SAS® Energy Distribution Optimization 5.1

Administrator's Guide

The correct bibliographic citation for this manual is as follows: SAS Institute Inc. 2014. *SAS® Energy Distribution Optimization 5.1: Administrator's Guide*. Cary, NC: SAS Institute Inc.

SAS® Energy Distribution Optimization 5.1: Administrator's Guide

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June 2014

Contents

Using This Book . . . . . *vii*

Chapter 1 • Introduction to SAS Energy Distribution Optimization **1**
What is SAS Energy Distribution Optimization? 1
SAS Energy Distribution Optimization Architecture 2
How Does SAS Energy Distribution Optimization Work? 5
SAS Energy Distribution Optimization and SAS Visual Analytics 8

Chapter 2 • Installation and Configuration Tasks **9**
Installation Overview 9
SAS Energy Distribution Optimization User Accounts 10
Installation Of SAS Energy Distribution Optimization 10
Post-Installation Tasks 11
Configuration Settings 13

Chapter 3 • Users and Groups **17**
Defining Groups, Roles, and Users In SAS Energy Distribution Optimization 17
Manage Metadata Permissions 19

Chapter 4 • Data Management **23**
SAS Energy Distribution Optimization Data Flow Overview 23
Loading Staging Data 24
Loading Networks 26
Adding Networks 26
Updating Networks 27
Reloading Data 27
Loading Device Settings 27

Chapter 5 • Data Dictionary **29**
SAS Energy Distribution Optimization Data Mart 29
BUS_OPTO_X_Y_Z Table 30

GLOB_BASE_OPT_LOSS_X_Y_Z Table 32
GLOB_RR_LOSS_REPORT_X_Y_Z Table 34
GLOB_O_REPORT_VOL_ANG_X_Y_Z Table 35
GLOB_TRAN_INI_OPT_SET_X_Y_Z Table 36
GLOB_CAP_INI_OPT_SET_X_Y_Z Table 37
INJECTION_IF_X_Y_Z Table 38
GLOB_BASE_LOSS_X_Y_Z Table 39

Index **41**

Using This Book

Audience

The *SAS Energy Distribution Optimization: Administrator's Guide* contains information that are related to installation, system administration, data management, and application environment setup in SAS Energy Distribution Optimization. For more information about working with SAS Energy Distribution Optimization to create optimization plans, view and analyze the optimization results, view reports, and monitor performance indicators of the various substation banks, see the *SAS Energy Distribution Optimization: User's Guide*.

The *SAS Energy Distribution Optimization: Administrator's Guide* is designed for the following users:

- Data and system administrators responsible for installing SAS Energy Distribution Optimization and related SAS software, managing the SAS Energy Distribution Optimization data mart, and providing administration services for SAS Energy Distribution Optimization.
- Grid engineers in the operations and maintenance community who are interested in the creating and managing the optimization routines. Grid engineers primarily use the information in the *SAS Energy Distribution Optimization: User's Guide*. However, they might refer to the *SAS Energy Distribution Optimization: Administrator's Guide* for information about creating output tables for analytical cases or how to customize the SAS Energy Distribution Optimization configuration settings.

1

Introduction to SAS Energy Distribution Optimization

What is SAS Energy Distribution Optimization? 1

SAS Energy Distribution Optimization Architecture 2

How Does SAS Energy Distribution Optimization Work? 5

SAS Energy Distribution Optimization and SAS Visual Analytics 8

What is SAS Energy Distribution Optimization?

SAS Energy Distribution Optimization enables electric distribution companies to optimize the performance of electric distribution networks through advanced analytical methods such as loss minimization and conservation voltage reduction (CVR). It uses smart grid technology to collect data from passive or active devices located in substations and along distribution feeders to forecast performance. This data provides recommendations for the optimal switching of devices such as voltage regulators, transformer load tap changers, static volt-ampere reactive (VAR) compensators, capacitors, and synchronous condensers or generators. The optimal device settings reduce transmission and distribution losses, minimize electricity consumption, improve voltage profiles, conserve energy, and manage peak load through voltage reduction.

The optimization results help the operators, engineers, and managers of the electric distribution companies to decide how best to minimizie the network operating cost and achieve demand reduction without violating regulatory or industry limits for consumers. It minimizes the cost of energy and facilitates the introduction of new technologies, such as wind power, solar power, storage, and micro-generation technologies.

Here are some of the key features of SAS Energy Distribution Optimization:

- Uses energy forecasts to develop an hourly load curve for each utility network that is applied to individual network loads. SAS Energy Distribution Optimization also contains features to modify the existing settings of the electric load based on the current environmental factors affecting the electric demand of the utility.
- Recommends the accurate tap settings for voltage regulators that are located in the substations and along distribution feeders to regulate the power flow. The recommended settings can minimize losses and increase the electricity savings of the substation.
- Recommends the optimal voltage levels required for each device to operate the distribution system and minimize the electricity demand. The suggested voltage levels help to reduce electricity consumption and to minimize the need for rolling blackouts during critical peak periods.
- Provides reactive power support for the transmission and distribution bus and increases efficiency by reducing system loss caused by reactive power.
- Displays the automated reports of the optimization results using interactive graphs in the dashboard.

SAS Energy Distribution Optimization Architecture

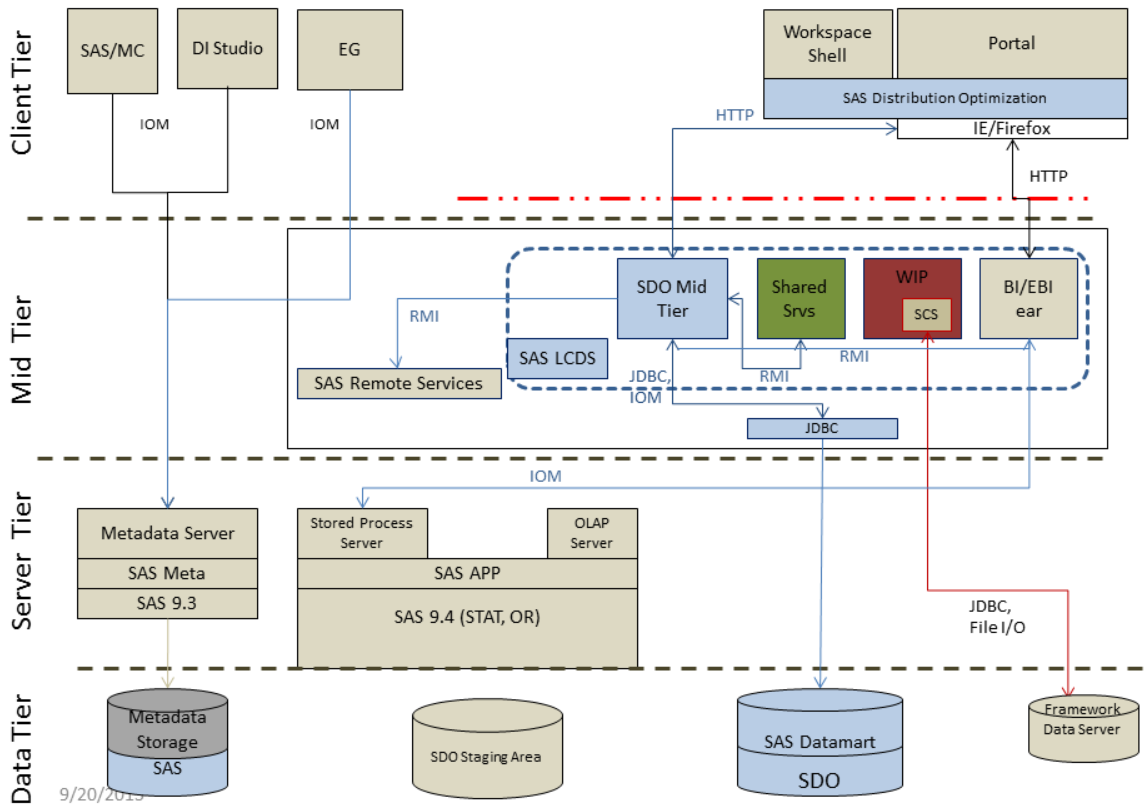
SAS Energy Distribution Optimization uses a multi-tiered architectural style to process large volumes of network data and produce results used to perform load flow and optimization analysis. The architecture enables the solution to use this data to support the user-driven workflow through the application user interface (UI).

A *tier* represents a conceptual category of software components that perform similar types of computing tasks and that require similar types of resources. Different tiers do not necessarily represent separate computers or groups of computers. More than one computer can be used for a specified tier as well. You can scale the architecture to meet the demands of your workload. For a large organization, the tiers can be installed across many machines with different operating systems. For tasks such as developing prototypes and presenting demonstrations, all the tiers can be installed on a single machine. Similarly, if you are implementing SAS Energy Distribution Optimization for small enterprises, then you can install all the tiers on a single machine.

To view the latest system requirements for your system, access `http://support.sas.com` and select **Install Center** under **Knowledge Base**.

The following diagram illustrates the relationship of these tiers to one another.

Display 1.1 *SAS Energy Distribution Optimization Architecture*



Client Tier

The client tier supports the SAS Energy Distribution Optimization UI content and applications. It interfaces with the server tier and enables you to compute the optimization results. The client tier also supports the other clients that you use with SAS Energy Distribution Optimization, such as SAS Management Console, SAS Data Integration Studio, and SAS Enterprise Guide.

The client tier uses an HTTP- or HTTPS-based communication model to communicate with the middle tier.

Middle Tier

The middle tier fulfills client requests by applying business criteria and by controlling access to shared resources. The applications run in a web application server and communicate with the user by sending and receiving data from the user's web browser. These include standard operations, such as configuration, authentication, schedule batch processing, and so on.

The middle-tier applications depend on the servers that are deployed on the server tier to process, query on, and analyze data.

Server Tier

The server tier uses the SAS Metadata Server, the SAS Stored Process Server, and the SAS OLAP Server to fulfill user requests from client programs (through middle-tier services) and other programs. SAS Management Console and the SAS Metadata Server help administer the SAS Energy Distribution Optimization users, groups, and roles.

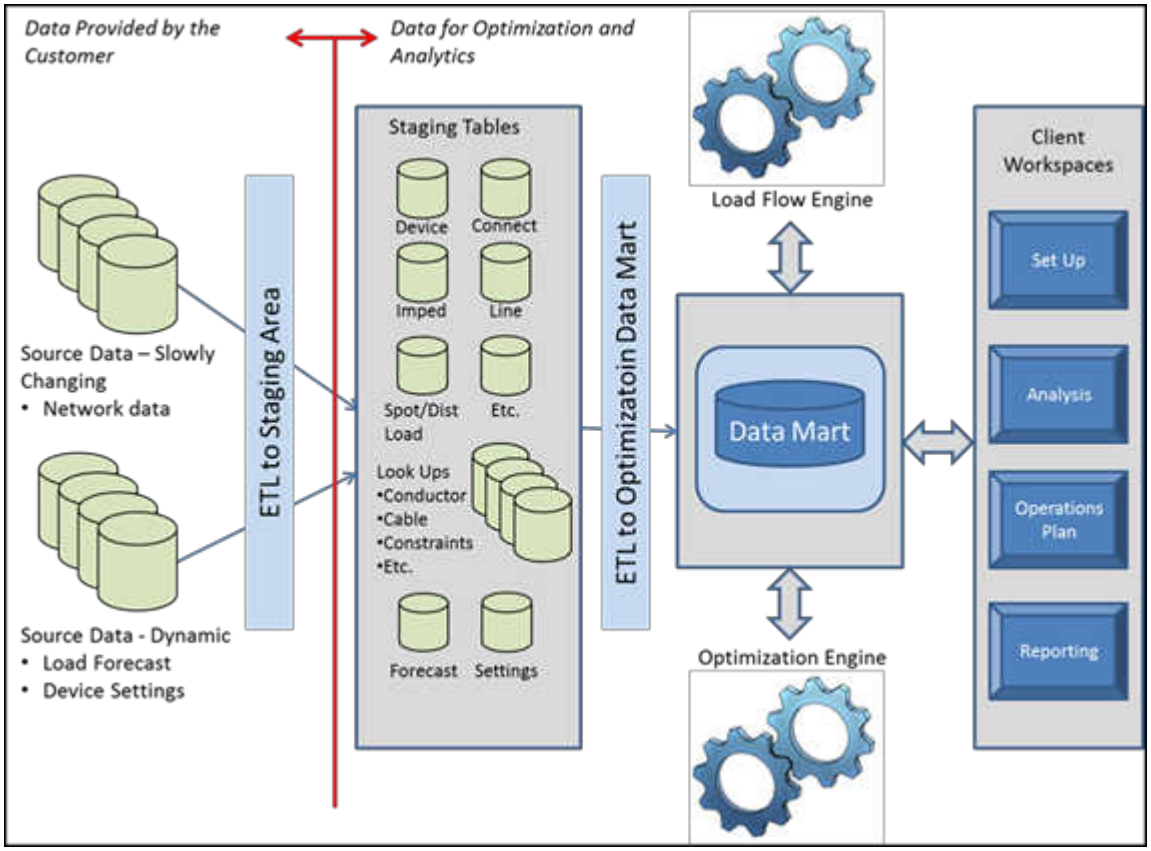
Data Tier

The data tier is where the staging data, metadata, and data selections are physically stored and maintained. It includes several sources of data for SAS Energy Distribution Optimization processes. This includes the source data that is provided in data files and created in CSV format. The data is imported into the ETL area of SAS Energy Distribution Optimization, and the output data of the ETL jobs is stored in the data mart.

How Does SAS Energy Distribution Optimization Work?

The following figure shows the basic components of the SAS Energy Distribution Optimization workflow and how the components work together.

Display 1.2 *SAS Energy Distribution Optimization Workflow*



1 The network data is fetched into SAS Energy Distribution Optimization through CSV files that the customer generates. The customer data warehouse contains two types of source data—slowly changing data and dynamic data.

   - The slowly changing data provides details for the configuration of the distribution network. This data is static and associated with the network. The data is imported during initial setup and whenever infrastructure changes occur. The network data is held in a data file folder named `Customer` and updated by the customer.
   - The dynamic data provides information about the current device settings and forecasts. This data is associated with load forecasts and device settings. The data is imported daily because of its variability.

   Data administrators populate the staging area in order to prepare the data for extraction to the SAS Energy Distribution Optimization data mart.

2 The SAS Energy Distribution Optimization data mart contains the output data from SAS Energy Distribution Optimization jobs that extract, transform, and load the data from the customer data warehouse tables to the data mart. The optimized results, plans, and reports are also stored in the SAS Energy Distribution Optimization data mart.

   The network data provided by the customer is transformed into SAS data sets that are later used to perform load flow and optimization analysis. The transformed data tables are placed into the staging area.

   The dynamic data from the `Customer` folder is used to update the data tables in the staging area during each run instance of the optimization process.

3 When the run instance is started in SAS Energy Distribution Optimization, data from the staging area is placed into the data mart and accessed by the load flow and optimization engines.

   - During initial load flow analysis, input data is taken from the data mart and output results are placed back into the data mart.
   - During optimization analysis, the input data files from the data mart and the output data files from the initial load flow are used to perform the CVR or loss minimization optimization. The results of the analysis are placed in output data tables and stored in the data mart.

4 The SAS Energy Distribution Optimization client provides four workspaces to schedule optimizations, analyze results, publish plans, present optimization plans, and provide reporting capabilities. For more information about working with these workspaces, see the *SAS Energy Distribution Optimization: User's Guide*.

   - The Setup workspace displays the interfaces to select the network banks for optimization, set optimization options, and schedule the optimization runs. You can also view the optimization status of the runs and individual banks.

     The input and output data tables located in the SAS Energy Distribution Optimization data mart are accessed by the user during optimization. After the optimization is complete, the results are written back to the data mart and displayed in the Analysis workspace.

- The Analysis workspace displays the results of optimization runs and tools for selecting banks to be included in the optimization plans. These tools include filters for viewing the result sets based on specific criteria, visual aids for selecting networks, and summary views providing overviews for the current interval and overall plan. Once a plan is published, it is displayed in the Operations workspace.

  The published plans developed by the grid engineer are stored in output data tables and located in the data mart for future access. This data is used for generating reports.

- The Operations workspace displays the results of the optimized plan after the plan is published from the Analysis workspace. This workspace includes both interval and summary views of the plan schedules.

- The Reporting workspace displays the optimization results using interactive graphs in the dashboard for report generation and viewing. Multiple reports summarizing the results of published plans can be created for specific days or date ranges.

SAS Energy Distribution Optimization and SAS Visual Analytics

SAS Energy Distribution Optimization uses SAS Visual Analytics to build insightful and highly visual reports to display the loss minimization and CVR optimization results. SAS Visual Analytics helps you explore your data using interactive visualizations such as charts, histograms, and tables. You can select the day or date range to generate the reports of the optimized plans that are published during the selected period. The graphical reports are generated as a time graph or a bar chart. You can also view these reports in a PDF format.

Note: Ensure that the SAS Visual Analytics server (SaSserver12) is active while you are creating reports in PDF.

2

Installation and Configuration Tasks

Installation Overview 9

SAS Energy Distribution Optimization User Accounts 10

Installation Of SAS Energy Distribution Optimization 10

Post-Installation Tasks 11
- Verifying the Instructions File 11
- Setting Folder Permissions 12
- Loading Sample Data 12
- Accessing the SAS Energy Distribution Optimization Application 13

Configuration Settings 13
- Setting Concurrent Background Jobs 13
- Modifying the Optimization Time-out Value 14
- Modifying the Warning Time-out Value 15

Installation Overview

Use the SAS Deployment Wizard to install and configure SAS and related products that are included in your deployment plan. To begin the installation, follow the instructions in the *SAS Intelligence Platform: Installation and Configuration Guide*, which is available at the following location: `http://support.sas.com/documentation/onlinedoc/intellplatform/index.html`.

Before you begin to install SAS Energy Distribution Optimization, review the *SAS Pre-Installation Checklist* that is provided with your deployment plan. This checklist provides a detailed list of the pre-installation requirements. It also enables you to record important information that you will need when you are installing the software.

SAS Energy Distribution Optimization User Accounts

SAS Energy Distribution Optimization uses the standard user accounts and groups that SAS uses. See the pre-installation checklist that is included in the deployment plan for details about standard user accounts and groups. For information about creating groups and adding user accounts for specific environments, see your Linux or Windows documentation.

Prior to installation, two users must exist on the operating system of the machine that you will use to install SAS Energy Distribution Optimization. You can use different account names from the examples provided, but the accounts should be separate.

- The first account is needed for the SAS Spawned Servers account (for example, *mydomain\sassrv*).
- The second account is used for the SAS Energy Distribution Optimization Server user account (for example, *mydomain\sasedouser)*.

Both of these accounts need full access to the **`EnergyDistributionOptimization`** folder, and all descendant folders, under **`SASConfig\Lev1\SASApp\Data`**.

Installation Of SAS Energy Distribution Optimization

During installation, the SAS Deployment Wizard displays certain prompts that are specific to SAS Energy Distribution Optimization. The following list describes the SAS Energy Distribution Optimization prompts:

1 On the SAS Energy Distribution Optimization Server Data Server page, enter the configuration details for theSAS Energy Distribution Optimization data server. This includes the host name of the server, the port number of the database, and the user information for administering the data server.

   Click **Next**. The SAS Energy Distribution Optimization Server Database Properties page appears.

2 Specify the connection information for the database properties. This includes the database schema name for your SAS Energy Distribution Optimization tables and the user information.

   Note: The user must be different from the details of the administrator account of the data server page that you set previously.

   Click **Next**. The External Account: SAS Energy Distribution Optimization page appears.

3 Specify the credentials for the external account to launch the workspace servers. The user ID should be in the domain\userID or machine\userID format (specific to Windows).

   Click **Next**. The SAS Energy Distribution Optimization Mid-Tier Data Source page appears.

4 Specify the credentials required for the SAS Energy Distribution Optimization mid-tier's database information. The user is created with limited access to the database.

Post-Installation Tasks

Verifying the Instructions File

At the end of the installation process, the SAS Deployment Wizard creates an instructions file called `Instructions.html` in the `Documents` directory in your SAS configuration directory. The `Instructions.html` file contains additional information

and details for configuring your installation. You can review this file for any additional steps to your installation.

Setting Folder Permissions

The SAS Spawned Servers (sassrv) and SAS Energy Distribution Optimization Server User (sasedouser) accounts are created prior to the installation of SAS Energy Distribution Optimization. Post-installation, you need to provide full access (read, write, delete, and list) to all the descendant folders under **`SASConfig\Lev1\SASApp\Data\EnergyDistributionOptimization`**.

For Windows, you can assign folder rights to each user or create a user group containing the two users and assign rights to the group.

For LAX installations, you should assign both users to the same group, and the group should have ownership of the folder. The owner and group permissions should contain write access (chmod 775 permissions).

Loading Sample Data

You can load sample data into SAS Energy Distribution Optimization to test the optimization details.

When the installer has run, the following directory structure is created:

Display 2.1 *Directory Structure*

```
-customer
   |-initial
   |   |-hierarchy
   |
   |   |-network
   |
   |-dynamic
```

The sample data is installed in the **`Customer`** folder under the following path: **`<SASHOME>:\ProgramFiles\SASHome`**

\SASEnergyDistributionOptimizationServerConfiguration\5.1\Config\Deployment\Samples.

To load the sample data:

- Copy the **Customer** folder from the sample data location to the **EnergyDistributionOptimization** staging location at the following path: **<SASHOME>:\SAS\Config\Lev1\SASApp\Data\EnergyDistributionOptimization**.
- Using a SAS session, run the %EDOLOAD(); macro. This command loads all the networks that are listed under the **initial\network** folder. For more information, see "Loading Networks" on page 26.

Note: You can later remove the existing sample data from the system and reload data using your own networks. For more information, see "Reloading Data" on page 27.

Accessing the SAS Energy Distribution Optimization Application

You can access the SAS Energy Distribution Optimization user interface (UI) through your web browser at **http://server.host.com/SASEnergyDistributionOptimization**. The information about this URL and the port number is displayed in the **Instructions.html** file that is generated for the middle tier. You can also connect to SAS Energy Distribution Optimization from the SAS Visual Analytics Hub, if the SAS Visual Analytics server (SaSserver12) is active.

For more information about the SAS Energy Distribution Optimization user interface, see *SAS Energy Distribution Optimization: User' Guide*.

Configuration Settings

Setting Concurrent Background Jobs

You can control the number of optimizations allowed to run at one time by using a configurable setting. This setting defines the maximum number of concurrent

background jobs to run at one time. You can add this as a parameter in the **services-config.xml** file at the following path:

<SASHOME>:\sas\Config\Lev1\Web\WebAppServer\SASServer3_1\sas_webapps\sas.energydistributionoptimization.war\WEB-INF\spring-config

<bean id="taskExecutor"
class="org.springframework.scheduling.concurrent.ThreadPoolTaskExecutor"

<property name="corePoolSize" value="2" />

<property name="maxPoolSize" value="2" />

<property name="queueCapacity" value="2" />

</bean>

- The *maxPoolSize* property sets the maximum number of concurrent background jobs.
- The *corePoolSize* property defines the initial size of the pool.
- The *queueCapacity* property defines the maximum number of jobs that can wait for execution. The values for the queueCapacity property must be set equal to the maxPoolSize property.

Modifying the Optimization Time-out Value

To modify the duration of the optimization runs, edit the <*property*> value in the **WEB-INF\spring-config\services-config.xml** file. The default time-out value is 4 hours. Following is an example:

<bean name="sasMacroFactory"
class="com.sas.solutions.edo.model.sas.services.WorkspaceTaskExecutorFactory

<!– The optimization run time out in seconds. —>

<property name="macroTimeout" value="3600"/>

</bean>

Modifying the Warning Time-out Value

To modify the duration of the warning messages, edit the <*warningDuration*> value in the <*timeout*> element of the **`config.xml`** file:

`AS\Config\Lev1\Web\WebAppServer\SASServer11_1\sas_webapps\sas.energydistributionoptimizationclient.war\config.xml`.

The default time-out value is 5 minutes.

3

Users and Groups

Defining Groups, Roles, and Users In SAS Energy Distribution Optimization 17
Overview of Groups, Roles, and Users 17
Understanding User Groups 18
About Roles and Capabilities 18

Manage Metadata Permissions 19

Defining Groups, Roles, and Users In SAS Energy Distribution Optimization

Overview of Groups, Roles, and Users

To perform tasks in SAS Energy Distribution Optimization, you need to define users with the assigned roles. SAS Energy Distribution Optimization is shipped with four predefined roles: Administrator, Grid Engineer, Manager, and Operator. A predefined set of capabilities is available for each role.

Note: A SAS administrator can define new roles, modify the roles, and specify the capabilities using SAS Management Console. For more information about defining users and granting roles and capabilities, see *SAS Management Console: Guide to Users and Permissions*.

Understanding User Groups

Groups enable you to assign roles or metadata permissions to multiple users, which simplifies security administration. A group consists of users who are classified by common traits or by common data access levels. Groups are typically used to give users access to data.

The following table describes the user groups and the associated roles that are provided in your initial installation.

Table 3.1 *SAS Energy Distribution Optimization User Group Settings*

Group Name	Roles or Group Members	Description
Energy Distribution Optimization: Administrator	Energy Distribution Optimization Administrators	Enables users to delete the data created in the SAS Energy Distribution Optimization application.
Energy Distribution Optimization: Grid Engineer	Energy Distribution Optimization Grid Engineers	Enables users to create the optimization plans for SAS Energy Distribution Optimization.
Energy Distribution Optimization: Manager	Energy Distribution Optimization Managers	Enables users to create and view the optimization reports.
Energy Distribution Optimization: Operator	Energy Distribution Optimization Operators	Enables users to implement the operations plan suggested by SAS Energy Distribution Optimization.

About Roles and Capabilities

A *role* provides the ability to group users. Roles determine what a user can do within the application. You can use roles within workflows to allow a restricted set of users to perform an activity. Roles provide users with a list of capabilities. Any user or group who

is a member of a role has all the capabilities of that role. Roles differ from permissions. In general, roles do not affect access to metadata or data.

The following table describes the roles and the capabilities associated to each role in SAS Energy Distribution Optimization.

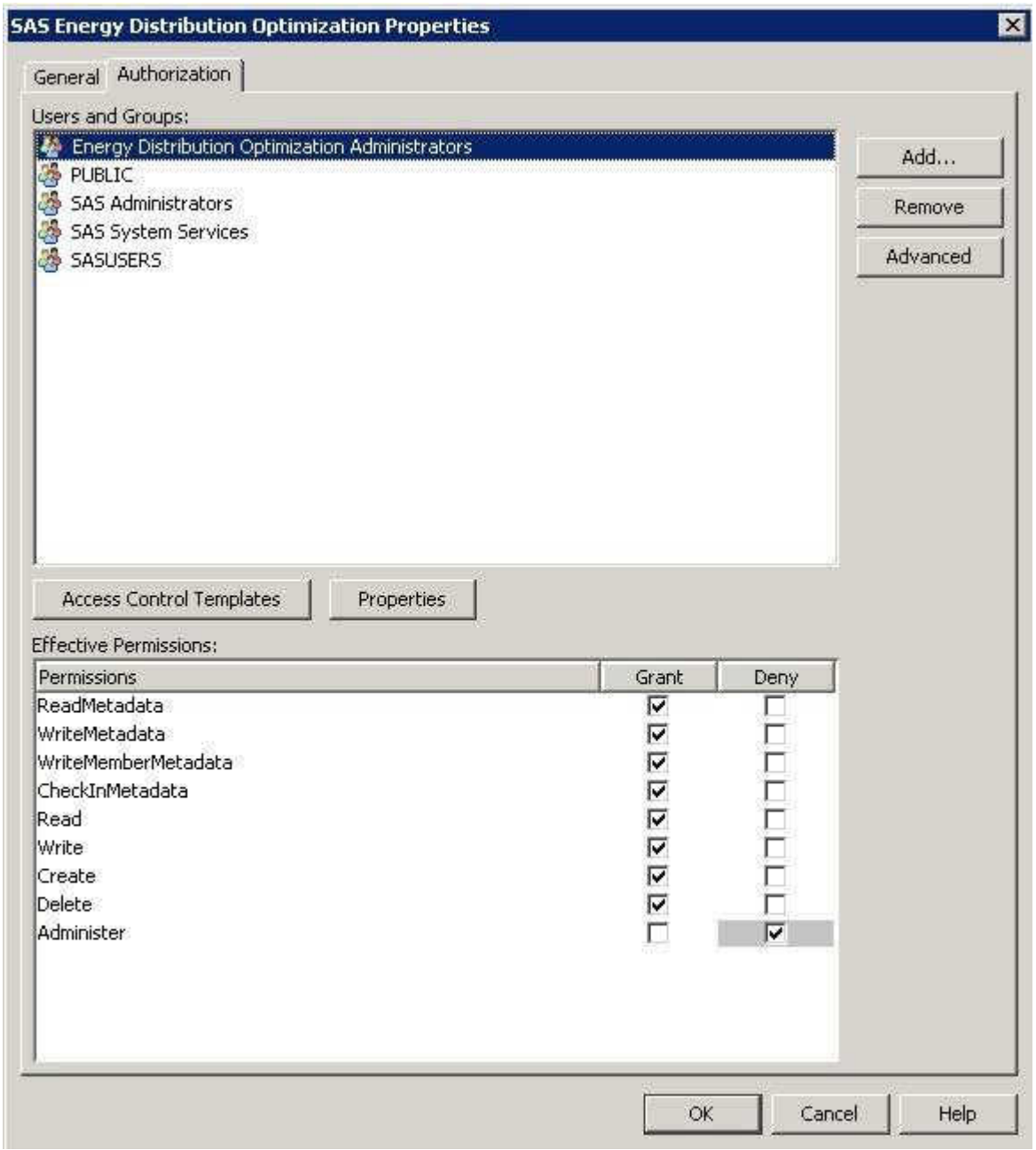
Table 3.2 *SAS Energy Distribution Optimization Capabilities*

Roles	Capabilities
Energy Distribution Optimization: Administrator	Delete LookAhead Run Delete Optimization Reports
Energy Distribution Optimization: Grid Engineer	Create LookAhead Run Schedule LookAhead Run View LookAhead Run Results Modify Operations Plan Publish Operations Plan
Energy Distribution Optimization: Manager	Create Optimization Reports View Optimization Reports
Energy Distribution Optimization: Operator	Implement Operations Plan

Manage Metadata Permissions

The user groups are defined by default on the SAS Metadata Server. You can view the metadata permissions for these user groups by using SAS Management Console.

Display 3.1 *SAS Management Console*



- The Energy Distribution Optimization Administrator user group contains the ReadMetadata, WriteMetadata, WriteMemberMetadata, CheckinMetadata, Read,

Write, Create, and Delete permissions on the following metadata folder and its subfolders:

Folders ▶ SAS Folders ▶ Products ▶ SAS Energy Distribution Optimization

- The Energy Distribution Optimization Manager user group contains the ReadMetadata, WriteMetadata, WriteMemberMetadata, CheckinMetadata, Read, Write, and Create permissions on the following metadata folder:

  Folders ▶ SAS Folders ▶ Products ▶ SAS Energy Distribution Optimization ▶ Reports

4

Data Management

SAS Energy Distribution Optimization Data Flow Overview 23
Loading Staging Data 24
Loading Networks 26
Adding Networks 26
Updating Networks 27
Reloading Data 27
Loading Device Settings 27

SAS Energy Distribution Optimization Data Flow Overview

SAS Energy Distribution Optimization imports source data files that are in CSV format into the ETL area of SAS Energy Distribution Optimization. The data is then processed into the SAS Energy Distribution Optimization data mart. This data mart contains the output data from the ETL jobs. For more information about the output data, see “Data Dictionary” on page 29.

The following sections describe the process to load data after the installation is complete.

Loading Staging Data

Source data contains the customer–provided network data. The input files for this data include files that define their network, the dynamic device settings, and the dynamic load forecast. In SAS Energy Distribution Optimization, a network is defined as a substation transformer bank that contains data files for each feeder of that substation transformer bank. For example, if a substation consists of two transformers that are connected by an open transfer switch, each transformer is considered as a separate network and contains the feeders served by that transformer. These input files should be placed at **`SASApp/Data/EnergyDistributionOptimization/`**.

When the installer has run, the following directory structure is created:

Display 4.1 *Directory Structure*

```
-customer
   |-initial
   |    |-hierarchy
   |
   |    |-network
   |
   |-dynamic
```

Note: The sasedoos user requires Read permission for each folder to access the directory listings.

The **`Customer`** folder contains two subfolders: **`initial`** and **`dynamic`**.

- The **`initial`** folder should contain those network data files that are primarily static, only changing with infrastructure changes. This data includes files that describe the hierarchy of the system network to be studied, network configuration files, and zip load models.
- The **`dynamic`** folder should contain data that is dynamic in nature, such as the dynamic device settings and forecasted data. The forecast data can be a mixture of the annual forecast, daily forecast, and actual loads. When the optimization has run

for any forecast period (future, current, or past), the forecast data from this folder is loaded.

Both these folders contain additional folders that list each unique network name in separate folders, as follows:

Display 4.2 *Network Names*

```
-customer
   |-initial
   |    |-hierarchy
   |    | |-hier.csv
   |    |-network
   |      |-Unique Network Name 1
   |      | |-Network files
   |      |-Unique Network Name 2
   |        |-Network files
   |
   |-dynamic
       |-Unique Network Name 1
       | |-capacitor_setting.csv
       | |-regulator_setting.csv
       | |-transformer_setting.csv
       | |-feederName1_forecast.csv
       | |-feederName2_forecast.csv
       |-Unique Network Name 2
         |-capacitor_setting.csv
         |-regulator_setting.csv
         |-transformer_setting.csv
         |-feederName1_forecast.csv
         |-feederName2_forecast.csv
```

The forecast for each feeder is contained in a separate file within the unique network name folder. The filename is the feeder name that is provided in the **`feeder.csv`** file (for example, **`feeder Name 1_forecast.csv`**).

The timestamp format of the forecast data is provided in the UTC timezone format (+00:00).

For more information about the input data files in SAS Energy Distribution Optimization, see the *Instructions for Importing Utility Data into EDO Document*.

Loading Networks

You need to load the staged data into the SAS Energy Distribution Optimization data model.

To run the macro, you must be an administrator and have access to the EDO librefs to run the macros from the following path: **`%install root%/%config%/%level%/sasapp`**. This path is configured during installation.

Windows example: **`CD <SASHOME>:\sas\config\lev1\sasappRun sas.bat -metauser sasadm@saspw -metapass<password>`**.

Linux example: **`cd /install/cfgsas94/SASConfig/Lev1/SASAppRun sas.sh -metauser sasadm@saspw -metapass<password>`**.

Using a SAS session, run the %EDOLOAD(); macro. This macro loads all the networks that are listed under the **`initial\network`** folder.

Adding Networks

Once the initial data is loaded, you can add networks using the %EDOADNET; macro. This macro compares the network data file directory and the PHYSICAL_NETWORK table to search new networks. If new networks are found under **`C:\SAS\Config\Lev1\SASApp\Data\EnergyDistributionOptimization\customer\initial\network`**, the network is automatically loaded into the system.

Note: As a best practice, stop the SAS Energy Distribution Optimization web server before you add the data and restart it once the update is complete.

Updating Networks

If the physical network, spot load, or zip model changes, you can update the networks using the %EDOUPNET(pnet_name=unique network name);`%edoupnet` macro. This macro reloads the network definition and supporting data. The update invalidates any optimizations that were created prior to the network update.

Note: As a best practice, stop the SAS Energy Distribution Optimization web server before the data update and restart it once the update is complete.

Reloading Data

You can remove all the existing data from the system and reload it using the %EDORESET(); macro.

If any of the installation parameters are different from the defaults, you can use the longer form of the macro %EDORESET (usr_name=sasedodbusr, edo_server=localhost, edo_port=9732, edo_authdomain=sasedo, edo_database=sasedo);

Note: As a best practice, stop the SAS Energy Distribution Optimization web server before you reset the data and start it once the update is complete.

Loading Device Settings

The optimization starts during the ETL phase and the folder, files, and formats for dynamic device settings are checked. Each unique network name (the unique name used in the initial loading of data) is listed in a separate folder. This folder contains a separate file for each device type (**`capacitor_setting.csv`**,

regulator_setting.csv, and **transformer_setting.csv**) and a forecast file for each feeder (**feedername_forecast.csv**).

The device files contain the unique ID provided by the customer for each device and the latest settings. The device filenames should match the device names in the network definition when the initial data was loaded. The forecast files contain the UTC-based Date/Time column, KW column, and KVAR column.

A valid forecast file for each feeder is required for the specified optimization period. If dynamic device settings are provided with the proper name and format, the settings are used as the starting point for optimization. Otherwise, the system uses the last provided settings.

5

Data Dictionary

SAS Energy Distribution Optimization Data Mart 29
BUS_OPTO_X_Y_Z Table 30
GLOB_BASE_OPT_LOSS_X_Y_Z Table 32
GLOB_RR_LOSS_REPORT_X_Y_Z Table 34
GLOB_O_REPORT_VOL_ANG_X_Y_Z Table 35
GLOB_TRAN_INI_OPT_SET_X_Y_Z Table 36
GLOB_CAP_INI_OPT_SET_X_Y_Z Table 37
INJECTION_IF_X_Y_Z Table 38
GLOB_BASE_LOSS_X_Y_Z Table 39

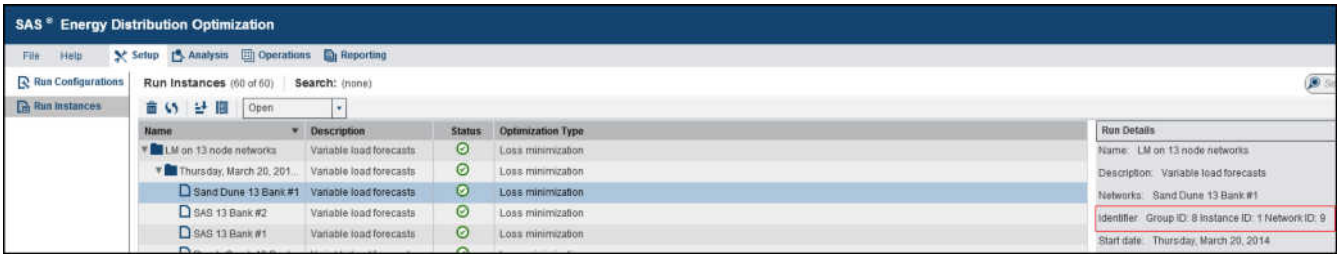
SAS Energy Distribution Optimization Data Mart

The SAS Energy Distribution Optimization data mart contains tables that are populated with the output data from the SAS Energy Distribution Optimization jobs that extract, transform, and load (ETL) data from the data warehouse tables to the data mart. You can access these output tables for ad hoc analysis. The tables capture the voltage, phase, angle, and loading for each bus at the system level. This data allows you to study the circuit or branch loading over time, voltage level at different buses, and so on.

The tables are found in the following library: **<SASHOME>:\SAS\Config\Lev1\SASApp\Data\EnergyDistributionOptimization\dstopt**.

The file names are appended with three numbers (_x_y_z) that represent the run group ID, instance ID, and bank ID. You can view these IDs in the SAS Energy Distribution Optimization user interface (UI). The IDs are displayed in the **Identifier Group ID** field under the Run Details pane.

Display 5.1 *Runs Identifier*



BUS_OPTO_X_Y_Z Table

This table contains data that describes the voltage, angle, and power for each bus in the bank. It contains the initial load flow and optimal load flow results. All calculated values are in per unit measures based on the substation transformer rating. Values are used to calculate the bank load and capture the savings from optimization. The values are used to assess the overall loading on the circuit or the loading on a branch.

Table 5.1 *Column Description of BUS_OPTO_X_Y_Z Table*

Column Name	Data Type	Length	Description
bus_id	Numeric	8	Indicates the unique ID assigned to each bus. Each bus can be linked back to its original name through the bus_data_opmod_x_y_z table.
phase_no	Numeric	8	Indicates the phase number of the bus.
interval_ID	Numeric	8	Defines the run interval that the data represents.
voltage	Numeric	8	Indicates the initial voltage for each bus.
voltage0	Numeric	8	Indicates the optimal voltage for each bus.
angle	Numeric	8	Indicates the initial angle for each bus.
angle0	Numeric	8	Indicates the optimal angle for each bus.
opt_p_inj	Numeric	8	Indicates the optimal p injection at each bus.
init_p_inj	Numeric	8	Indicates the initial p injection for each bus.
opt_q_inj	Numeric	8	Indicates the optimal q injection for each bus.

Column Name	Data Type	Length	Description
init_q_inj	Numeric	8	Indicates the initial q injection for each bus.
p_load	Numeric	8	Indicates the real power load at the bus.
q_load	Numeric	8	Indicates the reactive power load at the bus.

GLOB_BASE_OPT_LOSS_X_Y_Z Table

This table captures the initial loss results and the optimal loss results for each interval. These values are used to capture the actual savings based on the banks selected in the operations plan.

Table 5.2 *Column Description of the GLOB_BASE_OPT_LOSS_X_Y_Z Table*

Column Name	Data Type	Length	Description
interval_ID	Numeric	8	Defines the run interval that the data represents.
Base_loss	Numeric	8	Indicates the bank level loss for each interval based on the initial load flow run.
Opt_loss	Numeric	8	Indicates the bank level loss for each interval based on the optimal load flow run.

Column Name	Data Type	Length	Description
Opt_sol_status	Character	7	Indicates the solution status returned by the NLP solver (for internal reference).
lf_obj	Numeric	8	Indicates the value of the load flow objective function returned by the NLP solver (for internal reference).
volt_violation	Numeric	8	Indicates the value of the load flow with voltage violation for the 10% rule (for internal reference).
Opt_num_status	Numeric	8	Represents the sum of slack variables from optimization (for internal reference).
LF_status	Numeric	8	Indicates the final status of the load flow.
Round_id	Numeric	8	Indicates the iteration rounds for optimization (for internal reference).
LF_volt_status_5pct	Numeric	8	Indicates the value of the load flow with voltage violation for the 5% rule (for internal reference).
OPT_status	Numeric	8	Indicates the final optimization status of loss minimization.

GLOB_RR_LOSS_REPORT_X_Y_Z Table

This table captures the updated load flow results after a new bank is included in the operations plan. Future interval load flow results are based on these new settings. The Reporting workspace uses these values to capture the savings for the plan over a period of time.

Table 5.3 *Column Description of the GLOB_RR_LOSS_REPORT_X_Y_Z Table*

Column Name	Data Type	Length	Description
interval_ID	Numeric	8	Defines the run interval that the data represents.
Base_loss	Numeric	8	Indicates the bank level loss for each interval when a bank is selected for the plan interval and the load flow is run again.
LF_status	Numeric	8	Indicates the final status of the load flow.
Opt_loss	Numeric	8	Indicates the bank level loss for each interval based on the optimal load flow run.
OPT_status	Numeric	8	Indicates the final status of the loss minimization optimization.

GLOB_O_REPORT_VOL_ANG_X_Y_Z Table

This table describes the bus voltage and angle for each interval. The table reports the lowest node voltage after optimization to the Analysis workspace.

Table 5.4 *Column Description of the GLOB_O_REPORT_VOL_ANG_X_Y_Z Table*

Column Name	Data Type	Length	Description
bus_id	Numeric	8	Indicates the unique ID assigned to each bus.
phase_no	Numeric	8	Indicates the phase number for the corresponding bus voltage and angle.
interval_ID	Numeric	8	Defines the run interval that the data represents.
bus_voltage0	Numeric	8	Defines the per unit (PU) bus voltage.
bus_angle	Numeric	8	Defines the PU bus angle.
voltage_type	Character	3	Indicates whether the voltage type is line to line or line to ground.
nodal_voltage	Numeric	8	Indicates the bus voltage after optimization.

GLOB_TRAN_INI_OPT_SET_X_Y_Z Table

This table captures the regulator and transformer tap settings and the percentage of voltage change resulting from these settings.

Table 5.5 *Column Description of the GLOB_TRAN_INI_OPT_SET_X_Y_Z Table*

Column Name	Data Type	Length	Description
interval_id	Numeric	8	Defines the run interval that the data represents.
branch_id	Numeric	8	Indicates the unique ID assigned to each branch.
from_bus	Numeric	8	Represents the starting point for the branch segment.
to_bus	Numeric	8	Represents the ending point for the branch segment.
branch_type	Numeric	8	Represents the connection type for the branch.
branch_tap_low0	Numeric	8	Indicates the initial setting for a regulator tap.
phase_no	Numeric	8	Represents the phase number, such as 1 for phase A, 2 for phase B, and 3 for phase C.

Column Name	Data Type	Length	Description
phase_flag	Numeric	8	Indicates whether the phase is missing.
tran_switch	Numeric	8	Indicates whether a transformer has switch taps.
opt_branch_tap_low	Numeric	8	Indicates the optimal tap setting in the format of a continuous number.
opt_tap_step	Numeric	8	Indicates the optimal tap setting in the format of an integer number.

GLOB_CAP_INI_OPT_SET_X_Y_Z Table

This table captures the capacitor settings before and after the run.

Table 5.6 *Column Description of the GLOB_CAP_INI_OPT_SET_X_Y_Z Table*

Column Name	Data Type	Length	Description
interval_id	Numeric	8	Defines the run interval that the data represents.
bus_id	Numeric	8	Indicates the unique ID assigned to each bus.
bus_b_shunt_0	Numeric	8	Represents the KVAR value of the phase.

Column Name	Data Type	Length	Description
bus_b_shunt_init	Numeric	8	Represents the initial switch status of the phase.
cap_switch	Numeric	8	Indicates whether the device can be switched..
phase_no	Numeric	8	Represents the phase number, such as 1 for phase A, 2 for phase B, and 3 for phase C.
phase_flag	Numeric	8	Indicates whether the phase is missing.
switch_flag	Numeric	8	Indicates whether the phase can be switched in case of a missing phase.
opt_bus_b_shunt	Numeric	8	Represents the optimal switch status of the phase.

INJECTION_IF_X_Y_Z Table

This table captures the P and Q injection at each bus. It is used to calculate the power factor and kvar values.

Table 5.7 Column Description of the INJECTION_IF_X_Y_Z Table

Column Name	Data Type	Length	Description
bus_id	Numeric	8	Indicates the unique ID assigned to each bus.
phase_no	Numeric	8	Indicates the phase number for the corresponding bus voltage and angle.
interval_ID	Numeric	8	Defines the run interval that the data represents.
global_p_injection	Numeric	8	Indicates the real power injection at each bus.
global_q_injection	Numeric	8	Indicates the reactive power injection at each bus.

GLOB_BASE_LOSS_X_Y_Z Table

This table captures the system–level base loss for the initial load flow runs at each interval.

Table 5.8 Column Description of the GLOB_BASE_LOSS_X_Y_Z Table

Column Name	Data Type	Length	Description
interval_ID	Numeric	8	Indicates the unique ID assigned to each bus.

Column Name	Data Type	Length	Description
Base_loss	Numeric	8	Indicates the system–level loss for each interval.
Lf_sol_status	Numeric	8	Indicates the solution status returned by the NLP solver (for internal reference).
Lf_num_status	Numeric	8	Represents the sum of slack variables in the load flow run (for internal reference).
LF_volt_status	Numeric	8	Indicates whether the load flow has a voltage violation for the 10% rule (for internal reference).
LF_volt_status_5pct	Numeric	8	Indicates whether the load flow has a voltage violation for the 5% rule (for internal reference).
Lf_obj	Numeric	8	Indicates the value of the load flow objective function returned by the NLP solver (for internal reference).
run-time	Numeric	8	Represents the run time of the load flow.
Lf_status	Numeric	8	Indicates the final status of the load flow.

Index

A

architecture 4
  solution workflow 5

C

concurrent background jobs
    settings 13

D

data loading
  loading staging data 24
data mart output tables 29
data reloading 27
device settings 27

I

installation tasks 10
  post-installation tasks 11
  pre-installation tasks 9

M

metadata permissions 19

N

network data
  adding networks 26
  loading networks 26
  updating networks 27

S

SAS Visual Analytics 8

T

time-out values
  modifying optimization time-out value 14
  modifying warning time-out value 15

U

user capabilities 18

user roles 18