SoftCOM AI
V200R019C30

DC PUE Optimization Model Generation Service

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## Contents

1 Documentation Guide.................................................................................................................. 1

2 Product Introduction.....................................................................................................................2
  2.1 What is the DC PUE Optimization Model Generation Service..............................................2
  2.2 Application Scenarios..............................................................................................................2
  2.3 Product Features.....................................................................................................................3
  2.4 Product Values.......................................................................................................................3
  2.5 Relationships with Other Cloud Services................................................................................5
  2.6 Restrictions............................................................................................................................6
  2.7 Basic Concepts.....................................................................................................................6
  2.8 Accessing the DC PUE Optimization Model Generation Service........................................6

3 Quick Start......................................................................................................................................8
  3.1 Prerequisites...........................................................................................................................8
  3.2 Accessing the DC PUE Optimization Model Generation Service........................................8
  3.3 Creating a Service..................................................................................................................9
  3.4 Generating a Model...............................................................................................................10
  3.5 Evaluating a Model...............................................................................................................15
  3.6 Downloading a Model Package............................................................................................16
  3.7 Verifying a Model................................................................................................................16
  3.8 Other Operations..................................................................................................................18

4 FAQs...........................................................................................................................................19
  4.1 What Factors Can Affect the PUE........................................................................................19
  4.2 What Are the Measures to Lower the PUE..........................................................................19
  4.3 How Can We Optimize Cooling Systems..............................................................................19

5 Glossary......................................................................................................................................20
Documents including Introduction, Quick Start, FAQs, and Glossary are given to help customers learn and use the DC PUE optimization model generation service in order to customize site-oriented models.

<table>
<thead>
<tr>
<th>Document</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>This document describes the positioning, application scenarios, functions, benefits, and restrictions of the DC PUE optimization model generation service.</td>
</tr>
<tr>
<td>Quick Start</td>
<td>This document describes how to use the DC PUE optimization model generation service to quickly generate DC PUE optimization models, helping users quickly get familiar with and use the DC PUE optimization model generation service.</td>
</tr>
<tr>
<td>FAQs</td>
<td>This document provides answers to frequently asked questions (FAQs) for users of the DC PUE optimization model generation service.</td>
</tr>
<tr>
<td>Glossary</td>
<td>This document describes the product terms related to the DC PUE optimization model generation service.</td>
</tr>
</tbody>
</table>
2 Product Introduction

2.1 What is the DC PUE Optimization Model Generation Service

The data center (DC) power usage effectiveness (PUE) optimization model generation service is oriented to DC energy power saving scenarios. It combines artificial intelligence (AI) with traditional heating, ventilation, and air conditioning (HVAC) knowledges experience and collects data of the equipment room outer doors environment, IT loads, cooling stations equipment status, and end air conditioner status for analysis and modeling. The group control system can be automatically adjusted by the model to reduce energy power consumption without sacrificing service quality.

HVAC experts only need to set parameters based on the DC cooling mode and corresponding HVAC techniques. The model generation service will automatically perform modeling, generating a DC PUE optimization model through training, and deploy the model for customers. After the scheduling mode of the DC PUE optimization model and interaction mode with the network management system (NMS) are configured for customers, real-time data exchange and policy delivery between the PUE optimization model and NMS can be implemented, and the reducing DC energy power consumption will reduce.

2.2 Application Scenarios

Power consumption costs make up a large proportion of large DC operations costs. In addition to the IT loads, other systems (such as cooling systems) should reduce power consumption costs. Currently, there are two delivery scenarios.

Initial Generation of the DC PUE Optimization Model

If a DC PUE optimization model is introduced to a DC for the first time, HVAC experts need to import engineering parameters and historical data collections of the cooling system. The service will generates a PUE optimization model based on the parameters and the data.

Update an existing DC PUE optimization model.

If a DC already has a PUE optimization model, but the cooling system has changed (for example, device aging or upgrade) or the service IT loads have changed greatly, HVAC
experts need to adjust the cooling system parameters and import new environment data to update the PUE optimization model, avoiding the deterioration of the model prediction effect.

2.3 Product Features

Cooling Mode and HVAC Technique Configuration

HVAC experts can set parameters based on the DC cooling scenarios and HVAC implementation techniques.

Data import

HVAC experts can import data from a local path or an object storage service (OBS) bucket.

Service modeling topology modification

The service modeling topology can be automatically generated based on the data imported by HVAC experts. In addition, the service topology can be modified.

Automatic modeling

Algorithms are automatically selected for model training. In this way, the DC PUE optimization model can be generated automatically.

2.4 Product Values

Multi-Scenario Adaptation

Models adapting to different cooling modes (such as mechanical cooling and free cooling) and different cooling device engineering techniques (such as constant-frequency or variable-frequency water chillers, open or closed cooling towers, and in-row or in-room air conditioners) can be generated based on Huawei's extensive experience in DC energy engineering, helping HVAC experts handle multiple DC scenarios.
Comprehensive Control Policy

The models can infer a policy to control all DC cooling devices (such as chillers, cooling water pumps, cooling towers, chilled water pumps, and heat exchangers) based on the capability of optimizing the DC cooling device control policy, helping HVAC experts flexibly control the cooling system.

Oriented to HVAC Experts, Solving AI Modeling Problems Without Coding

HVAC experts only need to provide data of the DC chilled water system (such as data of IT loads, cooling stations, and air conditioners), and technique parameters of DC cooling devices (such as the header system/single pipe system and the system where the chiller and heat...
exchanger are connected in parallel/in series). An AI model that matches the DC can be automatically obtained.

**Figure 2-3** Process of AI modeling by an HVAC expert

2.5 Relationships with Other Cloud Services

**Relationship with the ModelArts Service**

The SoftCOM AI platform uses the ModelArts service provided by the Huawei public cloud system to implement data preprocessing and large-scale distributed model training.

**Relationship with the IAM Service**

The SoftCOM AI platform uses the Identity and Access Management (IAM) service provided by the Huawei public cloud system to implement unified identity authentication and permission management.

**Relationship with the API Gateway**

The SoftCOM AI platform must interconnect with the unified API gateway provided by the Huawei public cloud system. The API gateway provides a unified entrance for users to invoke SoftCOM AI cloud service APIs. APIs provided by the SoftCOM AI cloud service for tenants must be registered with the API gateway before being released.

**Relationship with the OBS**

The SoftCOM AI platform uses the OBS (Object Storage Service) to store data and model backup and snapshots, achieving secure, reliable, and low-cost storage.
Relationship with the CCE

The SoftCOM AI platform uses the Cloud Container Engine (CCE) to deploy models as online services. The high concurrency and auto-scaling requirements of services are supported.

2.6 Restrictions

This service is applicable to a DC that meets the following conditions:

(1) Requires AI technologies to reduce the PUE.
(2) Has inference framework components.
(3) Lacks the AI model development capability.

For example, a DC that uses the chilled water system for temperature adjustment wants to use AI technologies to perform energy saving optimization on the chilled water system. The prediction framework has been deployed, but the PUE optimization model that matches the DC environment is unavailable. In this case, the service can be used to reduce the PUE.

2.7 Basic Concepts

PUE

PUE is used to measure the energy efficiency of DCs. If the PUE value is 2, it indicates that when an IT device consumes electricity of 1 watt, additional electricity of 1 watt needs to be consumed to cool and distribute the IT device. If the PUE value is close to 1, almost all power is consumed for IT device running.

2.8 Accessing the DC PUE Optimization Model Generation Service

Step 1  Enter https://telcloud.huawei.com/#/ in the address box of a browser on a user PC and press Enter to access the AI marketplace.

Step 2  Click Login in the upper right corner of the page. The login page is displayed.

Step 3  Select IAM User Login and enter the account name, IAM user name, and password, as shown in Figure 2-4.
Step 4  Click Log In to access the AI marketplace.

Step 5  Choose **AI Services > Model Service > AI Model Generation Service > DC PUE Optimization AI Model Generation Service**. The introduction page of the DC PUE optimization model generation service is displayed.

Step 6  Click **Enter Service**. The DC PUE optimization model generation service page is displayed.

---End
3 Quick Start

3.1 Prerequisites

- You have registered a Huawei cloud account.
- An administrator tenant and IAM user of the SoftCOM AI platform have been registered.
- You have subscribed to the DC PUE optimization model generation service of SoftCOM AI cloud services.

3.2 Accessing the DC PUE Optimization Model Generation Service

**Step 1** Enter [https://telcloud.huawei.com/#/](https://telcloud.huawei.com/#/) in the address box of a browser on a user PC and press **Enter** to access the AI marketplace.

**Step 2** Click **Login** in the upper right corner of the page. The login page is displayed.

**Step 3** Select **IAM User Login** and enter the account name, IAM user name, and password, as shown in **Figure 3-1**.
Step 4  Click Log In to access the AI marketplace.

Step 5  Choose AI Services > Model Service > AI Model Generation Service > DC PUE Optimization AI Model Generation Service. The introduction page of the DC PUE optimization model generation service is displayed.

Step 6  Click Enter Service. The DC PUE optimization model generation service page is displayed.

---End

3.3 Creating a Service

Step 1  Click Add Service in the upper right corner of the page.

The Add Service dialog box is displayed, as shown in Figure 3-2.
Step 2  Click Add. The service is added successfully.

3.4 Generating a Model

Step 1  Click corresponding to the new service in the Operation column. The HVAC System Configuration page is displayed, as shown in Figure 3-3.

The system provides the following configuration items: Optimization Scenario, Cooling Mode, and Pipe Type. For example, the Pipe Type configuration item includes the following options: Header and Single Pipe. Currently, HVAC devices do not support these configurations.
Step 2  Click Next. The Selecting Data page is displayed.

Set the following parameters:

- **Dataset Information**: Use the default value Local. If Data catalog is selected, you need to subscribe to and download a dataset on the data catalog platform and import the dataset to the DC PUE optimization model generation service platform.

- **Select File**: Select a local data file. For details about the data file format requirements, see the dataset downloaded on the Download Sample Dataset page or click . You can directly upload the downloaded sample dataset package trainTemplate.zip for trial use.

Step 3  Click Import Data. The system automatically uploads and checks the data.

If the feature name of the dataset does not completely match the parameter topology, a data check report shown in Figure 3-4 is displayed. You can ignore the error message or add the missing feature column and upload the dataset again. You can click Details to view the missing feature column.

If the feature name of the dataset matches the parameter topology, a data check report shown in Figure 3-5 is displayed.

The table lists the number of invalid values, percentage of invalid values, maximum value, and minimum value of each feature value.

Figure 3-4 Importing a dataset (1)
Step 4  Click **Re-Import** to upload the data again if required.

Step 5  Click **Next**.

The **Training Configuration** page is displayed, as shown in **Figure 3-6**.

The **Name** column lists the names of all control parameters of the cooling system. You can set the value range and adjustment precision of each control parameter. The system automatically records the latest data settings and updates the value range of the corresponding control parameter in the parameter topology.

**Figure 3-6 Parameter configurations**

- **Step 6**  Click the drop-down arrow next to **Advanced**. The parameter topology configuration information is displayed, as shown in **Figure 3-7**.

The parameters in different areas are described as follows:

- All parameters in area 3 are control parameters, which can be adjusted based on the site requirements.
  Hover the pointer over a parameter icon to view the alias, type, maximum value, minimum value, and adjustment precision of the parameter. You can right-click the icon and choose **Modify** from the shortcut menu. In the dialog box that is displayed, modify the parameter information, as shown in **Figure 3-8**. After the maximum value, minimum value, and adjustment precision are modified, the modification is automatically synchronized to the **Parameter Setting** area shown in **Figure 3-6**.

- All parameters in area 2 are environment parameters, which cannot be controlled.
  Hover the pointer over an icon to view the parameter alias and type. You can right-click the icon and choose **Modify** from the shortcut menu. In the dialog box that is displayed, modify the parameter information, as shown in **Figure 3-9**.

- All parameters in area 1 are correlative parameters. Hover the pointer over a correlative parameter. Then lines are displayed between the correlative parameter and the environment parameters and control parameters. The lines...
indicate that the correlative parameters are affected by the environment parameters and control parameters in the ring.

Hover the pointer over an icon to view the parameter alias and type. You can right-click the icon and choose Modify from the shortcut menu. In the dialog box that is displayed, modify the parameter information, as shown in Figure 3-10.

**Figure 3-7 Parameter topology configuration**

![Parameter topology configuration](image)

**Figure 3-8 Control parameter information**

![Control parameter information](image)
**Figure 3-9** Environment parameter information

<table>
<thead>
<tr>
<th>Parameter Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
</tr>
<tr>
<td>OutsideRHumidity</td>
</tr>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td>Environment parameters</td>
</tr>
<tr>
<td><strong>Alias</strong></td>
</tr>
<tr>
<td>Outdoor relative humidity</td>
</tr>
<tr>
<td><strong>Unit</strong></td>
</tr>
<tr>
<td>%</td>
</tr>
<tr>
<td><strong>Parameter value type</strong></td>
</tr>
<tr>
<td>float</td>
</tr>
</tbody>
</table>

**Description**
Outdoor relative humidity. Relative humidity is the ratio of the partial pressure of water vapor to the equilibrium vapor pressure of water at a given temperature.

**Figure 3-10** Correlative parameter information

<table>
<thead>
<tr>
<th>Parameter Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
</tr>
<tr>
<td>CoolingStation</td>
</tr>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td>Correlative parameters</td>
</tr>
<tr>
<td><strong>Alias</strong></td>
</tr>
<tr>
<td>Total power consumption of cooling stations</td>
</tr>
<tr>
<td><strong>Unit</strong></td>
</tr>
<tr>
<td>kWh</td>
</tr>
<tr>
<td><strong>Parameter value type</strong></td>
</tr>
<tr>
<td>float</td>
</tr>
</tbody>
</table>

**Description**
Total energy consumption in the collection period on the cold site, including the power consumption of cooling towers, cooling water pumps, chilled water pumps, and chillers. (The sample data collection period is one hour.)

---

**Step 7** Perform the following operations as required if you are a service expert.

- Right-click the icon of an unnecessary parameter and choose **Delete** from the shortcut menu to delete the parameter. Then, click **Save** for the parameter deletion to take effect.

- Click **Add**. A dialog box is displayed, as shown in **Figure 3-11**. Select a defined parameter name from the parameter name drop-down list box and set other parameters based on the site requirements.

- Right-click a line and choose **Delete** from the shortcut menu to delete the correlation relationship between the two parameters.
• Draw a line between two icons to establish a correlation relationship.

**Figure 3-11** Adding a parameter

<table>
<thead>
<tr>
<th>Parameter Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Unit</td>
</tr>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Describe the parameter.</td>
</tr>
</tbody>
</table>

**Step 8** Click **Generate Model** and wait until the model is generated.

If the service status is **Model has been generated** in the **Status** column, the model has been generated.

---

**CAUTION**

If the service status is **RUNNING**, the foreground of the DC PUE optimization model generation service platform keeps sending messages to the background to query the current service status. Even if the platform access times out, the interface for querying service status keeps sending query messages to the background and the messages do not time out. When the service status changes to **FINISHED**, the interface automatically stops querying the service status.

---

### 3.5 Evaluating a Model

Model evaluation is to obtain some data that is not used for training from historical data packages and evaluate the model.

**Step 1** Click **corresponding to a service in the Operation column.** The model evaluation starts and a model evaluation report is generated, as shown in **Figure 3-12**.

The red curve represents the actual energy consumption of the cooling station. The black curve represents the predicted energy consumption of the cooling station, which is deduced...
from the AI model. The more the red curve overlaps the black curve, the smaller the deviation is and the more accurate the AI model is. If the precision in the evaluation report is less than 95%, adjust the parameter topology on the Advanced tab page. For example, you can add, delete, and modify a fitting relationship between a correlative parameter and a control variable or environment variable, and add, delete, and modify a correlative parameter. After the modification is complete, generate a new model.

**Figure 3-12** Model evaluation report

![Model evaluation report](image)

- **Step 2** Drag the scroll bar shown in **Figure 3-12**.
  For example, if the current data is from 2018-9-22 to 2018-10-22, drag the scroll bar to narrow down the range. You can view the curve fitting information of a day in the chart.

- **Step 3** Click **Back** to close the model evaluation report.

--- End

### 3.6 Downloading a Model Package

Click corresponding a service in the **Operation** to download the executable file generated by the model.

### 3.7 Verifying a Model

You need to upload a new dataset for model verification.

- **Step 1** Click corresponding to a service in the **Operation** column.
  The model verification page is displayed.

- **Step 2** Click the icon shown in **Figure 3-13** to upload a new dataset for model verification.
You can click Sample Dataset to download the sample dataset and view its format, and then upload the sample data package predictTemplate.zip to verify the model.

**Figure 3-13** Uploading a dataset

![Upload Dataset](image)

**Step 3** Click Run. The system starts to verify the model.

After the model verification is complete, a model evaluation report is generated. The report is displayed on the Optimization Result tab page, which contains the Expected Energy Saving Effect and Energy Saving Control Policy areas, as shown in **Figure 3-14**.

- **Expected Energy Saving Effect**: View the bar chart of the predicted energy saving effects. You can drag the scroll bar below the chart to narrow down the time range and view the data of a certain day or time.

- **Energy Saving Control Policy**: View the adjustment value of the AI energy saving control policy in different time segments compared with the original control policy. You can adjust the value of a control parameter of the data center based on the data in the Adjusted Value row.

**Figure 3-14** Optimization result

![Optimization Result](image)

**Step 4** Click Back to return to the domain service home page.

---End
3.8 Other Operations

**Step 1** Click Learn More in the row where a service is located to view all reference documents of the DC PUE optimization model generation service.

**Step 2** Click Generate Model corresponding to a service in the Operation column and reconfigure the information on the HVAC System Configuration, Selecting Data, and Training Configuration pages.

**Step 3** Click More corresponding to a service in the Operation column and select Delete from the drop-down list box to delete the service.

----End
4 FAQs

4.1 What Factors Can Affect the PUE

The following factors can affect the PUE:
- Power consumption of non-IT systems, including cooling systems, such as the compressors, pumps, fans, and air conditioners.
- Power loss of the power supply and distribution systems.

4.2 What Are the Measures to Lower the PUE

The following measures can lower the PUE:
- Improve the working efficiency of the cooling systems to reduce the costs of heat exchange.
- Optimize the power supply and distribution systems to improve the power conversion efficiency.

4.3 How Can We Optimize Cooling Systems

The cooling systems can be optimized in the following ways:
- Accurately calculate the cooling capacity to match the IT heat sources.
- Improve the working efficiency of each device, for example, making full use of the optimal working ranges of compressors and pumps.
- Improve the working efficiency of each system, for example, properly adjusting the ratio of compressors to pump.
- Set the best working parameters for the systems, for example, setting the ratio of cooling towers to water chillers, setting parameter linkage between cooling towers and water chillers, and setting parameter linkage between water chillers and end systems.
Power Usage Effectiveness (PUE) is used to measure the energy efficiency of data centers. If the PUE value is 2, it indicates that when an IT device consumes electricity of 1 watt, additional electricity of 1 watt needs to be consumed to cool and power the IT device. If the PUE value is close to 1, almost all power is consumed for device running.