zenon manual
Load Management

v.7.20
Contents

1. Welcome to COPA-DATA help ........................................................................................................................................ 5

2. Load Management .................................................................................................................................................... 5

3. Introduction ................................................................................................................................................................. 6
   3.1 Initial situation in the electricity industry ................................................................................................................ 6
   3.2 Initial situation in the natural gas industry .............................................................................................................. 7
   3.3 Aims of an economic management ....................................................................................................................... 7

4. Functionality of the whole system .............................................................................................................................. 7
   4.1 Function of the system when electricity is used as the power source ................................................................. 8
   4.2 Function of the system when natural gas is used as the power source ............................................................. 8
   4.3 Principal thoughts .................................................................................................................................................. 9
      4.3.1 Options in order to influence the output in the electrical power area ......................................................... 10
      4.3.2 Options in order to influence the output in the gas area ............................................................................ 12
      4.3.3 Power consumption characteristics of devices .......................................................................................... 12

5. Load management method ........................................................................................................................................ 13
   5.1 Input values ......................................................................................................................................................... 13
   5.2 The model for the short term prognosis ................................................................................................................ 14
      5.2.1 Calculation of the correction power ............................................................................................................. 15
      5.2.2 Actual value and real value forecast ............................................................................................................ 16
      5.2.3 Lowering the supply limit ........................................................................................................................... 16
   5.3 Operating principle of the obtaining rule ................................................................................................................ 17
      5.3.1 Output determination for the devices ............................................................................................................ 18
      5.3.2 Switching process ......................................................................................................................................... 20
   5.4 Overlapping of schedule inputs ................................................................................................................................... 22

6. Multi-level combined heat and power plants (CHPs) ................................................................................................. 23
   6.1 Set value processing at CHPs ............................................................................................................................... 23
   6.2 Planned switchings for CHPs .................................................................................................................................... 24
   6.3 Priorities of CHPs ................................................................................................................................................... 24
   6.4 Time-dependent restrictions for CHPs .................................................................................................................... 25
      6.4.1 Running time according to level switching ................................................................................................. 25
7. Setting load management parameters ........................................ 28
   7.1 Minimum requirements .................................................. 30
   7.2 Load Management: Detail view of toolbars and context menus .............. 31
      7.2.1 Power grids .......................................................... 33
      7.2.2 Natural gas grids .................................................... 36
   7.3 Data for load management .............................................. 40
   7.4 Grids ............................................................................ 41
      7.4.1 Natural gas grids ...................................................... 42
   7.5 Supply area ..................................................................... 42
      7.5.1 Additional parameters for the gas supply areas ......................... 43
   7.6 Device group .................................................................... 44
      7.6.1 Additional parameters for the gas device groups ....................... 46
   7.7 Generator ....................................................................... 46
      7.7.1 Switching steps .......................................................... 48
   7.8 Device ............................................................................ 49
      7.8.1 Additional settings for the gas devices ................................. 51
   7.9 Specific elements of the natural gas grid ...................................... 52
      7.9.1 Natural gas storage ...................................................... 52
      7.9.2 Liquid gas plant .......................................................... 54
   7.10 Locking times ................................................................. 56
   7.11 Creating a process screen .................................................. 56
   7.12 Engineering the screen switch function ....................................... 57
   7.13 Create function start/stop .................................................. 59
   7.14 Engineering switching operations preview ..................................... 60
      7.14.1 Column settings for the switching operations preview ............... 61
      7.14.2 Switching operations preview in the Runtime .......................... 62

8. Internal state of the components .................................................. 63

9. Creation of the Runtime files ..................................................... 66

10. Operating load management in Runtime ..................................... 66
1. Welcome to COPA-DATA help

GENERAL HELP

If you cannot find any information you require in this help chapter or can think of anything that you would like added, please send an email to documentation@copadata.com (mailto:documentation@copadata.com).

PROJECT SUPPORT

You can receive support for any real project you may have from our Support Team, who you can contact via email at support@copadata.com (mailto:support@copadata.com).

LICENSES AND MODULES

If you find that you need other modules or licenses, our staff will be happy to help you. Email sales@copadata.com (mailto:sales@copadata.com).

2. Load Management

The Load Management is a tool for the support of the economical management. It is for implementation of energy supply management for small and medium-sized power supply companies and also for industrial firms whose energy supply is arranged by special contracts.

The module includes two high-quality functions to support the user:

- Forecast (short-term forecast): To avoid load peaks and to automate load shedding.
- Optimization: Optimization of the determined energy consumption of a billing period.
The focus is on energy-related electrical equipment, but the module can also be used without problems for mixed equipment from electricity and gas grids. Special forecasting and optimization models have been implemented for gas grids.

**License information**

*Must be licensed in Editor and Runtime.*

---

**3. Introduction**

The task of a Load Management is to optimize the operation of customers with special contracts, such as energy supply companies or industrial companies. Energy trend calculations are used as a significant aid; these serve as the basis for automated optimization of energy consumption.

The situation in electricity and gas grids is sometimes significantly different and thus requires, in a Load Management, different consideration in terms of forecasting and optimization.

### 3.1 Initial situation in the electricity industry

As a ruler in the energy industry a rate is used which includes both the investments of the provider and the arising costs for power generation and grid maintenance.

In order to set the price, these companies normally take into consideration a number of the peak power consumptions which arose over the year. The determination of the average power consumption takes place in a fixed measuring time, normally 15 to 30 minutes. In addition the price also includes the received power. Contracts concluded on this basis are valid on the long term.
3.2 Initial situation in the natural gas industry

When working with natural gas, peaks in demand can be compensated by taking natural gas from gas storages, storing it in the natural gas grid (pressure adaptation) and device which can be switch or turned off.

In gas storages or in the grid certain amount of natural gas can be stored preventively in order to use them on demand. In addition non-contractual supplied natural gas contingents are used which are referred to as spotgas.

3.3 Aims of an economic management

The aim of the economic management when using electricity and natural gas as power source is to receive as much energy as possible from your provided for an as low as possible price (optimization).

Potential savings come along when expensive peak power consumptions are avoided. The peak power consumptions during a measuring period can be avoided by pointedly controlled interventions.

- Load shedding at switchable devices
- Input of own generators

In order to do this, it is necessary to anticipate the average power consumption of a measuring period (prediction). Thus a threatening violation of the set limit can be recognized timely and an appropriate intervention can be carried out.

4. Functionality of the whole system

The electrical energy area and the natural gas area act in quite similar ways. As it is not possible to store electrical energy in noteworthy amounts, the contract conditions of the electrical energy providers are adjusted to this fact.

In the natural gas area not only the contract conditions must be adhered to but there are also arrangements necessary in order to store the natural gas.
4.1 Function of the system when electricity is used as the power source

The measuring period for the supply with electrical power is normally 15 or 30 minutes. During this time the averaged power received at the hand-over point - from here on it is referred to as power or load - or the equivalent amount of energy is determined and recorded.

The price is usually fitted to the three highest values which accrued for the measuring periods in different months. The price is then valid on the long term.

The average power which is used to calculate the price can be reduced when corresponding peak power consumptions are limited due to pointedly controlled interventions. This short term optimization can be achieved by the following interventions:

- Load shedding at switchable devices
- Increasing input of own generators

The aim of this optimization is to not exceed the contractual set limit for the power in a measuring period under no circumstances. Additionally, the energy consumption should stay very close below the set limit in order to receive as much energy as possible.

The consumption optimization is performed by way of a short-term trend calculation. The measured values which were gathered during the handling interval (typically 30, 60 or 180 seconds) are used to perform a trend analysis. The calculated trend is projected to the end of the period.

4.2 Function of the system when natural gas is used as the power source

The measuring period normally is an hour or a day when natural gas is supplied. During this time the determined amount of natural gas at the hand-over point is rated.

If the limit is exceeded, here a high price must also be paid. The definition of the price when the limit is exceeded is much more specific than in the electricity area.

Basically in the gas grid it is also targeted to not exceed the agreed limit.

Possible interventions are the following:

- Load shedding at switchable devices
- Own production of natural gas in liquified gas facilities
- Switching boilers to other fuels
- Switching combined heat and power units to other fuels
- Using natural gas from gas storages
Using natural gas which is stored in gas storages is important because it may only be small amounts which are available but these are needed during peak demands. Independent of the amount of the stored natural gas, a strategy must be defined how these storages are filled again over short or long periods of time.

**POSSIBLE ACTIONS**

The exceeding of the limit with hour contracts is inhibited by a consumptions projection with turning off or switching devices.

Basically the expansion of the measuring period to a (gas) day is possible. However there are times during the day in which the behavior of the trend leads to unrealistic large amounts at the end of the day. In addition the balance between night and day is not taken into consideration. Therefore in this case the system is built in a way that:

- a prediction of the consumption takes place
- a plan is created which guarantees that the limit is not exceeded
- a short term projection observes that the planned maximum amount is not exceeded

**4.3 Principal thoughts**

The following chapter deals with thoughts and examples which make it easier for the user to indentify and select changeable elements of your plant. The question is what elements and devices can be influenced by the Load Management directly or indirectly in a sensible way.
4.3.1 Options in order to influence the output in the electrical power area

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
</table>
| Directly switchable devices                 | Devices which can be switched off briefly without interrupting any production processes are part of this group (industrial furnaces, pumps for water storages etc.).  
The loads have a fixed value. In general the are depended on the device and therefore known of measureable. |
| Direct heatings                             | Because of their storage effect, these device can be switched off briefly without decreasing the quality of supply significantly (heating in warm water storages, electrically operated floor heatings etc.).  
The loads consist of a consistent part and a part which is temperature-dependent. Additional the load is dependent on how long the device was switched off. |
| Monovalent heat pumps                       | In general these pumps are operated in the same way as direct heatings.  
The temperature-dependent part is more distinctive and rise with falling outside temperatures (pumps used for generating heat including air conditioners) or rises with rising outside temperatures (air conditioners). The load is dependent on how long the device was switched off. |
| Bivalent heat pumps                         | These can choose between fuels they use. Beneath a certain temperature they are switched to a different fuel by their control unit of by the optimization.  
At that no supply constraints emerge for the devices. These components are only switched in the long term and restrictively because the switching should not take place constantly.  
When the temperature falls, the load increases up to the switching point. There it vanishes completely. |
| Night storage heatings                      | These devices are supplied with energy according to schedule or if there is any needed output during low rate periods. They are switched off during the remaining time.  
The load depends essentially on the outside temperature. It is noticeable how many heatings are switched on (this is limited by the installed power) and how long they are charged. |
| Peak load aggregates and emergency power aggregates | These aggregates are switched on/off as required. In some cases these aggregates are controllable. The number of uses should be limited because the start of these aggregates coupled with additional costs on wear. In addition these aggregates should run |
for a minimum time in order to avoid thermal damages.

| Combined heat and power units (CHPs) | These aggregates were primarily built to generate heat and are controlled by the heat demand during their operation (heat priority).

Some aggregates can be directly used to generate electric power (electric power demand). In general this operational mode is inefficient if the generated heat is not used at the same time. Therefore the use is only beneficial if the heat demand is corresponding or there is a possibility to store the heat.

The load reduction with regard to the take over point depends on the nominal size and for controlled or heat demand controlled aggregates from their working point.

It is quiet common to combine aggregates to groups. According to the heat demand, a certain quantity from the group is used. The maximum power lowering in the electrical power area is given by the number an nominal power of the used aggregates. |
| Lowering the voltage | In the electrical power area it is possible to lower the voltage in some grids. In order to achieve this, the transformers to the medium voltage level are switched to a lower level.

The voltage-dependence of the devices (ohmic load) causes another load demand provided that the voltage or output is not adjusted by subordinated controls.

The load reduction is dependent on the grid load, on the possible lowering of the voltage (minimum voltages must be adhered to) and on the composition of the devices. |
### 4.3.2 Options in order to influence the output in the gas area

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directly switchable devices</td>
<td>Devices which can be switched off briefly without interrupting any production processes are part of this group.</td>
</tr>
<tr>
<td>Furnaces or combined heat and power unit</td>
<td>These can be switched to another fuel (e.g. from natural gas to oil) according to their design.</td>
</tr>
<tr>
<td>Natural gas storage</td>
<td>These are available in different sizes depending on the company. The piping can also be used as a storage if its volume is appropriate and its geographical extension and the operation mode are suitable. Natural gas can be taken from the storage in order to compensate peaks.</td>
</tr>
</tbody>
</table>

### 4.3.3 Power consumption characteristics of devices

In order to reconstruct the actual needed output, models must be used which represent the power consumption of the switched off components. These models are allocated to different classes.
5. Load management method

The Load Management for electrical energy (electric current) is based on a time line analysis. At that the measured output progress is analyzed and extrapolated to the future. The forecast horizon of the Load Management corresponds to the remaining time of the measuring period.

5.1 Input values

As input value the Load Management expects a value from a counter or a calculated value which is supplied by the drivers or the result of the calculation of a mathematical formula in zenon.

Attention: It must be made sure that the value is supplied exactly one time in the update interval. Values must not be absent or be there twice.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant output</td>
<td>When switched on, an aggregate (pump, furnace) runs with a previously defined power consumption. Accordingly the output is reduced by the amount of the power consumption when the device is switched off. In this case it is enough to indicate the nominal power as a constant.</td>
</tr>
<tr>
<td>Directly temperature-dependent</td>
<td>The temperature dependence of the devices is directly dependent of weather effects and rises with thermal output approximately proportional to the negative gradient of the outdoor temperature. With respect to cooling capacity the behavior inverses itself.</td>
</tr>
<tr>
<td>Loading period model</td>
<td>At that the temperature makes itself felt with the size of the switch-on output and the length of the following loading period until the output drops when all heat stores are full.</td>
</tr>
<tr>
<td>Dependence on the switch-off time</td>
<td>At that several devices - because of the temporary cool down or warm up - are switched on dependent on the previous switch-off time. After a short period of time they switch themselves off again.</td>
</tr>
<tr>
<td>Dependent on the production process</td>
<td>In the industry sector behavior can occur - caused by production processes - which are subject to no behavior patterns or dependencies. These can only be determined by the production schedules.</td>
</tr>
</tbody>
</table>
THE DIMENSION: MW, KW, KWH OR M³

The system is designed on the basis of kW and hour. Therefore all power and energy amounts which must be entered in parameterization masks refer to these dimension. Internally the Load Management functions calculate without the dimensions. Thus it does not really matter in what dimensions the values are delivered and interpreted as long as they refer to the same basis. The base unit can be either kW or MW.

In the natural gas area it is also possible to calculate with standard m³. Combarability of the cubicmeters must be granted. This is only possible when using the standard cubic meter. The conversion of cubic meters in amount of energy and its timely connection is not necessary.

Information

Because the Load Management is a component which can cause high costs if it fails, it is very important the the input values are secured. It is recommended that values for this module are secured by using sensible alternate values or an alternate value strategy.

5.2 The model for the short term prognosis

For the projection of the current power progress it is necessary to design a mathematical model of the power progress. By extrapolation of the power progress of this model over the remaining time of the billing period, the expected power value at the end of the period is estimated.

POWER TREND

At the end of the period $T$ the power $P_{\text{prog}}(T)$ is to calculate. In order to calculate the current power trend a linear function is used which is extrapolated to the end of the period.

$$P_{\text{prog}}(T) = P_{\text{const}}(t) + P_{\text{trend}}(t) \times (T - t)$$

The mathematical polygon factors $p_0$, $p_1$ are named after their physical meaning in order to make it easier to understand.
Load management method

### ENERGY TREND

Deducted from this the energy trend up to the end of the period $E(T)$ can be calculated with the function

$$E_{prog}(T) = P_{aver}(t) \cdot t + P_{const}(t) \cdot (T - t) + \frac{1}{2} \cdot P_{trend}(t) \cdot (T - t)$$

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E_{prog}$</td>
<td>prognosticated energy value</td>
</tr>
<tr>
<td>$P_{aver}$</td>
<td>average power value</td>
</tr>
</tbody>
</table>

The first addend describes the determined energy up to the time $t$. The energy can be either determined by the average power value as described in the formula or is given as a direct calculated energy value $E(t)$.

The second addend continues the present constant power to the end of the period and calculates the constant energy amount from that.

The third addend describes the additional influence of the trend.

Concerning the energy calculation for the actual billing a value is necessary which is set back exactly at the beginning of the measuring period. Therefore it is not possible to use externally filtered values.

From the formula mentioned above the average value at the end of the period is determinable.

$$P_{prog\ aver}(T) = E_{prog}(T) / T$$

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_{prog\ aver}$</td>
<td>prognosticated average power value</td>
</tr>
</tbody>
</table>

### 5.2.1 Calculation of the correction power

During the measuring period the average power

$$P_{limit} = agreed\ limit$$
can be obtained. Over the measuring period $T$ this power equals

$$E_{\text{limit}} = P_{\text{limit}} \times T$$

By comparing this power with the expected energy $E_{\text{prog}} (T)$ at the end of the period, the de- and exceedance of the agreed limit

$$E_{\text{corr}} = E_{\text{prog}} (T) - E_{\text{limit}}$$

can be assessed. The de-/ or exceedance can be balanced by carrying out the corresponding switchings.

Minding that at time $t$ only $T-t$ balance time is available. Therewith a large correction power

$$P_{\text{corr}} (t) = E_{\text{corr}} / (T-t)$$
is necessary.

### 5.2.2 Actual value and real value forecast

The forecast is carried out for several trends in the Load Management module.

- The first trend considers the power consumption. This trend calculates the ascent of the the power requirement as actual value forecast.
- A second trend factor considers the switchings which have taken place in the past.
- A third trend factor calculates the influence of the switchings which will take place in the future.

The trend functions are laid on top of each other and result in the real value forecast. It describes the actual power consumption to the end of the billing period which is to be expected.

### 5.2.3 Lowering the supply limit

As the load trend can never be exactly predicted and as there are usually deviations of the switchable loads, it is necessary to go slightly below the actual supply set value for security reasons.

This is why there is a percentage Safety distance [\%] for the supply limit during parameterization, which must be undershot before connections are triggered.
<table>
<thead>
<tr>
<th>Digit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Supply limit (set value)</td>
</tr>
<tr>
<td>2</td>
<td>Safety distance</td>
</tr>
<tr>
<td>3</td>
<td>Deactivate hysteresis</td>
</tr>
<tr>
<td>4</td>
<td>Activate hysteresis</td>
</tr>
<tr>
<td>5</td>
<td>Hysteresis for switching</td>
</tr>
</tbody>
</table>

Around this limit a hysteresis can be built with the help of **Activate hysteresis [%]** and **Deactivate hysteresis [%]**. In doing so the **Activate hysteresis [%]** eliminates a part of the **Safety distance [%]**.

⚠️ **Attention**

*Take care that Activate hysteresis [%] is in any case smaller than the Safety distance [%]. Otherwise the system reacts too late if the agreed limit is exceeded.*

### 5.3 Operating principle of the obtaining rule

**CLOSED LOOP OPERATION**

Normally the obtaining rule is applied in the Closed Loop operation. There switch on and switch off times are calculated in accordance with the results of the optimization part. The switching is triggered directly by the corresponding switching commands.

💡 **Information**

*In the Load Management module the immediate switching points do not have to be used at the devices. You can decide whether you want to make direct switching possible or whether switching must be cleared by the user first.*

⚠️ **Attention**

The unchecked use of the closed loop operation necessitates an intensive pilot stage. At that all switchings which are then done by the control must be checked by the user. This pilot stage must be adjusted to the size and complexity of the system. It is possible that the pilot stage lasts up to one year.
5.3.1 Output determination for the devices

The output determination for the devices is especially important with regard to the assessment of the effect caused by switchings. The problem is that the output of the switched off devices cannot be measured directly and must sometimes be estimated.

In the system two mechanisms are implemented in order to determine the output:

- **Fixed value by parameterization**
  The value (e.g. the nominal power) is considered by the optimization as fixed and is always available.

- **Measuring the current value.**
  The value is measured and zenon describes this value with the help of a variable in the devices.

The initial value for the output of the device is determined with a polling of the variable value during the beginning of the optimization. In order to compensate errors due to fluctuations, the optimization calculates a gliding average value using the consecutively arriving measurements.

**Information**

If a component is switched off when the optimization starts, its output is presumed as zero. Thus the SCADA function cannot determine a valid output value as prerequisite for the use of the component. The component must be switch on by hand once.

**Attention**

As long as not at least one value has arrived, the output value of the component is not known and cannot be used for the optimization.

**Primary factors**

**THE AMOUNT OF THE ENERGY**

In general the device selection is determined by the amount of energy which can be switched on or off.

If the requested amount of energy cannot be reached exactly, it is treated as a minimum value at a switch-off request and a maximum value at a switch-on request. At that you are on the save side regarding the adherence of the datum line.
**Information**

During the Runtime the amount of energy can be adjusted dynamically with the help of a variable.

**AVAILABILITY**

The availability controls if the device is usable in general. The availability can be set manually and is always set back when the component cannot be used because of operational reasons (e.g. at overhauls) or when the optimization should not use it.

Conditions which arise during the process can also determine the availability of the component and control its use by the optimization.

**Info**

In the Runtime the availability can be adjusted dynamically with the help of a variable. For example time tables with respect to the availability can be implemented with the help of a scheduler or the Production & Facility Scheduler.

**Secondary factors**

**LOCK TIMES AND RELEASE TIMES OF THE DEVICES**

With the help of the lock times you can control during which times the components are not available for the optimization. The times which are not designated as lock times represent the release times.

**Attention**

During the lock times the components are not influenced by the optimization - or only in the released direction. Thus the components remain in the state they had reached at the end of the release time.

**MINIMUM AND MAXIMUM SWITCHING TIMES**

You can specify the minimum and maximum time for the single switch states (on/off) for each used device and generator. The time indicates what time period must have elapsed at least in order to trigger a switching in the opposite direction.

This parameter is important for aggregates because in order to avoid thermal damages and damages caused by soot they must not be switched off right after they were switched on. Thus for example a
certain amount of time must have passed after the heating groups had been activated before they switch on.

**SWITCHING FREQUENCY**

If devices and generators can only be switched a limited number of times in a certain time period, the components are no longer switched when this number is exceeded. Beside the number of switchings a time period must also be defined in order to carry out the parameterization.

**Example**

*Maximum 25 switchings in 12 hours*

**SWITCHING PRIORITIES**

The switching of the components is planned in accordance with a priority schedule. At that switch-on and switch-off priorities are listed separately. The user can determine the priorities in accordance with the operation requirements. The component with the highest priority (highest numerical value) is switched first.

If there is a requirement to switch the components in a sorted order by having the device that was switched on first be the one switched off last, a number pattern must be applied to all components: ascending for the first switch-on and descending for the last switch-off.

**Information**

*If several devices have the same priority in one plant, the Load Management automatically ensures that on average all devices of the same level are switched equally often.*

5.3.2 **Switching process**

The term switch-off request on the part of the optimization always refers to the reaction of the device which decreases the needed output and therewith the obtained output because it is switched-off. Therefore the request for the switch-off can be fulfilled by switching on an aggregate.
PROCESS DURING A SWITCHING

<table>
<thead>
<tr>
<th>Digit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pre-warning on</td>
</tr>
<tr>
<td>2</td>
<td>Output order ON</td>
</tr>
<tr>
<td>3</td>
<td>Delay time for switch-on</td>
</tr>
<tr>
<td>4</td>
<td>Pre-warning off</td>
</tr>
<tr>
<td>5</td>
<td>Output order OFF</td>
</tr>
<tr>
<td>6</td>
<td>Delay time for switch-off</td>
</tr>
</tbody>
</table>

DELAY TIME FOR THE SWITCH-ON (SWITCH-ON DEAD TIME)

Equals the time period from activating the switching order until the nominal power is reached.

This time - dependent on the aggregate - can be quite long; e.g. starting up the aggregate und synchronization, rearwards controlled heating etc.

DELAY TIME FOR THE SWITCH-OFF (SWITCH-OFF DEAD TIME)

Time period from activating the switching order until the output is zero. You must add the time of the activation of the switching order to the time when the total output is zero.

FOREWARN TIME FOR THE SWITCHING-ON AND THE SWITCHING-OFF (LENGTH OF FOREWARN TIME)

The switching times are planned to a second in order to exactly control the amount of energy. In order to give the user the opportunity to adhere to the times in the open-loop operation a certain lead time to
carry out the switching is necessary. This is defined by **Advance warning time**. Hereby the user receives information about switchings which are planned before they are actually carried out.

**Attention**

As the Load Management assumes that the switchings are carried out, the suggested switchings should be carried out in the corresponding time in respect to the exactness of the forecast.

TACTIC OF THE SWITCHING SCHEDULE

In general the switching selection happens in a way that as few switchings as possible are carried out. This calms the grid operation and keeps up the availability of the devices whose use are limited by a maximum of switchings. In addition conflicts are minimized which can occur at the command output of the switchings.

The use of components with a much higher output than that is used for the correction is possible by a specific time control. The components are used for such a short time that they compensate the needed output.

SUPPRESSED SWITCHINGS AT THE BEGINNING OF A MEASURING PERIOD

At the beginning of a measuring period it is possible that larger switchings are carried out or large deviations to the actual output average value are set in order to compensate large amounts of energy at the end of the period. That is why it is necessary at the beginning of the period to give the system the opportunity to adjust itself to the new circumstances.

That is why a **Down time begin tariff interval** can be engineered in the system. During this time the optimization does not carry out any switchings.

**Attention**

If for a long time no response is received for a switch command which was issued by the EMS (on the response variable), the Load Management assumes that the action failed and tries to carry out another switching (on the next available component). Therefore you must always ensure that the correct response about the success of a switching operation is transferred to the Load Management.

5.4 Overlapping of schedule inputs

The switching of aggregates and devices according to fixed times with the help of the Scheduler or the Production & Facility Scheduler is possible with several applications. As there is not explicit link between
these modules and the short term optimization, these switchings are not monitored in regard of the output trend. They are also not displayed in the trend of the obtained output. They are interfering in the short time optimization with regard to its result.

In order that these interferences do not have radical effects, external switchings should be engineered in a way that they take place at period change. If this is not possible, they should be scheduled right after a period change so that the interfering influence on the control can still be compensated. These switchings should be finished within **Down time begin tariff interval** and the influence of the switching on the input value should be present.

### 6. Multi-level combined heat and power plants (CHPs)

Multi-level CHPs can be regarded as one component. It is possible to describe CHPs with 2 to n levels.

The CHPs are controlled by a set value. Additionally different output levels can be defined which this set value can take on. The actual output of the CHP is registered by a measurement (variable) and sent to the Load Management.

**Attention**

*A CHP is only available for the Load Management when it has reached its nominal power.*

*The availability flag is set accordingly by the engineering. The Load Management cannot switch off the CHP but only switch it to its nominal power.*

#### 6.1 Set value processing at CHPs

The number of values which the set value can become equals the number of the defined levels. The value which the set value can become always equals exactly one of the defined values for the levels. The Load Management does not allocate another number to the set value.

The initialization is carried out with the currently measured output. If this value does not equal a defined level, the next smaller level is allocated. The CHP is treated as unavailable as long as the measured output does not match a level. If the measured output is disturbed, the CHP is not available and the set value is initialized as recently as a valid measured value arrives.

As a measured output does not have to equal a set value exactly, a hysteresis is defined around the set value. A level counts as reached or set as soon as the current output value is within the hysteresis of the given set value. The hysteresis can be defined for each CHP individually.

The defined levels must not be skipped when allocating the set value. The Load Management appoints the set value only to the next higher or lower level.
A set value input is only carried out if the CHP shows an explicit level (considering the hysteresis) at that time. Otherwise the CHP is not available because the measured value does not equal a level.

### 6.2 Planned switchings for CHPs

When planning the set value inputs for a CHP, the conditions for the set value inputs must be taken into consideration. If several levels of a CHP are necessary in order to cover the output, keep in mind that it is only possible to switch from one level to the next level when executing a switching schedule. At that the set value inputs for each level must be in accordance with the delay times for the switch-on and switch-off of each level.

⚠️ **Attention**

You must consider that the forewarning is only given at a defined level setting. Thus you must regard the length of the forewarning time for the individual levels when creating the switching schedule.

### 6.3 Priorities of CHPs

A CHP has a fixed switch-on and switch-off priority. The values can be controlled by variables. Thus priorities can be controlled flexible. The takeover of a new priority takes place at the next rate interval change.

The priorities are not set for each level individually but are valid for the whole CHP.

If at least two CHPs have the same priority, the rolling priority procedure is used. A more important condition for CHPs with same priority is that they are set to the same level if possible or that they differentiate by one level at the most. The prerequisite for this is that both the switch-on priority and the switch-off priority of these CHPs is the same.

The internal reference counter for the number of switchings is incremented when the CHP is switched on. This is exactly the case when the current output passes over from one level to the next higher level. At devices using electrical current the reference counter is incremented when the component is switched off. Thus within one priority level the switching between two CHPs is compared to the switch-on and switch-off of a device.
6.4  Time-dependent restrictions for CHPs

CHPs need special care with regard to their time behavior. The Load Management must consider special requirements at a level switch and at delay times while the CHP are running.

6.4.1  Running time according to level switching

The minimum and maximum running time of CHPs must be set for each level. Instead of four times for a component (minimum switch-on time, minimum switch-off time, maximum switch-on time and maximum switch-off time) there are only two times - minimum and maximum runtime per level - in order to describe a CHP with levels.

The minimum running time (switch-on time) of a level indicates how long the CHP has to run at the least on this level. After a level is reached, the optimization must wait at least this amount of time before a new set value input can be made for the next lower level.

The maximum running time of a level indicates how long a CHP is allowed to run on this level at the most. With the exception of the lowest level (nominal power), the CHP is switched to the next lower level after this time expires. At that a level counts as active even if the CHP actually runs on a higher level. The maximum running time of the individual levels must be attuned to other restrictions with regard to minimum running time and forewarning. Thus a timely switch to a lower level is possible. The optimization must also prevent set value inputs to a higher level when the maximum running time cannot be adhered to e.g. because of the minimum running time of the higher level.

Information

*Manual switching can cause violations of the defined restrictions. These are intercepted by the Load Management.*

For the lowest level (nominal level) the maximum running time has a different meaning than for the other levels. The maximum running time of the lowest level indicates how long a CHP is allowed to run on this level alone at the most. After that the CHP must be switched to the next higher level.
EXAMPLE FOR THE PARAMETERIZATION OF THE INDIVIDUAL LEVELS:

<table>
<thead>
<tr>
<th>Step</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
</tr>
<tr>
<td>minimum switch-on time (in seconds)</td>
<td>--</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Forewarn time (in seconds)</td>
<td>--</td>
<td>210</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Delay time for switch-on (in seconds)</td>
<td>--</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Delay time for switch-off (in seconds)</td>
<td>--</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Minimum value for the maximum switch-on time (in seconds)</td>
<td>210</td>
<td>240</td>
<td>180</td>
<td>120</td>
<td>60</td>
</tr>
</tbody>
</table>

The times which must be entered in the parameterization for the switch-on and switch-off always refer to the level for which they are entered. This means that the switch-off time which is parameterized for one level is considered if a "switching" is carried out from this level to the next lower level. The switch-on time is considered if a "switching" is carried out from a lower level to this level.

As the lowest level represents the CHP running with nominal power, no information for minimal running time, forewarn time, delay time for switch-on and delay time for switch-off is necessary.

The minimal allowed values for the maximum switch-on times of each level are as follows:

- For the first level:
  Forewarn time of the next higher level

- For the last level:
  maximum/minimum switch-on time, forewarn time of the last level

- For all other levels:
  maximum/minimum switch-on time, forewarn time of next higher level
  + delay time for switch-on for the next higher level
  + minimum value for the maximum switch-on time of the next higher level
  + forewarn time of the next higher level
  + delay time for switch-off for the next higher level

If for one CHP the maximum switch-on time for one level is below the calculated minimum value for the maximum switch-on time, the CHP is treated as not available and a corresponding availability identification is set for the readiness.

6.4.2 Expiration of the delay time

A set value remains at a certain level until that level is reached or until the defined delay time has passed. In case the delay time expires, the set value is re-initialized according to the currently measured
performance. This requires determining the level of the current performance. The following cases can apply:

- The current performance value matches the old level:
  The set value did not have any effect and is therefore reset to the old value.

- The current value does not match any level:
  There can be a check whether the current performance has approached the new set value.
  In that case, the configured set value can be kept; otherwise, it must be reinitialized.

- The current value matches another level:
  The performance of the CHP has changed in contrast to the set value input. This corresponds to
  a manual switch despite availability for the Load Management. See Manual switch (on page 27) for further steps.

Switching plans to the next levels must be revised or exchanged if the previously configured set value of
a switching action for a CHP was not reached. For any further switching actions, different components
will be preferred.

### 6.5 Manual operation of CHPs

If a measured value of the current output without set point input is outside of the level set by the Load
Management, this component is accepted as not available because it is obvious that the Load
Management is not controlling it at the time.

If a measured value of the current output re-enters the hysteresis area of a defined level, the difference
to the set value is registered and the difference at the level setting is assumed to be manual operation.
The set value is set to the newly identified level.

A recognized manual operation is transmitted to the forecast so that it can be considered in the trend
calculation.
7. Setting load management parameters

The engineering of the Load Management is carried out via a hierarchic tree structure. There corresponding sub-objects are linked to individual objects depending on their type. Sub-objects are added by selecting the corresponding menu item in the context menu of the selected node.

All objects have property **Name** and **Description**. The engineering of the individual objects is carried out via the property window.

All adjustable properties which are available in the property window are described in the help window after you click on them.

---

**Information**

*All mentioned or shown properties are only visible if the module Load Management is licensed. The licensed Load Management module is a separate element in the project tree. The settings in the Load Management can be made with the help of this entry.*

---

**Attention**

*Within the Load Management all existing units (grids, device groups, generators, devices etc.) should have a distinct name in order to ensure the perfect function of the forecast and the optimization.*

---

All objects have the following menu entries:
### Menu/Entry

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut</td>
<td>Cuts the selected object(s) and copies it/them to the clipboard.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies selected object(s) to the clipboard.</td>
</tr>
<tr>
<td>Paste</td>
<td>Pastes object(s) from the clipboard.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes selected object(s) including all sub-objects.</td>
</tr>
<tr>
<td>Export XML all ...</td>
<td>Exports the whole project to an XML file.</td>
</tr>
<tr>
<td>Export selected XML ...</td>
<td>Exports selected objects including sub-objects to an XML file.</td>
</tr>
<tr>
<td>Import XML...</td>
<td>Imports objects from an XML file.</td>
</tr>
</tbody>
</table>

Starting from the selected node, only objects from the same level or the level directly beneath it can be pasted.

### Information

All values of variables which are used in the Load Management to state or adjust time values during the Runtime (e.g. switch-on time variable) are interpreted as seconds. Therefore a numerical value of 300 corresponds to a time period of 5 minutes (=300 seconds).

In order to ensure the correct functionality of the Load Management, you must create at least the following variables for a supply area:

- Current total consumption
- Supply limit
- Start value of estimation
- First switching value
- Estimated error range
- Estimated final consumption
- Last switching value
- Gross actual deviation
- Net actual deviation

### Information

In the context menu for a supply area you can find the menu item “Create variable”. When selected, it automatically creates variables for the properties listed above and links the variables with the properties.

You must at least create the following variables for a generator/device in order to ensure the functionality of the Load Management.
Setting load management parameters

- **Switching state** for the generator
- **Switching state** for the device
- **Availability**

### 7.1 Minimum requirements

**SUPPLY AREA**

For the correct functionality of the Load Management, you must create at least the following variables for a supply area:

- Current total consumption
- Supply limit
- Start value of estimation
- First switching value
- Estimated error range
- Estimated final consumption
- Last switching value
- Gross actual deviation
- Net actual deviation

**Info**

*In the context menu for a supply area you can find the menu item Create variable. It automatically creates variables for the properties listed above and links the variables with the properties. Properties Current total consumption and Supply limit are an exception. You must create them manually.*

**GENERATORS/DEVICES**

For the correct functionality of the Load Management, you must create at least the following variables for a generator/device:

- for the device
  - Switching state
  - Standby output variable or value for property Standby output
- for the generator
  - Switching state
• Nominal output variable
  or value for property Nominal output
• for the generator and the device
• Availability

7.2 Load Management: Detail view of toolbars and context menus

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td>Creates a new object, depending on the position in the tree.</td>
</tr>
<tr>
<td>Gas grid new</td>
<td>Creates a new gas grid.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies selected element to the clipboard.</td>
</tr>
<tr>
<td>Paste</td>
<td>Pastes objects from the clipboard.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes selected element after confirmation message.</td>
</tr>
<tr>
<td>Export selected XML</td>
<td>Exports all selected elements as an XML file.</td>
</tr>
<tr>
<td>Import XML...</td>
<td>Imports objects from an XML file.</td>
</tr>
<tr>
<td>Properties</td>
<td>Opens the property window for the selected element.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

CONTEXT MENUS GRIDS

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>New power grid</td>
<td>Creates a new power grid.</td>
</tr>
<tr>
<td>Gas grid new</td>
<td>Creates a new gas grid.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Grid.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all defined grids to an XML file.</td>
</tr>
<tr>
<td>Import XML...</td>
<td>Imports objects of the type Grid.</td>
</tr>
<tr>
<td>Properties</td>
<td>Opens the property window for the selected element.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

Additional context menus:

Power grids (on page 33)
Natural gas grids (on page 36)
7.2.1 Power grids

**CONTEXT MENU POWER GRID**

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>New supply area</td>
<td>Creates a new supply area.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected device group. You can not copy more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type gas storage.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the selected entries as an XML file.</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Properties</td>
<td>Opens the properties window.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

**CONTEXT MENU SUPPLY AREA**

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator new</td>
<td>Creates a new generator in the selected supply area.</td>
</tr>
<tr>
<td>New device group</td>
<td>Creates a new device group in the supply area.</td>
</tr>
<tr>
<td>Creating variables</td>
<td>Automatically creates the minimally required variables for the selected supply area and links them with the fitting properties.</td>
</tr>
<tr>
<td>Cut</td>
<td>No function at the supply area.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected supply area. You can copy more than one supply area at a time using multi-select.</td>
</tr>
<tr>
<td>Paste</td>
<td>It is possible to paste objects of the type Supply area.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected supply area. You can delete more than one supply area at a time using multi-select.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the currently selected supply area. You can export more than one supply area at a time using multi-select.</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Properties</td>
<td>Opens the properties window.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>
### CONTEXT MENU GENERATOR (GROUP)

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator new</td>
<td>Creates a new generator for the selected supply area.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Generator.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all generators of the supply area</td>
</tr>
<tr>
<td>Import XML...</td>
<td>Imports objects of the type Generator.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### CONTEXT MENU GENERATOR

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator new</td>
<td>Creates a new generator for the selected supply area.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Generator.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all generators of the supply area</td>
</tr>
<tr>
<td>Import XML...</td>
<td>Imports objects of the type Generator.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### CONTEXT MENU DEVICE GROUPS (GROUP)

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>New device group</td>
<td>Creates a new device group.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Device group.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports the device group including all defined devices within the group.</td>
</tr>
<tr>
<td>Import XML...</td>
<td>Imports objects of the type Device group.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### CONTEXT MENU DEVICE GROUP

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>New device</td>
<td>Creates a new device in the selected device group.</td>
</tr>
<tr>
<td>Cut</td>
<td>No function at the device group.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected device group. You can not copy more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Device group, Device.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than</td>
</tr>
</tbody>
</table>
### Setting load management parameters

One group at a time (no multi-select).

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the currently selected device group. You can not export more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### Context menu Device

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut</td>
<td>No function at the device group.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected device group. You can not copy more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Device group, Device.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Properties</td>
<td>Opens the properties window.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the currently selected device group. You can not export more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>
7.2.2 Natural gas grids

### CONTEXT MENU NATURAL GAS GRID

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>New supply area</td>
<td>Creates a new supply area.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected device group. You can not copy more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type gas storage.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the selected entries as an XML file.</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Properties</td>
<td>Opens the properties window.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### CONTEXT MENU SUPPLY AREA

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas storage new</td>
<td>Creates a new gas storage in the selected supply area.</td>
</tr>
<tr>
<td>Liquid gas plant new</td>
<td>Creates a new liquid gas storage in the selected supply area.</td>
</tr>
<tr>
<td>New device group</td>
<td>Creates a new device group in the supply area.</td>
</tr>
<tr>
<td>Creating variables</td>
<td>Automatically creates the minimally required variables for the selected supply area and links them with the fitting properties (on page 30).</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected supply area. You can copy more than one supply area at a time using multi-select.</td>
</tr>
<tr>
<td>Paste</td>
<td>It is possible to paste objects of the type Supply area.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected supply area. You can delete more than one supply area at a time using multi-select.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the currently selected supply area. You can export more than one supply area at a time using multi-select.</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Properties</td>
<td>Opens the properties window.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>
### CONTEXT MENU GAS STORAGE

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas storage new</td>
<td>Creates a new gas storage for the selected supply area.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type <code>Generator</code>.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all generators of the supply area</td>
</tr>
<tr>
<td>Import XML...</td>
<td>Imports objects of the type <code>Generator</code>.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### CONTEXT MENU LIQUID GAS PLANT

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid gas plant new</td>
<td>Creates a new liquid gas plant for the selected supply area.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type <code>Generator</code>.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all generators of the supply area</td>
</tr>
<tr>
<td>Import XML...</td>
<td>Imports objects of the type <code>Generator</code>.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### CONTEXT MENU DEVICE GROUPS

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>New device group</td>
<td>Creates a new device group.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type <code>Device group</code>.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports the device group including all defined devices within the group.</td>
</tr>
<tr>
<td>Import XML...</td>
<td>Imports objects of the type <code>Device group</code>.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### CONTEXT MENU DEVICE GROUP

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas storage new</td>
<td>Creates a new gas storage in the selected supply area.</td>
</tr>
<tr>
<td>Liquid gas plant new</td>
<td>Creates a new liquid gas storage in the selected supply area.</td>
</tr>
</tbody>
</table>
### Setting load management parameters

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copy</td>
<td>Copies the currently selected device group. You can not copy more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type <code>Device group, Device</code>.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the selected entries as an XML file.</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type <code>Supply area</code>.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### CONTEXT MENU GAS STORAGE (GROUP)

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas storage new</td>
<td>Creates a new gas storage.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type <code>Device group, Device</code>.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the selected entries as an XML file.</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type <code>Supply area</code>.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### CONTEXT MENU GAS STORAGE

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut</td>
<td>No function at the device group.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected device group. You can not copy more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type <code>gas storage</code>.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Properties</td>
<td>Opens the properties window.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the currently selected device group. You can not export more than one group at a time (no multi-select).</td>
</tr>
</tbody>
</table>
### CONTEXT MENU LIQUID GAS PLANTS (GROUP)

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid gas plant new</td>
<td>Creates a liquid gas plant.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Device group, Device.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the selected entries as an XML file.</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### CONTEXT MENU LIQUID GAS PLANT

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut</td>
<td>No function at the device group</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected device group. You can not copy more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Liquid gas plant.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Properties</td>
<td>Opens the properties window.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the selected entries as an XML file.</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### CONTEXT MENU DEVICE

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut</td>
<td>No function at the device group.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected device group. You can not copy more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Command</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Device group, Device.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Properties</td>
<td>Opens the properties window.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the currently selected device group. You can not export more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### 7.3 Data for load management

The Load Management needs a historic data basis in order to calculate the trend and to perform the optimization. If no historic data are available for the data points, the Load Management cannot start the calculation. Therefore no calculated value is displayed for the Estimated final consumption.

At the moment the Load Management has no interface to the Historian. This is not necessary for the short term optimization. For this the historic data which were recorded via option **Harddisk data storage** are enough.

The following settings depending on the period length are recommended for the recording of the HD data.

**NUMBER OF PAST VALUES**

As guideline use the following rule-of-thumb:

The Historic data area which is provided by the **Harddisk data storage** has to be at least 1.5 times the size of the corresponding Billing period. If not enough data are available, the calculation of the optimization is not started.
Attention

At the beginning of the Billing period the Load Management needs a Current total consumption for the displayed supply area. Thereby the new value must be transferred to the Load Management during the next but one Optimization cycle, i.e. if the optimization cycle is 30 seconds, the value must be transferred in the period between 30 and 60 seconds.

If the Load Management does not receive a value in this period, the new initialization of the Load Management can be carried out during the next billing period at the earliest.

7.4 Grids

The collective node contains all projects which have been created in the grid but does not offer any setting possibilities itself.

Options:

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>New power grid</td>
<td>Creates a new power grid.</td>
</tr>
<tr>
<td>Gas grid new</td>
<td>Creates a new gas grid.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Grid.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all defined grids to an XML file.</td>
</tr>
<tr>
<td>Import XML...</td>
<td>Imports objects of the type Grid.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

You must place a distinct Name with each created grid. In order to ease identification you can place a free Description with each grid as an option. This is not mandatory. Gas grids contain a few additional Settings (on page 42).

Information

For each project only 1 power grid and 1 gas grid can be created or administrated.
7.4.1 Natural gas grids

For natural gas grids additional configuration possibilities are available. With their help you can configure grid-wide parameters such as Temperature or Characteristic days and total results such as Adjusted consumption or Forecast for the whole grid.

All adjustable properties which are available in the property window of the natural gas grid are described in the help window after you click on them.

7.5 Supply area

The supply area is the level of the object hierarchy which is used as a basis for the forecast and the optimization.

Information

In order to start the Load Management for a particular supply area, a function of the type "Load Management" must be executed which has this supply area as parameter.

SETTINGS FOR THE SUPPLY AREA OF A POWER GRID

For supply areas the following settings are available:

- **Input values**: Defines variables for the supply of the current values and the supply limits.
- **Calculated values**: Settings in order to adjust parameters for the forecast and the optimization with the help of variables during the Runtime.
- **Parameter**: Important settings for the optimization of the supply area with direct influence to the switchings of the Load Management.
- **Status information**: Setting which variable holds the information about the availability of the Load Management screen.

All in the respective groups adjustable properties are described in the help window after you click on them.
### CONTEXT MENU ENTRIES

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator new</td>
<td>Creates a new generator in the selected supply area.</td>
</tr>
<tr>
<td>New device group</td>
<td>Creates a new device group in the supply area.</td>
</tr>
<tr>
<td>Creating variables</td>
<td>Automatically creates the minimally required variables for the selected supply area and links them with the fitting properties (on page 30).</td>
</tr>
<tr>
<td>Cut</td>
<td>No function at the supply area.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected supply area. You can copy more than one supply area at a time using multi-select.</td>
</tr>
<tr>
<td>Paste</td>
<td>It is possible to paste objects of the type Supply area.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected supply area. You can delete more than one supply area at a time using multi-select.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all supply areas of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the currently selected supply area. You can export more than one supply area at a time using multi-select.</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### 7.5.1 Additional parameters for the gas supply areas

The supply area is the level of the object hierarchy which is used as a basis for the forecast and the optimization.
In order to start the Load Management for a supply area, a "Load Management" function must be executed that has this supply area as a parameter.

Supply areas for a gas grid have specific gas parameters. With the help of them e.g. Adjusted consumption, Forecast and Optimum load can be defined but also the relation between liquid gas supply and general supply. All adjustable properties are described in the help window after you click on them.

**CONTEXT MENU ENTRIES:**

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas storage new</td>
<td>Creates a new gas storage in the selected supply area.</td>
</tr>
<tr>
<td>Liquid gas plant new</td>
<td>Creates a new liquid gas storage in the selected supply area.</td>
</tr>
</tbody>
</table>

**7.6 Device group**

Individual devices are combined in a device group. At that each device group can contain any number of devices.

**CONTEXT MENU ENTRIES AT NODE "DEVICE GROUPS".**
Setting load management parameters

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>New device group</td>
<td>Creates a new device group.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Device group.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports the device group including all defined devices within the group.</td>
</tr>
<tr>
<td>Import XML...</td>
<td>Imports objects of the type Device group.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

**Information**

*These settings are identical for device groups in the power grid and in the gas grid.*

CONTEXT MENU ENTRIES AT THE NODE OF A DEVICE GROUP:

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>New device</td>
<td>Creates a new device in the selected device group.</td>
</tr>
<tr>
<td>Cut</td>
<td>No function at the device group.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected device group. You can not copy more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Device group, Device.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the currently selected device group. You can not export more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Import XML...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>
7.6.1 Additional parameters for the gas device groups

Individual devices are combined in a device group. At that each device group can contain any number of devices.

Device groups in gas grids have additional settings such as Adjusted consumption or Forecast with the configuration of upper and lower forecast errors. In addition, there are Optimum load, Current consumption and Daily energy.

**CONTEXT MENU ENTRIES**

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas storage new</td>
<td>Creates a new gas storage in the selected supply area.</td>
</tr>
<tr>
<td>Liquid gas plant new</td>
<td>Creates a new liquid gas storage in the selected supply area.</td>
</tr>
</tbody>
</table>

⚠️ **Attention**

A liquid gas storage can be created using the node "Supply area" no sooner than a gas storage with option Piping storage has been created.

Directly creating a liquid gas storage (without creating a gas storage first) is only possible in a device group.

7.7 Generator

Using the node Generator you can create new Generators for the selected supply area using the context menu.
Generators serve to lower the currently obtained power. Basically it is possible to engage each generator or to set it on higher load (Peak performance). If a generator is engaged, the power currently obtained (Current average consumption) is immediately lowered.

Context menu entries at node "Generator".

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator new</td>
<td>Creates a new generator for the selected supply area.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Generator.</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all generators of the supply area</td>
</tr>
<tr>
<td>Import XML...</td>
<td>Imports objects of the type Generator.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

**PROPERTIES**

In addition to name and identification, properties can be defined in different groups for the generator:

- **Capacity/Priority**: Defines the basic behavior of pieces of equipment in the electric grid.
- **Switching times**: Default of different life spans or timely requirements to single pieces of equipment.
- **Switching frequency**: Definition of the maximum number of switchings per time unity.
- **Switching variables**: Variable for the adaption of important parameters during the Runtime.
- **Locking times**: Excludes single pieces of equipment of the Load Management from the optimization.
- **Switching steps**: Define switching levels for combined heat and power units. (on page 48)

All adjustable properties are described in the help window after you click on them.
Attention

The switching priority is regarded by the Load Management taking all equipment into account. That means the same number circle is applied for generators and devices. Therefore the priorities for all defined equipment must be considered because it is not distinguished between generators and devices.

CONTEXT MENU ENTRIES FOR THE SELECTED GENERATOR:

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut</td>
<td>No function at the device group.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected device group. You can not copy more than one</td>
</tr>
<tr>
<td></td>
<td>group at a time (no multi-select).</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Device group, Device.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than</td>
</tr>
<tr>
<td></td>
<td>one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the currently selected device group. You can not export more than</td>
</tr>
<tr>
<td></td>
<td>one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

7.7.1 Switching steps

The CHPs (on page 23) (combined heat and power units) are a special case within the Load Management. This special type of generators can adjust their output in levels. In order to define a CHP, you can define switching levels for a random device in the Load Management.
Basically you can define under the node **Switching steps** settings for the **Setpoint variable**, for the current output and for the **Hysteresis** for each CHP.

For every CHP any number of switching levels can be defined:

![Switching steps settings](image)

Each switching level offers settings for the output, the forewarning of the switching and the switch-on and switch-off. All adjustable properties are described in the help window after you click on them.

**Attention**

*If switching levels are defined for a generator, these settings overwrite the standard parameters of the generator. An according warning is displayed during compiling in the output window.*

### 7.8 Device

In the Load Management devices are the essential components which "use up" energy. By switching devices on and off the Load Management can interfere in a regulative way. At that it helps to avoid peak loads.
CONTEXT MENU ENTRIES FOR THE SELECTED DEVICE GROUP:

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>New device</td>
<td>Creates a new device in the currently selected supply area.</td>
</tr>
<tr>
<td>Cut</td>
<td>No function at the device group.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected device group. You can not copy more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Device group, Device.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the currently selected device group. You can not export more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

PROPERTIES

In addition to name and identification, properties can be defined in different groups for the device:

Capacity/Priority: Defines the basic behavior of pieces of equipment in the electric grid.

Switching times: Default of different life spans or timely requirements to single pieces of equipment.

Switching frequency: Definition of the maximum number of switchings per time unity.

Switching variables: Variable for the adaption of important parameters during the Runtime.

Locking times: Excludes single pieces of equipment of the Load Management from the optimization.

All adjustable properties are described in the help window after you click on them.
### Context Menu Entries for the Selected Device:

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut</td>
<td>No function at the device group.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected device group. You can not copy more than one</td>
</tr>
<tr>
<td></td>
<td>group at a time (no multi-select).</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Device group, Device.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than</td>
</tr>
<tr>
<td></td>
<td>one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the currently selected device group. You can not export more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

#### 7.8.1 Additional settings for the gas devices

In the Load Management devices are the essential components which "use up" energy. By switching devices on and off the Load Management can interfere in a regulative way. At that it helps to avoid peak loads.

Devices in gas grids have additional settings for output such as **Proportion of group [%]**, **Return [€/kWh]/Priority** and information about minimum and maximum temperature. All adjustable properties are described in the help window after you click on them.
7.9 Specific elements of the natural gas grid

Hereafter the devices and elements used when working with natural gas grids are described. The settings documented hereafter are not available for electricity grids.

7.9.1 Natural gas storage

With the help of a gas storage, it is possible to shape the storage capacity of a natural gas supply area. They can be used in the following situations:

1. As gas storage in the supply area
2. As a piping storage a gas storage can be used to display the storage capacity of a geographically expanded piping.
3. As gas storage in device group.

CONTEXT MENU ENTRIES FOR THE SELECTED GAS STORAGE GROUP:
Setting load management parameters

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas storage new</td>
<td>Creates a new gas storage.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Device group, Device.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

PROPERTIES

In addition to name and identification, properties for the gas storage can be defined in different groups:

Type/Capacity: Settings for the basic behavior of the devices in the gas grid.

Switching variables: Variable for the adaption of important parameters during the Runtime.

Fill level: Here the Load Management receives important information about filling level and minimal and maximal value.

Switching times: Default of different life spans or timely requirements to single pieces of equipment.

All adjustable properties are described in the help window after you click on them.

CONTEXT MENU ENTRIES FOR THE SELECTED GAS STORAGE:
### Menu/Entry | Description
--- | ---
Cut | No function at the device group.
Copy | Copies the currently selected device group. You can not copy more than one group at a time (no multi-select).
Paste | Inserts objects of the type gas storage.
Delete | Deletes the currently selected device group. You can not delete more than one group at a time (no multi-select).
Export XML all... | Exports all device groups of the selected grid.
Export XML selected... | Exports the currently selected device group. You can not export more than one group at a time (no multi-select).
Import XML... | Imports objects of the type Supply area.
Help | Opens the online-help for the Load Management module.

### 7.9.2 Liquid gas plant

In the Load Management liquid gas plant are classical gas storage devices. Basically they are used to equalize peaks. In case of a peak, gas can be taken from the storage.

Context menu entries for the selected gas storage group:
### Menu/Entry

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid gas plant new</td>
<td>Creates a liquid gas plant.</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Device group, Device.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### PROPERTIES

In addition to name and identification, properties for the liquid gas plant can be defined in different groups:

- **Type/Capacity**: Settings for the basic behavior of the devices in the gas grid.

- **Switching variables**: Switching variables: Variable for the adaption of important parameters during the Runtime.

- **Fill level**: Here the Load Management receives important information about filling level and minimal and maximal value.

- **Switching times**: Default of different life spans or timely requirements to single pieces of equipment.

All adjustable properties are described in the help window after you click on them.

### CONTEXT MENU ENTRIES FOR THE SELECTED LIQUID GAS PLANT:

- **Cut** (Ctrl-X)
- **Copy** (Ctrl-C)
- **Paste** (Ctrl-V)
- **Delete** (Del)
- **Properties**
- **Export XML all...**
- **XML export selected...**
- **Import XML...**
- **Linked elements**
- **Help**
## Setting load management parameters

<table>
<thead>
<tr>
<th>Menu/Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut</td>
<td>No function at the device group</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the currently selected device group. You can not copy more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Paste</td>
<td>Inserts objects of the type Liquid gas plant.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the currently selected device group. You can not delete more than one group at a time (no multi-select).</td>
</tr>
<tr>
<td>Export XML all...</td>
<td>Exports all device groups of the selected grid.</td>
</tr>
<tr>
<td>Export XML selected...</td>
<td>Exports the selected entries as an XML file.</td>
</tr>
<tr>
<td>Import XML ...</td>
<td>Imports objects of the type Supply area.</td>
</tr>
<tr>
<td>Help</td>
<td>Opens the online-help for the Load Management module.</td>
</tr>
</tbody>
</table>

### 7.10 Locking times

For both generators and devices it is possible to define times in which switchings can be carried out only restricted or not at all. Any number of lock times can be defined for each generator/device.

**Information**

*In natural gas grids lock times are only available for devices.*

Any number of lock times can be defined for each element. You must ensure that the lock times do not overlap. If they do, it is possible that the component cannot be switched by the Load Management anymore.

**Information**

*The lock time parameters are set in the project and cannot be changed during the Runtime.*

### 7.11 Creating a process screen

The operating of the Load Management module during the Runtime is done with a screen of the type Load Management. This screen must be created in the editor first. (You will find more information on the pre-defined screen types in the chapter Screens / Pre-defined screen types.)
After the screen is opened an empty screen is displayed. You can add control elements via menu Control elements.

7.12 Engineering the screen switch function

When creating a screen switch function for a screen of the type Load Management the following dialog is displayed:

In the Runtime the Load Management screen is opened with the help of a screen switch function. For the screen call-up the following parameter can be set:
<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grids</td>
<td>Selection of the grids. After that the available areas are displayed in the selection box Supply area.</td>
</tr>
<tr>
<td>Supply areas</td>
<td>The selected supply area is displayed in the Runtime of the optimization. Only one supply area can be displayed per screen. You have however the possibility to open several screens of the type Load Management parallel. At that several supply areas can be displayed parallel.</td>
</tr>
<tr>
<td>Current value</td>
<td>This field is only for display. You cannot change the value. The variable of the property Current value of the currently selected supply area is displayed.</td>
</tr>
<tr>
<td>Final value of forecast</td>
<td>This field is only for display. You cannot change the value. The variable of the property Final value forecast of the currently selected supply area is displayed.</td>
</tr>
<tr>
<td>Forecast average</td>
<td>This field is only for display. You cannot change the value. The variable of the property Forecast average of the currently selected supply area is displayed.</td>
</tr>
<tr>
<td>Supply limit</td>
<td>This field is only for display. You cannot change the value. The variable of the property Supply limit of the currently selected supply area is displayed.</td>
</tr>
<tr>
<td>Scale maximum</td>
<td>Upper limit of the range scale for the display of the characteristic curve in the Load Management screen.</td>
</tr>
<tr>
<td>Scale minimum</td>
<td>Lower limit of the range scale for the display of the characteristic curve in the Load Management screen.</td>
</tr>
<tr>
<td>Billing period (min.)</td>
<td>This field is only for display. You cannot change the value. Shows the currently set length of the Billing period for the selected supply area.</td>
</tr>
<tr>
<td>Value color and width</td>
<td>Color and line width for the display of the elements for the current average value and for the forecasted average value.</td>
</tr>
<tr>
<td>Axis color and width</td>
<td>Color and line width for the display of the chart axes.</td>
</tr>
<tr>
<td>Curve color and width</td>
<td>Color and line width for the display of the chart curves (display of the current value and the scheduled switchings).</td>
</tr>
<tr>
<td>Font axis</td>
<td>Font which is used for the axis caption and the trend curve.</td>
</tr>
</tbody>
</table>

**SWITCHING OPERATION**

For the engineering of the switching operation you define the filter settings for the display in the Runtime in tab Column settings for the switching operations preview. You can find details in chapter Column settings for the switching operations preview (on page 61).
7.13 Create function start/stop

For each area you must start the optimization separately in the Runtime. For this you use the function **Start Load Management**. In order to stop started areas, create the function **Stop Load Management**.

**Note:** These functions are only carried out on the server.

**Attention**

In the Runtime all started areas recorded by the licensing. Take care of sufficient licensing.

**Hint:** Stop the optimization of areas if they are not needed in order to use your license in an optimal way. In order to stop areas regularly e.g. in the night or in certain shifts, you can control functions **Start Load Management** or **Stop Load Management** with the help of the Production & Facility Scheduler.

**LOAD MANAGEMENT START**

- select New Function
- click on **Start Load Management** in the node applications
- the dialog for the selection of the areas opens
- first select the desired grid
- then select the desired area
- by clicking **OK** the function is created

**STOP LOAD MANAGEMENT**

- select New Function
- click on **Load Management stop** in the node applications
Setting load management parameters

- the dialog for the selection of the areas opens

- first select the desired grid
- then select the desired area
- by clicking OK the function is created

7.14 Engineering switching operations preview

Planned switching operations can be displayed as a preview in the Runtime.

In order to engineer the switching operations preview in the Runtime:

1. Link a String variable to the desired Load Management supply area with the help of property Planned switchings (group Status information). The variable receives a list of all planned switching operations from the Load Management.

   Hint: A String variable from the internal driver makes most sense.
   For server operation set the calculation to Network. Thus the variable is distributed in the whole zenon network.

2. Define the desired content of the switching operations preview. For this open tab Load Management Column settings for the switching operations preview (on page 61) in the dialog of the screen switch function (on page 57) to the screen Load Management.

3. Insert the Table view: control element into the the Load Management screen. Switching operations preview ON.

   You can customize color and font using its properties.

LANGUAGE SWITCH

You can switch between languages for all information displayed in the switching operations preview with the help of the language table.
For this you can define the name for the column titles in the filter dialog (on page 61). For example if you define a name such as @Switching time, @Object name or similar, these names are replaced by the corresponding entries from the language table in the Runtime.

In addition the whole content of the switching operations preview can be replaced:

1. Object names are replaced by putting a @ in front of them during the Load Management engineering. For example: @Generator1
2. Current value and switching value can either have a numerical content (with CHP steps) or @On/@Off

### 7.14.1 Column settings for the switching operations preview

Via the column setting you can define which information is displayed in what order.

**Note:** The language of all information displayed in the switching operations can be switched via the language table:

Select the name with a @ before it, for example @Schaltzeit, so that this can be replaced with the corresponding language table entries in Runtime.

In the list field of this tab all available column types are displayed. With the help of a checkbox you decide which column types are displayed. You can change the description and the width of each column type by left-clicking the corresponding area and entering the desired value in the input field.
Setting load management parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column type</td>
<td>Type of the column. Cannot be edited. The display in the Runtime is activated or deactivated with the help of a checkbox.</td>
</tr>
<tr>
<td>Description</td>
<td>Defines the header of the respective column. You can configure it as language switchable. The value can be edited.</td>
</tr>
<tr>
<td>Width</td>
<td>Defines the width of the column in pixels. You can also define the width of the column by clicking and dragging the column with the mouse.</td>
</tr>
<tr>
<td>Move selected entry up</td>
<td>Moves the selected column up. You can also move the columns with drag&amp;drop.</td>
</tr>
<tr>
<td>Move selected entry down</td>
<td>Moves the selected column down. You can also move the columns with drag&amp;drop.</td>
</tr>
<tr>
<td>Field with horizontal display of the column names</td>
<td>Shows the columns which are active in the list. You can define the size of the columns by clicking and dragging the column borders with the mouse.</td>
</tr>
</tbody>
</table>

⚠️ Attention

The column width is dependent on the used font. If the column width is not a multiple of the character width of the used font, the actual column width can differ from the set column width.

7.14.2 Switching operations preview in the Runtime

In the Runtime screen Switching operations preview displays the upcoming switching operations with date and consequence:

<table>
<thead>
<tr>
<th>Switching time</th>
<th>Generator/Devices</th>
<th>Variable name</th>
<th>Current value</th>
<th>Switching value</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>04.11.2009 11:49:06</td>
<td>Heating2</td>
<td>sP1/Global/Hall1_Body_Shop_Heating2_Off</td>
<td>Off</td>
<td>Off</td>
<td>400</td>
</tr>
<tr>
<td>04.11.2009 11:49:06</td>
<td>Heating1</td>
<td>sP1/Global/Hall1_Body_Shop_Heating1_Off</td>
<td>On</td>
<td>Off</td>
<td>400</td>
</tr>
<tr>
<td>04.11.2009 11:49:06</td>
<td>Ventilation</td>
<td>sP1/Global/Hall1_Body_Shop_Ventilation_Off</td>
<td>On</td>
<td>Off</td>
<td>300</td>
</tr>
</tbody>
</table>
8. **Internal state of the components**

Internally in the Load Management different states for the components are carried along. This states can be shown using a variable. We recommend to monitor the states with reaction matrix and e.g. to evaluate them in the Chronological Event List.

The variable **Internal switching state** of components can take on the following values:
## GENERAL REASONS (VALID FOR ALL COMPONENTS)

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Not used (Booting).</td>
</tr>
<tr>
<td>100</td>
<td>Service is possible.</td>
</tr>
<tr>
<td>101</td>
<td>No switching request of the peak load forecast.</td>
</tr>
<tr>
<td>102</td>
<td>Deactivated until the end of the rate interval.</td>
</tr>
<tr>
<td>103</td>
<td>The switching forewarn command is invalid.</td>
</tr>
<tr>
<td>104</td>
<td>Not enough time in order to forewarn.</td>
</tr>
<tr>
<td>105</td>
<td>The forewarn time has not yet expired.</td>
</tr>
<tr>
<td>106</td>
<td>It is not possible to add output at the end of the rate interval because of the parameterization.</td>
</tr>
<tr>
<td>107</td>
<td>The switching state cannot be detected.</td>
</tr>
<tr>
<td>200</td>
<td>Delay time has not expired yet.</td>
</tr>
<tr>
<td>201</td>
<td>Component is set to &quot;not available.&quot;</td>
</tr>
<tr>
<td>202</td>
<td>Availability message is invalid.</td>
</tr>
<tr>
<td>203</td>
<td>No variable is defined in order to determine the operation state.</td>
</tr>
<tr>
<td>204</td>
<td>Parameterization is faulty.</td>
</tr>
<tr>
<td>205</td>
<td>Dead time has not expired yet.</td>
</tr>
<tr>
<td>206</td>
<td>Report of the current switching state is invalid.</td>
</tr>
<tr>
<td>207</td>
<td>No data for the gliding average value of the output are available yet.</td>
</tr>
<tr>
<td>208</td>
<td>Current output value is invalid.</td>
</tr>
<tr>
<td>209</td>
<td>Is set to &quot;implicit&quot; (schedule medium-term).</td>
</tr>
<tr>
<td>210</td>
<td>Text address or value for switch-on priority is invalid.</td>
</tr>
<tr>
<td>211</td>
<td>Text address or value for switch-off priority is invalid.</td>
</tr>
<tr>
<td>212</td>
<td>Blocking time is active, blocking time type OFF.</td>
</tr>
<tr>
<td>213</td>
<td>Blocking time is active, blocking time type ON.</td>
</tr>
<tr>
<td>214</td>
<td>Maximum number of switchings has already been reached.</td>
</tr>
<tr>
<td>215</td>
<td>Switching command cannot be used.</td>
</tr>
<tr>
<td>216</td>
<td>Minimum switching time has not been reached yet.</td>
</tr>
<tr>
<td>217</td>
<td>Schedule data have not been written completely yet.</td>
</tr>
<tr>
<td>218</td>
<td>General problem.</td>
</tr>
<tr>
<td>219</td>
<td>Command variable cannot be used for switching.</td>
</tr>
<tr>
<td>220</td>
<td>No command defined for sending the switching forewarning.</td>
</tr>
<tr>
<td>221</td>
<td>Extended parameterization for minimum power-on time per unit time is not valid.</td>
</tr>
</tbody>
</table>
Because of other restrictions, it is not possible to stick to restriction "Adhere to minimum power-on time per time unit".

Switched on implicitly because of "minimum switch-on time per time unit". Variable or value for minimum switch-on time is invalid.

Variable or value for minimum switch-off time is invalid.

Variable or value for maximum switch-on time is invalid.

Variable or value for maximum switch-off time is invalid.

Restrictions are not reasonable.

**REASONS FOR STORAGE**

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td>Current filling level value is invalid.</td>
</tr>
<tr>
<td>4001</td>
<td>Current roll out (actual value) is invalid.</td>
</tr>
<tr>
<td>4001</td>
<td>Roll out is implicit because of the manual set value.</td>
</tr>
<tr>
<td>4003</td>
<td>Storage capacity limited because of filling level limit.</td>
</tr>
<tr>
<td>4004</td>
<td>Storage is full.</td>
</tr>
<tr>
<td>4005</td>
<td>Set value for storage is not defined.</td>
</tr>
<tr>
<td>4006</td>
<td>Maximum roll in capacity and maximum roll out capacity are both 0.</td>
</tr>
<tr>
<td>4007</td>
<td>Variable which is used to measure the current filling level is invalid.</td>
</tr>
</tbody>
</table>

**REASONS FOR CHPS (GENERATOR)**

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000</td>
<td>The current output does not comply with a level output.</td>
</tr>
<tr>
<td>5001</td>
<td>CHP does not run below nominal power.</td>
</tr>
<tr>
<td>5002</td>
<td>The CHP only has one level can cannot be switched.</td>
</tr>
<tr>
<td>5003</td>
<td>The CHP runs with nominal power and cannot be switched down further.</td>
</tr>
<tr>
<td>5004</td>
<td>The highest switched on level cannot be switched off because of the minimal switch-on time per time unit.</td>
</tr>
<tr>
<td>5005</td>
<td>The CHP is already running on its highest level.</td>
</tr>
<tr>
<td>5006</td>
<td>The variable which is used to measure the current output is invalid.</td>
</tr>
<tr>
<td>5007</td>
<td>The forewarning for a level was activated. Waiting for set value input.</td>
</tr>
<tr>
<td>5008</td>
<td>The variable for the set value is invalid.</td>
</tr>
<tr>
<td>5009</td>
<td>The order of the output guidelines by variables is not ascending.</td>
</tr>
</tbody>
</table>
9. Creation of the Runtime files

After engineering the functions **Start Load Management** or **Stop Load Management** a consistency check of the EMS engineering is carried out during the creation of the Runtime files. If problems occur, a corresponding message is displayed in the output window (e.g. if necessary variables were not allocated).

**RUNTIME DOES NOT START**

If a project cannot be started in the Runtime, it can have the following reasons:

- wrong engineering
- missing license: With the function **Start Load Management** the license is checked. If the license is not available, the Load Management does not start and a corresponding entry is generated in the log.

10. Operating load management in Runtime

Screens of the Load Management make it possible to monitor the prognosis and the optimization during the Runtime in form of a trend screen.

The single operating elements are positioned in the screen with the help control elements (prognosis area and the display of the current supply area).
For example a prognosis can look like this:

<table>
<thead>
<tr>
<th>Digit</th>
<th>Description (properties of the supply area)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Previous tariff interval</td>
</tr>
<tr>
<td>2</td>
<td>Current tariff interval</td>
</tr>
<tr>
<td>3</td>
<td>Supply limit</td>
</tr>
<tr>
<td>4</td>
<td>First switching value</td>
</tr>
<tr>
<td>5</td>
<td>Estimated final consumption</td>
</tr>
<tr>
<td>6</td>
<td>Current average consumption value</td>
</tr>
<tr>
<td>7</td>
<td>Start value of estimation</td>
</tr>
<tr>
<td>8</td>
<td>Last switching value</td>
</tr>
<tr>
<td>9</td>
<td>Estimated error range</td>
</tr>
<tr>
<td>10</td>
<td>Forecast average value</td>
</tr>
</tbody>
</table>

**Information**

The screen in Runtime only serves for the display of optimization and prognosis data. No interventions can be carries out in the screen. Parameters of the Load Management module are exclusively controlled via variables.