



# **Energy Management in copper industry using OSIsoft PI System**

## **Aurubis AG Hamburg**

**Thorsten Stölcken**

**Energy management representative Aurubis AG Hamburg**

**Presented by Atanas Rusev  
Managing Director, PlantSoft GmbH**

# Agenda

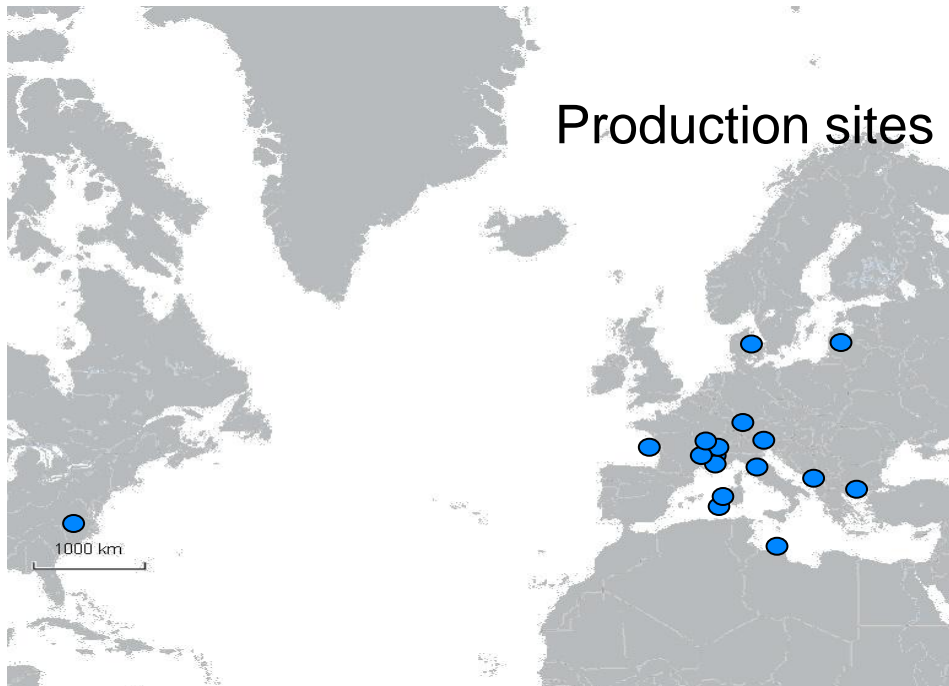


## **1. Aurubis**

## **2. Energy management at Aurubis Hamburg**

## **3. The energy management system (EnMS)**

# Aurubis has taken its first step outside of Europe with the acquisition of Luvata RPD



## Copper production

### BU Primary Copper

- » Hamburg D
- » Pirdop BG
- » Olen B
- » Röthenbach D

### BU Recycling / Precious Metals

- » Lünen D
- » Olen B
- » Hamburg D
- » Fehrbellin D

## Copper processing

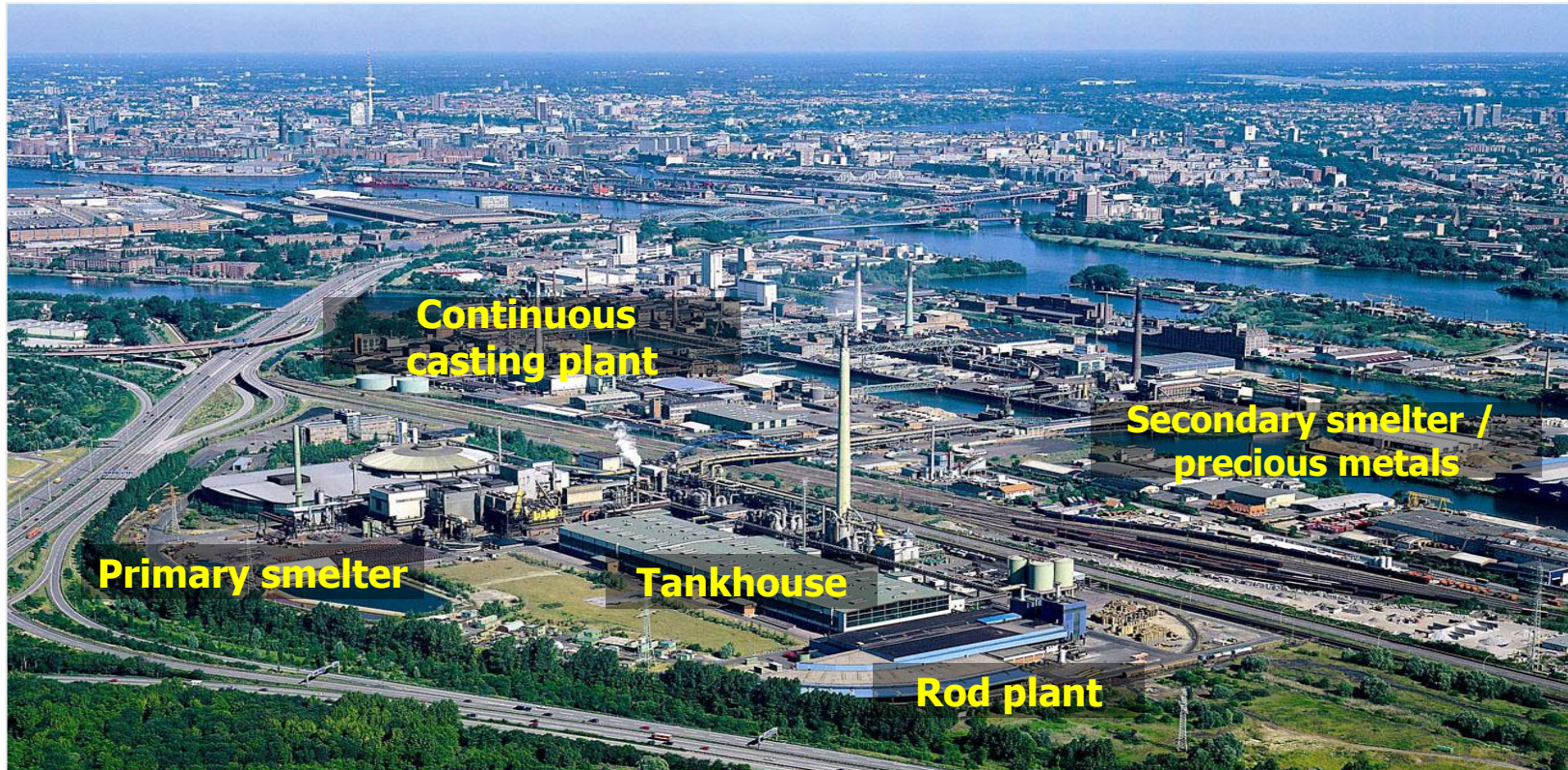
### BU Copper Products

- » Hamburg D
- » Olen B
- » Emmerich D
- » Avellino I
- » Stolberg D
- » Buffalo USA
- » Pori FIN
- » Finspång S
- » Zutphen NL
- » Mortara I
- » Yverdon-les-Bains CH
- » Smethwick GB
- » Dolný Kubín SK

Aurubis has a service and sales network in more than 20 countries  
(Europe, Asia and North America)



# Aurubis main production works in Hamburg - a downtown copper smelter



# Aurubis, an integrated copper producer

## Integrated copper processor

Mines and  
recycling markets

Copper production

Copper processing

Processors and  
end users



Concentrates

### BU Primary Copper



Sulphuric acid



Iron silicate

### BU Recycling / Precious Metals



Recycling



Other metals



Precious  
metals

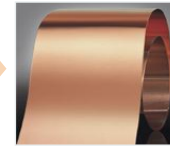


Cathodes

### BU Copper Products



Shapes



Pre-rolled strip  
and strips



Shaped wires



Wire rod



Special profiles

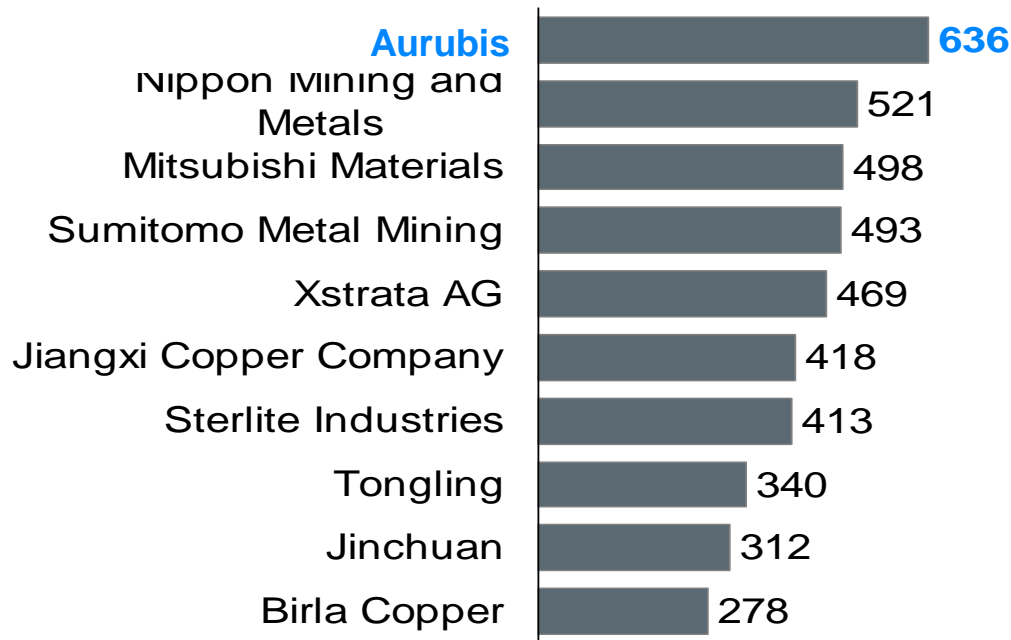




# Aurubis is the leading market participant in the free concentrate market



International custom smelter production  
(2010; in 1,000 t Cu content; primary / without internal concentrates)



# Around 2 million tonnes of copper concentrates are processed in the Group



Discharging copper concentrates in Brunsbüttel

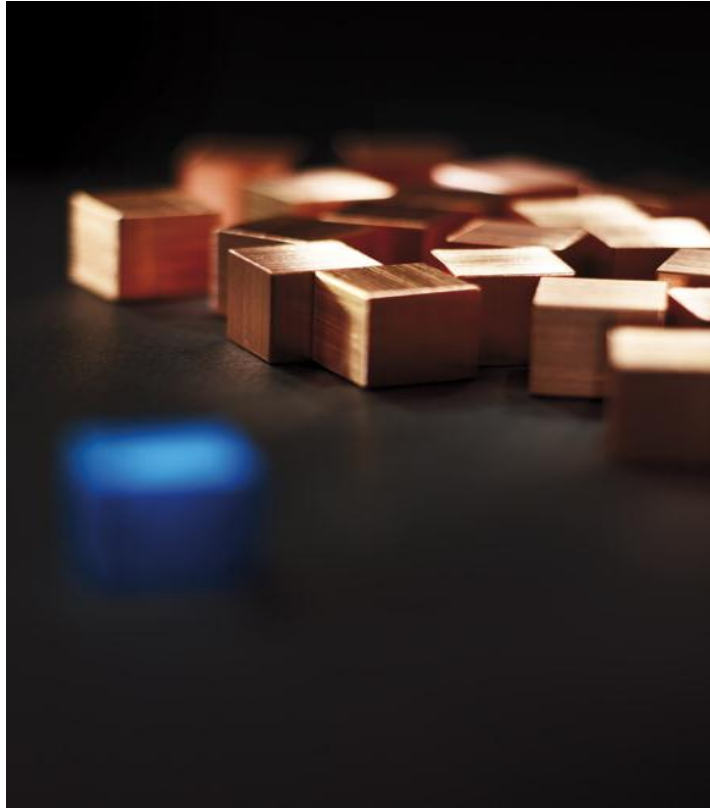


Storage and mixing of copper concentrate for further transportation



Casting of copper anodes in the primary smelter

# Agenda



**1.Aurubis**

**2.Energy management at  
Aurubis Hamburg**

**3.The energy management  
system (EnMS)**



# Energy data

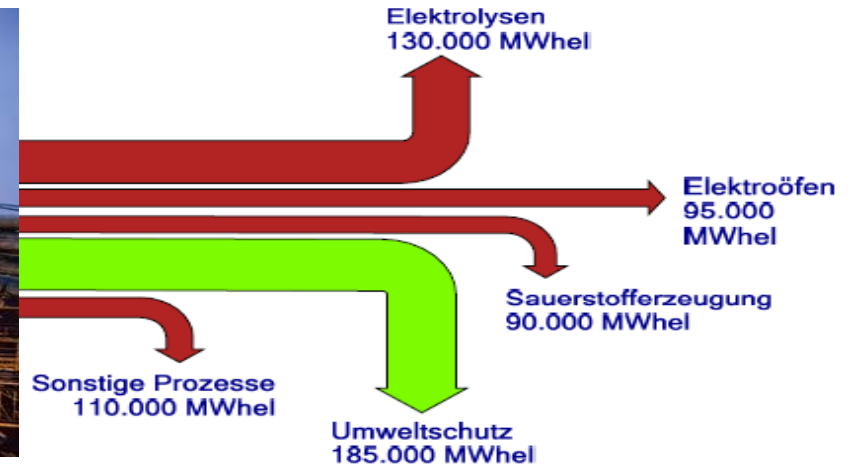
## Energy data 2012; plant site Hamburg

• Electricity	645	Mio. kWh in HH
• Oxygen	200	Mio. Nm <sup>3</sup>
• Nat.gas	40	Mio. Nm <sup>3</sup>
• Cooling water	75	Mio. m <sup>3</sup>
• Dem.water	400.000	m <sup>3</sup>
• Drinking water	200.000	m <sup>3</sup>
• Compressed air	200	Mio. Nm <sup>3</sup>
• Steam		
– 60 bar	340.000	t/a
– 20 bar	100.000	t/a
– 3 bar	35.000	t/a
• Self produced	10	Mio. kWh,el.

**External delivery of energy in 2012 : 1160 GWh**

# Electricity for environmental protection.

## 1/3 for environmental protection



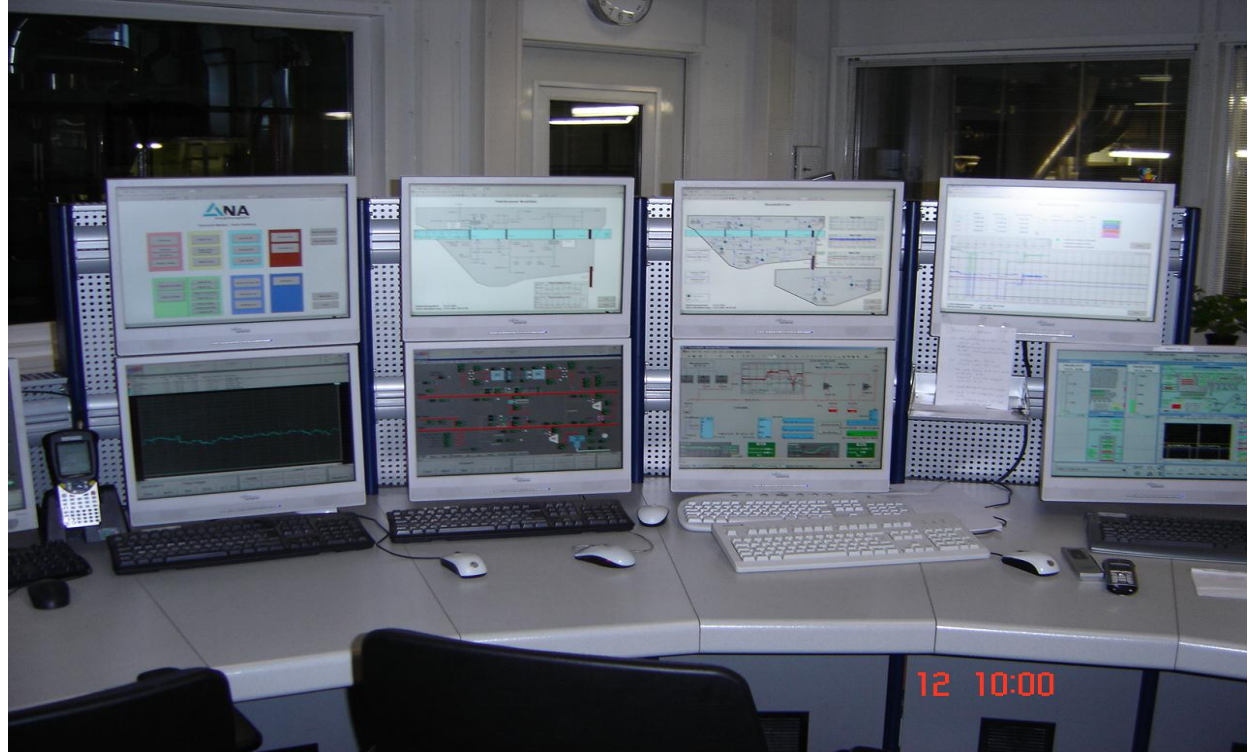
# Energy Department

39 employees

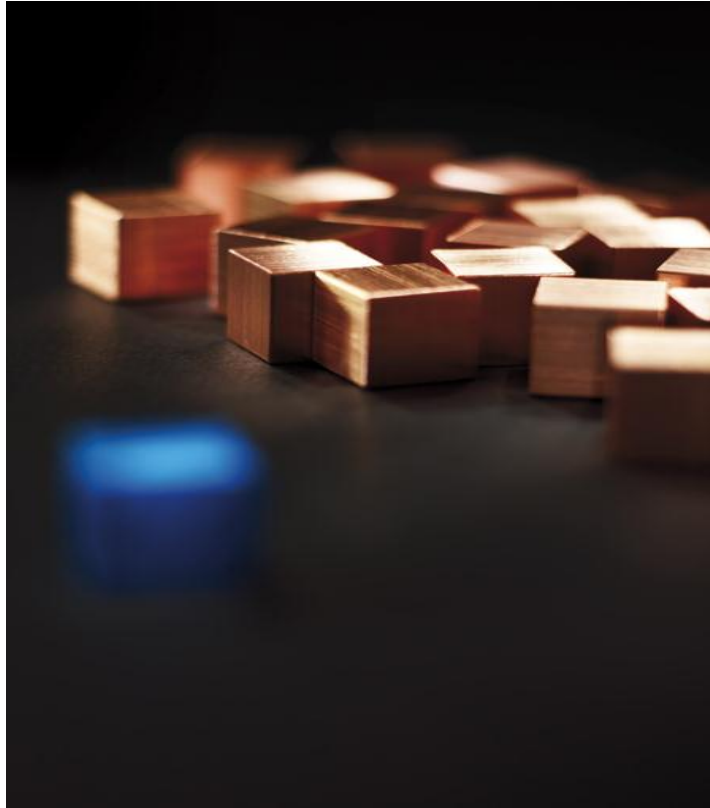
8 white collar

31 blue collar

3 employees in  
energy management



# Agenda



**1.Aurubis**

**2.Energy management at  
Aurubis Hamburg**

**3.The Energy Management  
system (EnMS)**



# Why energy management systems (EnMS) according to DIN EN ISO 50001?

Energy becomes more and more a very important issue for companies:

- energy costs are rising, especially additional costs
- delivery of energy becomes more complicated
- environmental protection is needed
- sustainability is in the focus
- reliable data in detail are needed, e.g. for ETS (CO<sub>2</sub>-trading)

An Energy Management System according to DIN EN ISO 50001 provides a systematic way to detect ways to increase energy efficiency and lower energy costs. The certificate documents this for the public and authorities.

The PI system is a very good tool to support this and such is needed.  
**It is not the Energy Management System.**

And:

Only realized energy efficiency projects or changes in behaviour saves energy!

# Aspects considered for development of an EnMS according to DIN EN ISO 50001, part 1

An EnMS is a management system that needs a strong support by the management:

- => The company has to have a commitment for efficient energy usage and energy targets.
- => Sufficient employees and money has to be provided.
- => A responsible energy management representative has to be named, this person directly reports to the management.
- => All production units, the purchasing dep., the engineering dep. etc. have to be included.
- => Energy performance indicators have to be build and checked.
- => Processes should be transparent and documented.
- => Energy optimazation projects have to be implemented.
- => The system has to be certified by a external certifier like TÜV, Norske Veritas, ...

For this the PI-system can not help.

# Aspects considered for development of an EnMS according to DIN EN ISO 50001, part 2

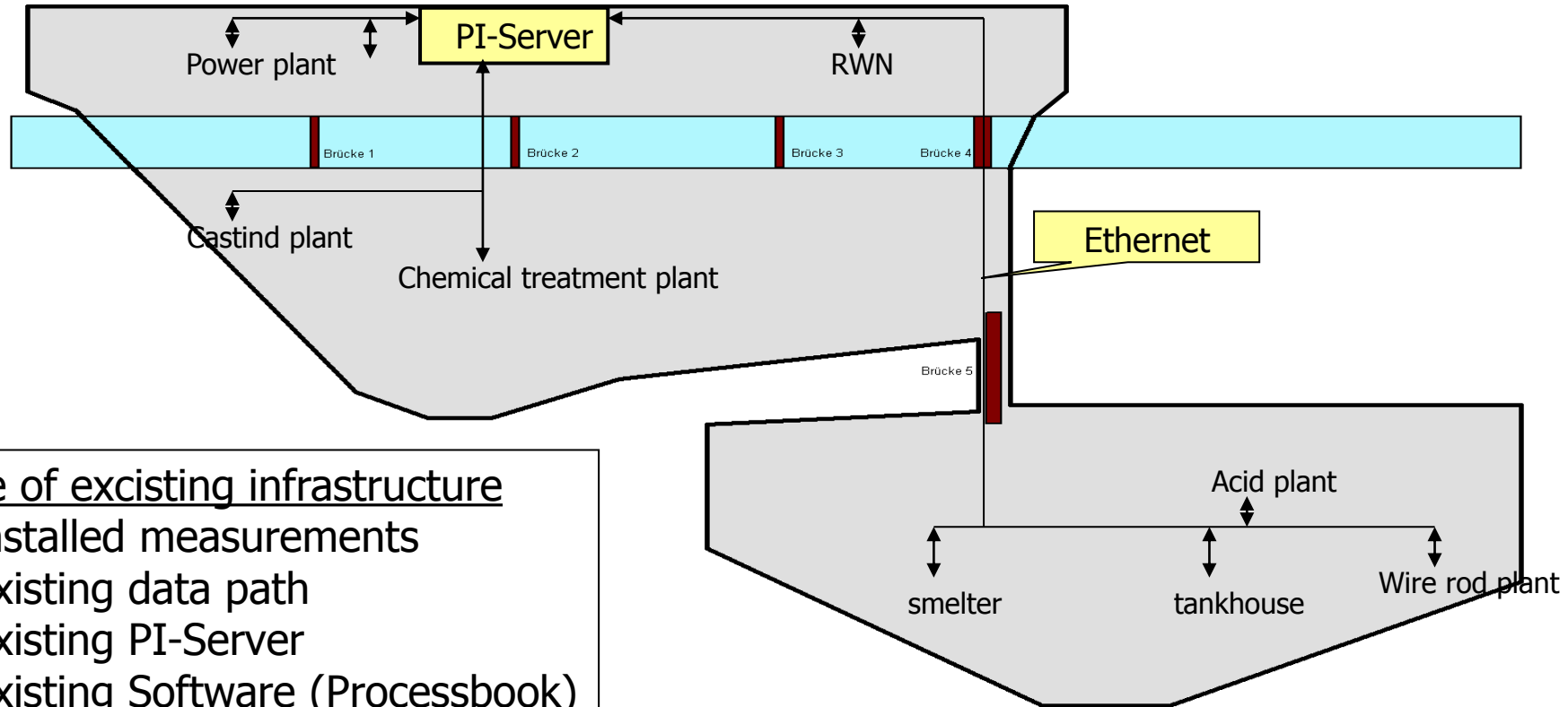
Here the PI-system can help perfectly:

- => Energy flows should be transparent.
- => Energy flows have to be analysed.
- => Possibilities for energy optimization identified; implemented projects controlled.
- => A data storage system has to be installed.  
All data have to be comprehensible; data validation is very important.
- => Incorrect measurements have to be detected and replaced.
- => Energy reports have to be made regularly, also yearly a management review.



=> See how it is made =>

# IT infrastructure for EnMS at Hamburg plant site



## Use of existing infrastructure

- installed measurements
- existing data path
- existing PI-Server
- existing Software (Processbook)

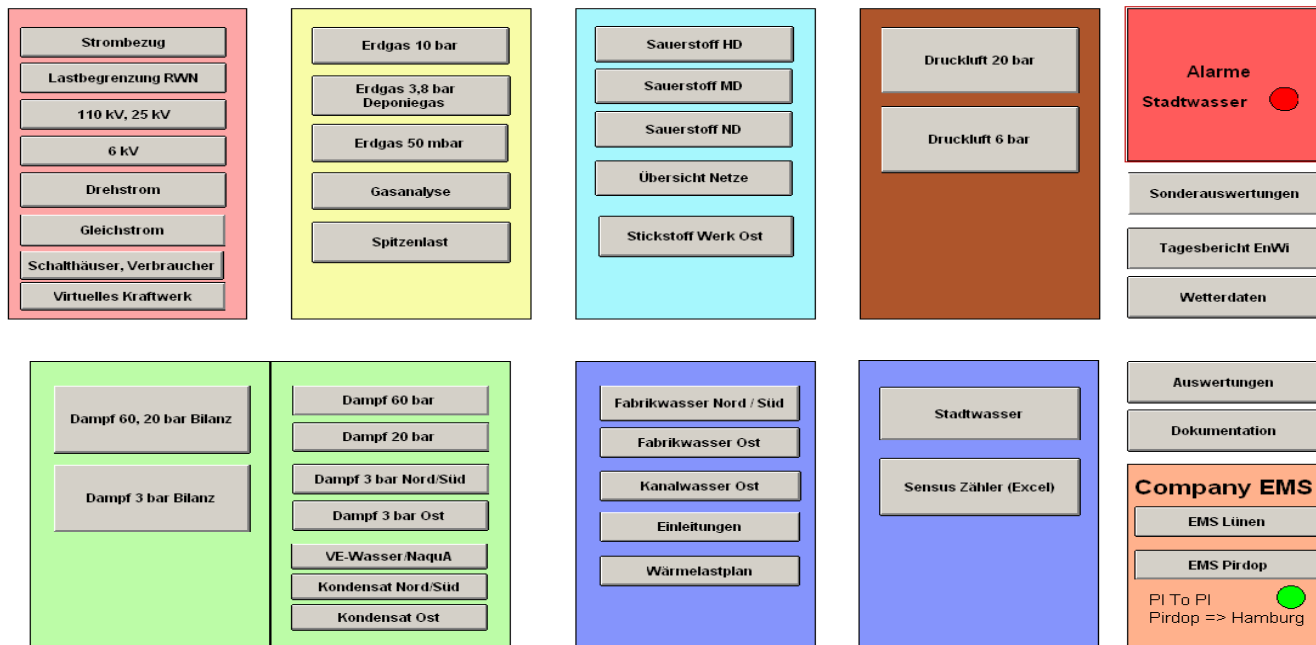


# All over 30 different energy types are in the EnMS start mask



EMS Hamburg

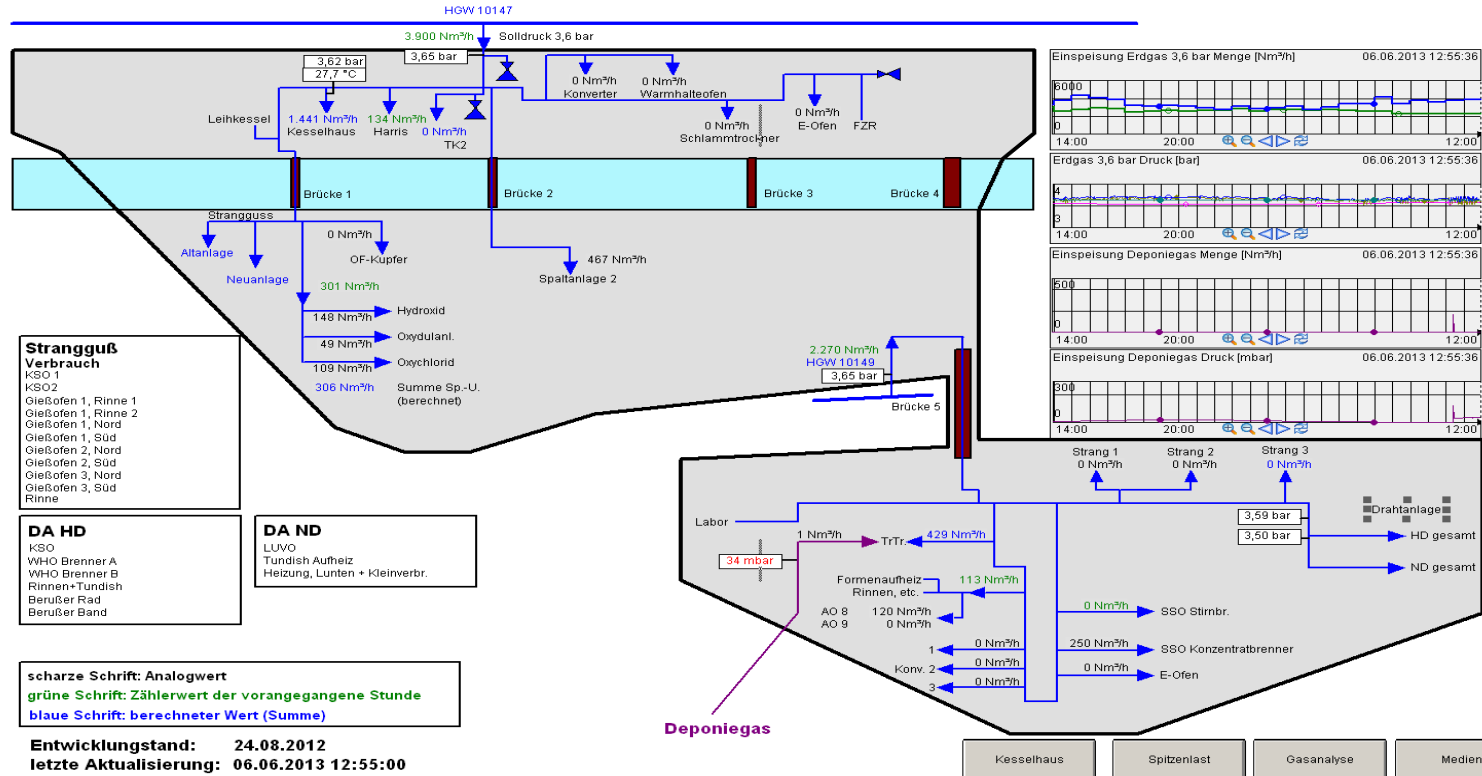
Energiemanagement



Entwicklungsstand: 03.05.2011  
letzte Aktualisierung: 10.05.2011 17:22:00

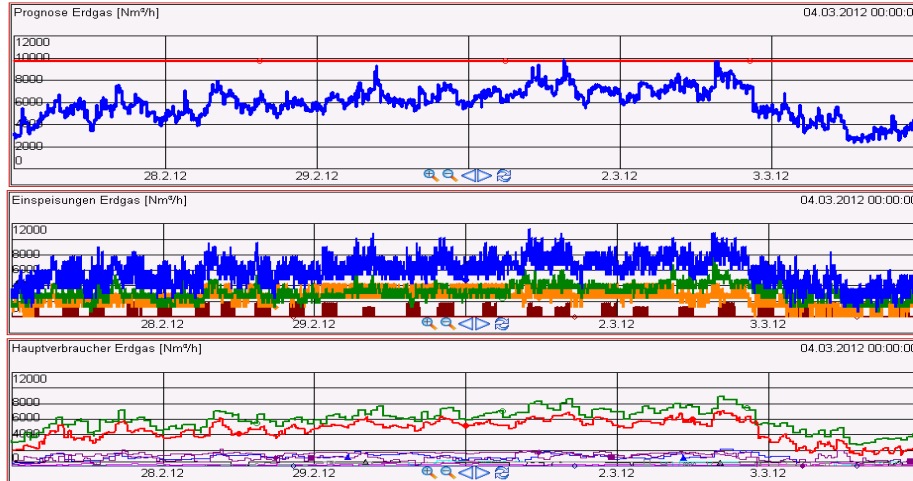
# Flow of nat.gas is monitored

## Erdgas 3,6 bar Deponiegas



# Maximum consumption of nat.gas has to be checked

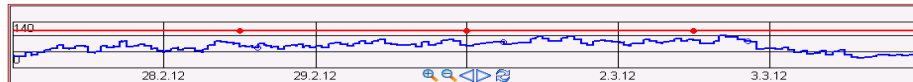
## Erdgas Spitzenlastbegrenzung



### Hinweise:

- Die Berechnung ist jeweils für eine Zeitstunde (Minute 0 bis 59)
- Mit jeder neuen Stunde wird der Alarm aufgehoben.
- Verbraucher können wieder freigegeben werden, falls der Wert der Hochrechnung dieses zulässt.
- Kosten einer Überschreitung um 1.000 Nm³/h: 65.000 €

### Erdgaseinspeiseleistung:



Entwicklungsstand: 03.04.2012  
letzte Aktualisierung: 05.05.2012 12:46:00

### Erdgaseinspeisung:

kontinuierliche Hochrechnung: 2.846 Nm³  
Grenzwert: 9.800 Nm³  
Intervallzeit (60 Minuten): 46 min



### Bei Grenzwertüberschreitung nach 30 Minuten:

folgende Verbraucher telefonisch zum Reduzieren der Leistung auffordern:



Anlage	Bezug aktuell	Telefonnummer
1. Kessel 4 auf Öl	0 Nm³/h	
2. AO Polgas	4 Nm³/h	3811
3. Spaltanlage	601 Nm³/h	17-3166
4. Harrisanlage	277 Nm³/h	17-3658
5. AO Brenner	278 Nm³/h	3811
6. Trockentrommel	397 Nm³/h	3847
7. Konverter Aufheizbr.	1 Nm³/h	3845

### Bei Grenzwertüberschreitung nach weiteren 15 Minuten:

- die Turbine wird automatisch gestoppt
- der Druck im 3 bar-Netz wird auf 0,5 bar(ü) gesenkt
- => die Leistung der Kessel 3+4 fährt zurück



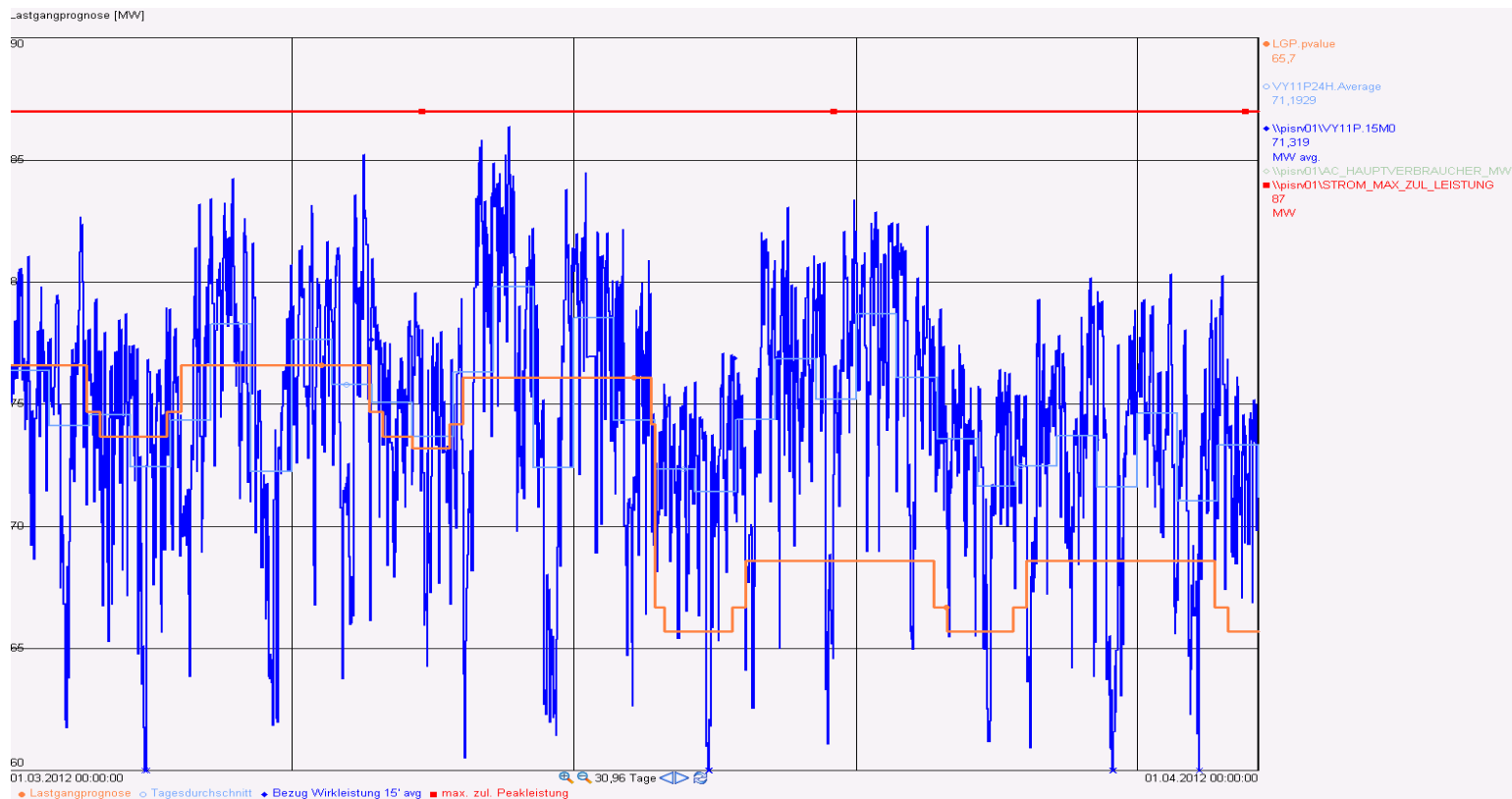
Dampfbezug folgender Verbraucher reduzieren:

Anlage	Bezug aktuell
1. DTT	15,0 t/h
2. MCT	3,9 t/h
3. 20/3 bar Red.Br.5	0,0 t/h

max. zul. Einspeiseleistung: 115 MW  
max. Einspeiseleistung in diesem Jahr: 113,8 MW  
letzte 60-MW-Leistung: 41,4 MW avg.

Medien

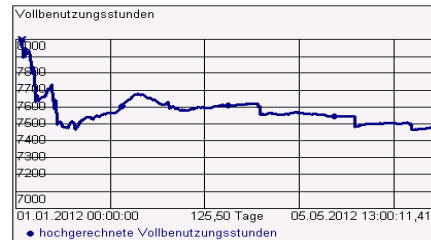
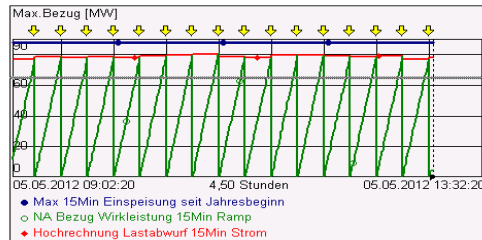
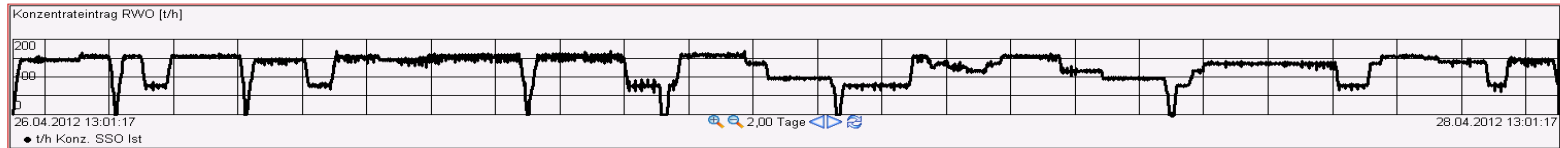
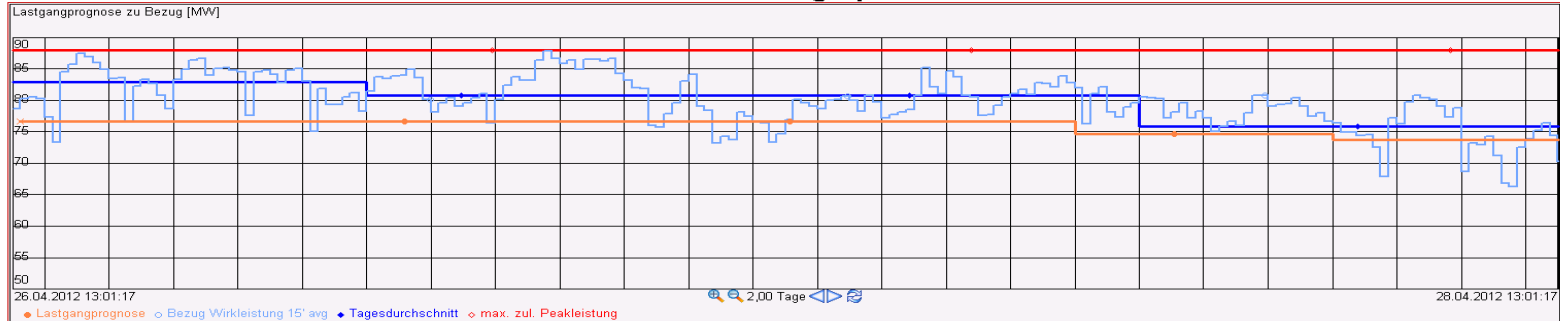
# electricity – prognosis from SQL-DB vs. consumption monitored in PI





# Monitoring of electricity grid

## Strombezug Spitzenlast



## 7.000 Vollbenutzungsstunden

Vereinbarung der max. 15'-MW-Leistung: 88,0 MW  
 Max. 15'-MW-Leistung in diesem Jahr: 87,8 MW  
 Max.zul. 15'-MW-Leistung (Hochrechnung): 93,7 MW  
 Letzte 15'-MW-Leistung: 76,8 MW  
 Hochrechnung diese 15': 77,7 MW  
 Hochrechnung Vollbenutzungsstunden: 7.471 VBh  
 (mathematisch gerechnet, ohne Prognose/Stillstände)

Entwicklungsstand: 04.02.2012  
 letzte Aktualisierung: 05.05.2012 13:02:00

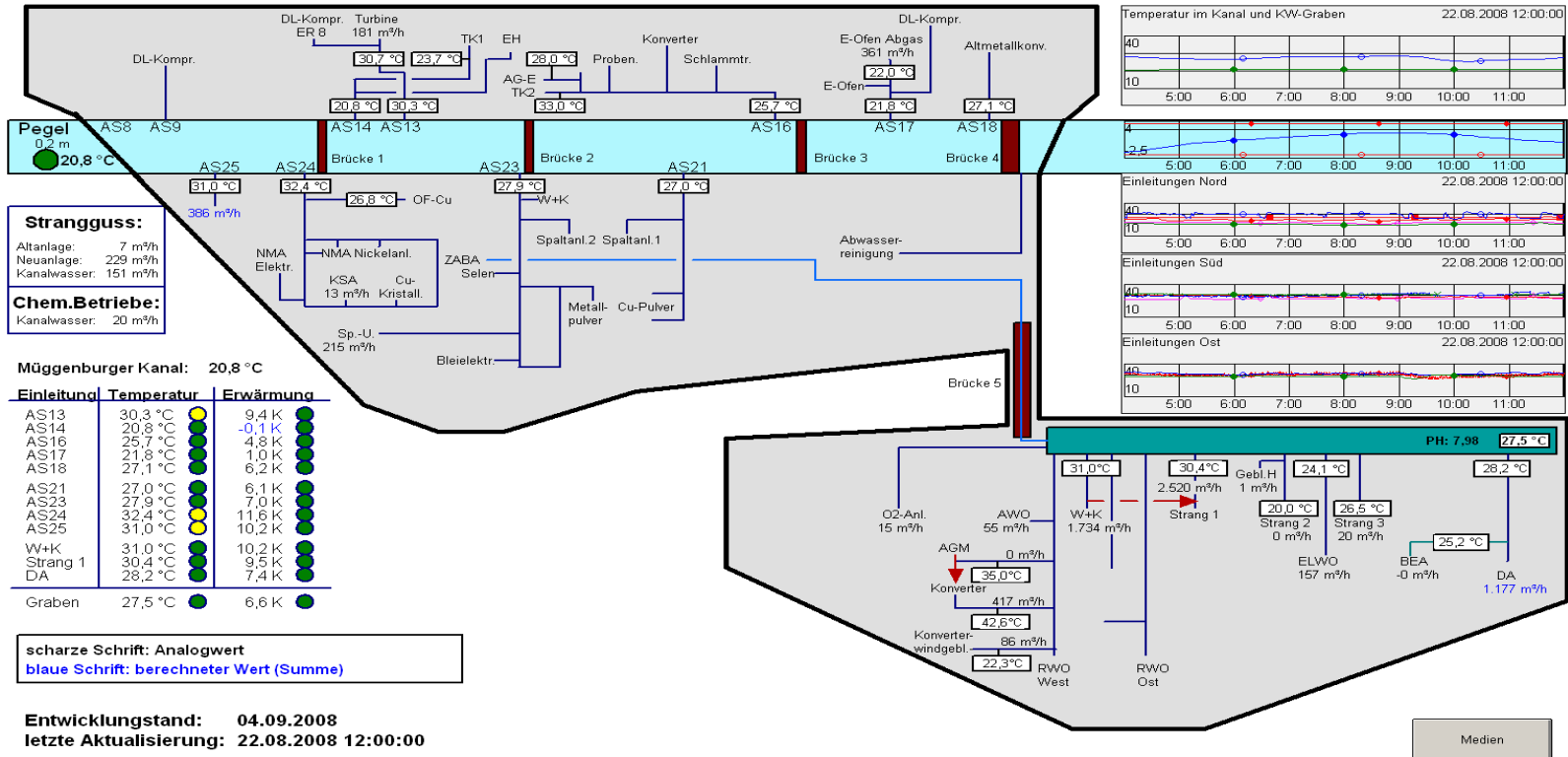
zurück

SQC

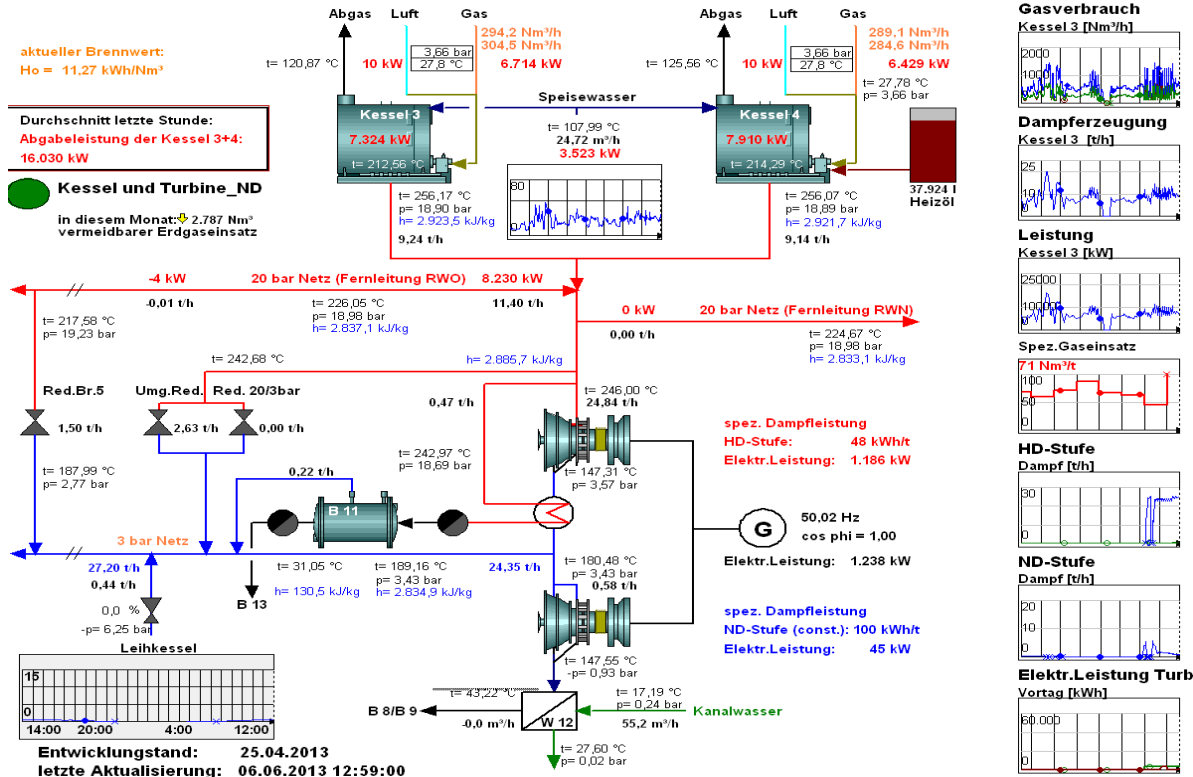
Medien

# Check of cooling water temperatures

## Kühlwassereinleitungen



# Detailed presentations are necessary for energy optimization



# PI-NotifyMe

In case of defined situations, PI-NotifyMe sends

- E-Mails
- SMS

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Betreff: Warnung - Stromlastabwurf R/W/N möglich  
Von: notifyEMS  
An: t.stoelcken, f.behn, u.goethe, h.broehan, a.bartsch, l.ehemann, i.bauer, t.preiss  
Datum: 16.05.2012 18:32

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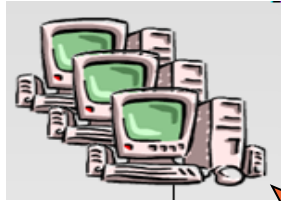
Aktuelle Hochrechnung: 87,37 MW  
Grenzwert: 88 MW

Diese Nachricht wurde automatisch von PI-NotifyMe erstellt.

This application was made by Plantsoft.

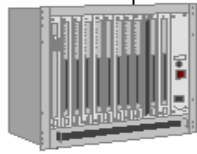
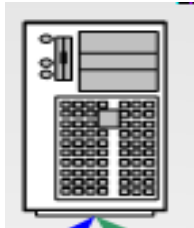
# Data Security, Analyses, Energy reports

See all results on  
all desktop PC



Energy Reports  
Analyses

SAP



All meterings in PLC and via OPC  
(by using a buffer) to PI Server



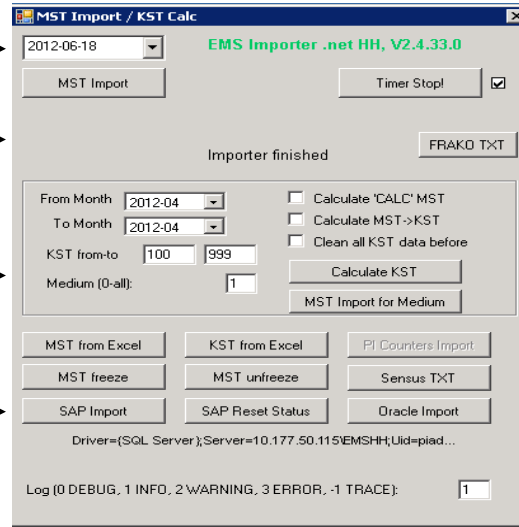
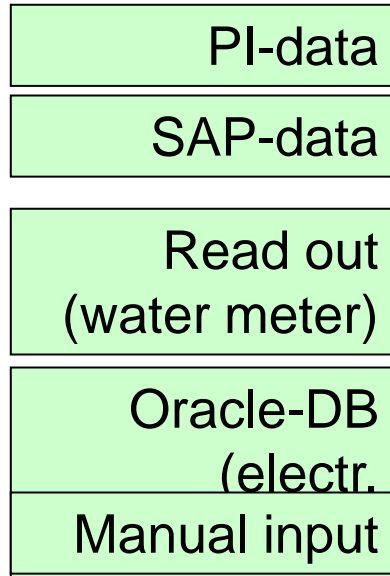
All metering data stored in PI Server;  
Specific calculations (PE, ACE, AF)



The EMS-Server is used for energy  
accounting, related to SAP cost  
accounting positions, and archived  
the results in a SQL-Database;  
SAP interface via XML

**No direct access from EnMS to PLC/DCS**

# Intelligent combination of PI and SQL-DB



All data written in SQL-DB

Monthly data for

- measurement
- cost center
- cost center group


These data are essential for

- Monthly calculations and balances
- Energy optimization projects
- emission trading system (ETS)

**The Importer**  
is the all-in-one Gateway,  
developed by PlantSoft



# Example for SQL-templates

Aurubis AG Energiemanagement			
Kostenstellenabfrage	Erstellt am	18.06.2012	Energiemanagement
Kostenstelle	9000	Medium	27
Von	01.01.2011	Eigenerzeugung Strom	
Bis	01.12.2011		
Beschreibung	Übergeordnete KST		
Energiewirtschaft Erzeugung und Bezug	-1		
Summe:	8.794.956,20	527.697,37	21.987.391
Durchschnitt:	732.913,02	43.974,78	1.832.283
Datum	Menge [kWh]	Kosten [€]	eNergiA [kWh]
Januar 2011	862.793,08	51.767,58	2.156.983
Februar 2011	739.726,43	44.383,59	1.849.316
März 2011	430.420,18	25.825,21	1.076.050
April 2011	597.024,38	35.821,46	1.492.561
Mai 2011	656.616,72	39.397,00	1.641.542
Juni 2011	951.013,92	57.060,84	2.377.535
Juli 2011	712.867,82	42.772,07	1.782.170
August 2011	772.756,10	46.365,37	1.931.890
September 2011	683.659,94	41.019,60	1.709.150
Oktober 2011	674.533,54	40.472,01	1.686.334
November 2011	815.638,56	48.938,31	2.039.096
Dezember 2011	897.905,54	53.874,33	2.244.764

Using Microsoft Excel

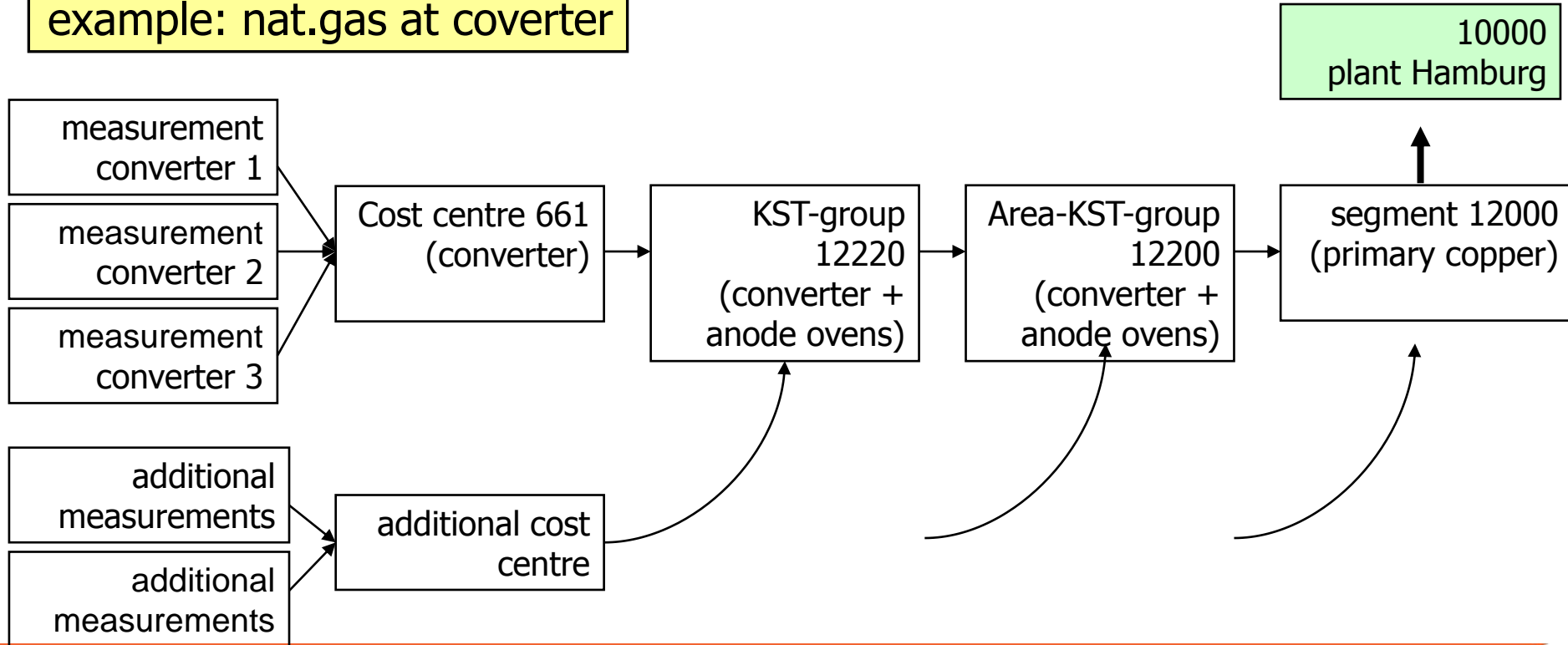
# The SQL-Query

=sqlquery("select sum (KSD_Value) from KSTdaten where KSD_KST_id in (" & \$C\$6 & ") and KSD_Medium_ID in (" & \$F\$7 & ") and ksd_timestamp between " & \$D10 & " and " & \$E10 & """)															
B	C	D	E	F	G	H	I	J	K	L	M	N	O		
Energiebezug rod und shapes Werk Hamburg															
Drahtanlage															
EMS-KST-ID	14100				Strom										
EMS-Med.ID					25										
					[kWh]										

Using Microsoft Excel and the add-in sqlquery (product of Plantsoft), SQL-queries can be made easily, referring to cells in Excel.

# Compression of measured energy data to total sum at Aurubis site in Hamburg

example: nat.gas at coverter



# Compression of Measurements to Costs positions in SAP

**Norddeutsche Affinerie**

Zentrale Services, Primär Cu - Erzeugung, Sekundär Cu - Erzeugung, Kupferverarbeitung, E-Kunden Sonstige, Hüttenwerke Kayser, Fremdfirmen

**Kostenstelle 661 - KONVERTER WERK OST**

Meßstellen für KST 661:

- 631
- 632
- 633
- 643
- 659
- 667
- 669
- 717
- 718
- 722
- 723
- 725
- 726
- 771
- 961
- 962
- 982
- 984

Kostenstelle:  Meßstelle:

Bericht KST, Bericht MST

**Norddeutsche Affinerie Energiemanagement**

**Kostenstelle 661 KONVERTER WERK OST**

Datum: 01-Jun-07

Medium	Einheit	01-Dez-06	01-Jan-07	01-Feb-07	01-Mrz-07	01-Apr-07	01-Mai-07
Dampf 3 bar	t						
Dampf 20 bar	t						
Dampf 60 bar	t						
VE-Wasser	m³						
Nagua	m³						
Erdgas 0.05 bar	Nm³						
Erdgas 3.8 bar	Nm³						
Erdgas 10.0 bar	Nm³						
Deponiegas	Nm³						
Sauerstoff 95% ND	Nm³						
Sauerstoff 95% MD	Nm³						
Sauerstoff 99% HD	Nm³						
Stickstoff	Nm³						
Kanalwasser	m³						
Fabrikwasser Ost	m³						
Fabrikwasser N+S	m³						
Stadtwasser o. Sief	m³						
Stadtwasser m. Sief	m³						
Druckluft 6 bar feucht	Nm³						
Druckluft 6 bar trocken	Nm³						
Druckluft 20 bar	Nm³						
Strom - n/u	MWh						
Strom - n/u	MWh						
Strom - n/u	MWh						
Drehstrom	kWh						
Gleichstrom	kWh						
Diesel	dm³						
Heizöl	dm³						
Rückstandsöl	dm³						
Koks	t						

**Meßstelle Nr 1633 Konverter Ost 1**

Medium 7	Erdgas 3.8 bar
PI Tag	GAS.KONV.OST 1
Kostenstelle	661
Verteiler	
MST Quelle	PI
MST Parameter	66F130A

Zurück

# The energy report (part 1)

Aurubis AG

Energiebericht

Kostenstelle:

plant xy

5GJ+3Mon

12Mon

PDF speichern



Energiemanagement

Erstellt am: 26.04.2013 11:35

Monat: März 2013

Freigegeben am: 26.04.2013 11:29

T.Stolcken

## Mengen

Medium		Letzte 5 GJ - Monatsdurchschnittswerte Oktober bis März					Letzte 3 Monate				Okt-Mrz	Okt-Mrz	Okt-Mrz/Okt-Mrz
Medium	MedID	Einh.	GJ 2007 / 2008	GJ 2008 / 2009	GJ 2009 / 2010	GJ 2010 / 2011	GJ 2011 / 2012	Jan 2013	Feb 2013	März 2013	Summe GJ	Ø GJ	Veränderung zum Vorjahres-zeitraum
Erdgas 0,05 bar	6	Nm³									0,0	0,0	
Erdgas 3,0 bar	7	Nm³	364.213,1	396.347,8	406.888,2	371.469,3	398.843,6	892.676,3	151.214,1	1.027.026,8	3.183.711,0	630.618,6	33%
Erdgas 10,0 bar	8	Nm³	225.630,0	180.141,2	202.977,0	175.208,6	186.197,8	162.719,0	178.933,0	217.188,0	1.186.879,0	197.646,6	6%
Sauerstoff 95% MD	11	Nm³	1.297.672,1	1.133.620,0	1.136.512,2	1.030.364,6	1.075.897,7	748.939,0	903.866,0	1.054.823,0	4.976.097,0	829.349,6	-23%
Kanalwasser	14	m³	306.144,3	329.440,7	251.239,6	217.295,6	271.754,6	271.747,2	263.247,0	297.814,1	1.713.105,6	286.517,6	6%
Fabrikwasser Ost	15	m³	110.681,0	138.543,9	141.136,7	131.014,9	132.064,6	136.913,7	126.409,0	139.265,3	802.144,6	133.693,0	1%
Stadtwasser o. Siel	17	m³	2.714,2	74,2	66,7	170,4	269,2	486,0	442,3	362,5	1.731,3	289,6	-4%
Druckluft 6 bar, trocken	20	Nm³		877.743,9	1.791.867,2	1.299.650,3	621.171,7	499.330,3	428.479,2	119.692,1	2.436.666,6	406.942,7	-22%
Druckluft 20 bar	21	Nm³		269.547,9	453.454,2	553.102,6	609.930,0	486.763,9	541.696,3	630.183,3	3.621.647,8	603.606,0	-1%
Drehstrom	25	kWh	3.167.478,3	3.121.961,6	3.348.370,6	3.030.339,8	3.468.727,3	2.951.776,0	2.813.277,0	3.420.702,0	19.078.750,0	3.179.791,7	-7%

## Kosten nach eNergia Plus

Medium	Med_ID	Einh.	GJ 2007 / 2008	GJ 2008 / 2009	GJ 2009 / 2010	GJ 2010 / 2011	GJ 2011 / 2012	Jan 2013	Feb 2013	März 2013	Summe GJ	Ø GJ	Veränderung zum Vorjahres-zeitraum
Erdgas 0,05 bar	6	€									0,0	0,0	
Erdgas 3,0 bar	7	€	90.484,91	98.836,96	101.722,05	92.067,33	99.710,87	223.189,08	37.803,61	256.756,70	796.927,8	132.664,6	33%
Erdgas 10,0 bar	8	€	54.889,66	45.036,20	50.744,25	43.802,15	46.549,46	40.679,75	44.708,25	64.297,00	296.469,8	49.411,6	6%
Sauerstoff 95% MD	11	€	124.957,41	46.496,69	46.599,00	42.244,53	44.149,80	30.706,60	37.059,51	43.247,74	204.020,0	34.003,3	-23%
Kanalwasser	14	€	4.110,64	4.812,17	3.617,36	3.042,06	3.604,66	3.896,46	3.695,46	4.169,40	23.983,6	3.997,2	6%
Fabrikwasser Ost	15	€	2.492,63	2.909,42	2.963,87	2.751,73	2.773,14	2.864,19	2.654,59	2.924,67	16.845,0	2.807,5	1%
Stadtwasser o. Siel	17	€	4.071,24	1.111,26	100,02	255,63	448,78	729,05	663,46	673,29	2.597,0	432,8	-4%
Druckluft 6 bar, trocken	20	€		7.460,82	15.230,87	11.047,03	4.429,96	4.244,31	3.642,07	1.016,63	27.033,1	3.450,5	-22%
Druckluft 20 bar	21	€	4.282,68	3.426,03	6.966,60	7.300,96	8.065,08	6.412,36	7.150,42	8.318,42	47.806,6	7.967,6	-1%
Drehstrom	25	€	190.048,70	187.317,09	200.923,29	181.620,39	204.523,64	171.106,66	168.796,62	205.242,12	1.144.725,0	190.787,6	-7%
Summe / Monat			476.337,67	396.195,66	427.763,24	395.131,62	414.403,30	483.706,25	306.162,89	676.646,78	2.653.076,80	426.512,00	

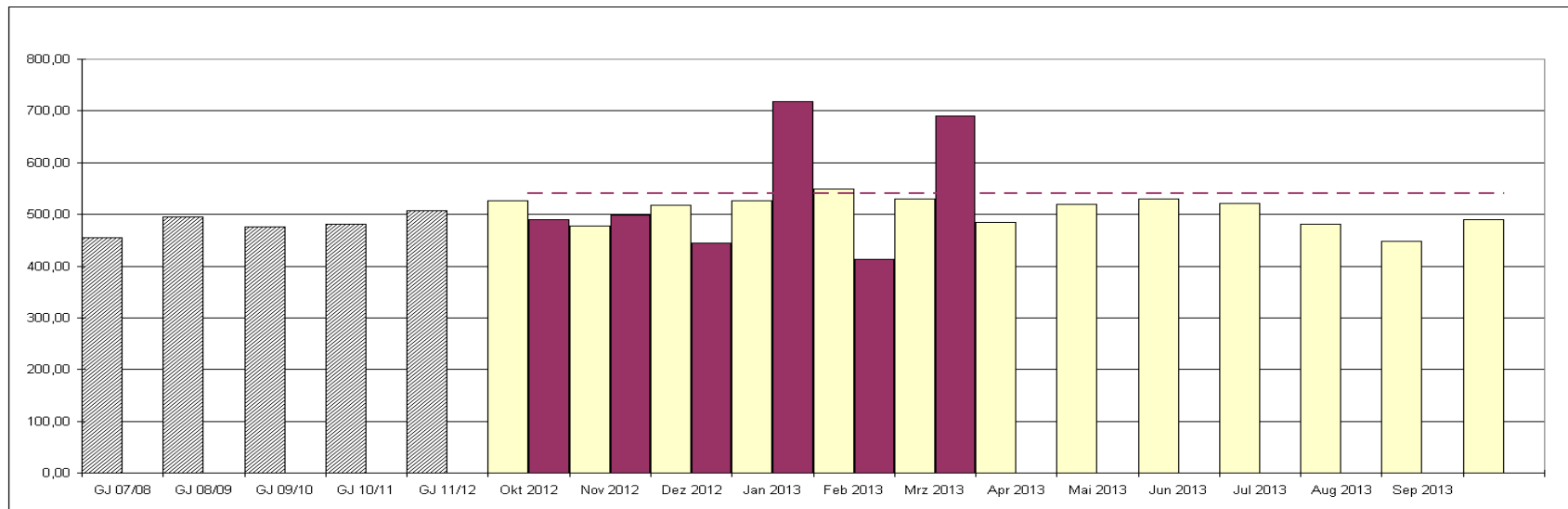
## Genormt nach eNergia Plus

Medium	Med_ID	Einh.	GJ 2007 / 2008	GJ 2008 / 2009	GJ 2009 / 2010	GJ 2010 / 2011	GJ 2011 / 2012	Jan 2013	Feb 2013	Mrz 2013	Summe GJ	Ø GJ	Veränderung zum Vorjahres-zeitraum
Erdgas 0,05 bar	6	MWh									0,0	0,0	
Erdgas 3,8 bar	7	MWh	4.189,5	4.546,5	4.679,2	4.271,9	4.596,7	10.265,8	1.739,0	11.810,8	36.612,7	6.102,1	33%
Erdgas 10,0 bar	8	MWh	2.597,1	2.071,6	2.334,2	2.014,9	2.141,3	1.871,3	2.066,6	2.497,7	13.637,6	2.272,9	6%
Sauerstoff 95% MD	11	MWh	1.427,3	1.247,2	1.260,2	1.133,4	1.183,6	823,8	994,3	1.160,3	6.473,7	912,3	-23%
Kanalwasser	14	MWh	145,4	156,5	119,3	103,2	129,1	126,0	141,5	161,7	813,7	136,6	6%
Fabrikwasser Ost	15	MWh	79,3	91,4	93,2	86,6	87,2	89,7	83,4	91,9	529,4	88,2	1%
Stadtwasser o. Siel	17	MWh	244,3	6,7	6,0	16,3	26,9	39,8	34,4	155,8	26,0	-4%	
Druckluft 6 bar, trocken	20	MWh		219,4	448,0	324,9	130,3	124,8	107,1	29,9	608,9	101,6	-22%
Druckluft 20 bar	21	MWh		129,8	226,7	276,6	305,0	242,9	270,8	315,1	1.810,8	301,8	-1%
Drehstrom	25	MWh	7.918,7	7.834,9	8.370,9	7.676,8	8.620,8	7.128,4	7.033,2	8.661,8	47.696,9	7.949,5	-7%
Summe / Monat			16.766,7	16.274,0	17.527,7	15.802,5	17.111,7	20.720,6	12.449,2	24.633,3	107.339,6	17.889,9	

The energy report is made with a template in Excel  
and filled dynamically.  
Datasource: SQL-database

# The energy report (part 2)

Spezifischer Energiebedarf normiert



Fehlbuchungen von Erdgas auf KST 665 im SAP seit Dez.12. Sind im SAP korrigiert worden.





# EnMS Aurubis Hamburg

## Costs and Benefits

### Costs for Aurubis plant site Hamburg

Costs 1 Mio.€, mostly for metering devices;  
existing PI System for the production has been extended.  
Total metering devices: app. 2.000

**The EMS Hamburg is tested and certificated by the German TÜV according DIN EN ISO 50001.**

**This is a prerequisite for EEG (renewable energy law) tax exemption in Germany.  
Only this saves some Mio.€/a.**

**Moreover we detected saving potential of some Mio.€/a.  
(But to realise the saving, the projects have to be implemented!)**

# Summary

An EnMS system provides the possibility to increase energy efficiency systematically. In some countries a certified system is necessary to lower the additional energy costs. Without having all data in a reliable database, it is nearly impossible to deliver all data we are asked for (e.g. ETS).

The PI system is a perfect basis for real time data, analysis of data and display.

In combination with the “importer” and other application made by Plantsoft we built the perfect software solution for our needs. This was also the statement by the certifier of TÜV.

## Outlook:

**We are going to continue the connection of more Aurubis group plant sites in cooperation with Plantsoft and OSIsoft.**

# End of presentation



**1.Aurubis**

**2.Energy management at  
Aurubis Hamburg**

**3.The Energy Management  
system (EnMS)**

# Atanas Rusev

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