



# Process Data

Version 5.12

## *Manual*



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# 1 About this document


This document describes the fundamental configuration and use of the Process Data module in FORCE MES FLEX.

 This document describes the basic configuration of process data acquisition. Configurations for special cases are not described. If you should have any special needs, please do not hesitate to ask your contact person at FORCAM GmbH.

 For better readability, we generally use the generic masculine in the text. The phrasing, however, is equally inclusive of all genders and intended to address all persons equally.

## 1.1 Target group

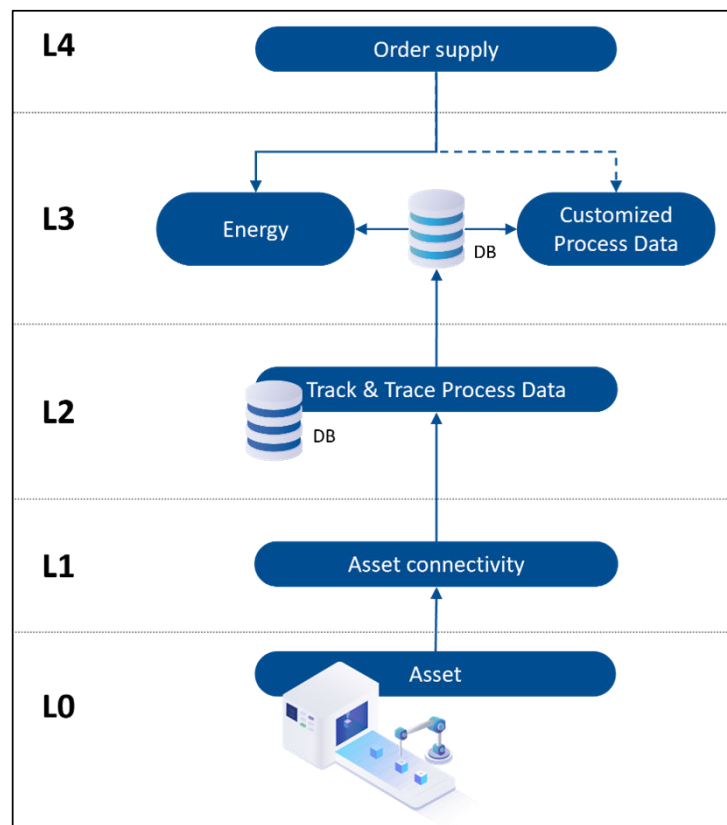
This manual requires knowledge in handling of FORCE MES FLEX and the Office Client components. If you do not have any knowledge in this area, take the time to familiarize yourself with the basics.

 We recommend that you use our Academy: <https://forcam.com/academie/>  
The FORCAM Academy provides the knowledge to effectively use the methods for digital transformation and the technologies for the Smart Factory.  
Based on lean manufacturing and TPM methods, our institute team will guide you to initiate changes in your company and to use the technologies appropriately.

## 2 Process data concept

In general, the concept of process data refers to values acquired by sensors such as, for example, temperature, pressure, etc. Process data acquisition is performed continuously and runs independently of the workplace status and current operation.

### 2.1 Schematic diagram of the system structure



**Figure 1: Schematic diagram of process data processing**

#### Level 0 – Generation of process data

Process data are generated by assets fitted with the suitable hardware for their generation. These are, for example, sensors for pressure, temperature, energy consumption, etc.

#### Level 1 – Digital asset connectivity

This level represents the digital connection between assets and IT systems. Data exchange is usually performed directly via the PLC of an asset and/or communication protocols. However, data sources (assets) may also be individual sensors or clusters of sensors. (Sensors are bundled at the hardware level). The asset connectivity level implements the connection and makes the data available to the higher-level systems.

#### Level 2

Process Data is an application of the Track & Trace module. It is used to receive process data from the asset connectivity level, save them and make them available for evaluation.

### Level 3

Process data are received from the Track & Trace module and mapped to order data from the order supply. In the standard configuration, these data are available in the performance report for energy data.

- ❗ Optionally, the process data can be used for the customer's individual process data reports. These are not covered in this document.

### Level 4

Order supply can be performed via the order supply component integrated in FORCE MES FLEX, an ERP system or other systems.

## 2.2 Schematic diagram of signal mapping

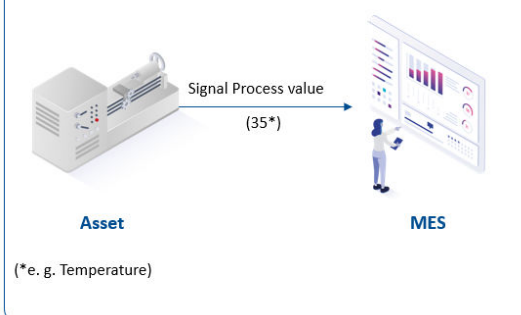
An asset may send signal values with or without an associated unit. In order to ensure comparability of the data of various assets, they are mapped to a base unit within FORCE MEX FLEX. The base units are configured in the master data. Mapping of signals to the process values supplied is performed in the configuration of data capturing items (DCI).

Process values supplied without an associated unit are mapped to physical units in the DCI configuration. This is the normal situation described in this document.

For process values supplied with an associated unit, it is first necessary to define the undefined unit symbol supplied. This is a special case which is not described in this document. If you should have any special needs, please do not hesitate to ask your contact person at FORCAM GmbH.

#### Basic version

- Asset provides undefined process value
- Internal enrichment by physical unit



#### Extension

- Asset provides undefined process value
- Asset provides undefined "unit symbol"
- Internal mapping to unit symbol

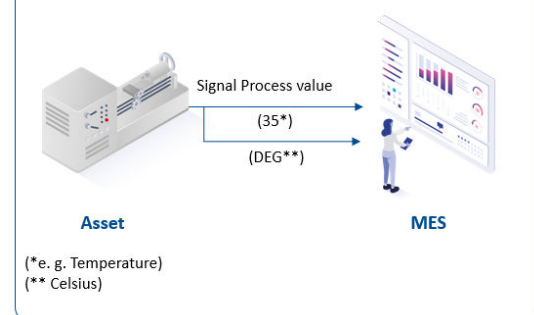


Figure 2: Schematic diagram for signal mapping with and without symbols supplied from an asset


### 3 Master data configuration

This chapter describes the global configurations that are necessary in the system to be able to implement process data handling in the system.

#### 3.1.1 Physical units

In most cases, process data are sent by the various assets without an associated physical reference unit. Comparability can be improved by configuring physical units in the system for the input and conversion of the process data received to the appropriate base unit.

**Path:** Workbench > Master Data > Physical Units


-  For more detailed information about the configuration of physical units, please refer to the manual for **Master data**.

The most common physical units from production are preconfigured, e.g. temperature, water consumption, water pressure, compressed air consumption and air pressure, gas consumption and pressure.

Process Value	Unit Collected	Base Unit	Units Defined
Energy consumption	Wh	Joule (J)	kWh/Wh/J/KJ
Compressed air consumption	Nm <sup>2</sup>	(Nm <sup>2</sup> )	m <sup>2</sup>
Temperature	°C	Kelvin (K)	C/K
Pressure	bar	Torr	Pascal/Bar/mbar/PSI/ATM/Torr

**Table 1: Mapping of units for process data acquisition**

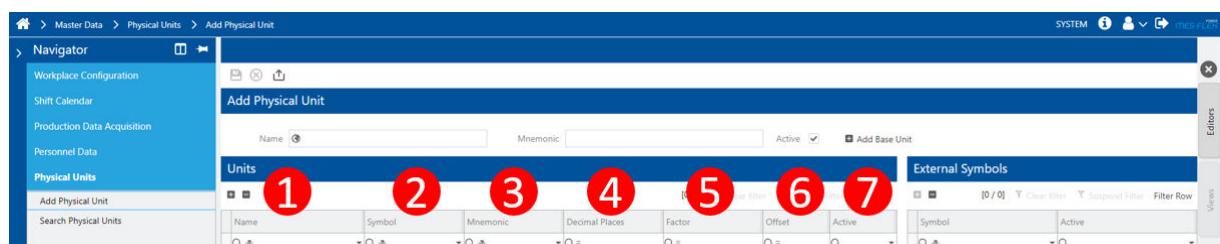
Other units can be created on a customer-specific basis.

-  Physical units have to be created before they can be mapped to specific process data.

When creating the physical units, various parameters need to be configured.

#### Base units

The base unit is the fundamental unit of the physical unit. Its factor is always 1.



**Figure 3: Parameters for configuring physical units**

- (1) Name
- (2) Symbol
- (3) Mnemonic
- (4) Decimal Places
- (5) Factor
- (6) Offset
- (7) Active


### Other units

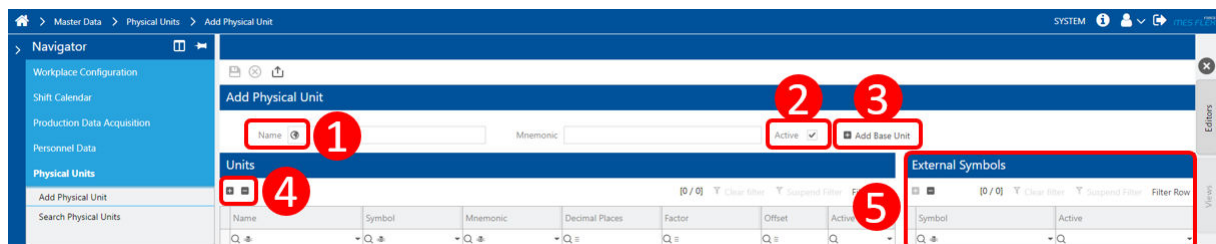
All other units and their (decimal) factors, offsets (other measuring units with their conversion values), etc. relate to the base unit.

### Creating physical units


**Path:** Workbench > Master Data > Physical Units > Add Physical Unit

#### To create base units:


1. Click + **Add Base Unit** (3).
-  The appropriate language / base unit designation are created on a customer-specific basis next to the globe icon (1).
2. Configure the base unit according to your needs.
3. Save.



**Figure 4: Creating physical units as a basis for process data acquisition and evaluation in the master data**

 Once created, you cannot modify or delete a base unit.  
You may activate or deactivate it by the check mark (2).

#### To create other units:

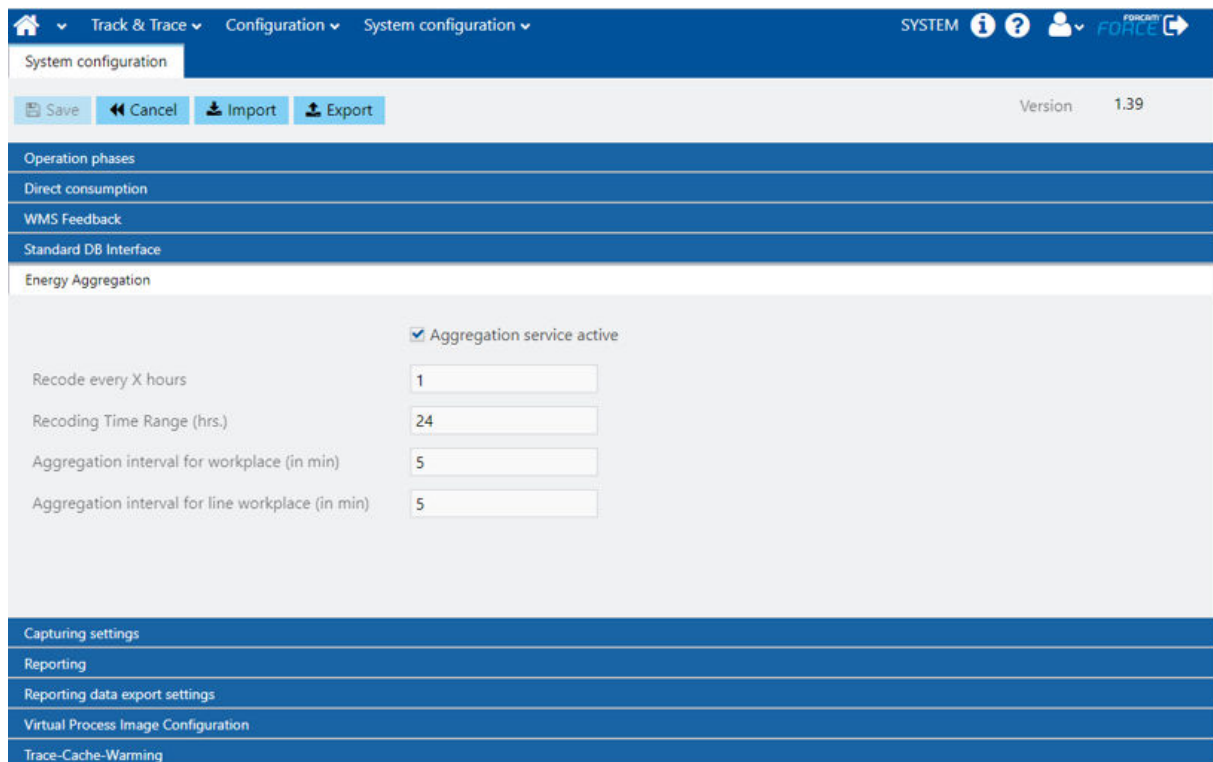
1. Click + symbol (4).
2. Configure the units according to your needs.
-  The factors and offsets specified here refer to the base unit created.
3. Save.

### 3.1.2 Energy value aggregation (global configuration)

The energy value aggregation function allows further processing of the process data from the Track & Trace module and makes these available to the performance report for energy data.

**Path:** Workbench > Office Client > Track & Trace > Configuration > System Configuration > Energy Aggregation

The aggregation service may be activated or deactivated. Aggregation is based on the calculation in this module. By default, calculation runs every 5 minutes. The values of the last hour are calculated.



The screenshot shows the 'System configuration' window in MES FLEX. The 'Energy Aggregation' section is active, displaying the following settings:

- Aggregation service active:** ☒ (checked)
- Recode every X hours:**
- Recoding Time Range (hrs.):**
- Aggregation interval for workplace (in min):**
- Aggregation interval for line workplace (in min):**

The left sidebar contains the following menu items: Operation phases, Direct consumption, WMS Feedback, Standard DB Interface, Energy Aggregation (selected), Capturing settings, Reporting, Reporting data export settings, Virtual Process Image Configuration, and Trace-Cache-Warning.

Figure 5: Configuration of energy data aggregation

Parameter	Description
<b>Aggregation service active</b>	If a check mark is set, the EAS is active.
<b>Recode every X hours</b>	Sets the time interval in hours after which to recalculate the values (default 1). This means that usually the last 24 hours are calculated once every hour.
<b>Recoding Time Range (hrs.)</b>	Sets the time period to be recalculated in hours (default 24).
<b>Aggregation interval for workplace (in min)</b>	Sets the time in minutes after which the distribution of the new energy consumption values takes place after the previous distribution for a single workplace.
<b>Aggregation interval for line workplace (in min)</b>	Sets the time in minutes after which the distribution of the new energy consumption values takes place after the previous distribution for a line workplace.

Table 2: Configuration parameters of the energy aggregation service



### 3.1.3 Energy type configuration

**Path:** Workbench > Office Client > Track & Trace > Configuration > Energy Type Configuration

In the energy type configuration, physical units are mapped to specific energy types. This makes it possible to calculate the energy consumption later in 'Energy aggregation at signal level (DCI)' (see chapter 4.3.4).

**To add an energy type:**

1. Click **+Add**.
2. Set the following configurations:
  - **Mnemonic:** Abbreviation for the energy value
  - **Code:** Assigned automatically
  - **Physical Unit:** Use the drop-down menu to select from all physical units (previously created in the master data)
  - **Colors:** A color can be optionally assigned
  - **Description:** For better understanding, a description can be added to the energy type. Descriptions can be added in several languages by clicking on the globe icon.
3. Save.

## 4 Process data configuration (basic variant)

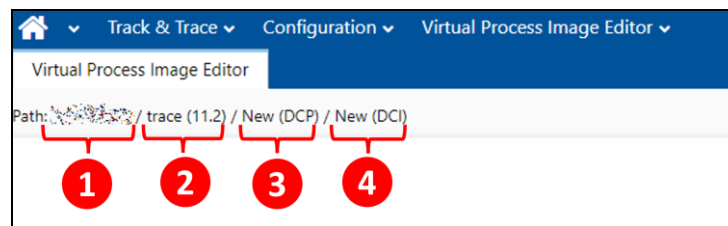


**Figure 6: Schematic illustration of process data acquisition configuration**

The schematic illustrates the structure of process data acquisition configuration.

- The virtual process image (VPIE) shows the real signals in a digital representation.
- The data capturing point (DCP) corresponds to the workplace and/or asset connected.
- The data capturing item (DCI) represents the signal (process value) of the asset connected.
- Process data handling configures handling during signal processing in the process data acquisition function.

For better orientation, the current position within the schematic is shown at the top left of the screen:





**Figure 7: Path for orientation within process data configuration**

- (1) Customer
- (2) Project (version no.)
- (3) DCP
- (4) DCI

### 4.1 Virtual process image (VPIE)

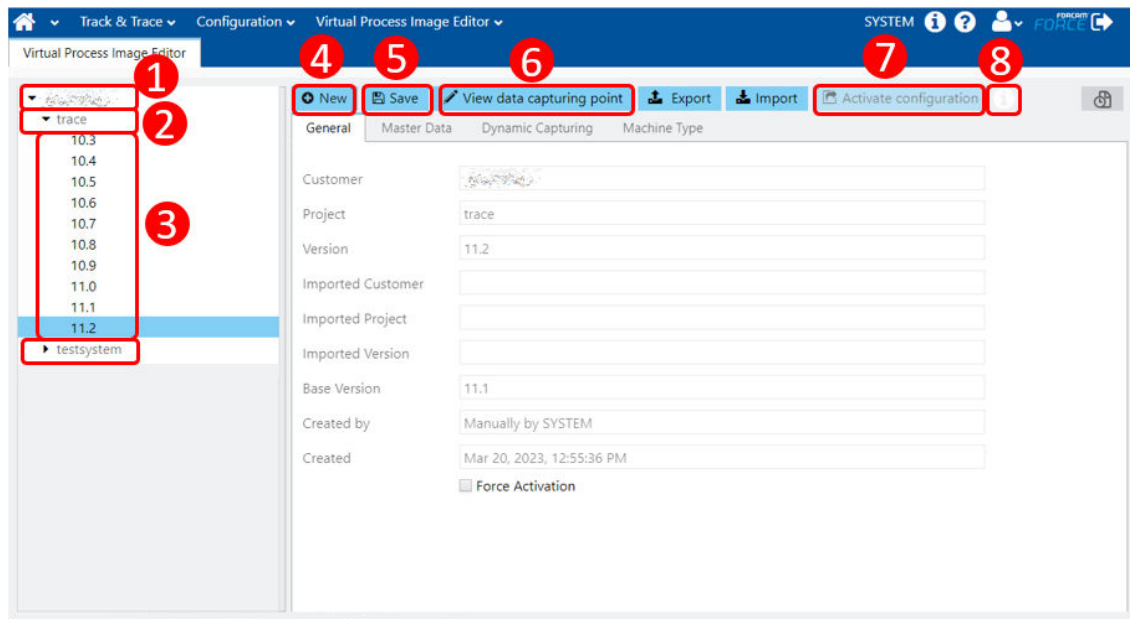
The virtual process image configures the acquisition of process data intended for later evaluation in reports.

-  As a prerequisite for creating DCPs, the required **Physical Units** must have been created.
-  As a prerequisite for machine data recording, the machine must be connected to FORCE MES FLEX.

For more detailed information, please refer to the manual on **Master Data**.

#### 4.1.1 Root base page

**Path:** Workbench > Office Client > Track & Trace > Configuration > Virtual Process Image Editor



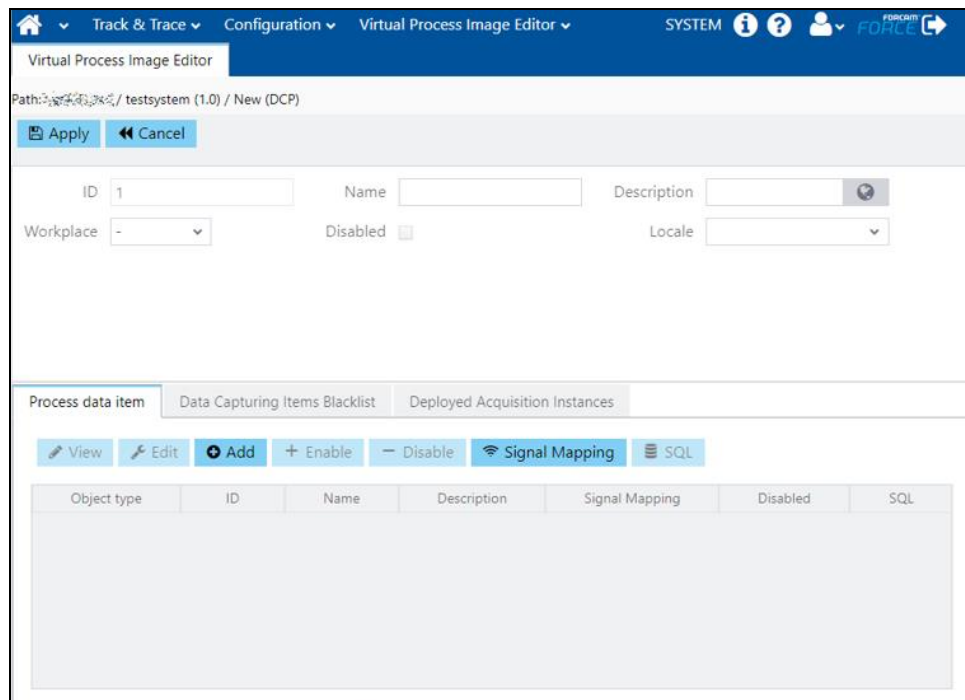
**Figure 8: Root base page in the virtual process image editor**

- (1) Customer name
- (2) Project name
- (3) Project configuration version
- (4) Create new DCP
- (5) Save DCP
- (6) Shows the DCPs already created in this version.
- (7) Activates the selected version of the configuration.
- (8) Info icon: Shows the currently active configuration (customer, project and version)

## 4.2 Creating data capturing points (DCP) for process data

**To create data capturing points, the following steps are required in the VPIE:**

- ✓ Click on the Info icon to check which version is currently active.
  1. Select the current version.
  2. Click **View data capturing point**.
  3. In the new window, click **+ Add**.
  4. In the dialog window, go to the **Capturing Type** and select **Process Data Capturing 24/7** from the drop-down menu.
  5. For **Copy Existing DCP**, select a DCP from the drop-down menu.
- OR
- Enter a new DCP.
- 6. Click **Add**.
- ➔ The DCP dialog window opens (Figure 9).




**Figure 9: Dialog window for data capturing point (DCP)**

**To configure a DCP:**

1. Enter the **Name** and **Description** of the DCP in the upper area of the DCP dialog window.
2. Select the associated **Workplace**.
3. Select the **Locale** from the drop-down menu.
4. Optionally: You can use the check mark to deactivate the signal.
5. In the lower area, go to the **Process data item** tab and click the **+ Add** button.

**To edit data capturing points:**

1. Select the current version in the root base page of the VPIE.
2. Click **View data capturing point**.
3. Select the desired data capturing point.
4. At the top of the tab, click **Edit**.
5. Select the appropriate item in the **Process data item** tab.
6. Click **Edit**.
7. Configure the process data.
8. Click **Apply**.
9. Click **Apply** at the top left of the screen.

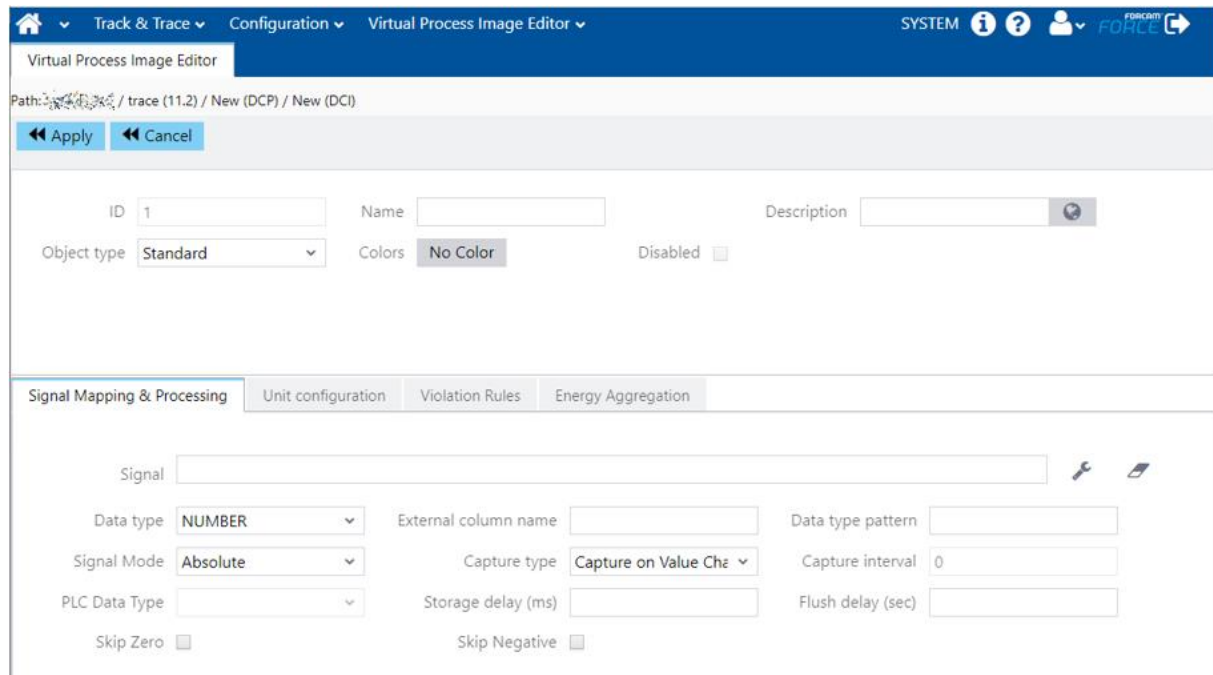
-  Preconfigured DCPs can be used for backups or further processing using the **Export** functions. The **Import** function is provided to be able to use external templates in the system.

## 4.3 Creating data capturing items (DCI) for process data

**Path:** Workbench > Office Client > Track & Trace > Configuration > Virtual Process Image Editor

**To create a DCI, the following steps are required in the DCP dialog window:**

1. In the lower area, go to the **Process data item** tab and click the **+ Add** button.
  - ➔ The DCI dialog window opens.



**Figure 10: Dialog window for data capturing item (DCI)**

**To configure a DCI:**


1. Enter the **Name** and **Description** of the DCI in the upper area of the DCI dialog window. Optionally you can enter descriptions in various languages by the globe icon in the upper area.
2. For **Object type**, select *Standard*.
3. Optionally: Choose color.
4. Optionally: Deactivate the signal by the check mark.

### 4.3.1 Signal mapping and processing

A signal from the machine connection is added here. The way the signal is recorded and processed is also configured.

**To map signals:**

1. In the lower area, click on the wrench icon.
2. Select the signal and click **OK** to confirm.
3. Select **Signal Mode**.
  - Absolute: Specifies the current status, e.g. of a counter
  - Incremental: Specifies the increase of the previous value (+1, +1, +1)
  - Calculated Increment: Calculates an incremental value from unsigned data
4. Select the **Capture type**.
  - Capture on Value Change: Signals are only collected when the value changes.
  - Capture by Interval: Signals are collected at regular time intervals.

 There is no automated synchronization between the signals created in the master data and the signal assignment in data capturing items.  
If a signal name is subsequently changed in the master data, this signal must be reassigned to all related data capturing items.  
If not, the signal is not recognized at all and will not be recorded. As a consequence, subsequent evaluations will not be correct.

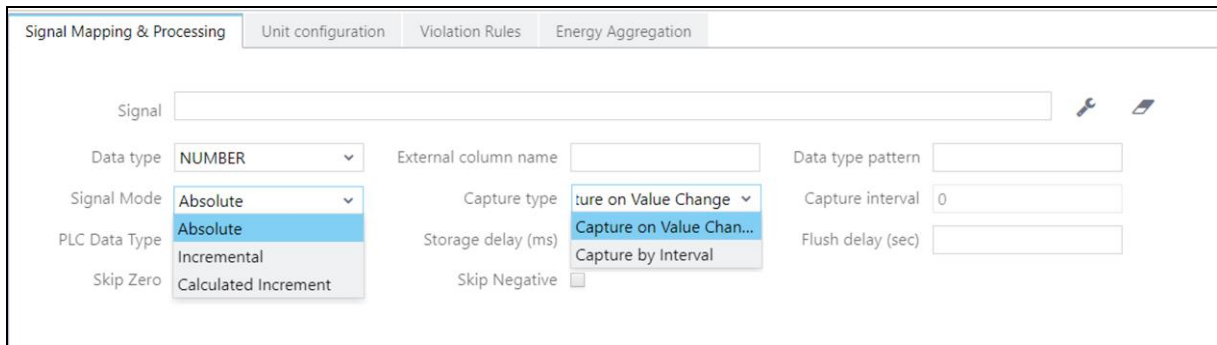


Figure 11: DCI configuration: Signal mapping and processing

### 4.3.2 Unit configuration

The physical unit categories have to be mapped to the units delivered from the ERP. In addition the unit shown for reports and the SFT is selected here.

Configuration	Description
<b>Physical Unit</b>	Selection from the data defined in the master data configuration (see 3.1.1).
<b>Delivered Unit</b>	Selection based on the previously configured physical units in the master data.
<b>Dynamic Unit</b>	Advanced. Please contact your FORCAM Technical Consultant.
<b>Display Unit</b>	Selection based on the previously configured physical units in the master data (see 3.1.1).
<b>Rounding Type</b>	Selection from drop-down menu
<b>Decimals</b>	Number of decimal places. Depends on the precision of the asset.

Table 3: DCI mapping: Unit configuration

### 4.3.3 Violation rules

Limit values (upper and lower limits) can be defined for process data collected. It is also possible to define the information to be output on reaching or violating these limit values.

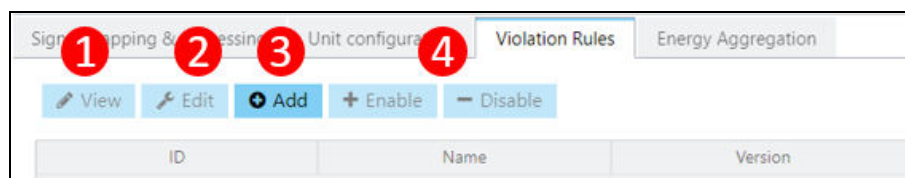


Figure 12: DCP mapping: Violation rules

- (1) Show existing rules
- (2) Edit existing rules (previously defined)
- (3) Add new rule
- (4) Activate or deactivate individual or several rules

#### 4.3.3.1 Specifying violation rules

Different colors can be specified for violation rules, they can be assigned to various violation levels and their priorities can be defined.

When upper or lower limit values are violated, there are various options for sending notifications to the SFP or specific persons.

**Figure 13: DCI mapping: Specifying violation rules**

- (1) Name the violation rule.
  - (1a) A rule ID is automatically assigned.
  - (1b) A rule version level is automatically assigned after editing.
- (2) Select display color.
- (3) Select violation level.
- (4) Select priority.
- (5) Define the condition when a limit value is violated. For example, on reaching the limit value (=), when exceeding it (>), within a defined range of values (from - to), etc.
- (6) Set the signal value.
- (7) Define how limit violations are reported.
  - Notification on the shopfloor terminal (alert the worker; initiate processes in production)
  - E-mail: Alerting e.g. maintenance personnel (initiate processes in support functions)
  - API callback: Alerting via technical interface (initiate automatic / technical processes)
- (8) Set time intervals for limit violation reporting.

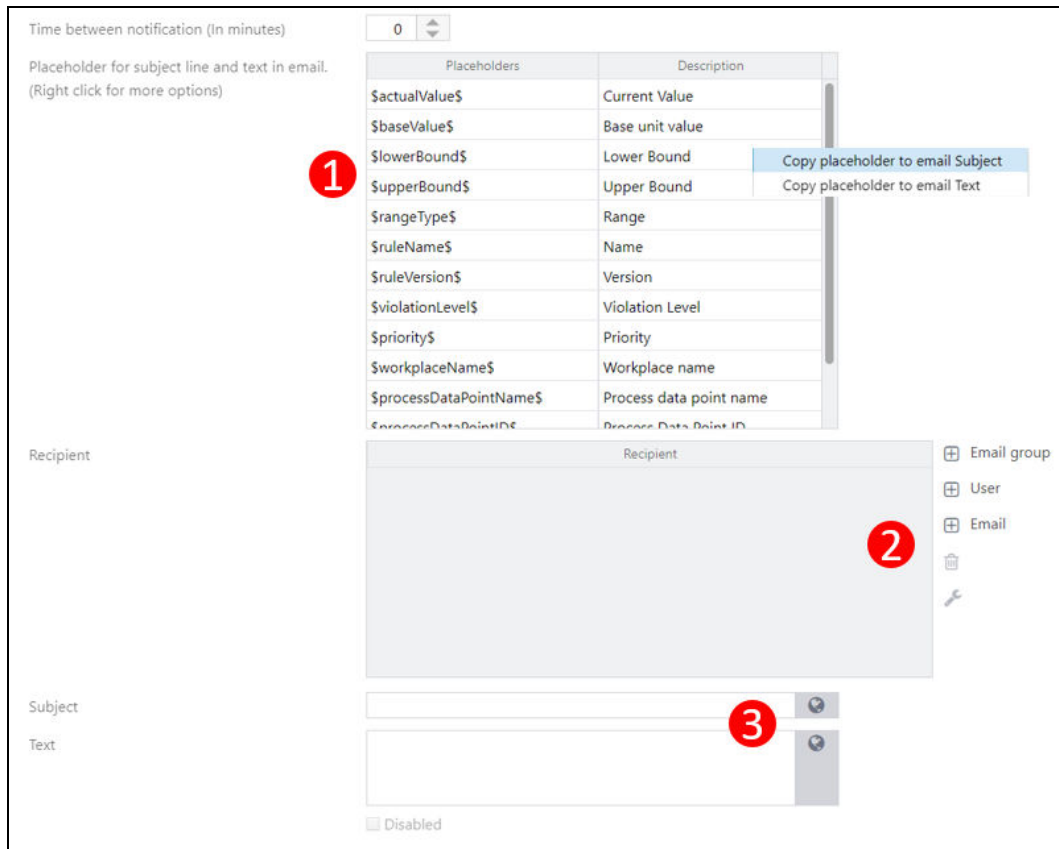
#### To create violation rules:

1. Click the **Violation Rules** tab.
2. Click **+ Add**.
3. Fill in the configuration fields (see Figure 13).
4. Click **Apply**.

### 4.3.3.2 Reporting limit violations via email

If notification via email is configured for limit violations, the subject and the text of the e-mail must be defined and one or more recipients specified.

Subject and text of the e-mail can either be taken from preconfigured placeholders or entered freely. This function can be deactivated later.



Time between notification (In minutes) 0

Placeholder for subject line and text in email.  
(Right click for more options)

Placeholders	Description
\$actualValue\$	Current Value
\$baseValue\$	Base unit value
\$lowerBound\$	Lower Bound
\$upperBound\$	Upper Bound
\$rangeType\$	Range
\$ruleName\$	Name
\$ruleVersion\$	Version
\$violationLevel\$	Violation Level
\$priority\$	Priority
\$workplaceName\$	Workplace name
\$processDataPointName\$	Process data point name
\$processDataPointID\$	Process Data Point ID

Copy placeholder to email Subject  
Copy placeholder to email Text

Recipient

Subject

Text

Disabled

**Figure 14: DCI mapping: Configuring email notification**

**To configure email notification with placeholders (see Figure 14, (1)):**

1. In the configuration of violation rules (see Figure 13, (7)), click **Email Notification**.
2. Select the appropriate placeholder.
3. Click the right-hand mouse key in the field of the placeholder selected.
4. Select if the placeholder should appear in the subject or text of the email.
- ➔ Placeholder appears in the text area (Figure 14, (3)).
5. Select the recipient of the email.
  - a. Click **+ Email group**, **+ User** or **+ Email**.
  - b. Enter address(es) or select user(s).
6. Click **Apply**.

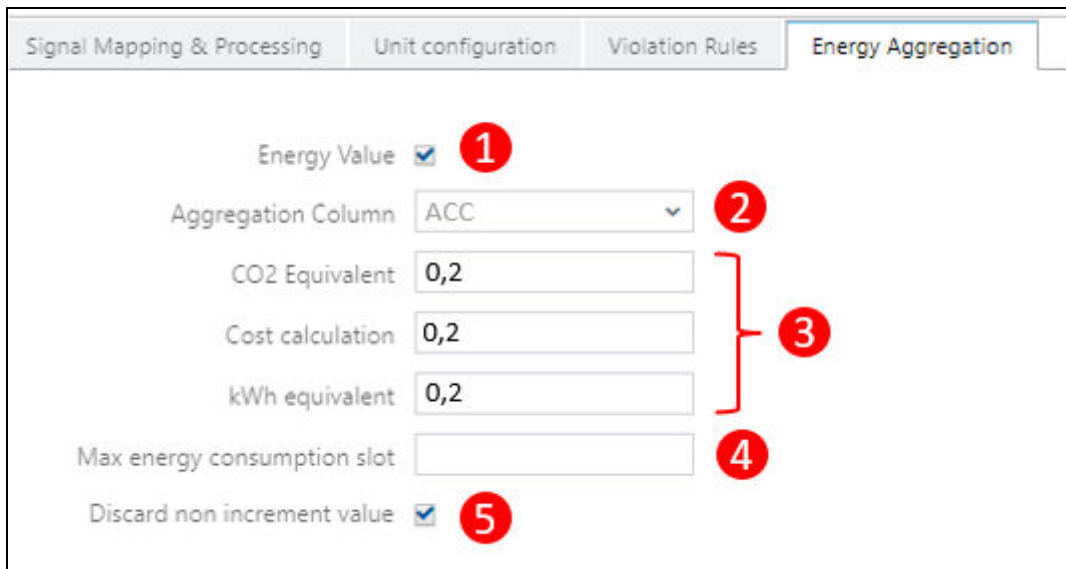


#### To configure email notification with free text:

- ✓ A violation rule has been defined.
- 1. In the dialog window (see Figure 14), click into the free text area (2).
- 2. Type the desired text.
- 3. Click **Apply**.

### 4.3.4 Energy aggregation at signal level (DCI)

The conversion factors specified here are used to convert the energy values captured (raw data) into costs or power consumption (kWh) and/or CO<sup>2</sup> equivalents. The costs or power or CO<sup>2</sup> equivalents are displayed in the energy report in the general **New Office**. They cannot be retrieved on the SFT.



**Figure 15: Energy aggregation**


- (1) If the values collected are energy values, the check mark must be set here. Otherwise, the values are not included in the energy reporting.
- (2) This column uses the “mnemonic” entry in the physical units.
- (3) Customer-specific factors to convert energy into CO<sub>2</sub> equivalents, costs or kWh equivalents are entered here.
- (4) For example, high energy consumption may occur when starting a machine. It may be that peaks are not to be included in the calculation of the process data. In this case, a maximum value can be specified here that can be captured per recording period. Higher energy consumption in a recording period is only included in the calculation with the maximum value.
- (5) In the event of an update, it can happen that incrementally recorded values are reset to 0. If a check mark is set here, recorded values are not reset.

## 4.4 Saving DCI

1. Click **Apply** at the top of the screen.
  - ➔ The screen returns to the DCP configuration; this is evident from the path displayed.
- ⚠ All steps described in the sections 4.3 to 4.3.4 have to be performed. Otherwise, the configuration settings made will be discarded.


## 4.5 Saving DCP


1. Select the appropriate DCI in the **Process data item** tab.
2. Click the **SQL** button.
  - The check mark is set in the SQL column.
3. Click **Apply** at the top of the screen.
  - The screen returns to the project configuration (VPIE); this is evident from the path displayed.

 All steps described in the sections 4.2 to 4.3.4 have to be performed. Otherwise, the configuration settings made will be discarded.

## 4.6 Saving and activating the VPIE configuration

1. Click **Close** at the top of the screen.
  - The screen returns to the root base page of the virtual process image editor.

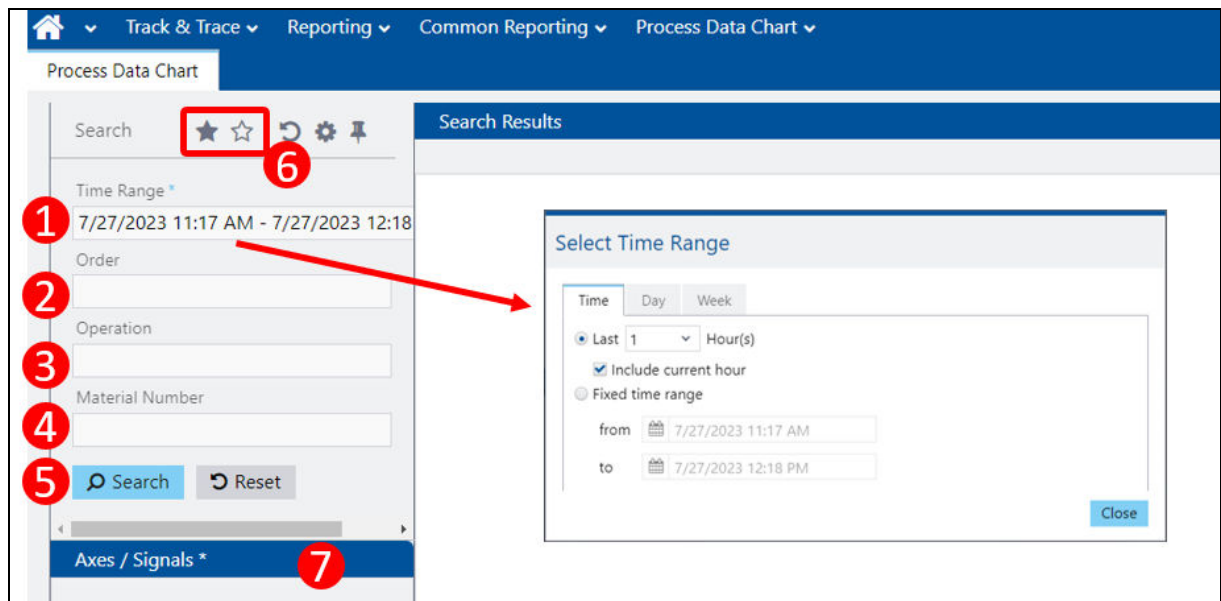
 The configuration becomes active immediately. The previous version is automatically deactivated.

 After creating and/or editing DCPs in the root base page, do not omit to click **Save** (Figure 8, (5)). Otherwise all configuration settings made will be discarded.

## 5 Process data evaluation

### 5.1 Trace reporting / process data chart

#### Root base page



**Figure 16: Process data chart input screen**

- (1) Select the period for which you want to create a report
- (2) Input field for the order number
- (3) Input field for the operation number
- (4) Input field for the material number
- (5) Execute or reset the query
- (6) Dark star: Save the current input as a favorite  
Bright star: Select favorite from list
- (7) Selection and display of the axes / signals for the report (right-click to edit)

## Generate process data chart

### To visualize process data:

1. Enter the desired data (Figure 16, (1 – 4)) into the input screen.
2. Click the right-hand mouse key in **Axes / Signals** (Figure 16, (7)).
- ① A maximum of two axes can be selected.
3. Click **Add axis**.
4. Select **Physical Unit** from the drop-down menu and click **Save**.
5. Click the right-hand mouse key on the unit added.
6. Click **Add Signal**.
7. Make the entries in the **Signals** input screen and click **Save**.
  - Workplace
  - Machine Type
  - Process Data
- ① Perform steps 3 – 7 for both axes.
8. Click **Search** (Figure 16, (5)).
- ➔ The chart is displayed.

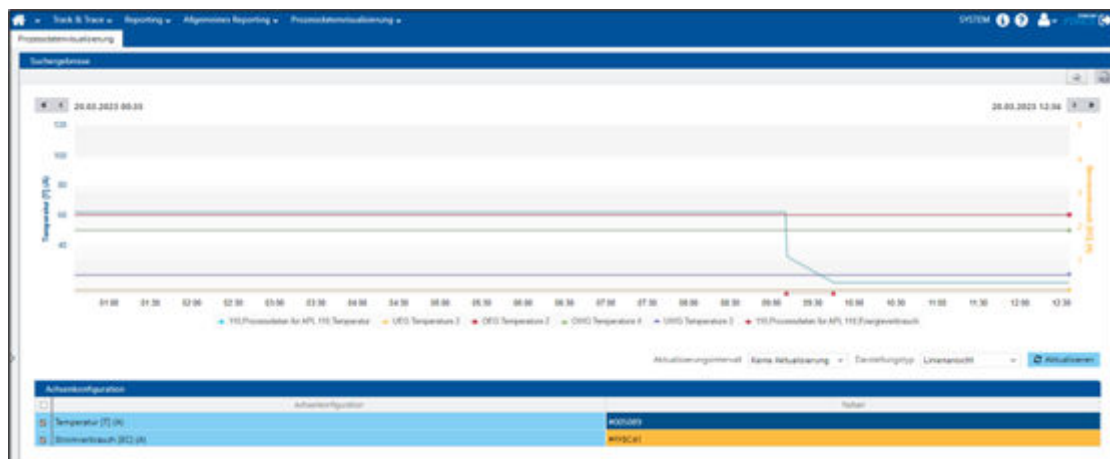
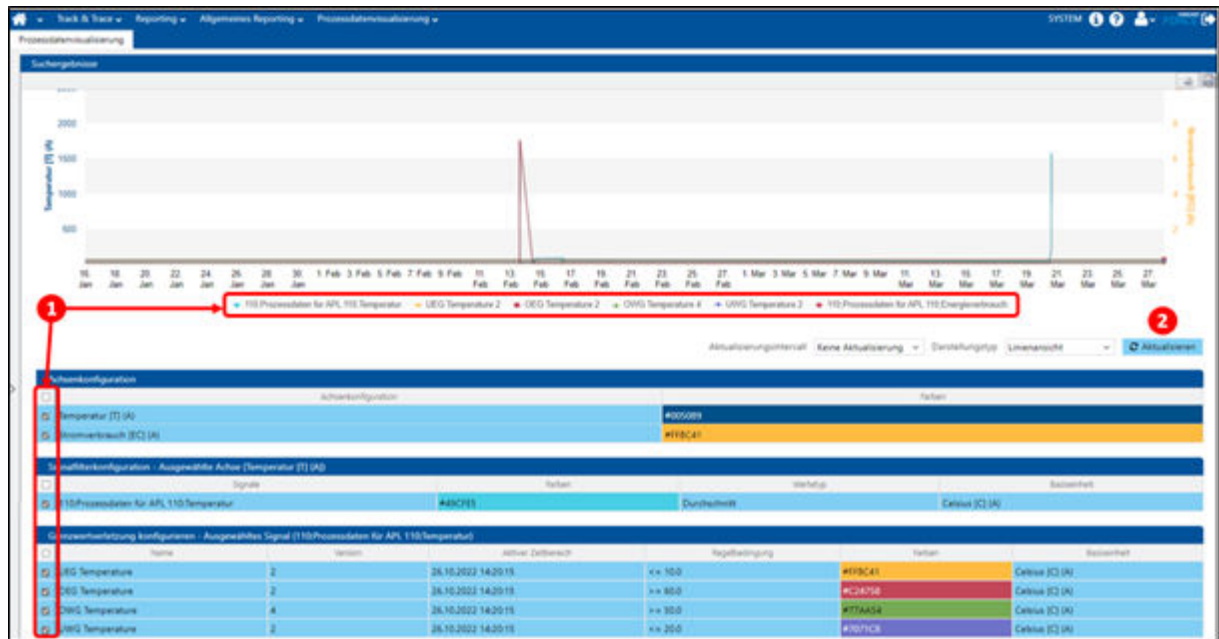


Fig. 17: Example of a process data chart

## Show / hide process data

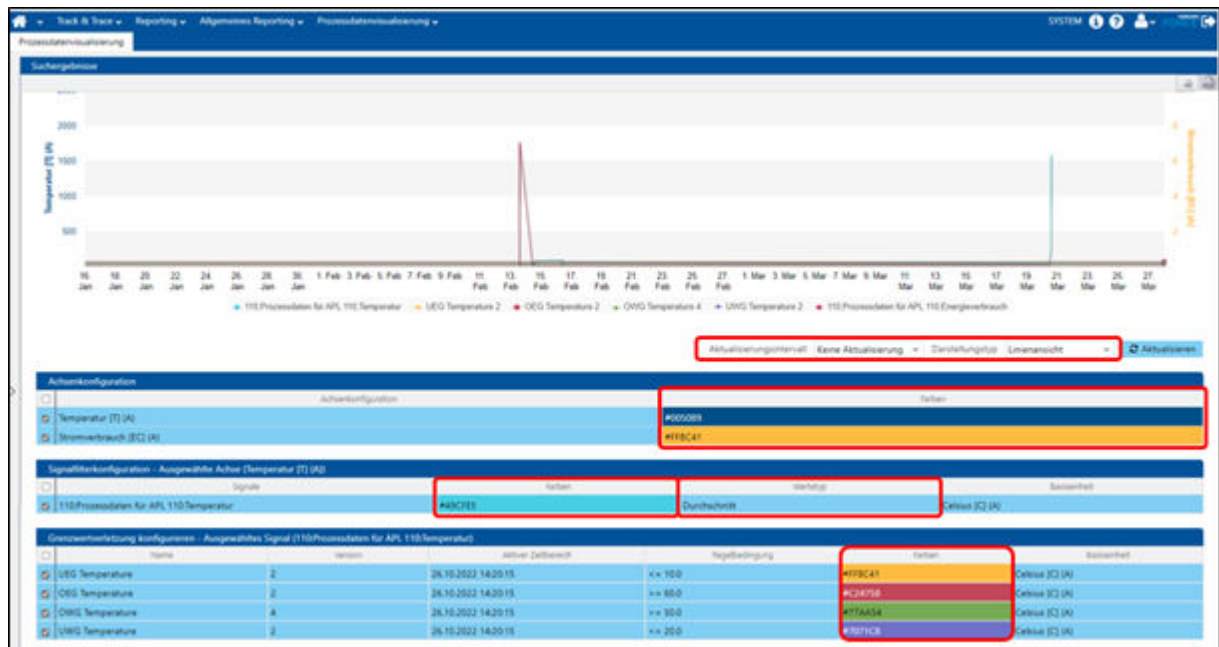


**Figure 18: Process data chart: Show / hide values displayed**

You can show or hide individual values in the process data chart by clicking (Figure 18, (1)).

Click **Refresh** (Figure 18, (2)) to refresh the graphic display.

## Change display mode



**Figure 19: Process data chart: Change display mode**

You can modify the areas marked in red (Figure 19) to obtain a clearly arranged view. Double-click on these fields to open a configuration page.

- **Refresh Interval:**  
The display is updated automatically at certain intervals.
- **Chart Type:**  
The following display types are available:
  - Line View
  - Spline View
  - Series View
- **Colors:**  
You can assign colors to the values for display.
- **Value type:**
  - Minimum
  - Mean
  - Maximum
  - Sum
  - Standard Deviation
  - Variance
  - Raw Value

 Click **Refresh** to refresh the graphic display.

## 5.2 SFT reporting

Reportings can also be displayed on the shopfloor terminal for selected process data.

**To visualize process data on the shopfloor terminal:**

1. On the right of the shopfloor terminal, click **View process data**.
  2. Select the desired process data from the dialog window.
- A window opens and shows the view.

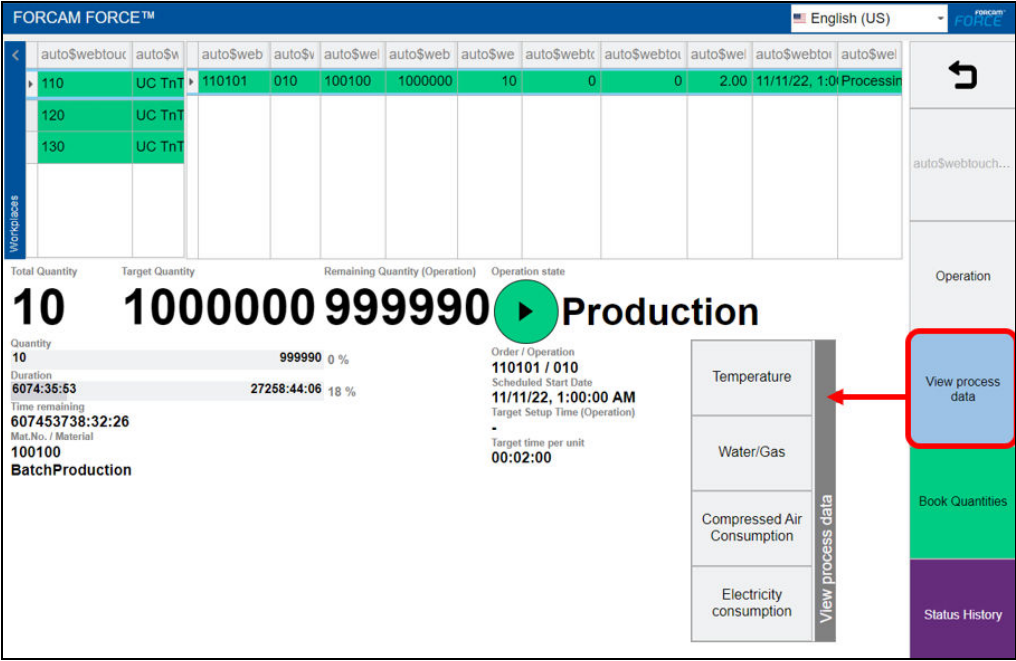


Figure 20: Shopfloor terminal – process data display

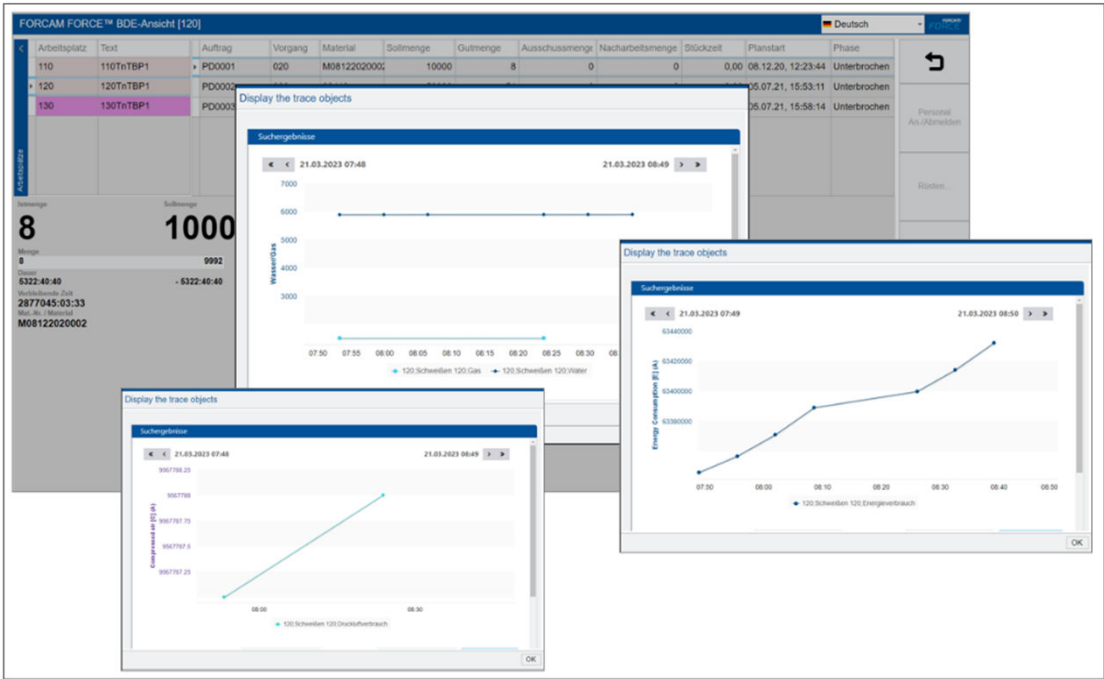


Figure 21: Various reporting options on the shopfloor terminal

## 6 Process data in FORCE MES FLEX performance analysis

The FORCE MES FLEX performance analysis module includes reporting for various use cases. In the context of process data acquisition, the reports for energy data acquisition are relevant in the standard configuration. It is also possible to use the process data for custom reports (this is not covered in this document).


### 6.1 Energy data reporting

#### Using energy aggregation in energy reporting (performance analysis)

**Path:** Workbench > Office Client > Performance Analysis > Reporting > Energy Data Acquisition / Sustainability

For more detailed information about energy reporting, please refer to the **Manual – Energy Analysis**.

### 6.2 Customized reports for process data

 This document describes the basic configuration of process data acquisition. Configurations for special cases are not described. If you should have any special needs, please do not hesitate to ask a Technical Consultant of FORCAM GmbH at any time.



## 7 Annex

### 7.1 Document conventions

Convention	Description
<b>Bold type</b>	Buttons and option names are written in bold type.
<i>Italics</i>	Highlighted words are in italics.
<b>Icons</b>	For a function that is represented by an icon, the icon is referenced as the object.
<b>Action result</b>	Results from actions are indicated by ➔.
<b>Prerequisites</b>	Prerequisites are indicated by ✓.
<b>Warnings</b>	Warnings are indicated by ⚠.
<b>Notes</b>	Notes are indicated by ⓘ.
<b>Tips</b>	Tips are indicated by ⓘ.

Table 4: Fonts, formatting and characters used

### 7.2 Abbreviations and terms used

Abbreviation	Description
<b>Asset</b>	Generic term that refers to all objects the signals of which are processed.
<b>DCI</b>	Data capturing item
<b>DCP</b>	Data capturing point
<b>PLC</b>	Programmable Logic Control

Table 5: Abbreviations and terms used