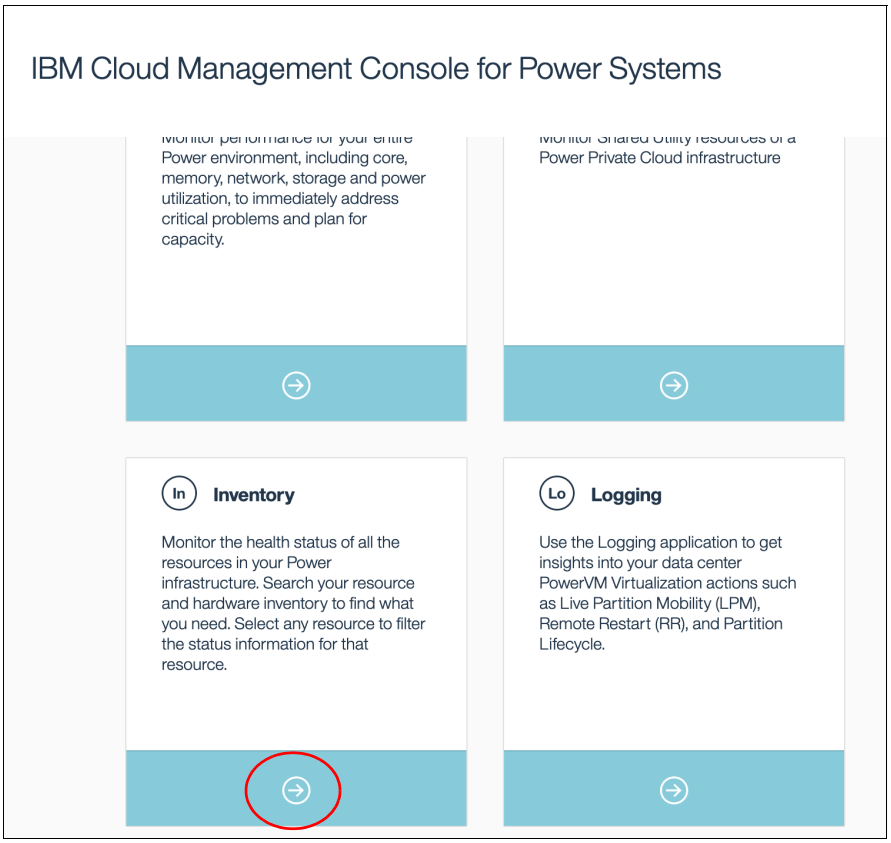

Figure 3-73 IBM Cloud Management Console: Inventory

In the Inventory window, select **Full Inventory** and choose either **Managed systems and HMCs** or **Partitions and Virtual I/O Servers**. In the list, you can filter or search for specific entries. Select the entries that you want to group and click **Add a Tag**, as shown in Figure 3-74.

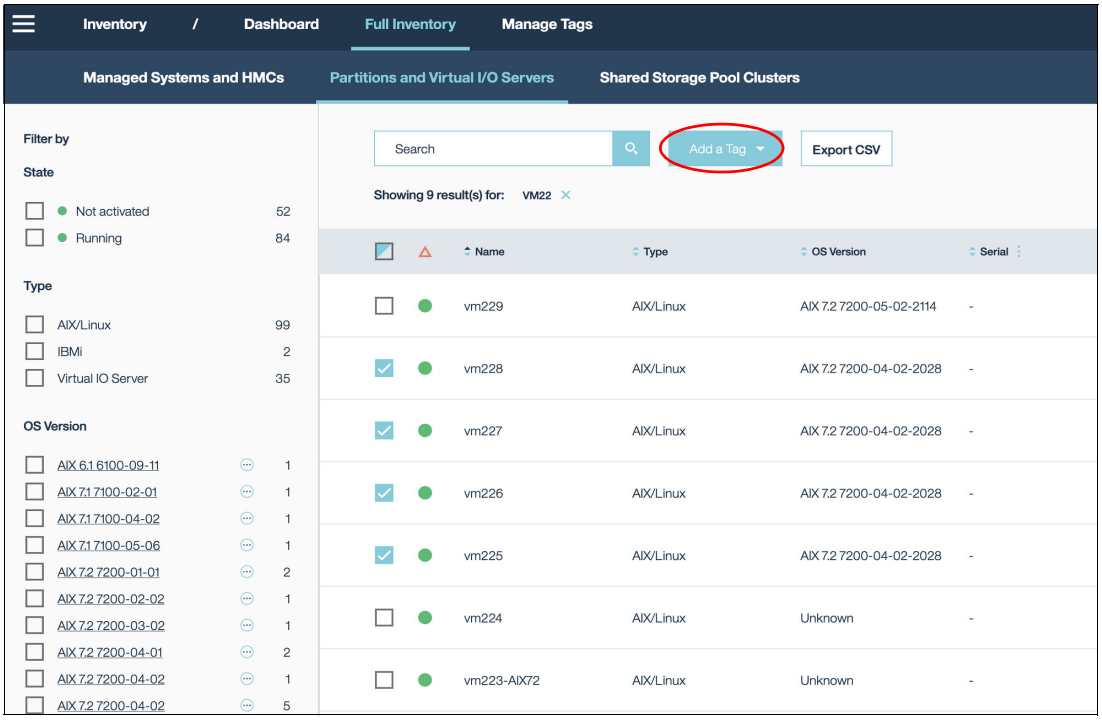

Figure 3-74 Selecting LPARs for tagging

You can either choose to add an existing tag to the entries you selected or create a tag, as shown in Figure 3-75.

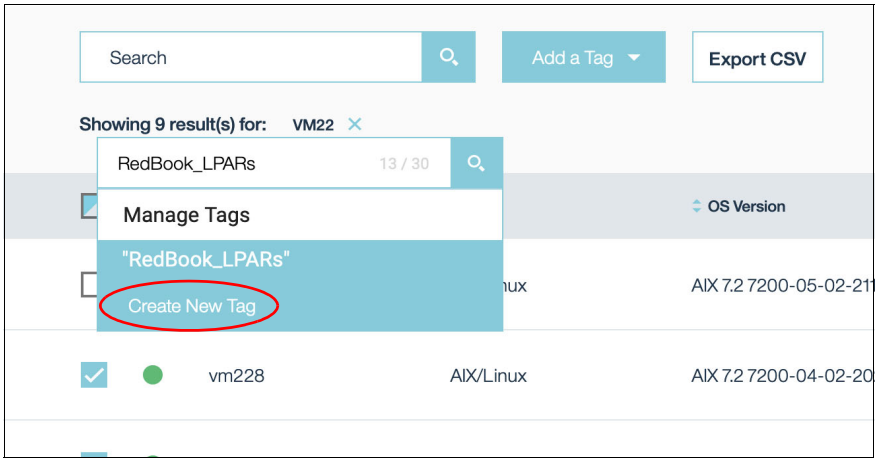

Figure 3-75 Adding a tag

Partitions and servers can have one or more tags that are attached to them. Clicking the small tag icon next to an entry, as shown in Figure 3-76, provides the information about the attached tags and an option to remove tags from a server or LPAR.

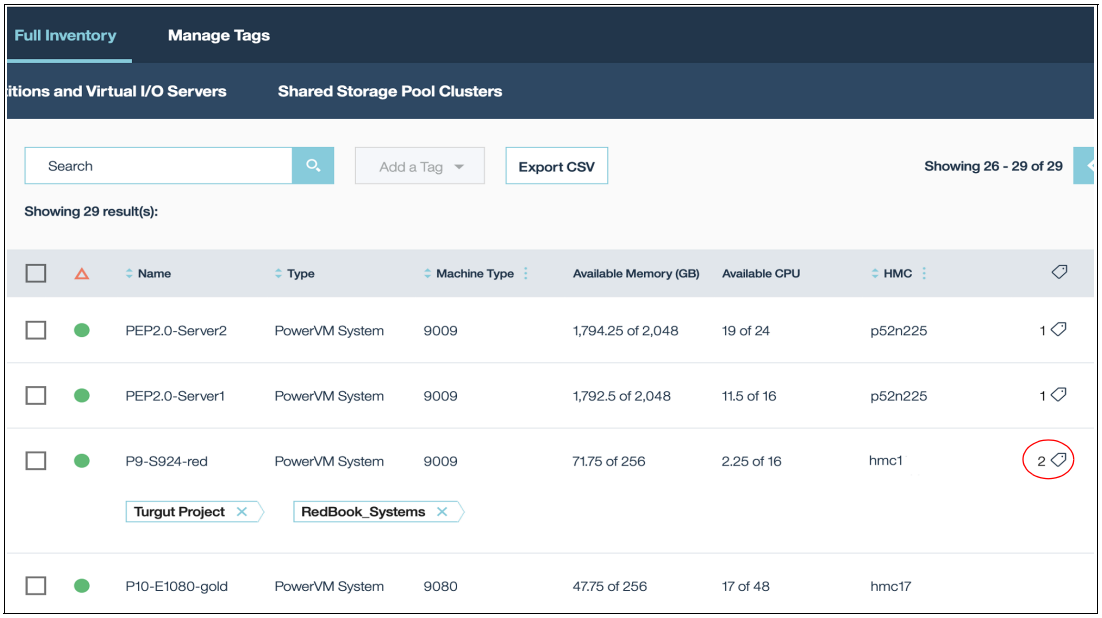

Figure 3-76 Tags that are attached to servers

3.3.2 Authentication

To work with the IBM CMC Public API, you must set your client ID value in the `X-CMC-Client-Id` header and the client secret value in the `X-CMC-Client-Secret` header on every request. To form the IBM CMC Public API full URL, append the relative path of the endpoint that you want to use to the API Base URL, in the form `<base_url>/ep/inventory/tags`.

Your base URL, client ID, and client secret can be found in the IBM CMC settings under **Public API**. To reveal your client secret, click the small eye symbol next to **Client Secret**, as shown in Figure 3-77.

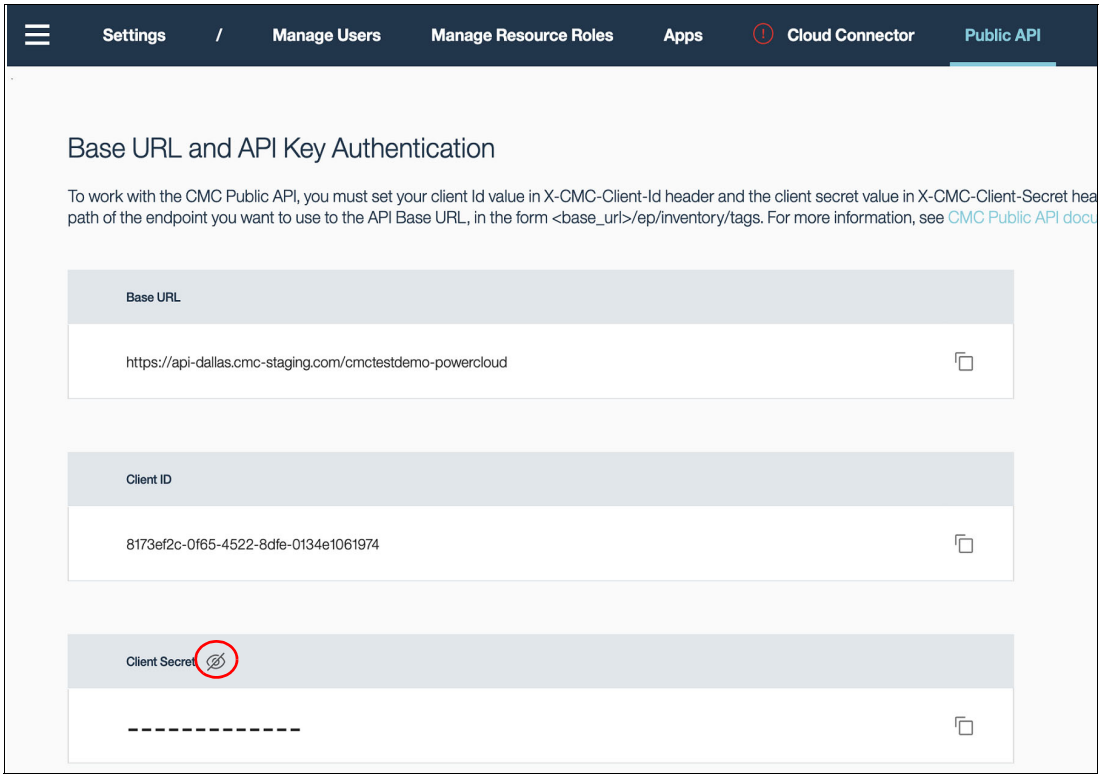

Figure 3-77 Base URL and API Key Authentication

3.3.3 GET /ep/inventory/tags

The `/ep/inventory/tags` API gets information about systems and partitions that are part of an Enterprise Pool 2.0. Information that is provided for individual servers includes type and model, serial number, pool ID and pool name that the system belongs to, number of LPARs, managing HMC, installed memory and cores, and base activations and licenses of a system. For LPARs, information is provided about the LPAR state, associated system, OS type and version, processor configuration, and current memory.

You can provide an optional `tag_name`. If no `tag_name` is specified, a list of all defined tags is returned together with the information pertaining to the systems and LPARs that have the specific tag.

Example 3-8 shows the API that returns all Enterprise Pool information for the specified IBM CMC instance.

Example 3-8 ep/inventory/tags

```
curl -s --write-out "\nAPI Status Code:%{http_code}"
https://api-dallas.cmc-staging.com/cmctestdemo-powercloud/v1/ep/inventory/tags
-H "X-CMC-Client-Id:8763ab2c-560f-4522-8dfe-0134e0123454"
-H "X-CMC-Client-Secret:a1234567-abcd-123c-efgh-1234abcd5678"
```

The API in Example 3-9 returns information for servers and LPARs that are tagged with `Redbooks_Systems`.

Example 3-9 ep/inventory/tags for specific tag

```
curl -s --write-out "\nAPI Status Code:%{http_code}"
https://api-dallas.cmc-staging.com/cmctestdemo-powercloud/v1/ep/inventory/tags/Red
Book_Systems
-H "X-CMC-Client-Id:8763ab2c-560f-4522-8dfe-0134e0123454"
-H "X-CMC-Client-Secret:a1234567-abcd-123c-efgh-1234abcd5678"
```

Example 3-10 provides a sample output from the `ep/inventory/tags` API where the specified tag contains one server and no LPAR.

Example 3-10 Output from ep/inventory/tags on server basis


```
{
   "Tags":[
      {
         "ID":"tag_Redbook_Systems_1623872846525",
         "Name":"RedBook_Systems",
         "Systems":[
            {
               "UUID":"123456ef-abcd-3333-aaaa-ed6c58df5f51",
               "MTMS":{
                  "MachineType":"9009",
                  "Model":"22G",
                  "SerialNumber":"7843210"
               },
               "Name":"P9-S922-amber",
               "State":"operating",
               "PoolID":"0014",
               "PoolName":"RedBook",
               "BaseCores":{
                  "BaseAnyOSCores":1,
                  "BaseRHELCoreOSCores":0,
                  "BaseSLESCores":0,
                  "BaseAIXCores":1,
                  "BaseIBMiCores":0,
                  "BaseLinuxVIOSCores":0
               },
               "BaseMemory":256,
               "ProcessorConfiguration":{
                  "AvailableProcessorUnits":5.65,
                  "InstalledProcessorUnits":16
               },
               "MemoryConfiguration":{
                  "AvailableMemory":184.25,
                  "InstalledMemory":256,
                  "MemoryUsedByHypervisor":10.25
               },
               "PartitionCount":15,
               "ManagingHMCs":[
                  {
                     "HmcName":"hmc16.com",
                     "State":"Active"
```

```
                },
                {
                   "HmcName":"hmc15.com",
                   "State":"Active"
                }
             ]
          },
       ],
       "Partitions":[

       ]
    }
 ]
}
```

Example 3-11 provides output from `ep/inventory/tags` where the specified tag contained two LPARs.

Example 3-11 Output from ep/inventory/tags on LPAR basis

```
{
   "Tags":[
      {
         "ID":"tag_RedBook_LPARs_1629901236646",
         "Name":"RedBook_LPARs",
         "Systems":[

         ],
         "Partitions":[
            {
               "UUID":"058B78BC-1234-4711-8E60-A4807495C5AA",
               "ID":"10",
               "Name":"vm228",
               "State":"running",
               "AssociatedSystemUUID":"123456ef-abcd-3333-aaaa-ed6c58df5f51",
               "OSType":"AIX",
               "OSVersion":"AIX 7.2 7200-04-02-2028",
               "ProcessorConfiguration":{
                  "ProcessorMode":"dedicated",
                  "CurrentProcessors":"1"
               },
               "CurrentMemory":"2048"
            },
            {
               "UUID":"6AA1A3FC-1A6D-4188-981D-193C32BDE102",
               "ID":"18",
               "Name":"vm226",
               "State":"running",
               "AssociatedSystemUUID":"123456ef-abcd-3333-aaaa-ed6c58df5f51",
               "OSType":"AIX",
               "OSVersion":"AIX 7.2 7200-04-02-2028",
               "ProcessorConfiguration":{
                  "ProcessorMode":"shared",
                  "AllocatedVirtualProcessors":2,
                  "CurrentProcessingUnits":1
```

```
            },
            "CurrentMemory":"2048"
         },
      ]
   }
]
}
```

3.3.4 GET /ep/usage/pools

The `ep/usage/pools` API provides usage information on a pool basis. Information that is provided includes pool ID, pool name, current remaining credit balance, overall core usage, metered core usage, metered credits for core usage, overall memory usage, metered memory usage, metered credits for memory usage, and usage data for the individual selected intervals.

The `pool_name` is an optional parameter. If no `pool_name` is specified, a list of all defined pools is returned together with the information pertaining to the individual pools. In addition, `StartTS` (start time in format yyyy-MM-ddTHH:mm:ssZ), `EndTS` (end time in format yyyy-MM-ddTHH:mm:ssZ) and `Frequency` (Hourly, Daily, Weekly, or Monthly) must be provided.

The following maximum ranges of data can be queried:

- 168 hours
- 180 days
- 108 weeks
- 120 months

Example 3-12 shows an API that queries the IBM CMC for pool usage data for pool IBMRedbooksPool with an hourly frequency for the time interval August 26th, 2021 - 00:00:00 to August 26th, 2021 - 01:00:00.

Example 3-12 ep/usage/pools

```
curl -s --write-out "\nAPI Status Code:%{http_code}"
"https://api-dallas.cmc-staging.com/cmctestdemo-powercloud/v1/ep/usage/pools/IBMRe
dbooksPool?
StartTS=2021-08-26T00:00:00Z&EndTS=2021-08-26T02:00:00Z&Frequency=Hourly"
-H "X-CMC-Client-Id:8763ab2c-560f-4522-8dfe-0134e0123454"
-H "X-CMC-Client-Secret:a1234567-abcd-123c-efgh-1234abcd5678"
```

Example 3-13 provides the output that is generated by this API statement. Be aware that core usage AIX, core usage IBM i, core usage Red Hat Enterprise Linux (RHEL), core usage SUSE Linux Enterprise Server, and core usage Other Linux pertain to software charges, and core usage AnyOS and core usage Linux/VIOS pertain to hardware charges.

Example 3-13 Output from ep/usage/pools

```
{
   "Pools":[
      {
         "PoolID":"0014",
         "PoolName":"IBMRedbooksPool",
         "CurrentRemainingCreditBalance":9933.917,
```

```
"Usage":{
   "CoreMinutes":{
      "AIX":1054.807,
      "IBMi":0,
      "OtherLinux":1.629,
      "RHELCoreOS":0,
      "RHEL":94.773,
      "SLES":0,
      "VIOS":38.457,
      "Total":1189.666
   },
   "CoreMeteredMinutes":{
      "AIX":694.807,
      "IBMi":0,
      "RHEL":0,
      "SLES":0,
      "LinuxVIOS":134.859,
      "AnyOS":694.807,
      "Total":1524.473
   },
   "CoreMeteredCredits":{
      "AIX":0.277,
      "IBMi":0,
      "RHEL":0,
      "SLES":0,
      "LinuxVIOS":0.067,
      "AnyOS":0.348,
      "Total":0.692
   },
   "MemoryMinutes":{
      "AIX":18000,
      "IBMi":0,
      "OtherLinux":10080,
      "RHELCoreOS":0,
      "RHEL":2880,
      "SLES":0,
      "VIOS":4320,
      "SystemOther":4005,
      "Total":43290
   },
   "MemoryMeteredMinutes":0,
   "MemoryMeteredCredits":0,
   "Frequency":"Hourly",
   "Usage":[
      {
         "StartTime":"2021-08-26T00:00:00.000Z",
         "CoreMinutes":{
            "AIX":335.932,
            "IBMi":0,
            "RHELCoreOS":0,
            "RHEL":11.488,
            "SLES":0,
            "OtherLinux":0.594,
            "VIOS":12.115,
            "Total":360.129
```

```
    },
    "CoreMeteredMinutes":{
       "AIX":215.932,
       "IBMi":0,
       "RHEL":0,
       "SLES":0,
       "LinuxVIOS":24.197,
       "AnyOS":215.932,
       "Total":456.061
    },
    "CoreMeteredCredits":{
       "AIX":0.086,
       "IBMi":0,
       "RHEL":0,
       "SLES":0,
       "LinuxVIOS":0.012,
       "AnyOS":0.108,
       "Total":0.206
    },
    "MemoryMinutes":{
       "AIX":6000,
       "IBMi":0,
       "OtherLinux":3360,
       "RHELCoreOS":0,
       "RHEL":960,
       "SLES":0,
       "VIOS":1440,
       "SystemOther":1335,
       "Total":14430
    },
    "MemoryMeteredMinutes":0,
    "MemoryMeteredCredits":0
 },
 {
    "StartTime":"2021-08-26T01:00:00.000Z",
    "CoreMinutes":{
       "AIX":345.328,
       "IBMi":0,
       "RHELCoreOS":0,
       "RHEL":11.858,
       "SLES":0,
       "OtherLinux":0.505,
       "VIOS":11.997,
       "Total":369.688
    },
    "CoreMeteredMinutes":{
       "AIX":225.328,
       "IBMi":0,
       "RHEL":0,
       "SLES":0,
       "LinuxVIOS":24.36,
       "AnyOS":225.328,
       "Total":475.016
    },
    "CoreMeteredCredits":{
```

```
                        "AIX":0.09,
                        "IBMi":0,
                        "RHEL":0,
                        "SLES":0,
                        "LinuxVIOS":0.012,
                        "AnyOS":0.113,
                        "Total":0.215
                     },
                     "MemoryMinutes":{
                        "AIX":6000,
                        "IBMi":0,
                        "OtherLinux":3360,
                        "RHELCoreOS":0,
                        "RHEL":960,
                        "SLES":0,
                        "VIOS":1440,
                        "SystemOther":1335,
                        "Total":14430
                     },
                     "MemoryMeteredMinutes":0,
                     "MemoryMeteredCredits":0
                  },
               ]
            }
         }
   ]
}
```


3.3.5 GET /ep/usage/tags

The `ep/usage/tags` API provides usage information on a tag basis. Information that is provided includes pool ID, pool name, current remaining credit balance, overall core usage, metered core usage, metered credits for core usage, overall memory usage, metered memory usage, metered credits for memory usage, and usage data detailed for the individual selected intervals.

The `tag_name` is an optional parameter. If no `pool_name` is specified, a list of all tags is returned together with the information pertaining to the servers and LPARs that have the specified tag. In addition, `StartTS` (start time in format yyyy-MM-ddTHH:mm:ssZ), `EndTS` (end time in format yyyy-MM-ddTHH:mm:ssZ) and `Frequency` (Hourly, Daily, Weekly, or Monthly) must be provided.

The following maximum ranges of data can be queried:

- 168 hours
- 180 days
- 108 weeks
- 120 months

Example 3-14 shows an API that queries the IBM CMC for pool usage data for servers or LPARs that are tagged with `Redbook_LPARs` with an hourly frequency for the time interval August 26th, 2021 - 00:00:00 to August 26th, 2021 - 01:00:00.

Example 3-14 ep/usage/tags

```
curl -s --write-out "\nAPI Status Code:%{http_code}"
"https://api-dallas.cmc-staging.com/cmctestdemo-powercloud/v1/ep/usage/tags/RedBoo
k_LPARs?
StartTS=2021-08-26T00:00:00Z&EndTS=2021-08-26T02:00:00Z&Frequency=Hourly"
-H "X-CMC-Client-Id:8763ab2c-560f-4522-8dfe-0134e0123454"
-H "X-CMC-Client-Secret:a1234567-abcd-123c-efgh-1234abcd5678"
```

Example 3-15 provides sample output from this API.

Example 3-15 ep/usage/tabs sample output

```
{
   "Tags":[
      {
         "ID":"tag_RedBook_LPARs_1629901236646",
         "Name":"RedBook_LPARs",
         "SystemsUsage":{
            "Systems":[

            ]
         },
         "PartitionsUsage":{
            "CoreMinutes":{
               "AIX":327.18399999999997,
               "Total":327.184
            },
            "MemoryMinutes":{
               "AIX":600,
               "Total":600
            },
            "Partitions":[
               {
                  "UUID":"058B78BC-2618-4111-8E60-A4807495C5AA",
                  "ID":"10",
                  "Name":"vm228",
                  "OSType":"AIX",
                  "AssociatedSystemUUID":"123456ef-abcd-3333-aaaa-ed6c58df5f51",
                  "Usage":{
                     "CoreMinutes":60,
                     "AverageCoreUsage":1,
                     "MemoryMinutes":120,
                     "AverageMemoryUsage":2,
                     "Frequency":"Hourly",
                     "Usage":[
                        {
                           "StartTime":"2021-08-26T00:00:00Z",
                           "AverageCoreUsage":1,
                           "CoreMinutes":60,
                           "AverageMemoryUsage":2,
                           "MemoryMinutes":120
```

```
                        }
                     ]
                  }
               },
               {
                  "UUID":"4EBDFF51-9A52-4CBC-8290-EA59D80C0E59",
                  "ID":"8",
                  "Name":"vm227",
                  "OSType":"AIX",
                  "AssociatedSystemUUID":"123456ef-abcd-3333-aaaa-ed6c58df5f51",
                  "Usage":{
                     "CoreMinutes":60,
                     "AverageCoreUsage":1,
                     "MemoryMinutes":120,
                     "AverageMemoryUsage":2,
                     "Frequency":"Hourly",
                     "Usage":[
                        {
                           "StartTime":"2021-08-26T00:00:00Z",
                           "AverageCoreUsage":1,
                           "CoreMinutes":60,
                           "AverageMemoryUsage":2,
                           "MemoryMinutes":120
                        }
                     ]
                  }
               },
            ]
         }
      }
   ]
}
```


For code examples about how to use these APIs together with Python code, see this GitHub repository.

4

Migrating Power Enterprise Pools from Version 1.0 to Version 2.0

Power Enterprise Pools (PEP) 2.0 can be implemented on:

- Newly purchased servers
- Existing servers

Servers, whether existing or new, must satisfy all the requirements before implementing PEP 2.0. The supported systems and the requirements are described in 2.1, “Requirements for Power Enterprise Pools 2.0” on page 32.

There are different scenarios for existing systems to be moved to PEP 2.0:

- Existing IBM Power10 or IBM POWER9 processor-based servers with only static activations.
- Existing IBM Power E1080 (Power E1080) or IBM Power E980 (Power E980) servers in a PEP 1.0 configuration that have a mix of static and mobile activations.
- Existing IBM Power E880 (Power E880) servers that are in a PEP 1.0 configuration and have a mix of static and mobile activations.

This chapter describes the steps for moving from PEP 1.0 to 2.0. It also describes the different scenarios and aspects to be considered when moving existing systems to PEP 2.0. Your specific migration might include extra steps like hardware upgrades from IBM POWER8 processor-based systems to POWER9 processor-based systems.

Attention: Do not take these lists as a complete migration cookbook, but more as a list of activities that you should plan for while migrating from PEP 1.0 to 2.0. Also, consider getting support from an IBM Business Partner or IBM Systems Lab Services when planning and implementing the migration.

4.1 Moving to Power Enterprise Pools 2.0

Migrating from PEP 1.0 to 2.0 requires careful planning and execution. This section describes some of the considerations and steps that are required for the migration.

4.1.1 Prerequisites

If you operate an environment with PEP 1.0 and use mobile resources to accommodate your changing workload needs, then the process of migrating that live environment to PEP 2.0 with base and metered capacity requires careful planning. The primary challenge here is that a system cannot be part of multiple pools concurrently. Also, a server with assigned mobile activations cannot be taken out of a PEP 1.0 until those mobile activations are taken off the server and returned back to the pool. After a server is removed from a PEP 1.0, it has access only to its static resources.

There are a few prerequisites that you should check before performing the actual migration:

- Make sure that you sign the license supplement that is described in 2.3, “Contracts, terms, and conditions” on page 40.
- Make sure that your environment meets the requirements that are described in 2.1, “Requirements for Power Enterprise Pools 2.0” on page 32. Pay special attention to the firmware (FW) levels and the required settings on the Hardware Management Console (HMC), such as active Domain Name System (DNS), Network Time Protocol (NTP), and Performance Data Collection.
- Make sure that you purchase credits and that they show up in the IBM Entitled Systems Support website.
- Make sure that you have access to your IBM Cloud Management Console (IBM CMC) environment.
- Make sure that the upgrade order that places your system in a Shared Utility Capacity pool (Feature Code #EP20) is marked as Installed.
- Connect your HMCs to IBM CMC, as described in 3.1, “Configuration” on page 74.
- Establish a Pool ID on the IBM Entitled Systems Support website, as described in 3.1, “Configuration” on page 74.
- To remove an old pool, you must submit a change request form and get a new XML file from IBM.
- You must sign the IBM License Supplement for PEP Addendum (the document that states which systems are part of a specific PEP 1.0) to remove the system from the old pool. Send this document to `pcod@us.ibm.com`. This action generates a new XML file for your existing pool that can be downloaded from IBM Systems Support: Power Enterprise Pools.

Downtime considerations

After these prerequisites are met, the main question is: “Do you have downtime that is available to perform the move from PEP 1.0 to 2.0”? If the answer to this question is “yes”, then to perform the migration, complete the following steps:

1. When you are ready for downtime, stop your workloads and return all mobile resources from the system that you want to take out of the old pool. A system cannot be removed from a PEP 1.0 if it still has mobile resources that are assigned.
2. Remove the system from the old pool by downloading the new XML file that you requested and updating the existing pool with this new XML file.
3. Repeat steps 1 and 2 for each system.

4. Using IBM CMC, start your new pool with the first system that you want to add.
5. Add the systems that you removed from your PEP 1.0.
6. Restart your workloads.

If you have no available downtime, consider using Live Partition Mobility (LPM) to evacuate all workloads by using mobile activations from a system that is part of a PEP 1.0 by completing the following steps:

1. Use LPM to remove all workloads from a server that is using mobile activations. The workload remaining on the server should be able to run with only the static activations of the server.
2. Return all mobile resources from the servers to the old pool.
3. Remove the systems from the old pool by downloading the new XML file that you requested and updating the existing pool with this new XML file.
4. Using IBM CMC, start your new pool with the first system that you want to add.
5. After the system is operating successfully in the new Shared Utility Capacity Pool, you can move workloads back to that server by using LPM.
6. For all subsequent systems that you want to migrate from PEP 1.0 to Shared Utility Capacity Pool, complete steps 1 - 5.

4.1.2 Removing a system from Power Enterprise Pools 1.0

To move a system from PEP 1.0 to 2.0, the system must first be removed from the PEP 1.0 configuration by completing the following steps:

1. Clients must work with their IBM representative or IBM Business Partner to complete a form to remove systems from PEP 1.0. This form is processed by IBM Power Systems Capacity on Demand (CoD) Project Office, which generates a new XML file.

   Tip: You must request only one XML file to remove all servers from the pool. You can still remove them one at a time because when the XML file is used to update the pool, only servers with no mobile resources are removed.

2. Deallocate the mobile resources from the system.

   If mobile resources are in use, they must be freed by migrating the workloads that are using these resources to other available systems or by shutting them down. The workloads can be moved to other systems by using LPM online or offline, if it is enabled.

3. Apply this XML file on the PEP 1.0 controller HMC to remove the system from the pool.

   Note: Removing a system from a PEP 1.0 or deleting a pool requires careful planning and implementation. If you need assistance, contact IBM Systems Lab Services or your IBM representative.

   Tip: Depending on the configuration, IBM might be able to provide a method to replace mobile activations with Exception Trial CoD codes. IBM Systems Lab Services designed a study for replacing in-use mobile activations with Exception Trial CoD codes by using a customer tailored *runbook*. If you need assistance, contact your IBM representative.

4.1.3 Feature code upgrades for systems

Only Power10 and POWER9 processor-based systems are supported in PEP 2.0. To move an existing system to a PEP 2.0, you must issue an upgrade order to apply feature code conversions to the existing system.

Power10 or POWER9 processor-based systems

If the existing system is a POWER9 or Power10 processor-based system, the upgrade order should include the following actions:

1. Add Feature Code #EP20 to the configuration.

   Convert Feature Code #EB35 to #EP20 (zero priced) for the system if the existing system is in PEP 1.0.

2. Convert some (or all) activations (static/mobile) to base activations.

   The quantity of base activations to be ordered depends on the sizing and solution.

   Important: If you decide to convert only part of your static/mobile activations to base activations, the rest of the activations are forfeited.

3. Order Capacity Credits, which are required for creating PEP 2.0.

   Capacity Credits can be ordered through the upgrade process or the IBM Entitled Systems Support website (in countries where the website is available. For more information about IBM Entitled Systems Support, see 2.6.2, “Capacity Credits” on page 64.

4. Order an IBM CMC subscription.

   IBM CMC is a prerequisite for implementing PEP 2.0.

These steps do not involve any physical supplies and installation.

For more information about the ordering process, base activation feature codes, and base activations that are converted from static/mobile, see 2.6, “Ordering process” on page 59.

POWER8 processor-based systems

If the existing system is a POWER8 processor-based system, then the upgrade order involves a model upgrade to a POWER9 processor-based system, which also requires all the steps in “Power10 or POWER9 processor-based systems”.

Because this upgrade is a model upgrade, planning for the physical installation must be done for the move to PEP 2.0.

Note: After the upgrade order is installed, the installation status should be reflected in the IBM Entitled Systems Support portal before you start creating the Pool ID or adding the system to a PEP 2.0.

4.1.4 IBM i license transfer considerations with Power Enterprise Pools 2.0

It is possible to order transfer of IBM i licenses from old systems to new systems. When an IBM i license transfer is ordered, the entitlements are marked as “Parked” in the IBM inventory. The customer must remove workload from the old system, install a new key for the reduced number of IBM i licenses (normally zero) on the donor system (which is not possible if the transferred licenses are still in use by active logical partitions (LPARs)), and provide proof of this installation to the IBM License Key Center before the transferred licenses are associated with the new system and a license key is generated for the system receiving the transferred licenses. If new systems are planned to be configured with IBM Power Systems Private Cloud with Shared Utility Capacity, IBM i license transfers should be planned.

By design, IBM CMC reads the configuration and entitlements of each pool member from IBM Entitled Systems Support inventory at the time of adding the system to the pool, automatically every 24 hours, and when the Refresh Capacity button is clicked in the Enterprise Pools 2.0 application. If the IBM i license transfer process is not complete, then IBM CMC does not reflect those IBM i licenses in the pool's base capacity. If the customer starts using IBM i workloads on a Pools 2.0 member system before the transfers are complete, IBM CMC must charge the usage to Capacity Credits. This charging will continue until the transfers are completed and either the daily automatic update runs or the customer clicks Refresh Capacity to update the pool's base capacity with the transferred licenses.

When an IBM i license transfer is requested, the customer might want to use one of the following methods before using IBM i workloads on the new hardware:

- Complete the IBM i license transfer process before adding the new system to the pool. This option might be challenging if the new systems are configured with a limited number of processor activations.
- If the target system is already added to a PEP 2.0, it means all of the physical hardware is already activated. It is possible to carry on with IBM i license transfers while a system is in the pool, but by the design of this process, IBM i partitions will need to be activated on the target system before licenses are registered against the target system in the IBM ESS inventory. This may lead to unnecessary Capacity Credit consumption during this process until the IBM i license transfer process is completed and the licenses are reflected on CMC. To eliminate unnecessary Capacity Credit consumption, as a temporary solution, the system can be taken out of the Enterprise Pool 2.0 (grace period is 30 days) to start migrating IBM i workloads and completing the transfer process. When the system is added back to the pool, IBM CMC reads the latest configuration and entitlements from IBM Entitled Systems Support databases.

4.2 Migration scenarios

This section provides two examples of migration scenarios to PEP 2.0.

4.2.1 Scenario 1: From Power Enterprise Pools 1.0 with POWER9 or Power10 processor-based systems

To move to a PEP 2.0, complete the following steps:

1. Issue an upgrade order to the existing system, as described in 4.1.3, “Feature code upgrades for systems” on page 138.
2. Review the system and HMC FW requirements for PEP 2.0. Plan for the necessary FW updates or upgrades.

3. The upgrade order for the system should be marked as “Installed” at the IBM Entitled Systems Support website. Verify that the portal shows Feature Code #EP20 against the system serial number.
4. Create a Pool ID on the IBM Entitled Systems Support website. This step requires that the upgrade order on this system is complete and marked in the IBM Entitled Systems Support as “Installed”.
5. Complete the IBM CMC activation.
6. Configure DNS for all HMCs.
7. Configure NTP for all HMCs.
8. Enable Performance and Capacity Monitoring (PCM) data collection for the systems.
9. Configure Cloud Connector on the HMCs.
10. Remove the system from PEP 1.0, as described in 4.1.2, “Removing a system from Power Enterprise Pools 1.0” on page 137. If you need assistance with removing the system from a PEP 1.0, contact your IBM representative.
11. Create a Power Enterprise Pool 2.0 on IBM CMC.

4.2.2 Scenario 2: From Power Enterprise Pools 1.0 with POWER9 and POWER8 processor-based systems

In this scenario, POWER8 processor-based systems must be upgraded to POWER9 processor-based systems to be added to a PEP 2.0. During this upgrade, POWER8 processor-based systems might need to be powered off for physical upgrade installations (unless you use the side-by-side migration method).

Attention: Only two consecutive generations of Power servers are supported in the same PEP 1.0, so Power E1080 servers can be mixed only with Power E980 servers. Power E1080 and Power E880 servers cannot be in the same pool. Therefore, any Power E880 servers must be upgraded to Power E980 or taken out of the pool before adding Power E1080 servers.

PEP 2.0 can be created by using the existing POWER9 processor-based systems, and then the other systems can be added to the pool. Alternatively, clients can wait for hardware upgrades of POWER8 processor-based systems to POWER9 processor-based systems to complete, and then they can create a PEP 2.0 by using all the systems. In these cases, clients might need to consider whether they can afford to shut down some workloads during physical installations or whether their infrastructure and workloads support LPM of workloads.

To move to a PEP 2.0, complete the following steps:

1. Issue a hardware upgrade order:
   a. For a POWER8 processor-based system:
      i. Upgrade from the POWER8 processor-based system to the POWER9 processor-based system.
      ii. Convert Feature Code #EB35 to Feature Code #EP20 (zero priced) for each system.
   b. For a POWER9 processor-based system, issue an upgrade order to the existing system, as described in 4.1.3, “Feature code upgrades for systems” on page 138.
2. Review the system and HMC FW requirements for the PEP 2.0. Plan for any necessary FW updates or upgrades.

3. The upgrade order for the system should be marked as “Installed” in the IBM Entitled Systems Support website. Verify that the portal shows Feature Code #EP20 against the system serial number.
4. Create a Pool ID on the IBM Entitled Systems Support website. This step requires that the upgrade order on this system is complete and marked in the IBM Entitled Systems Support as “Installed”.
5. Complete the IBM CMC activation.
6. Configure DNS for all HMCs.
7. Configure NTP for all HMCs.
8. Enable PCM data collection for the systems.
9. Configure Cloud Connector on the HMCs.
10. Remove the system from PEP 1.0, as described in 4.1.2, “Removing a system from Power Enterprise Pools 1.0” on page 137. If you need assistance removing the system from a PEP 1.0, contact your IBM representative.
11. Create a PEP 2.0 on IBM CMC.

4.2.3 Scenario 3: Power Enterprise Pools 1.0 with Power E980 to Power Enterprise Pools 2.0 with Power E1080 servers

In this scenario, a PEP 1.0 consisting of Power E980 servers is migrated to PEP 2.0 consisting of Power E1080 servers. A machine type and model upgrade from Power E980 to Power E1080 servers is not supported. Therefore, customers have two possible migration paths from Power E980 servers to Power E1080 servers:

- Option 1: Convert the pool first and then add Power E1080 servers to PEP 2.0.
- Option 2: Add a Power E1080 server to PEP1.0 first and then convert the pool to PEP2.0.

Further details of each migration path are listed in the following sections.

Option 1: Convert the pool first

1. Convert the PEP 1.0 to PEP 2.0 by using that steps that are provided in 4.2.1, “Scenario 1: From Power Enterprise Pools 1.0 with POWER9 or Power10 processor-based systems” on page 139.
2. Order new Power E1080 systems with base activations.
3. Add Power E1080 servers to an existing PEP 2.0 pool.
4. Migrate workloads from Power E980 servers to Power E1080 servers.
5. Transfer base activations of Power E980 servers to Power E1080 servers by using the IBM Entitled Systems Support self-service portal. For every base activation that is purchased for Power E1080 servers, IBM allows transferring three base activations from Power E980 servers with no charge.
6. Remove Power E980 servers from the pool and decommission it.

Option 2: Add a Power E1080 server to PEP 1.0 first

1. Order new Power E1080 servers with Mobile activations and features.
2. Add Power E1080 servers to the existing PEP 1.0 pool (by using a new XML file).
3. Migrate workloads from Power E980 servers to Power E1080 servers while moving mobile activations from Power E980 servers to Power E1080 servers.

4. Transfer Mobile activations of Power E980 servers to Power E1080 servers by using the IBM Entitled Systems Support self-service portal. IBM allows 1:1 Mobile activation transfers between Power E980 and E1080 servers.
5. Remove Power E980 servers from the PEP 1.0 pool (by using a new XML file).
6. Convert the pool from PEP 1.0 to PEP 2.0 by using the steps that are provided in 4.2.1, “Scenario 1: From Power Enterprise Pools 1.0 with POWER9 or Power10 processor-based systems” on page 139.

5

Use cases and sizing examples

This chapter provides some ideas for general use cases for IBM Power Systems Private Cloud with Shared Utility Capacity. In addition, there is a section that shows some real-world sizing examples that use the IBM Systems Lab Services Private Cloud Capacity Assessment (PCCA) feature Capacity Planning Tool - Metered Capacity Modeling (CPT-MCM). That section shows an overview about how sizing without using Shared Utility Capacity would have looked and how the sizing changes when using Shared Utility Capacity.

5.1 Use cases for Power Enterprise Pools 2.0

Power Enterprise Pools (PEP) 2.0 provides increased flexibility and simplifies the operation of a private cloud that is based on IBM Power servers. The customer can rely on similar flexibility while using public cloud providers.

For customers who want an operating expenses (OpEx)-like payment solution, IBM Power Systems Private Cloud with Shared Utility Capacity offers low total cost of acquisition (TCA) with the ability to pre-pay for usage above the initially acquired base capacity. With all cores and memory activated, you do not have to make a “reservation” for resources that you probably need like in a public cloud environment. With metered capacity, you can use the available resources if and when you need them and pay only for what you used. The minimal base and prepaid offering comes with no commitment after the initial purchase.

Another use case is peak processing capacity for busy workloads or workload patterns where it is difficult to exactly predict resource requirements, for example, short spikes in your workload like end of day processing or special promotions in a web shop where buyer behavior cannot be predicted. Instead of sizing your system for the expected peak performance, you can size systems for average workload and use metered capacity to cover workload spikes.

In high availability (HA) or disaster recovery (DR) environments, you can purchase multiple systems for redundancy and failover. With Shared Utility Capacity, 100% of core and memory resources are active on your HA and DR systems. There is no need to plan for reduced capacity in a failure, and the cost for usage is debited only if resource usage is above the pool’s base capacity.

Figure 5-1 shows potential use cases where PEP 2.0 technology can be applied.

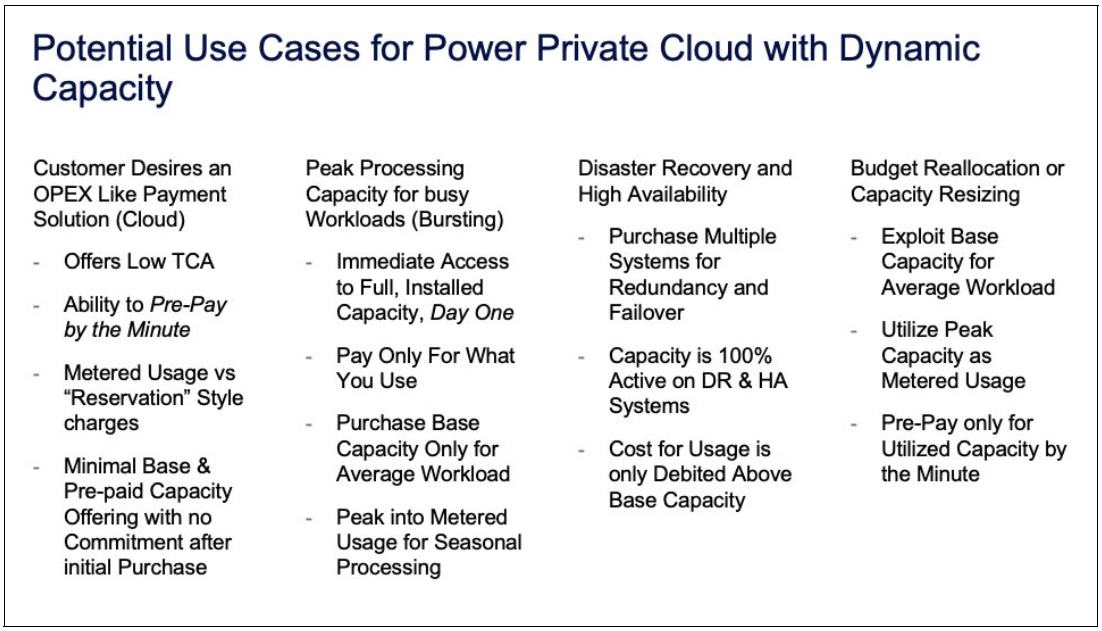

Figure 5-1 Power Enterprise Pools 2.0: Potential use cases

5.2 IBM Systems Lab Services sizing support

This section gives you a brief overview of the IBM Systems Lab Services PCCA offering.

5.2.1 Offering overview

In PEP 2.0, CPU resources are monitored by IBM Cloud Management Console (IBM CMC), which automatically tracks usage by the minute. Consumption above base activations is debited against Capacity Credits based on actual usage. Because base activations and Capacity Credits have different costs, estimating an optimal number of base activations for a PEP 2.0 pool is important for maximizing the cost efficiency of resource sharing.

IBM Systems Lab Services developed a set of Capacity Planning Tools (CPTs) to analyze workload utilization characteristics. CPT-MCM is one of the tools that is used in a PCCA analysis. A PCCA analysis provides results with estimated number of base activations for a set of candidate workloads of a PEP 2.0 configuration by using a CPU utilization information analysis. It also provides estimated number of Capacity Credits for the specified duration of time.

This analysis requires a detailed minute-based processor utilization data from all of the candidate systems in the scope. This data can be the **`lparutil`** data to be collected by the Hardware Management Console (HMC). If the systems are already connected to IBM CMC and Performance and Capacity Monitoring (PCM) is enabled, then it might be possible to export data from IBM CMC and work with it. It also might be possible to extract up to 60 days of usable 1-minute utilization data from an LPAR2RRD server.

Note: Because the projections are made based on the provided data, it is a best practice to provide long periods of data for analysis.

PCCA runs an analysis of the provided minute-based CPU utilization data and aggregates it; makes an rPerf conversion from existing systems to a specified target architecture; incorporates available pricing information for the target architecture; and generates a short report that compares processor activation costs:

- Static licensing model: Minimum number of required cores (without any pooling)
- PEP 1.0 Model: Peak value of aggregated CPU utilization across candidate workloads
- PEP 2.0 Model: Estimated optimal number of base activations for PEP 2.0 and required number of Capacity Credits for specified duration

A PCCA study can be requested from IBM System Lab Services before, during, or after a new system procurement. Eligible clients in the IBM Power to Cloud Rewards program can access this study by choosing the **IBM Power Systems Private Cloud with Shared Utility Capacity** option. When Feature Code #EP2X is included in a new purchase order for eligible systems, a PCCA analysis is offered to the clients. At the time of writing, Feature Code #EP2X is available for IBM Power E1080, IBM Power E980, and IBM Power E950 servers. Systems that are ordered with Feature Code #EP2X are eligible to receive up to 60 days of Trial Capacity as part of the Private Cloud Capacity Assessment.

5.2.2 Using lparutil data collection

Utilization data collection for managed systems is not automatically enabled. The **chlparutil** command on the HMC CLI can be used to enable utilization data collection and configure the sample rate. Once utilization data collection is enabled, the HMC fetches the utilization data from the POWER Hypervisor and retains it on the HMC only for 24 - 48 hours, which is why the collected data must be exported and saved before it is deleted from the HMC. IBM Systems Lab Services can provide a small **crontab** script to export this data from HMCs every night.

If **lparutil** data collection is not enabled, run the following command against every managed system to enable data collection:

```
chlparutil -r config -m <CECname> -s 60
```

Some clients already might have enabled utilization data collection and might be using a tool that is called *LPAR2RRD* to regularly export this data. If so, it might be possible to extract up to 2 months of usable historical **lparutil** data from this tool. For more information, contact IBM Systems Lab Services.

Important: It is crucial to have Network Time Protocol (NTP) configured on every HMC to align the utilization data and make a proper analysis.

5.2.3 Outcome examples

This section shows a couple of examples of an IBM Systems Lab Services PCCA study output. The results of these analyses clearly exhibit the cost efficiency of a PEP 2.0 configuration against static and PEP 1.0 licensing models for various configurations and input parameters.

Example 1: AIX Cloud Edition with 5 years of ownership

Example 5-1 shows an analysis output for a set of input parameters and **lparutil** data. In step 5 in the example, you can find the total number of static cores that is required in a worst case scenario, and the aggregated peak utilization across systems that might be used as input for a PEP 1.0 pool. Finally, at the bottom, you see that a total of 97 base activations are estimated to be the optimal value for a PEP 2.0 configuration that is based on the **lparutil** data and input parameters.

Example 5-1 Output of CPT-MCM for Example 1

```
turgut@systemslab perl % ./cptmcm.pl --country=GB --months=60 --AIX=AIXCE
--cec=EFP1

Step 1: Process feature data ...

Target CECs selected: EFP1

   Reading HW prices for United Kingdom: [******] 100%
   Reading SW prices for United Kingdom: [***************] 100%

Step 2: Process server config file and retrieve rPerf information...

   Target Server CEC: EFP1 MTM: 9080-M9S rPerfPerCore: 28.44

   POOL: Client_AIX_POOL
```

```
      Source Server: dc1-p8-E870-01 MTM: 9119-MME rPerfPerCore: 21.40
      Source Server: dc2-p8-E870-01 MTM: 9119-MME rPerfPerCore: 21.40
      Source Server: dc1-p8-E870-02 MTM: 9119-MME rPerfPerCore: 21.40
      Source Server: dc2-p8-E870-03 MTM: 9119-MME rPerfPerCore: 21.40
      Source Server: dc1-p8-E870-03 MTM: 9119-MME rPerfPerCore: 21.40
      Source Server: dc2-p8-E870-02 MTM: 9119-MME rPerfPerCore: 21.40

Step 3: Process server xml pool data - find overlapping start and stop
times.........done.

      Latest Start Time: 1590393780 25/05/2020 08:03:00
      Earliest End Time: 1595577720 24/07/2020 08:02:00

Step 4: Process server xml pool data - store physC data...

   POOL: Client_AIX_POOL
      Processing server dc1-p8-E870-01
      Processing server dc1-p8-E870-02
      Processing server dc1-p8-E870-03
      Processing server dc2-p8-E870-01
      Processing server dc2-p8-E870-02
      Processing server dc2-p8-E870-03

Step 5: Calculate per minute usage...

   POOL: Client_AIX_POOL
       dc1-p8-E870-01  (peak= 66.44/69) rPerfPerCore=21.40 peak rPerf=1421.816
       dc1-p8-E870-02  (peak= 70.56/73) rPerfPerCore=21.40 peak rPerf=1509.984
       dc1-p8-E870-03  (peak= 56.76/62) rPerfPerCore=21.40 peak rPerf=1214.664
       dc2-p8-E870-01  (peak= 37.40/40) rPerfPerCore=21.40 peak rPerf=800.36
       dc2-p8-E870-02  (peak= 42.61/46) rPerfPerCore=21.40 peak rPerf=911.854
       dc2-p8-E870-03  (peak= 34.50/45) rPerfPerCore=21.40 peak rPerf=738.3

   Worst case rPerf total  = 6,597 (this value assumes no pooling or optimization
through server consolidation)

        232 cores, EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc (28.44
rPerf per core) £8,248/1 core Proc Act for #EFP1  £1,913,536

   Peak minute rPerf total = 4,945 (21/07/2020 23:25:00) Best case is perfectly
managed pool to this peak.

        174 cores, EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc (28.44
rPerf per core) £11,547/1 core mob-enab Proc Act for #EFP1/#EFP5 £1,722,182 -
£1,951,806


Step 6: Calculate systems software annual charges...

Retrieving System Software Prices for in-scope Software:
Displaying and Calculating System Software Per-Core-Per-Minute Charges:

  -->  24x7 support elected
  -->  60 months owned
```

```
   PowerVM -    version chosen: PVMEE (PowerVM Enterprise Edition)
       AIX -    version chosen: AIXCE (AIX Cloud Edition)
      IBM i -    version chosen: NONE (Not Used by Customer)
   PowerHA -    version chosen: NONE (Not Used by Customer)
   PowerVC -    version chosen: NONE (Not Used by Customer)

      +----------------------------------------+
      +     SYSTEM SOFTWARE PER CORE PRICES    + (based on 60 months owned)
      +       POOL Client_AIX_POOL CEC: EFP1   +
      +--------.----------.----------.----------+
      |  Per-  |      BASE|  STATIC  |  MOBILE  |
      +--------+----------+----------+----------+
      +  Year  |  1552.00 |  1552.00 |  1552.00 |
      +--------+----------+----------+----------+
      + Minute | 0.002951 | 0.002951 | 0.002951 | (525960 minutes in a year)
      +--------+----------+----------+----------+

Possible configurations:

   POOL: Client_AIX_POOL

   EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc:

      Minimum 6 32-core CECs, 192 installed cores, peaking to 174.


      60-month cost per static core = £8248 (activation) + £1552.00 SW cost
annually*5 years

      60-month cost per typical PEP1.0 core (10% static, 90% mobile) = £11217.28
(activation) + £1552.00 SW cost annually*5 years

      60-month cost per base core = £13198.45 (activation) + £1552.00 SW cost
annually*5 years

      1 Capacity Credit = £364.39, utility price per minute: £0.0304

+--------+-------------+-------------+-------------+-------------+-------------+
|  Base  |    60  M O N T H   A C T I V A T I O N  C O S T S    (GB / £GBP ) |
| Procs  | 100% static | pep1.0 ideal|        base |   utility   |  base+util  |
+--------+-------------+-------------+-------------+-------------+-------------+
|     1  | £ 3,713,856 | £ 3,302,046 | £    20,958 | £ 6,958,971 | £ 6,979,929 |
|    50  | £ 3,713,856 | £ 3,302,046 | £ 1,047,922 | £ 3,041,658 | £ 4,089,580 |
|    90  | £ 3,713,856 | £ 3,302,046 | £ 1,886,260 | £   549,786 | £ 2,436,046 |
|    91  | £ 3,713,856 | £ 3,302,046 | £ 1,907,218 | £   519,733 | £ 2,426,951 |
|    92  | £ 3,713,856 | £ 3,302,046 | £ 1,928,177 | £   491,196 | £ 2,419,373 |
|    93  | £ 3,713,856 | £ 3,302,046 | £ 1,949,135 | £   464,131 | £ 2,413,266 |
|    94  | £ 3,713,856 | £ 3,302,046 | £ 1,970,094 | £   438,495 | £ 2,408,589 |
|    95  | £ 3,713,856 | £ 3,302,046 | £ 1,991,052 | £   414,256 | £ 2,405,308 |
|    96  | £ 3,713,856 | £ 3,302,046 | £ 2,012,011 | £   391,340 | £ 2,403,351 |
+--------+-------------+-------------+-------------+-------------+-------------+
|    97  | £ 3,713,856 | £ 3,302,046 | £ 2,032,969 | £   369,750 | £ 2,402,719 |
+--------+-------------+-------------+-------------+-------------+-------------+
|    98  | £ 3,713,856 | £ 3,302,046 | £ 2,053,928 | £   349,384 | £ 2,403,312 |
|    99  | £ 3,713,856 | £ 3,302,046 | £ 2,074,886 | £   330,140 | £ 2,405,026 |
```

```
|   100  | £ 3,713,856 | £ 3,302,046 | £ 2,095,845 | £   311,988 | £ 2,407,833 |
|   150  | £ 3,713,856 | £ 3,302,046 | £ 3,143,767 | £     5,513 | £ 3,149,280 |
+--------+-------------+-------------+-------------+-------------+-------------+
```

This analysis estimates the required number of processor activations for each licensing model and (by using the available pricing information) also calculates the associated costs at the same time for comparison. A summary of the results is provided in Table 5-1.

Table 5-1 Processor activation cost comparison for Example 1

Item	Static	PEP 1.0	PEP 2.0
Activations	232	174	97 Base Activations 1015 Capacity Credits
Cost	£3,713,856	£3,302,046	£2,402,719

In this example, the static licensing model is estimated to require a minimum of 232 cores, which requires a minimum of a £3,713,856 investment for static processor activations. A PEP 1.0 configuration requires a minimum of 174 cores, which requires a £3,302,046 investment for Static and Mobile Processor Activations. More capacity requirements also must be considered for these activation models.

A PEP 2.0 configuration requires only 97 base core activations and 1015 Shared Utility Capacity Credits to cover the peaks above base activations, which requires a total of a £2,402,719 investment for 5 years, which provides a potential cost saving of £1,311,317 compared to the static activation model. Because all the installed resources are fully activated in PEP 2.0, any extra capacity requirements can be easily satisfied by using metered capacity.

Example 2: AIX Enterprise Edition with 3 years of ownership

Example 5-2 shows an analysis output for another client for a set of input parameters and their **lparutil** data. In this analysis, the target system ownership is planned for 3 years, and AIX Enterprise Edition is requested.

Example 5-2 Output of CPT-MCM for Example 2

```
turgut@systemslab perl % ./cptmcm.pl --country=DE --months=36 --AIX=AIXEE --cec=EFP1

Step 1: Process feature data ...

Target CECs selected: EFP1

   Reading HW prices for Germany: [******] 100%
   Reading SW prices for Germany: [***************] 100%

Step 2: Process server config file and retrieve rPerf information...

   Target Server CEC: EFP1 MTM: 9080-M9S rPerfPerCore: 28.44

   POOL: CustomerPOOL
      Source Server: DC1-E880-Sys1 MTM: 9119-MHE rPerfPerCore: 22.38
      Source Server: DC1-E880-Sys2 MTM: 9080-MHE rPerfPerCore: 22.38
      Source Server: DC2-E880-Sys1 MTM: 9119-MHE rPerfPerCore: 22.38
      Source Server: DC1-E880-Sys3 MTM: 9119-MHE rPerfPerCore: 22.38
      Source Server: DC2-E880-Sys2 MTM: 9119-MHE rPerfPerCore: 22.38
      Source Server: DC2-E880-Sys3 MTM: 9080-MHE rPerfPerCore: 22.38
```

Step 3: Process server xml pool data - find overlapping start and stop times.....done.

Latest Start Time: 1587047820 16/04/2020 14:37:00
Earliest End Time: 1592228040 15/06/2020 13:34:00

Step 4: Process server xml pool data - store physC data...

POOL: CustomerPOOL
Processing server DC1-E880-Sys1 (26 missing minutes)
Processing server DC1-E880-Sys2 (33 missing minutes)
Processing server DC2-E880-Sys1 (26 missing minutes)
Processing server DC1-E880-Sys3 (62 missing minutes)
Processing server DC2-E880-Sys2 (33 missing minutes)
Processing server DC2-E880-Sys3 (33 missing minutes)

Step 5: Calculate per minute usage...

POOL: CustomerPOOL
DC1-E880-Sys1 (peak= 68.61/ 72) rPerfPerCore=22.38 peak rPerf=1535.4918
DC1-E880-Sys2 (peak=165.89/172) rPerfPerCore=22.38 peak rPerf=3712.6182
DC2-E880-Sys1 (peak=123.17/220) rPerfPerCore=22.38 peak rPerf=2756.5446
DC1-E880-Sys3 (peak= 27.15/ 94) rPerfPerCore=22.38 peak rPerf=607.617
DC2-E880-Sys2 (peak=123.98/130) rPerfPerCore=22.38 peak rPerf=2774.6724
DC2-E880-Sys3 (peak=140.89/204) rPerfPerCore=22.38 peak rPerf=3153.1182

Worst case rPerf total = 14,541 (this value assumes no pooling or optimization through server consolidation)

512 cores, EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc (28.44 rPerf per core) €9,343/1 core Proc Act for #EFP1 €4,783,616

Peak minute rPerf total = 10,076 (14/05/2020 00:04:00) Best case is perfectly managed pool to this peak.

355 cores, EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc (28.44 rPerf per core) €13,080/1 core mob-enab Proc Act for #EFP1/#EFP5 €3,980,118 - €4,510,800

Step 6: Calculate systems software annual charges...

Retrieving System Software Prices for in-scope Software:
Displaying and Calculating System Software Per-Core-Per-Minute Charges:

--> 24x7 support elected
--> 36 months owned

PowerVM - version chosen: PVMEE (PowerVM Enterprise Edition)
AIX - version chosen: AIXEE (AIX Enterprise Edition)
IBM i - version chosen: NONE (Not Used by Customer)
PowerHA - version chosen: NONE (Not Used by Customer)
PowerVC - version chosen: NONE (Not Used by Customer)
CMC - needed for PEP2.0: CMCSE

SYSTEM SOFTWARE PER CORE PRICES	(based on 36 months owned)
POOL CustomerPOOL	CEC: EFP1

Per-	BASE	STATIC	MOBILE
Year	1885.13	1855.93	1855.93

```
      + Minute | 0.003584 | 0.003529 | 0.003529 | (525960 mins in a year)
      +--------+----------+----------+----------+

Possible configurations:

   POOL: CustomerPOOL

   EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc:

      Minimum 12 32-core CECs, 384 installed cores, peaking to 355.

      36-month cost per static core = €9343 (activation) + €1855.93 SW cost annually*3
years

      36-month cost per typical PEP1.0 core (10% static, 90% mobile) = €12706.48
(activation) + €1855.93 SW cost annually*3 years

      36-month cost per base core = €14950.67 (activation) + €1885.13 SW cost annually*3
years

      1 Capacity Credit = €418.18, utility price per minute: €0.0348
```

Base Procs	36 MONTH ACTIVATION COSTS (DE / ? EUR) 100% static	pep1.0 ideal	base	utility	base+util
1	€ 7,634,324	€ 6,487,365	€ .. . 20,606	€ 9,808,001	€ 9,828,607
50	€ 7,634,324	€ 6,487,365	€ 1,030,302	€ 7,117,369	€ 8,147,672
100	€ 7,634,324	€ 6,487,365	€ 2,060,605	€ 4,387,427	€ 6,448,033
150	€ 7,634,324	€ 6,487,365	€ 3,090,908	€ 2,004,186	€ 5,095,095
190	€ 7,634,324	€ 6,487,365	€ 3,915,151	€ . . 790,227	€ 4,705,378
191	€ 7,634,324	€ 6,487,365	€ 3,935,757	€ . . 768,555	€ 4,704,312
192	€ 7,634,324	€ 6,487,365	€ 3,956,363	€ .. 747,281	€ 4,703,644
193	**€ 7,634,324**	**€ 6,487,365**	**€ 3,976,969**	**€ . . 726,400**	**€ 4,703,369**
194	€ 7,634,324	€ 6,487,365	€ 3,997,575	€ . . 705,903	€ 4,703,478
195	€ 7,634,324	€ 6,487,365	€ 4,018,181	€ . . 685,775	€ 4,703,956
196	€ 7,634,324	€ 6,487,365	€ 4,038,787	€ . . 666,033	€ 4,704,820
197	€ 7,634,324	€ 6,487,365	€ 4,059,393	€ . . 646,663	€ 4,706,056
198	€ 7,634,324	€ 6,487,365	€ 4,079,999	€ . . 627,644	€ 4,707,643
199	€ 7,634,324	€ 6,487,365	€ 4,100,605	€ . . 608,985	€ 4,709,590
200	€ 7,634,324	€ 6,487,365	€ 4,121,211	€ . . 590,712	€ 4,711,924
250	€ 7,634,324	€ 6,487,365	€ 5,151,514	€ . . . 74,686	€ 5,226,200
300	€ 7,634,324	€ 6,487,365	€ 6,181,817	€ 1,745	€ 6,183,562
350	€ 7,634,324	€ 6,487,365	€ 7,212,120	€ 2	€ 7,212,122

A summary of the results is provided in Table 5-2.

Table 5-2 Processor activation cost comparison for Example 2

Item	Static	PEP 1.0	PEP 2.0
Activations	512	355	193 Base Activations 1737 Capacity Credits
Cost	€7,634,324	€6,487,365	€4,703,369

In this example, the static licensing model is estimated to require a minimum of 512 cores, which requires a minimum of a €7,634,324 investment for static processor activations. A PEP 1.0 configuration requires a minimum of 355 cores, which costs €6,487,365 for static and mobile processor activations. A PEP 2.0 configuration requires only 193 base core activations and 1737 Shared Utility Capacity Credits to cover the peaks above base activations, which costs €4,703,369 for 3 years. This scenario provides a €2,930,955 cost savings in processor activations compared to the static activation model.

Example 3: Using OS type breakdown in a mixed OS environment: AIX, Linux, and Virtual I/O Server

Example 5-3 shows an analysis output for another customer for a set of input parameters and using their **`lparutil`** data. In this analysis, we demonstrate virtual machine (VM) level aggregation across existing servers and calculate optimal number of activations for each OS type separately.

Example 5-3 Execution of CPT-MCM for Example 3

```
turgut@systemslab perl % ./cptmcm.pl --country=US --months=36 --AIX=AIXEE
--cec=EFP1
```

Figure 5-2 to Figure 5-13 on page 157 show the calculation process.

```
Step 0: Check options and apply defaults ...

Step 1: Process feature data ...

Step 2: Get feature pricing ...
        Reading HW prices for United States: [******] 100%
        Reading SW prices for United States: [***************] 100%

Step 3: Process server config file and retrieve rPerf info...

        Target Server CEC: EFP1 Desc: 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc MTM: 9080-M9S rPerfPerCore: 28.44

        POOL: E980POOL
                Source Server: MaskedMachine1 MTM: 9080-M9S rPerfPerCore: 28.44
                Source Server: MaskedMachine2 MTM: 9080-M9S rPerfPerCore: 28.44
                Source Server: MaskedMachine3 MTM: 9040-MR9 rPerfPerCore: 23.88
                Source Server: MaskedMachine4 MTM: 9080-M9S rPerfPerCore: 28.44
                Source Server: MaskedMachine5 MTM: 9080-M9S rPerfPerCore: 28.44
                Source Server: MaskedMachine6 MTM: 9080-M9S rPerfPerCore: 28.44
                Source Server: MaskedMachine7 MTM: 9080-M9S rPerfPerCore: 28.44
                Source Server: MaskedMachine8 MTM: 9080-M9S rPerfPerCore: 28.44
                Source Server: MaskedMachine9 MTM: 9080-M9S rPerfPerCore: 28.44

Step 4: Process server xml pool data - find overlapping start and stop times....+++++++++++++++.+++++++++.++++++++++++++.++++++++++++++++++.+++++++++.++++++++++++  done.


        Latest Start Time: 1623172560 06/08/2021 17:16:00
        Earliest End Time: 1628551200 07/06/2021 06:00:00
            Total Seconds: 2378640
            Total Minutes: 39644
            Total   Hours: 660
            Total    Days: 27

          Cycles per  36  Month Term: 39.80
```

Figure 5-2 Example 3: CPT-MCM Initialization sequence

```
Step 5: Process server xml pool data - store physC data...


        POOL: E980POOL

                Processing server MaskedMachine1
                        Processing include VM VM1  (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM MaskedMachine1vio1 (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM MaskedMachine1vio2 (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM VM2  (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM VM3  (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM VM4  (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM VM5  (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM VM6  (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM VM7  (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM VM8  (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM VM9  (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM VM10 (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM VM11 (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM VM12 (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)
                        Processing include VM VM13 (  1064 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 03:16:00 /    747 minutes)

                Processing server MaskedMachine2
                        Processing include VM MaskedMachine2vio1 (  1263 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 04:55:00 /    846 minutes)
                        Processing include VM MaskedMachine2vio2 (  1263 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 04:55:00 /    846 minutes)
                        Processing include VM VM14 (  1263 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 04:55:00 /    846 minutes)
                        Processing include VM VM15 (  1263 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 04:55:00 /    846 minutes)
                        Processing include VM VM16 (  1263 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 04:55:00 /    846 minutes)
                        Processing include VM VM17 (  1263 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 04:55:00 /    846 minutes)
                        Processing include VM VM18 (  1263 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 04:55:00 /    846 minutes)
                        Processing include VM VM19 (  1263 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 04:55:00 /    846 minutes)
                        Processing include VM VM20 (  1263 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 04:55:00 /    846 minutes)
                        Processing include VM VM21 (  1263 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 04:55:00 /    846 minutes)
                        Processing include VM VM22 (  1263 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 04:55:00 /    846 minutes)
                        Processing include VM VM23 (  1263 missing minutes, first  bad= 20444 longest gap = 06/23/2021 14:50:00 to 06/24/2021 04:55:00 /    846 minutes)
```

Figure 5-3 Example 3: Processing VMs

```
Step 7: Calculate per minute usage...


        POOL: E980POOL

           MaskedMachine1  (  AIX peak= 51.33/ 55 time=06/23/2021 13:31:00) rPerfPerCore=28.44 peak rPerf=1459.83808682902
           MaskedMachine1  (Linux NO ACTIVITY ON SERVER
           MaskedMachine1  ( VIOS peak=  3.30/ 55 time=06/18/2021 15:06:00) rPerfPerCore=28.44 peak rPerf=93.9938205855984

           MaskedMachine2  (  AIX peak= 52.69/130 time=07/02/2021 03:26:00) rPerfPerCore=28.44 peak rPerf=1498.54351349595
           MaskedMachine2  (Linux peak= 72.68/130 time=06/22/2021 04:59:00) rPerfPerCore=28.44 peak rPerf=2067.12972734335
           MaskedMachine2  ( VIOS peak=  2.08/130 time=06/15/2021 06:01:00) rPerfPerCore=28.44 peak rPerf=59.0705354124461

           MaskedMachine3  (  AIX peak= 18.01/ 24 time=06/30/2021 13:10:00) rPerfPerCore=23.88 peak rPerf=430.136532932257
           MaskedMachine3  (Linux NO ACTIVITY ON SERVER
           MaskedMachine3  ( VIOS peak=  4.78/ 24 time=07/05/2021 08:09:00) rPerfPerCore=23.88 peak rPerf=114.064664771379

           MaskedMachine4  (  AIX peak= 67.47/ 75 time=07/01/2021 06:01:00) rPerfPerCore=28.44 peak rPerf=1918.7290895968
           MaskedMachine4  (Linux NO ACTIVITY ON SERVER
           MaskedMachine4  ( VIOS peak=  7.73/ 75 time=07/02/2021 12:12:00) rPerfPerCore=28.44 peak rPerf=219.789261136724

           MaskedMachine5  (  AIX peak= 94.19/128 time=06/29/2021 07:01:00) rPerfPerCore=28.44 peak rPerf=2678.70703662984
           MaskedMachine5  (Linux peak=  4.86/128 time=06/28/2021 10:59:00) rPerfPerCore=28.44 peak rPerf=138.246603403524
           MaskedMachine5  ( VIOS peak=  5.14/128 time=06/13/2021 07:10:00) rPerfPerCore=28.44 peak rPerf=146.090891770468

           MaskedMachine6  (  AIX peak= 79.30/135 time=07/03/2021 13:10:00) rPerfPerCore=28.44 peak rPerf=2255.15154187388
           MaskedMachine6  (Linux peak= 29.23/135 time=06/30/2021 13:02:00) rPerfPerCore=28.44 peak rPerf=831.417378796507
           MaskedMachine6  ( VIOS peak=  6.72/135 time=06/15/2021 07:10:00) rPerfPerCore=28.44 peak rPerf=191.206063548945

           MaskedMachine7  (  AIX peak= 93.67/128 time=06/29/2021 19:09:00) rPerfPerCore=28.44 peak rPerf=2663.88628123757
           MaskedMachine7  (Linux peak= 22.66/128 time=06/16/2021 19:06:00) rPerfPerCore=28.44 peak rPerf=644.442397045808
           MaskedMachine7  ( VIOS peak=  8.03/128 time=06/29/2021 08:57:00) rPerfPerCore=28.44 peak rPerf=228.335081263363

           MaskedMachine8  (  AIX NO ACTIVITY ON SERVER
           MaskedMachine8  (Linux peak= 46.49/ 80 time=06/26/2021 07:22:00) rPerfPerCore=28.44 peak rPerf=1322.11084151239
           MaskedMachine8  ( VIOS peak=  1.76/ 80 time=06/09/2021 13:22:00) rPerfPerCore=28.44 peak rPerf=50.1329599053209

           MaskedMachine9  (  AIX NO ACTIVITY ON SERVER
           MaskedMachine9  (Linux peak= 37.69/ 80 time=06/09/2021 07:03:00) rPerfPerCore=28.44 peak rPerf=1071.90452553769
           MaskedMachine9  ( VIOS peak=  1.39/ 80 time=06/18/2021 17:56:00) rPerfPerCore=28.44 peak rPerf=39.413375697958
```

Figure 5-4 Example 3: Calculated OS utilization breakdown per machine

```
Worst case rPerf total (  AIX)  = 12,905 (this assumes no pooling or optimization via server consolidation)

         454 core(s), EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc (28.44 rPerf per core)
              * ($5,000/1 core Proc Act for #EFP1  + ($44/monthly maint per core * 36 months) ) = $ 2,989,136

Peak minute rPerf total = 12,343 (07/02/2021 07:01:00) Best case is perfectly managed pool to this peak.

         434 core(s), EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc (28.44 rPerf per core)
              * ($7,000/1 core mob-enab Proc Act for #EFP1/#EFP5 + ($50/monthly maint per core * 36 months) ) = $ 3,338,328 - $ 3,723,025


Worst case rPerf total (Linux)  = 6,076 (this assumes no pooling or optimization via server consolidation)

         214 core(s), EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc (28.44 rPerf per core)
              * ($2,000/Power Linux processor activation for #EFP1/#EFP5 + ($17/monthly maint per core * 36 months) ) = $   558,968

Peak minute rPerf total = 4,398 (06/22/2021 04:01:00) Best case is perfectly managed pool to this peak.

         155 core(s), EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc (28.44 rPerf per core)
              * ($7,000/1 core mob-enab Proc Act for #EFP1/#EFP5 + ($50/monthly maint per core * 36 months) ) = $   884,430 - $ 1,268,086


Worst case rPerf total ( VIOS)  = 1,143 (this assumes no pooling or optimization via server consolidation)

          41 core(s), EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc (28.44 rPerf per core)
              * ($2,000/Power Linux processor activation for #EFP1/#EFP5 + ($17/monthly maint per core * 36 months) ) = $   107,092

Peak minute rPerf total = 919 (06/29/2021 08:03:00) Best case is perfectly managed pool to this peak.

          33 core(s), EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc (28.44 rPerf per core)
              * ($7,000/1 core mob-enab Proc Act for #EFP1/#EFP5 + ($50/monthly maint per core * 36 months) ) = $   188,298 - $   269,979
```

Figure 5-5 Example 3: Calculated peak rPerf values and cores per OS type

```
Step 10: Get Systems Software per-minute pricing...

             ----------------------
             AIX Enterprise Edition
             ----------------------
             Per-Core License cost for 36 months: $  2320.00
             Per-Core License cost      per year: $   773.33
             Per-Core SWMA 9x5 cost   for year 1: $   580.00  (+ 24x7) $ 152.00
             Per-Core SWMA 9x5 cost   for year 2: $   580.00  (+ 24x7) $ 152.00
             Per-Core SWMA 9x5 cost   for year 3: $   580.00  (+ 24x7) $ 152.00
             Per-Core SWMA total for  36  months: $  2196.00
             Per-Core SWMA average  per one year: $   732.00
             ------------------------------------ ---------
             Per-Core Software    Total Per Year: $  1505.33

             -------------------------------------------
             Cloud Management Console (socket price / 10)
             -------------------------------------------
             Per-Core License cost for 36 months: $     0.00
             Per-Core License cost      per year: $     0.00
             Per-Core SWMA 9x5 cost   for year 1: $    24.00  (+ 24x7) $  0.00
             Per-Core SWMA 9x5 cost   for year 2: $    24.00  (+ 24x7) $  0.00
             Per-Core SWMA 9x5 cost   for year 3: $    24.00  (+ 24x7) $  0.00
             Per-Core SWMA total for  36  months: $    72.00
             Per-Core SWMA average  per one year: $    24.00
             ------------------------------------ ---------
             Per-Core Software    Total Per Year: $    24.00

             ------------------------
             PowerVM Enterprise Edition
             ------------------------
             Per-Core License cost for 36 months: $     0.00
             Per-Core License cost      per year: $     0.00
             Per-Core SWMA 9x5 cost   for year 1: $   300.00  (+ 24x7) $ 21.00
             Per-Core SWMA 9x5 cost   for year 2: $   300.00  (+ 24x7) $ 21.00
             Per-Core SWMA 9x5 cost   for year 3: $   300.00  (+ 24x7) $ 21.00
             Per-Core SWMA total for  36  months: $   963.00
             Per-Core SWMA average  per one year: $   321.00
             ------------------------------------ ---------
             Per-Core Software    Total Per Year: $   321.00
```

Figure 5-6 Example 3: Systems Software pricing calculations

```
Step 11: Display possible configurations...

        POOL: E980POOL

        [AIX] EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc:

                Minimum 14 32-core CECs, 448 installed cores, peaking to 434.


                36 month cost per           static core = $ 5000.00 (activation)
                                          + $   44.00 * 36 = $ 1584.00 (monthly hw per core maint)
                                          + $ 1826.33 *  3 = $ 5479.00 (annual SW cost)
                                                            ---------
                                                            $12063.00

                36 month cost per typical PEP1.0** core = $ 6800.00 (activation)
                                          + $   49.40 * 36 = $ 1778.40 (monthly hw per core maint)
                                          + $ 1826.33 *  3 = $ 5479.00 (annual SW cost)
                                                            ---------
                                                            $14057.40
                  ** 10% static 90% mobile

                36 month cost per             base core = $ 8000.00 (activation)
                                          + $   57.00 * 36 = $ 2052.00 (monthly hw per core maint)
                                          + $ 1850.33 *  3 = $ 5551.00 (annual SW cost)
                                                            ---------
                                                            $15603.00

                                        1 capacity credit = $  240.00

                                    utility price per minute: $    0.0120 (activation cost)
                                                            $    0.0080 (system sw cost)
                                                            -----------
                                                            $    0.0200 (total)
```

Figure 5-7 Example 3: AIX workload pricing calculations

Base Procs	36 MONTH 100% static	ACTIVATION AND SOFTWARE LICENSING COSTS (US / $ USD) pep1.0 ideal	base	utility	base+util
1	$ 5,476,602	$ 6,100,911	$ 15,603	$ 8,656,175	$ 8,671,778
50	$ 5,476,602	$ 6,100,911	$ 780,150	$ 7,109,853	$ 7,890,003
100	$ 5,476,602	$ 6,100,911	$ 1,560,300	$ 5,531,973	$ 7,092,273
150	$ 5,476,602	$ 6,100,911	$ 2,340,450	$ 3,955,136	$ 6,295,586
200	$ 5,476,602	$ 6,100,911	$ 3,120,600	$ 2,393,590	$ 5,514,190
250	$ 5,476,602	$ 6,100,911	$ 3,900,750	$ 1,000,172	$ 4,900,922
270	$ 5,476,602	$ 6,100,911	$ 4,212,810	$ 588,739	$ 4,801,549
271	$ 5,476,602	$ 6,100,911	$ 4,228,413	$ 571,442	$ 4,799,855
272	$ 5,476,602	$ 6,100,911	$ 4,244,016	$ 554,469	$ 4,798,485
273	$ 5,476,602	$ 6,100,911	$ 4,259,619	$ 537,842	$ 4,797,461
274	$ 5,476,602	$ 6,100,911	$ 4,275,222	$ 521,545	$ 4,796,767
275	$ 5,476,602	$ 6,100,911	$ 4,290,825	$ 505,568	$ 4,796,393
276	$ 5,476,602	$ 6,100,911	$ 4,306,428	$ 489,900	$ 4,796,328
277	$ 5,476,602	$ 6,100,911	$ 4,322,031	$ 474,559	$ 4,796,590
278	$ 5,476,602	$ 6,100,911	$ 4,337,634	$ 459,533	$ 4,797,167
279	$ 5,476,602	$ 6,100,911	$ 4,353,237	$ 444,842	$ 4,798,079
300	$ 5,476,602	$ 6,100,911	$ 4,680,900	$ 206,899	$ 4,887,799
350	$ 5,476,602	$ 6,100,911	$ 5,461,050	$ 13,348	$ 5,474,398
400	$ 5,476,602	$ 6,100,911	$ 6,241,200	$ 195	$ 6,241,395
430	$ 5,476,602	$ 6,100,911	$ 6,709,290	$ 3	$ 6,709,293
431	$ 5,476,602	$ 6,100,911	$ 6,724,893	$ 2	$ 6,724,895
432	$ 5,476,602	$ 6,100,911	$ 6,740,496	$ 1	$ 6,740,497
433	$ 5,476,602	$ 6,100,911	$ 6,756,099	$ 0	$ 6,756,099
434	$ 5,476,602	$ 6,100,911	$ 6,771,702	$ 0	$ 6,771,702

Figure 5-8 Example 3: Identifying the optimal base for AIX workloads

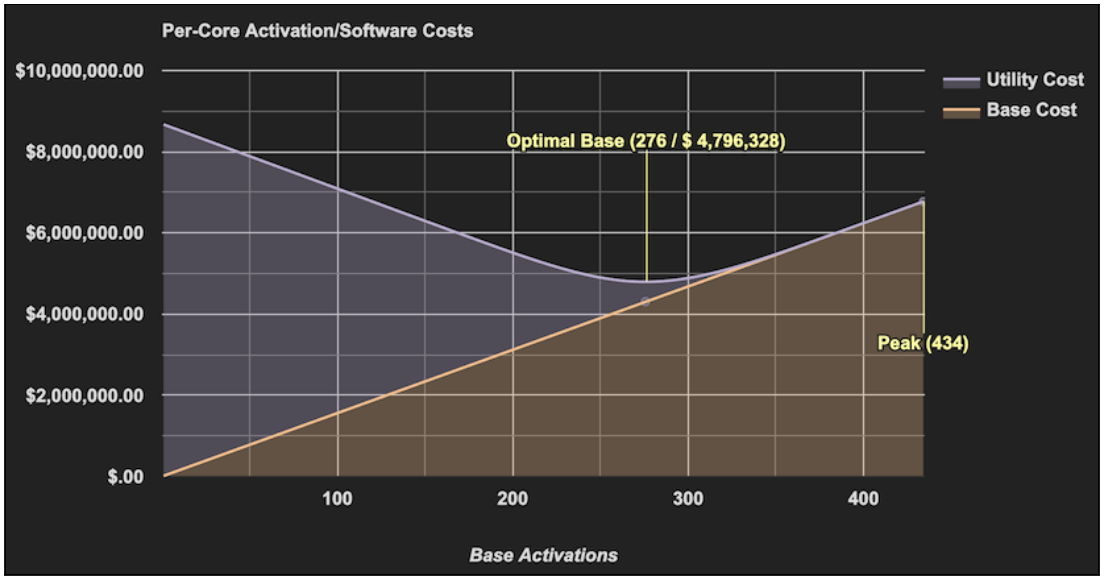

Figure 5-9 Example 3: Optimal base graph for AIX workloads

```
[Linux] EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc:

        Minimum  5 32-core CECs, 160 installed cores, peaking to 155.


        36 month cost per              IFL core = $ 2000.00 (activation)
                                + $   17.00 * 36 = $  612.00 (monthly hw per core maint)
                                + $  321.00 *  3 = $  963.00 (annual SW cost)
                                                   ---------
                                                   $ 3575.00

        36 month cost per typical PEP1.0** core = $ 6500.00 (activation)
                                + $   46.70 * 36 = $ 1681.20 (monthly hw per core maint)
                                + $  321.00 *  3 = $  963.00 (annual SW cost)
                                                   ---------
                                                   $ 9144.20
          ** 10% static 90% mobile

        36 month cost per        baselinux core = $ 4000.00 (activation)
                                + $   29.00 * 36 = $ 1044.00 (monthly hw per core maint)
                                + $  345.00 *  3 = $ 1035.00 (annual SW cost)
                                                   ---------
                                                   $ 6079.00

                               1 capacity credit = $  240.00

                        utility price per minute: $    0.0060 (activation cost)

                +--------+------------+------------+------------+------------+------------+
                |  Base  |    36 MONTH  ACTIVATION AND SOFTWARE LICENSING COSTS ( US / $ USD ) |
                | Procs  | 100%    IFL | pep1.0 ideal|   baselinux |   utility   |  base+util  |
                +--------+------------+------------+------------+------------+------------+
                |     1  | $   765,050 | $ 1,417,351 | $     6,079 | $   873,412 | $   879,491 |
                |    50  | $   765,050 | $ 1,417,351 | $   303,950 | $   409,515 | $   713,465 |
                |    85  | $   765,050 | $ 1,417,351 | $   516,715 | $    98,748 | $   615,463 |
                |    86  | $   765,050 | $ 1,417,351 | $   522,794 | $    92,099 | $   614,893 |
                |    87  | $   765,050 | $ 1,417,351 | $   528,873 | $    85,719 | $   614,592 |
                +--------+------------+------------+------------+------------+------------+
                |    88  | $   765,050 | $ 1,417,351 | $   534,952 | $    79,610 | $   614,562 |
                +--------+------------+------------+------------+------------+------------+
                |    89  | $   765,050 | $ 1,417,351 | $   541,031 | $    73,793 | $   614,824 |
                |    90  | $   765,050 | $ 1,417,351 | $   547,110 | $    68,250 | $   615,360 |
                |    91  | $   765,050 | $ 1,417,351 | $   553,189 | $    62,992 | $   616,181 |
                |    92  | $   765,050 | $ 1,417,351 | $   559,268 | $    58,026 | $   617,294 |
                |    93  | $   765,050 | $ 1,417,351 | $   565,347 | $    53,344 | $   618,691 |
                |    94  | $   765,050 | $ 1,417,351 | $   571,426 | $    48,937 | $   620,363 |
                |   100  | $   765,050 | $ 1,417,351 | $   607,900 | $    27,812 | $   635,712 |
                |   150  | $   765,050 | $ 1,417,351 | $   911,850 | $         2 | $   911,852 |
                |   151  | $   765,050 | $ 1,417,351 | $   917,929 | $         1 | $   917,930 |
```

Figure 5-10 Example 3: Identifying the optimal base for Linux workloads

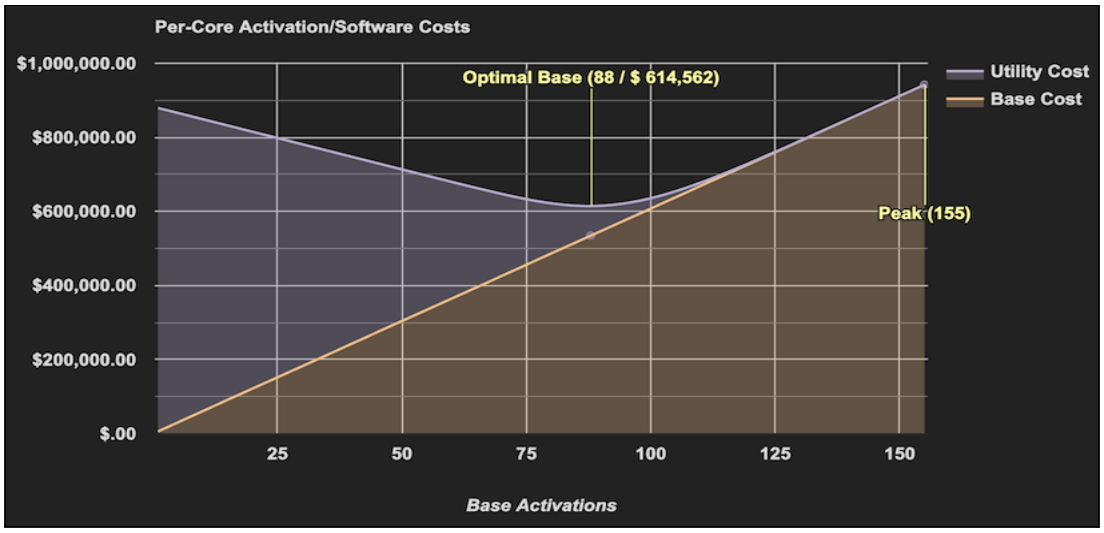

Figure 5-11 Example 3: Optimal base graph for Linux workloads

```
[VIOS] EFP1 32-core (4x8) Typ 3.9 to 4.0 GHz (max) P9 Proc:

        Minimum  2 32-core CECs,  64 installed cores, peaking to 33.


        36 month cost per              IFL core = $ 2000.00 (activation)
                              + $   17.00 * 36 = $  612.00 (monthly hw per core maint)
                              + $  321.00 *  3 = $  963.00 (annual SW cost)
                                                 ---------
                                                 $ 3575.00

        36 month cost per typical PEP1.0** core = $ 6500.00 (activation)
                              + $   46.70 * 36 = $ 1681.20 (monthly hw per core maint)
                              + $  321.00 *  3 = $  963.00 (annual SW cost)
                                                 ---------
                                                 $ 9144.20
          ** 10% static 90% mobile

        36 month cost per        baselinux core = $ 4000.00 (activation)
                              + $   29.00 * 36 = $ 1044.00 (monthly hw per core maint)
                              + $  345.00 *  3 = $ 1035.00 (annual SW cost)
                                                 ---------
                                                 $ 6079.00

                             1 capacity credit = $  240.00

                      utility price per minute: $    0.0060 (activation cost)

                +--------+------------+------------+------------+------------+------------+
                |  Base  |    36 MONTH  ACTIVATION AND SOFTWARE LICENSING COSTS ( US / $ USD ) |
                | Procs  | 100%    IFL | pep1.0 ideal|   baselinux |   utility   |  base+util  |
                +--------+------------+------------+------------+------------+------------+
                |     1  | $   146,575 | $   301,758 | $     6,079 | $   201,014 | $   207,093 |
                |     5  | $   146,575 | $   301,758 | $    30,395 | $   163,145 | $   193,540 |
                |    10  | $   146,575 | $   301,758 | $    60,790 | $   115,808 | $   176,598 |
                |    15  | $   146,575 | $   301,758 | $    91,185 | $    68,579 | $   159,764 |
                |    20  | $   146,575 | $   301,758 | $   121,580 | $    25,668 | $   147,248 |
                +--------+------------+------------+------------+------------+------------+
                |    21  | $   146,575 | $   301,758 | $   127,659 | $    19,092 | $   146,751 |
                +--------+------------+------------+------------+------------+------------+
                |    22  | $   146,575 | $   301,758 | $   133,738 | $    13,598 | $   147,336 |
                |    23  | $   146,575 | $   301,758 | $   139,817 | $     9,203 | $   149,020 |
                |    24  | $   146,575 | $   301,758 | $   145,896 | $     5,858 | $   151,754 |
                |    25  | $   146,575 | $   301,758 | $   151,975 | $     3,459 | $   155,434 |
                |    30  | $   146,575 | $   301,758 | $   182,370 | $        28 | $   182,398 |
                |    33  | $   146,575 | $   301,758 | $   200,607 | $         0 | $   200,607 |
                +--------+------------+------------+------------+------------+------------+
```

Figure 5-12 Example 3: Identifying the optimal base for Virtual I/O Servers

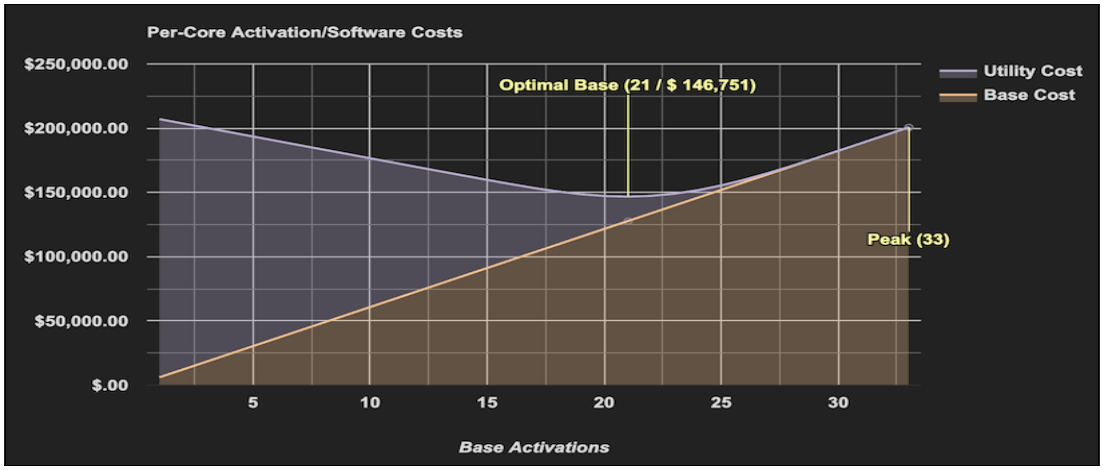

Figure 5-13 Example 3: Optimal base graph for Virtual I/O Servers

A summary of the results is provided in Table 5-3.

Table 5-3 Processor activation cost comparison for Example 3

Activation type	Static	PEP 1.0	PEP 2.0
AIX activations	454	434	276 Base Activations 2042 Capacity Credits
Linux activations	214	155	88 Base Linux Activations 332 Capacity Credits
Virtual I/O Server (VIOS) activations	41	33	21 Base Linux Activations 80 Capacity Credits
AIX cost	$5,476,602	$6,100,911	$4,796,328
Linux cost	$765,050	$1,417,351	$614,562
VIOS cost	$146,575	$301,758	$146,751
Total cost	**$6,388,227**	**$7,820,020**	**$5,557,641**

In this example, the static licensing model is estimated to require a minimum of 454 static activations and 255 IBM PowerLinux activations, which requires a minimum of a $6,388,227 investment. A PEP 1.0 configuration requires a minimum of 622 activations, which costs $7,820,020 for static and mobile processor activations. A PEP 2.0 configuration requires only 276 base core activations, 109 base Linux activations, and 2453 Shared Utility Capacity Credits to cover the peaks above base activations, which requires a total of $5,557,641 investment for 3 years. This model provides a $830,586 cost savings in processor activations compared to the static activation model.

Example 4: Using OS type breakdown in a mixed environment: IBM i and VIOS

Example 5-4 shows an analysis output for an IBM i customer for a set of input parameters and using their **`lparutil`** data.

Example 5-4 Execution of CPT-MCM for Example 4

```
turgut@systemslab perl % ./cptmcm.pl --country=US --months=36 --IBMi=IBMi_P30
--cec=EFP4
```

Figure 5-14 on page 159 to Figure 5-23 on page 164 show the calculation process.

```
Step 0: Check options and apply defaults ...

Step 1: Process feature data ...

Step 2: Get feature pricing ...
        Reading HW prices for United States: [******] 100%
        Reading SW prices for United States: [***************] 100%

Step 3: Process server config file and retrieve rPerf info...

        Target Server CEC: EFP4 Desc: 44-core (4x11) Typ 3.58 to 3.9 GHz (max) P9 Proc MTM: 9080-M9S rPerfPerCore: 26.85

        POOL: E980_POOL
                Source Server: Server-9080-MME-SNMasked1 MTM: 9080-MME rPerfPerCore: 21.08
                Source Server: Server-9080-MME-SNMasked2 MTM: 9080-MME rPerfPerCore: 21.08

Step 4: Process server xml pool data - find overlapping start and stop times....+++++++++.+++++++++  done.


        Latest Start Time: 1622458440 05/31/2021 10:54:00
        Earliest End Time: 1624049580 06/18/2021 20:53:00
            Total Seconds: 1591140
            Total Minutes: 26519
            Total   Hours: 441
            Total    Days: 18

          Cycles per  36  Month Term: 59.50
```

Figure 5-14 Example 4: CPT-MCM Initialization sequence

```
Step 5: Process server xml pool data - store physC data...


        POOL: E980_POOL

                Processing server Server-9080-MME-SNMasked1
                        Processing include VM                    VM1 (  2282 missing minutes, first  bad= 16444 longest gap = 06/11/2021 20:58:00 to 06/13/2021 10:59:00)
                        Processing include VM                    VM2 (  2282 missing minutes, first  bad= 16444 longest gap = 06/11/2021 20:58:00 to 06/13/2021 10:59:00)
                        Processing include VM                    VM3 (  2282 missing minutes, first  bad= 16444 longest gap = 06/11/2021 20:58:00 to 06/13/2021 10:59:00)
                        Processing include VM                    VM4 (  2282 missing minutes, first  bad= 16444 longest gap = 06/11/2021 20:58:00 to 06/13/2021 10:59:00)
                        Processing include VM                    VM5 (  2282 missing minutes, first  bad= 16444 longest gap = 06/11/2021 20:58:00 to 06/13/2021 10:59:00)
                        Processing include VM                    VM6 (  2282 missing minutes, first  bad= 16444 longest gap = 06/11/2021 20:58:00 to 06/13/2021 10:59:00)
                        Processing include VM                    VM7 (  2282 missing minutes, first  bad= 16444 longest gap = 06/11/2021 20:58:00 to 06/13/2021 10:59:00)
                        Processing include VM               PRD1VIOS1 (  2282 missing minutes, first  bad= 16444 longest gap = 06/11/2021 20:58:00 to 06/13/2021 10:59:00)
                        Processing include VM               PRD1VIOS2 (  2282 missing minutes, first  bad= 16444 longest gap = 06/11/2021 20:58:00 to 06/13/2021 10:59:00)

                Processing server Server-9080-MME-SNMasked2
                        Processing include VM                    VM8 (  2282 missing minutes, first  bad= 16446 longest gap = 06/11/2021 21:00:00 to 06/13/2021 11:01:00)
                        Processing include VM                    VM9 (  2282 missing minutes, first  bad= 16446 longest gap = 06/11/2021 21:00:00 to 06/13/2021 11:01:00)
                        Processing include VM                   VM10 (  2282 missing minutes, first  bad= 16446 longest gap = 06/11/2021 21:00:00 to 06/13/2021 11:01:00)
                        Processing include VM                   VM11 (  2282 missing minutes, first  bad= 16446 longest gap = 06/11/2021 21:00:00 to 06/13/2021 11:01:00)
                        Processing include VM                   VM12 (  2282 missing minutes, first  bad= 16446 longest gap = 06/11/2021 21:00:00 to 06/13/2021 11:01:00)
                        Processing include VM               PRD2VIOS1 (  2282 missing minutes, first  bad= 16446 longest gap = 06/11/2021 21:00:00 to 06/13/2021 11:01:00)
                        Processing include VM               PRD2VIOS2 (  2282 missing minutes, first  bad= 16446 longest gap = 06/11/2021 21:00:00 to 06/13/2021 11:01:00)
                        Processing include VM                   VM13 (  2282 missing minutes, first  bad= 16446 longest gap = 06/11/2021 21:00:00 to 06/13/2021 11:01:00)
                        Processing include VM                   VM14 (  2282 missing minutes, first  bad= 16446 longest gap = 06/11/2021 21:00:00 to 06/13/2021 11:01:00)

Step 6: Write physC data to CSV file...
```

Figure 5-15 Example 4: Processing VMs

```
Step 7: Calculate per minute usage...


        POOL: E980_POOL

           Server-9080-MME-SNMasked1  ( IBMi peak=  4.53/ 13 time=06/18/2021 04:03:00) rPerfPerCore=21.08 peak rPerf=95.3886456063033
           Server-9080-MME-SNMasked1  ( VIOS peak=  1.70/ 13 time=06/05/2021 04:01:00) rPerfPerCore=21.08 peak rPerf=35.8655367793637

           Server-9080-MME-SNMasked2  ( IBMi peak= 26.21/ 39 time=06/03/2021 04:01:00) rPerfPerCore=21.08 peak rPerf=552.428538146953
           Server-9080-MME-SNMasked2  ( VIOS peak=  6.00/ 39 time=06/02/2021 06:32:00) rPerfPerCore=21.08 peak rPerf=126.410280374983


        Worst case rPerf total ( IBMi)  = 648 (this assumes no pooling or optimization via server consolidation)

                   25 core(s), EFP4 44-core (4x11) Typ 3.58 to 3.9 GHz (max) P9 Proc (26.85 rPerf per core)
                       * ($6,000/1 core Proc Act for #EFP4  + ($45/monthly maint per core * 36 months) ) = $   190,500

        Peak minute rPerf total = 610 (06/03/2021 04:02:00) Best case is perfectly managed pool to this peak.

                   23 core(s), EFP4 44-core (4x11) Typ 3.58 to 3.9 GHz (max) P9 Proc (26.85 rPerf per core)
                       * ($7,000/1 core mob-enab Proc Act for #EFP4/#EFP8 + ($50/monthly maint per core * 36 months) ) = $   188,830 - $   199,686


        Worst case rPerf total ( VIOS)  = 163 (this assumes no pooling or optimization via server consolidation)

                    7 core(s), EFP4 44-core (4x11) Typ 3.58 to 3.9 GHz (max) P9 Proc (26.85 rPerf per core)
                       * ($2,000/Power Linux processor activation for #EFP4/#EFP8 + ($17/monthly maint per core * 36 months) ) = $    18,284

        Peak minute rPerf total = 163 (06/05/2021 04:01:00) Best case is perfectly managed pool to this peak.

                    7 core(s), EFP4 44-core (4x11) Typ 3.58 to 3.9 GHz (max) P9 Proc (26.85 rPerf per core)
                       * ($7,000/1 core mob-enab Proc Act for #EFP4/#EFP8 + ($50/monthly maint per core * 36 months) ) = $    39,942 - $    57,268

Step 8: Calculate systems software annual charges...

Step 9: Calculate systems software annual charges...
        *** OVERRIDING PRICE FOR FEATURE EFPN to $ 3223
        *** OVERRIDING PRICE FOR FEATURE EP93 to $ 4500
        *** OVERRIDING PRICE FOR FEATURE 5770SSA-1552 to $ 5000

Step 10: Get utility per-minute pricing...
```

Figure 5-16 Example 4: Calculated peak rPerf values and cores per OS type

```
Step 11: Get Systems Software per-minute pricing...

               ------------------------------------------
               Cloud Management Console (socket price / 10)
               ------------------------------------------
               Per-Core License cost for 36 months: $     0.00
               Per-Core License cost      per year: $     0.00
               Per-Core SWMA 9x5 cost   for year 1: $    24.00  (+ 24x7) $  0.00
               Per-Core SWMA 9x5 cost   for year 2: $    24.00  (+ 24x7) $  0.00
               Per-Core SWMA 9x5 cost   for year 3: $    24.00  (+ 24x7) $  0.00
               Per-Core SWMA total for  36  months: $    72.00
               Per-Core SWMA average  per one year: $    24.00
               ----------------------------------- ---------
               Per-Core Software    Total Per Year: $    24.00

               -------------
               IBMi P30 Tier
               -------------
               Per-Core License cost for 36 months: $  5000.00
               Per-Core License cost      per year: $  1666.67
               Per-Core SWMA 9x5 cost   for year 1: $     0.00  (+ 24x7) $ 980.00
               Per-Core SWMA 9x5 cost   for year 2: $  9800.00  (+ 24x7) $ 980.00
               Per-Core SWMA 9x5 cost   for year 3: $  9800.00  (+ 24x7) $ 980.00
               Per-Core SWMA total for  36  months: $ 22540.00
               Per-Core SWMA average  per one year: $  7513.33
               ----------------------------------- ---------
               Per-Core Software    Total Per Year: $  9180.00

               -------------------------
               PowerVM Enterprise Edition
               -------------------------
               Per-Core License cost for 36 months: $     0.00
               Per-Core License cost      per year: $     0.00
               Per-Core SWMA 9x5 cost   for year 1: $   300.00  (+ 24x7) $ 21.00
               Per-Core SWMA 9x5 cost   for year 2: $   300.00  (+ 24x7) $ 21.00
               Per-Core SWMA 9x5 cost   for year 3: $   300.00  (+ 24x7) $ 21.00
               Per-Core SWMA total for  36  months: $   963.00
               Per-Core SWMA average  per one year: $   321.00
               ----------------------------------- ---------
               Per-Core Software    Total Per Year: $   321.00
```

Figure 5-17 Example 4: Systems Software pricing calculations

```
Displaying and Calculating System Software Per-Core-Per-Minute Charges:

  -->  24x7 support elected

  -->  36 months owned/leased

          IBMi -    version chosen: IBMi_P30 (IBMi P30 Tier)

       PowerVM -    version chosen: PVMEE (PowerVM Enterprise Edition)

           CMC - needed for PEP2.0: CMCSE


               +---------------------------------------+
               +     SYSTEM SOFTWARE PER CORE PRICES     + (based on 36 months owned/leased)
               +  POOL E980_POOL      , IBMi   CEC: EFP4 +
               +--------.----------.----------.----------+
               |  Per-  |      BASE|  STATIC  |  MOBILE  |
               +--------+----------+----------+----------+
               +  Year  |  9525.00 |  9501.00 |  9501.00 |
               +--------+----------+----------+----------+
               + Minute | 0.018110 | 0.018064 | 0.018064 | (525960 minutes in a 365.25 day year)
               +--------+----------+----------+----------+



       PowerVM -    version chosen: PVMEE (PowerVM Enterprise Edition)

           CMC - needed for PEP2.0: CMCSE


               +---------------------------------------+
               +     SYSTEM SOFTWARE PER CORE PRICES     + (based on 36 months owned/leased)
               +  POOL E980_POOL      , VIOS   CEC: EFP4 +
               +--------.----------.----------.----------+
               |  Per-  | BASELINUX|     IFL  |  MOBILE  |
               +--------+----------+----------+----------+
               +  Year  |   345.00 |   321.00 |   321.00 |
               +--------+----------+----------+----------+
               + Minute | 0.000656 | 0.000610 | 0.000610 | (525960 minutes in a 365.25 day year)
               +--------+----------+----------+----------+
```

Figure 5-18 Example 4: Systems Software per minute pricing calculations

```
Step 12: Display possible configurations...

        POOL: E980_POOL

        [IBMi] EFP4 44-core (4x11) Typ 3.58 to 3.9 GHz (max) P9 Proc:

                Minimum  1 44-core CECs,  44 installed cores, peaking to 23.


                36 month cost per           static core = $ 6000.00 (activation)
                                          + $   45.00 * 36 = $ 1620.00 (monthly hw per core maint)
                                          + $ 9501.00 *  3 = $28503.00 (annual SW cost)
                                                             ---------
                                                             $36123.00

                36 month cost per typical PEP1.0** core = $ 3500.70 (activation)
                                          + $   49.50 * 36 = $ 1782.00 (monthly hw per core maint)
                                          + $ 9501.00 *  3 = $28503.00 (annual SW cost)
                                                             ---------
                                                             $33785.70
                  ** 10% static 90% mobile

                36 month cost per             base core = $ 4500.00 (activation)
                                          + $   57.00 * 36 = $ 2052.00 (monthly hw per core maint)
                                          + $ 9525.00 *  3 = $28575.00 (annual SW cost)
                                                             ---------
                                                             $35127.00

                                        1 capacity credit = $  240.00

                                    utility price per minute: $    0.0120 (activation cost)
                                                             $    0.1600 (system sw cost)
                                                             -----------
                                                             $    0.1720 (total)
```

Figure 5-19 Example 4: IBM i workload pricing calculations

Base Procs	36 MONTH ACTIVATION AND SOFTWARE LICENSING COSTS (US / $ USD)				
	100% static	pep1.0 ideal	base	utility	base+util
1	$ 903,075	$ 777,071	$ 35,127	$ 3,041,635	$ 3,076,762
2	$ 903,075	$ 777,071	$ 70,254	$ 2,793,594	$ 2,863,848
3	$ 903,075	$ 777,071	$ 105,381	$ 2,545,553	$ 2,650,934
4	$ 903,075	$ 777,071	$ 140,508	$ 2,297,523	$ 2,438,031
5	$ 903,075	$ 777,071	$ 175,635	$ 2,049,657	$ 2,225,292
6	$ 903,075	$ 777,071	$ 210,762	$ 1,802,257	$ 2,013,019
7	$ 903,075	$ 777,071	$ 245,889	$ 1,555,697	$ 1,801,586
8	$ 903,075	$ 777,071	$ 281,016	$ 1,311,216	$ 1,592,232
9	$ 903,075	$ 777,071	$ 316,143	$ 1,071,897	$ 1,388,040
10	$ 903,075	$ 777,071	$ 351,270	$ 843,673	$ 1,194,943
11	$ 903,075	$ 777,071	$ 386,397	$ 633,604	$ 1,020,001
12	$ 903,075	$ 777,071	$ 421,524	$ 447,942	$ 869,466
13	$ 903,075	$ 777,071	$ 456,651	$ 289,573	$ 746,224
14	$ 903,075	$ 777,071	$ 491,778	$ 162,862	$ 654,640
15	$ 903,075	$ 777,071	$ 526,905	$ 74,119	$ 601,024
16	$ 903,075	$ 777,071	$ 562,032	$ 25,347	$ 587,379
17	$ 903,075	$ 777,071	$ 597,159	$ 6,456	$ 603,615
18	$ 903,075	$ 777,071	$ 632,286	$ 1,517	$ 633,803
19	$ 903,075	$ 777,071	$ 667,413	$ 450	$ 667,863
20	$ 903,075	$ 777,071	$ 702,540	$ 135	$ 702,675
21	$ 903,075	$ 777,071	$ 737,667	$ 50	$ 737,717
22	$ 903,075	$ 777,071	$ 772,794	$ 15	$ 772,809
23	$ 903,075	$ 777,071	$ 807,921	$ 0	$ 807,921

Figure 5-20 Example 4: Identifying the optimal base for IBM i workloads

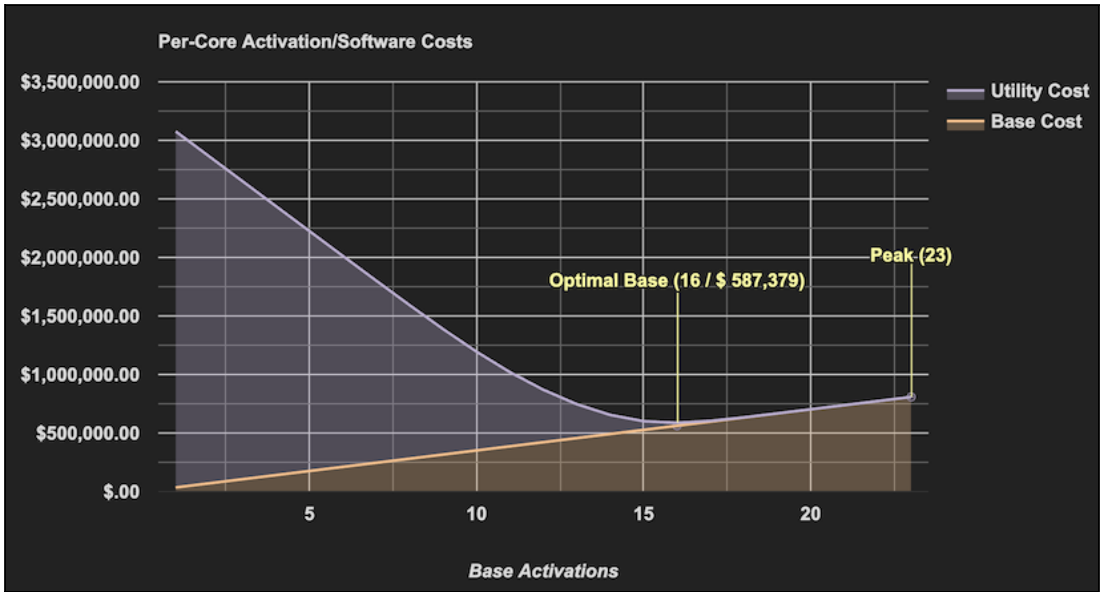

Figure 5-21 Example 4: Per-Core Activation/Software Costs

```
[VIOS] EFP4 44-core (4x11) Typ 3.58 to 3.9 GHz (max) P9 Proc:

       Minimum  1 44-core CECs,  44 installed cores, peaking to 7.


       36 month cost per              IFL core = $ 2000.00 (activation)
                         + $   17.00 * 36 = $  612.00 (monthly hw per core maint)
                         + $  321.00 *  3 = $  963.00 (annual SW cost)
                                            ---------
                                            $ 3575.00

       36 month cost per typical PEP1.0** core = $ 3100.70 (activation)
                         + $   46.70 * 36 = $ 1681.20 (monthly hw per core maint)
                         + $  321.00 *  3 = $  963.00 (annual SW cost)
                                            ---------
                                            $ 5744.90
         ** 10% static 90% mobile

       36 month cost per        baselinux core = $ 4000.00 (activation)
                         + $   29.00 * 36 = $ 1044.00 (monthly hw per core maint)
                         + $  345.00 *  3 = $ 1035.00 (annual SW cost)
                                            ---------
                                            $ 6079.00

                        1 capacity credit = $  240.00

                    utility price per minute: $    0.0060 (activation cost)

              +--------+------------+------------+------------+------------+------------+
              |  Base  |    36 MONTH  ACTIVATION AND SOFTWARE LICENSING COSTS ( US / $ USD ) |
              | Procs  | 100%    IFL | pep1.0 ideal|   baselinux |   utility   |  base+util  |
              +--------+------------+------------+------------+------------+------------+
              |     1  | $    25,025 | $    40,214 | $     6,079 | $    21,485 | $    27,564 |
              |     2  | $    25,025 | $    40,214 | $    12,158 | $    13,004 | $    25,162 |
              +--------+------------+------------+------------+------------+------------+
              |     3  | $    25,025 | $    40,214 | $    18,237 | $     5,750 | $    23,987 |
              +--------+------------+------------+------------+------------+------------+
              |     4  | $    25,025 | $    40,214 | $    24,316 | $     1,433 | $    25,749 |
              |     5  | $    25,025 | $    40,214 | $    30,395 | $        18 | $    30,413 |
              |     6  | $    25,025 | $    40,214 | $    36,474 | $         0 | $    36,474 |
              |     7  | $    25,025 | $    40,214 | $    42,553 | $         0 | $    42,553 |
              +--------+------------+------------+------------+------------+------------+
```

Figure 5-22 Example 4: Identifying the optimal base for VIOSs

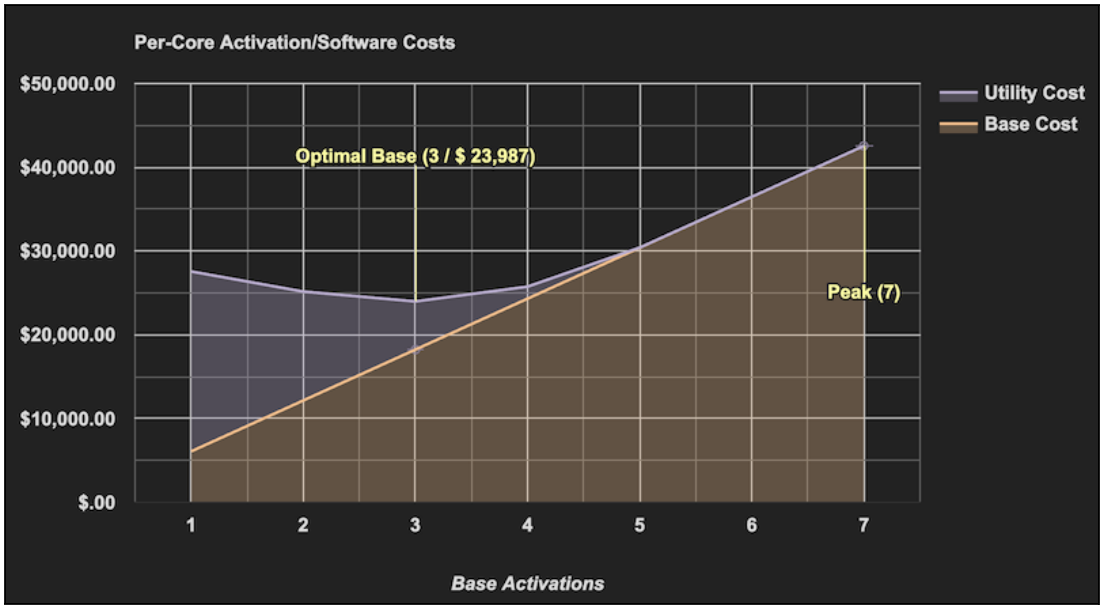

Figure 5-23 Example 4: Optimal base graph for VIOSs

A summary of the results is provided in Table 5-4

Table 5-4 Processor activation cost comparison for Example 4

Activation type	Static	PEP 1.0	PEP 2.0
IBM i activations	25	23	16 Base Activations 106 Capacity Credits
VIOS activations	7	7	3 Base Linux Activations 24 Capacity Credits
IBM i cost	$903,075	$777,071	$587,379
VIOS cost	$25,025	$40,214	$23,987
Total cost	**$928,100**	**$817,285**	**$611,366**

In this example, the static licensing model is estimated to require a minimum of 25 static activations for IBM i and seven PowerLinux activations for VIOS, which requires a minimum of a $928,100 investment. A PEP 1.0 configuration requires a minimum of 30 activations, which costs $817,285 for static and mobile processor activations. A PEP 2.0 configuration requires only 16 base core activations, three base Linux activations, and 130 Shared Utility Capacity Credits to cover the peaks above base activations, which requires a total of a $611,366 investment for 3 years. This model provides a $316,734 cost savings in processor activations compared to static activation model.

A

Additional material

Section 3.3, “IBM CMC Public APIs” on page 123 refers to additional material that can be downloaded from the internet. For code examples of how to use these APIs together with Python code, see this GitHub repository.

Related publications

The publications that are listed in this section are considered suitable for a more detailed description of the topics that are covered in this book.

IBM Redbooks

The following IBM Redbooks publications provide more information about the topics in this document. Some publications that are referenced in this list might be available in softcopy only.

- *IBM AIX Enhancements and Modernization*, SG24-8453
- *IBM Power System E950: Technical Overview and Introduction*, REDP-5509
- *IBM Power System E980: Technical Overview and Introduction*, REDP-5510
- *IBM Power Systems HMC Implementation and Usage Guide*, SG24-8334
- *IBM Power Systems S922, S914, and S924 Technical Overview and Introduction Featuring PCIe Gen 4 Technology*, REDP-5595
- *IBM Power E1080 Technical Overview and Introduction*, REDP-5649
- *IBM PowerVC Version 1.3.2 Introduction and Configuration*, SG24-8199
- *IBM PowerVM Virtualization Introduction and Configuration*, SG24-7940
- *Power Enterprise Pools on IBM Power Systems*, REDP-5101

You can search for, view, download, or order these documents and other Redbooks, Redpapers, web docs, drafts, and additional materials at the following website:

ibm.com/redbooks

Online resources

These websites are also relevant as further information sources:

- *Capacity on Demand (CoD) Users Guide*

  https://www.ibm.com/support/knowledgecenter/POWER6/ipha2/ipha2.pdf
- Creating Proxy Connections on the Hardware Management Console (HMC)

  https://ibmcmc.zendesk.com/hc/en-us/articles/115003101808-Creating-Proxy-Connections-on-the-HMC
- IBM Cloud Management Console website

  https://ibmcmc.zendesk.com/hc/en-us/articles/360021928094-Power-Enterprise-Pools-2-0-with-Utility-Capacity
- IBM Power Community - Connect, learn, share, and engage with the IBM Power Community

  https://community.ibm.com/community/user/power/participate/blogs

- IBM Power Enterprise Pools 2.0: Offering announcement

  https://www-01.ibm.com/common/ssi/ShowDoc.wss?docURL=/common/ssi/rep_ca/3/872/ENUSAG19-0003/index.html&request_locale=en

- IBM Power Enterprise Pools announcements

  https://www-01.ibm.com/common/ssi/SearchResult.wss?request_locale=en&MPPEFFTR=TITLE&MPPEFSRT=2&MPPEFSCH=Power%20Enterprise%20Pools

- IBM Power Systems Private Cloud Solution with Dynamic Capacity is offered on IBM Power S924 and IBM Power S922 technology-based servers.

  https://www-01.ibm.com/common/ssi/ShowDoc.wss?docURL=/common/ssi/rep_ca/4/897/ENUS120-044/index.html&request_locale=en

- Is SOCKS5 still the only way?

  https://ibmcmc.zendesk.com/hc/en-us/community/posts/360049260033-Is-SOCKS5-sill-the-only-way-?

- POWER8 Enterprise Pools 1.0

  https://www.ibm.com/support/knowledgecenter/POWER8/p8ha2/systempool_cod.htm

- POWER9 Enterprise Pools 2.0

  https://www.ibm.com/support/knowledgecenter/en/POWER9/p9ha2/p9ha2_systempool_2.0_cod.htm

- Power Enterprise Pools 2.0 with Utility Capacity - A Cloud-Based Approach

  https://community.ibm.com/community/user/power/blogs/stephanie-jensen1/2020/06/25/power-enterprise-pools-20-with-utility-capacity-a

- Power Enterprise Pools 2.0 with Utility Capacity

  https://ibmcmc.zendesk.com/hc/en-us/articles/360021928094-Power-Enterprise-Pools-2-0-with-Utility-Capacity

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