Energy Management: Providing Rich Visualizations of Plant Energy Consumptions

Applies to:

Energy management. SAP MII 12.1 SP4 or higher. SAP BI Xcelsius 2008.

For more information, visit the Sustainability homepage.

Summary

This paper describes the steps needed to provide rich visualizations on Energy Consumptions in a plant environment. Energy data is acquired by Historians, and processed/aggregated through SAP MII, and displayed in Xcelsius dashboards.

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Maumdar, Arijeet and Boecker, Stephan are currently working in Solution Management for SAP MII.

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Table of Contents

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Energy Management

Energy is not the commodity anymore it was once perceived to be. Companies face a growing number of external regulations and internal process in order to measure, visualize, and report on Energy consumed in their operations. The following article intends to serve as example and best practice on how Energy Management related dashboards can be created using SAP MII and SAP BI Xcelsius components.

Concepts

In order to visualize energy consumptions in a plant dashboard, the following steps have to be carried out:

1. Catching energy related consumption data. This is usually performed by historians which record the energy consumption of a piece of equipment
2. Mapping of tag based historian information to a plant equipment, which can be either based on a plant execution system or could be an SAP equipment/functional location. This mapping can be done using SAP MII business logic.
3. Association of equipment data with other plant relevant dimensions like product, tasks, organization areas. In most cases, energy related information is needed in context with other –non equipment based – plant characteristics. A typical usage might be to look for the energy consumption in building a certain product, or energy consumption in a certain plant area. In order to report those figures, the original equipment based energy value has to be associated with those dimensions of product, organization. Technically it can be performed by associating a set of equipment with the new dimension member, and then aggregating over the equipment used on the time span. In a 'task list' or process, for example we can map equipment data with product information, thus enabling a product based report on energy consumption.
4. Running queries against the data sources with respect to the dimension needed. In a plant based environment we chose a database as data store of daily aggregated daily consumption values. In a larger installation, this data store might be located in a central environment. Queries are run against this database returning the right aggregation for the desired time period and target dimension. An aggregation to a daily value in the database provides a reasonable trade off between the typical timeframe of an historian, and the reporting needs, which might extend to several months of aggregation. At the same time, we can take load of the historians for these reporting purposes.
5. Manipulating raw data queried to adjust for visualizations. This covers simple transformations from input format to output format as well as analytical operations, and is carried out in SAP MII business logic.
6. Building dashboards visualizing the data from SAP MII. We chose Xelsius 2008 dashboards built on top of SAP MII, a procedure which has been published before on SDN.

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Contents of the Demo Package

The demo package contains the Database files (MS SQL server), as well as the MII transactions, web pages, and Xcelisus dashboards, to show energy related data in a plant based environment. The demo content serves as a starter kit to help you in building your own energy management reporting solution based on MII. Download the demo package (ZIP 2 MB).

The Dashboards give an overview of Energy Information with respect to various dimensions and are organized under the tabs “Overview”, “Process”, “Prod & Prod Grp”, “Equipment” and “Organization”.

There is a capability to select the data viewed over time. The time range is common over all views. Also there is a provision to change the granularity of data viewed (Month / Day)

Some example dashboards are shown below:

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Energy Information Management
Start Date: Jan 2009
End Date: Oct 2009
displayed by Month
Overview
Process
Prod & Prod Grp
Equipment
Organization
Equipment AirCompress...
Go
Output
kWh
ton
Production
Consumption
Energy Intensity
kWh/ton
Energy Per Product
kWh
HG Paint Red
HG Paint Blue
Flat Paint Red
Equipment Thermal / Power Efficiency
Percent

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The whole dashboard can be accessed from the Web folder of the MII project. The page is called EnergyMgmtDashboard.htm/ EnergyMgmtDashboard.jsp.

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Installation

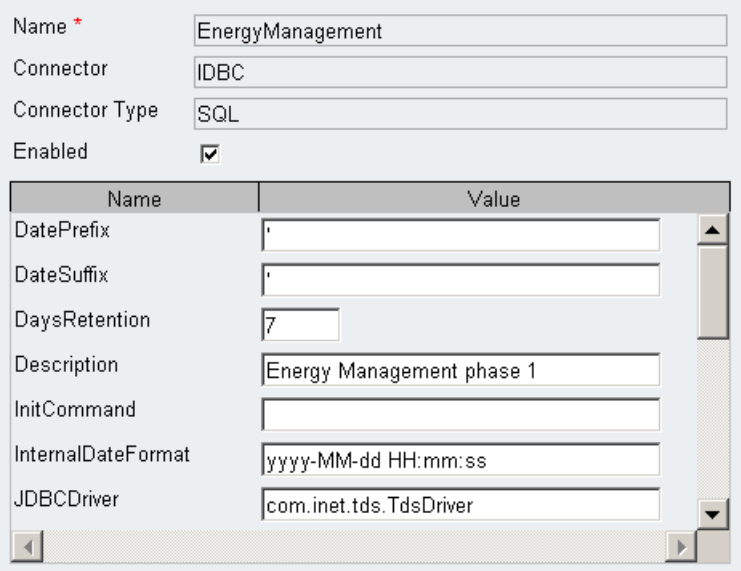
The package is contained in a .zip file. Extract the file to any location on your drive. You will see two subfolders called ‘DB’ and ‘MII’. The DB folder contains the database data and log files for an MS SQL server 2000 or higher. We provided you with a Database file filled with demo data, so you can start from a working example. Install the database file in your Enterprise Manager by Choosing Database->All Tasks->Attach database from the mouse context menu and browse to the location of the EnergyMgmt.mdf file.

The ‘MII’ folder contains the SAP MII project, which you can import directly into your SAP MII environment via System Management->Projects. The project contains the business logic and web pages to manipulate and display the data. The Xelsius original .xlf file is part of the ‘Web’ folder of the MII project.

Configuration

In order to run the contents of the package you need to set up the following connections

- A connection from the MII server to the MSSQL database. His connection is set up in the SAP MII Menu under Data Services->Data Servers as a connection to type ‘IDBC’.



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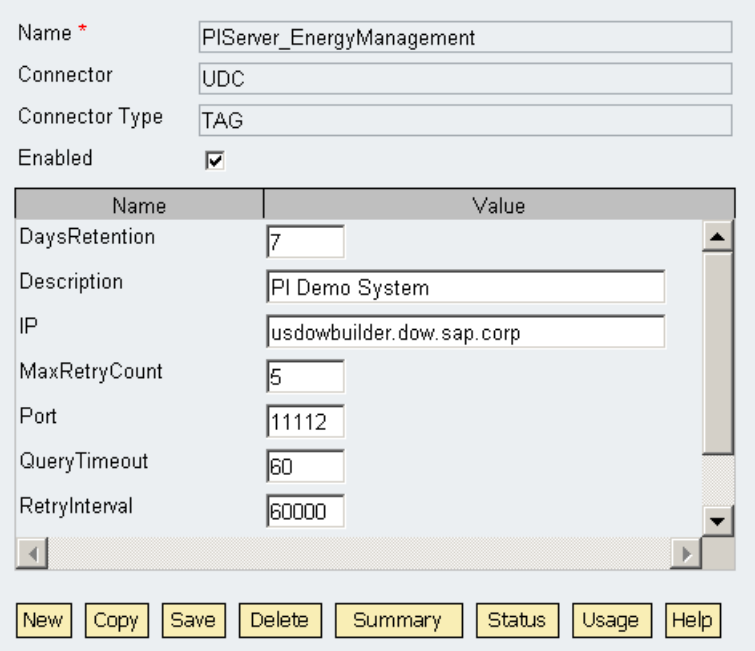
- A connection form the MII server to the historian holding the tag history. This connection is mediated by the usage to SAP MII UDC/PCo, where you first set up a connection between UDC/Pco and the historian system. In a second step you connect the MI server to the UDC/PCO instance. Our example uses a 'UDC' connector.



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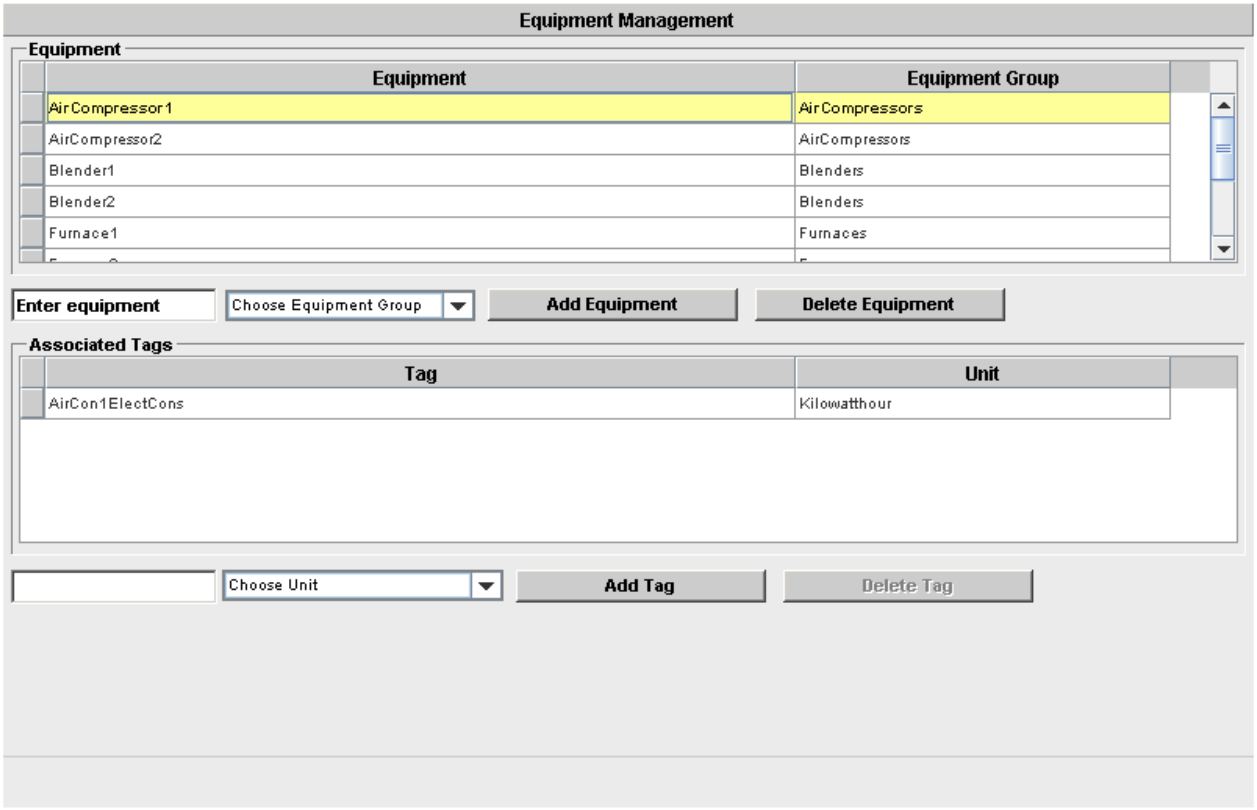
Master Data

In order to report on energy consumption in this demo environment you need to set up the corresponding master data. Master data includes equipments, products, and processes. For our example we provide master data via SAP MII web page data entry forms, which are described in this section. The corresponding set of business logic transactions is located in the EnergyManagement->Master Data folder.

Equipment is modeled in the 'Equipment.html' file located in the Web folder of the Energy Management project. This page allows you to define a piece of equipment and associate a set of tags to it. The tags are read via a tag based query ('GetTagList').



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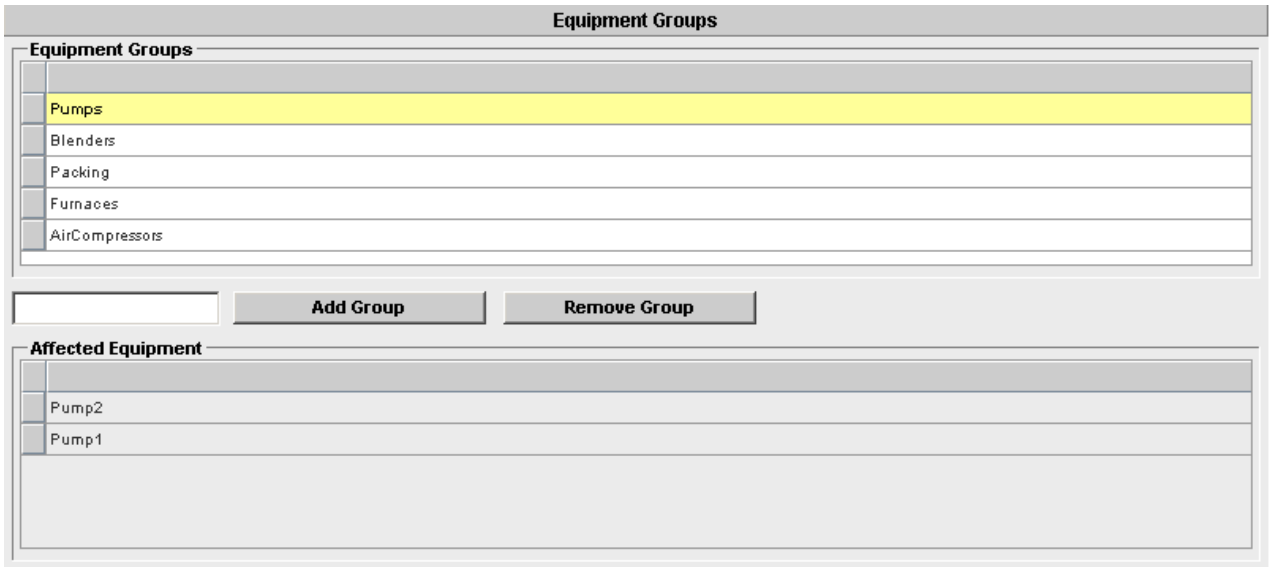
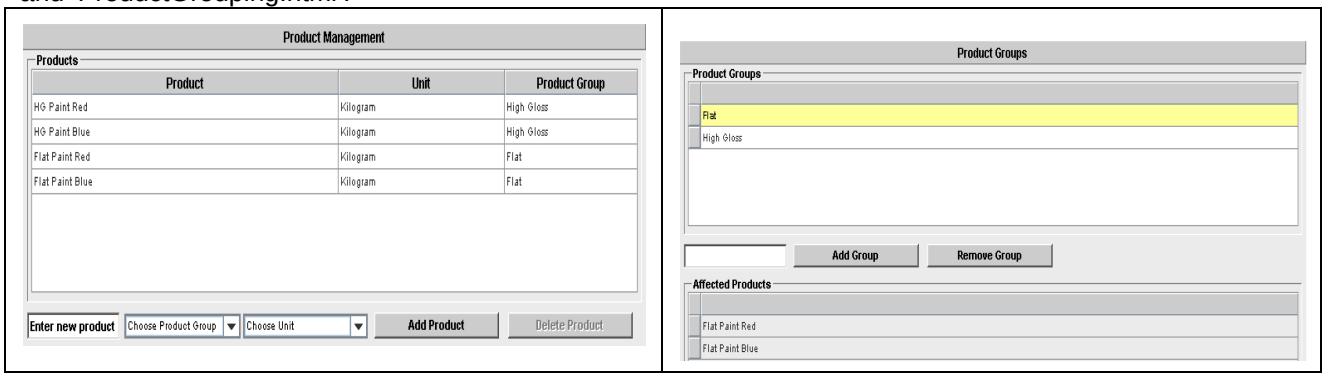
Adding an equipment will save the equipment and the tag associations in the database. Equipment is further grouped in to equipment groups which are defined in the web page 'EquipmentGrouping.html', shown below:



In a real world scenario, this page would be replaced by your existing equipment hierarchy. .

In a similar way, Products and product groups are entities describing a produced material. Products and products groups do not carry any tag information. The web pages in the SAP MII project are 'Product.html' and 'ProductGrouping.html'.



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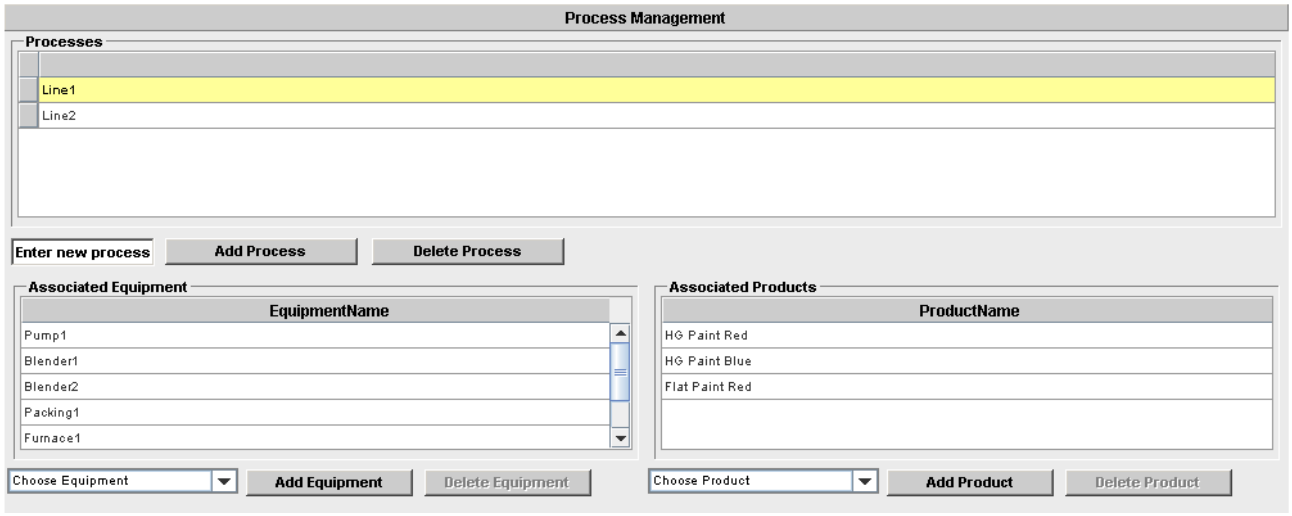
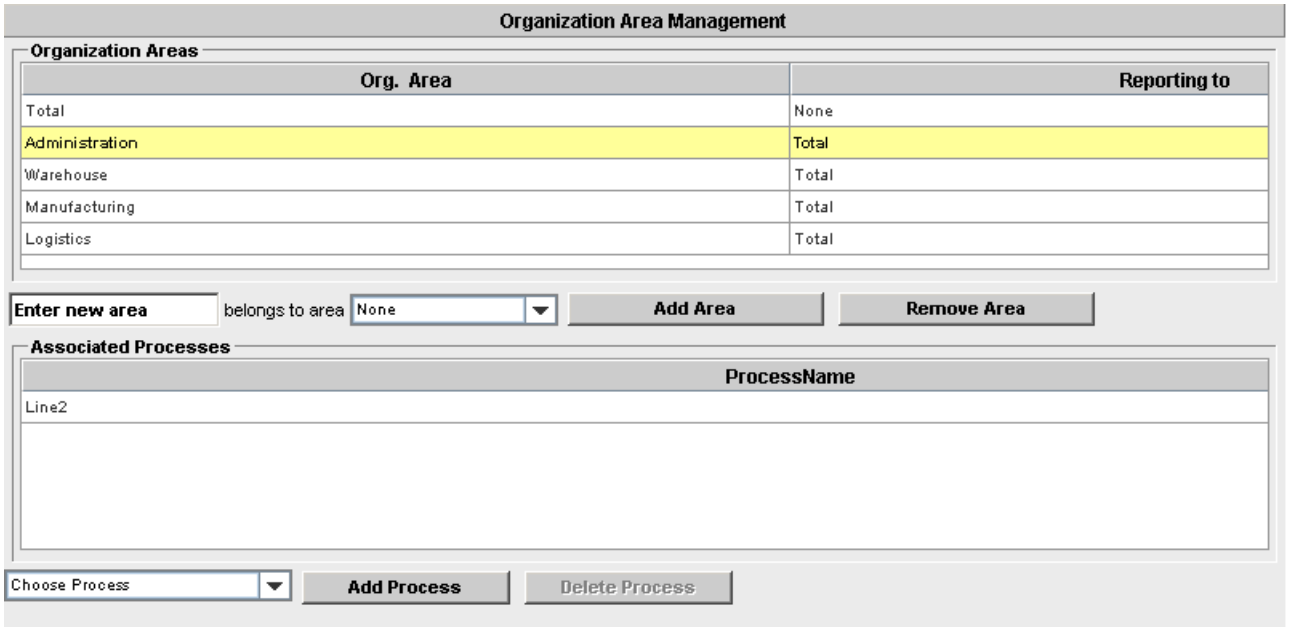
A process combines equipment and products together thus enabling the reporting of energy consumption for the whole set of equipment, products and processes. The SAP MI web page is called ‘Process.html’



Finally an organization area is associated with a set of pr0cesses in order to allow reporting from an organizational perspective. The Sap MI web page is called ‘OrgAreas.html’



Data acquistion

As indicated in section about concepts, tag based data is stored on an aggregated daily value in the local database. The transaction reading historian values and storing the daily aggregated value can be found in the folder EngeryManagement->Demo Data->RecordDayUsage. There is a transaction logical variable called ‘FullSimulation’ which will either read form the tag query or simulate the tag value. The result is the storage of a daily tag value in database table ‘EquipmentTagConsumption’. Please not that we store Energy consumption related values in kWh and convert other input values (like BTU) into kWh before storage.

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Reporting

Once data is stored on an aggregated daily value, reporting is merely a number of SQL queries running against the data store and aggregating/joining further to yield the desired report. All queries and business logic transactions are located in the folder EngergyManagement->Demo Execution. The result of the queries is formatted to fit the SAP Xcelisus required XML structures and rendered as part of the flash file. The flash file and original Xcelisus file are located in the 'Web' folder of the EnergyManagement project. All transaction follow a common pattern in preparing query results for display

- Xcelisus requires a fixed Excel array to serve as data source for a control. In order to not overrun this array with data, your MI transaction has to limit the number of data rows returned to the maximum number of rows in the Excel array. On SAP MII, the transaction EnergyManagement->Util-IntervalSequenceIllumDoc will reduce output to the number of rows requested. Given this number of rows, the transaction will try to cover the whole time range of the query in an equidistant way by dropping every nth data point. You can pass this parameter as MII transaction input parameter as part of the URL calling the MI transaction. In our example the parameter is called 'MaxDisplayNumber'
- Xcelsius has different needs for displaying a data point versus the corresponding x-Axis value. As an example consider receiving 200 data points for a graphic with time stamps. While the data points (=values) can easily be displayed, plotting 200 values on the x-Axis (representing the time stamps) will lead to unreadable graphics. In order to overcome this problem, the output has to contain all data points, but restrict the number of date times displayed. This problem is similar to the one mentioned before, with the exception that only one part of the information is dropped, not the whole row. On SAP MII, the transaction EnergyManagement->Util->XcelisusDateDisplayFormatter will reduce the number of time values in the output in the same, equidistant way as described before. The result is a graphic containing all data points, but not showing every single time value. You can pass this parameter as MII transaction input parameter as part of the URL calling the MI transaction. In our example the parameter is called 'MaxDateTimeDisplayNumber'
- Xcelisus requires a specific XML format in order to display data. This format is achieved by using transaction EnergyManagement->Util->Transformation->MapIllumDoc2XcelsiusXML

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