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SIMATIC Energy Management

www.siemens.com/simatic-energy-management

Agenda

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Motivation for energy management

Energy costs

Energy costs 2000-2018[1], Germany, industry

~6%

Average annual increase in electricity price (Ø ’00 – ’18)

Laws and climate protection

UN climate summit 2018, Katowice Poland

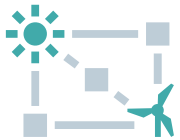
1,5 °C

Limiting the temperature rise worldwide

Change of energy supply

Share of renewable energies: 2016[2] in power consumption in Germany

32%



From 6.5% in the year 2000. Should rise to 80% by 2050

Responsibility for environment and image

Opinion research 2015

59%

A green image is decisive for the purchasing decisions of markets and customers[3]

Significant cost factor in production	Statutory measures to achieve environmental targets	New boundary conditions as a consequence of changing energy resources and continued requirements for supply reliability	Energy-efficient production as a key marketing argument

1 Prices including taxes, source: statista.com (Link) | **2** Source: E.ON-survey 2015 (Link) | **3** Source: Federal Environmental Agency (Link) | **4** Source: AGORA energy transition (Link)

Energy management - Objectives and challenges

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Typical drivers and objectives

Fluctuating energy costs, regulatory requirements and sustainability objectives

Fulfill and exceed production and efficiency objectives

Continuous detection of saving potentials

Challenges during realization

Scalable standard solution, which grows together with requirements

Dealing with the lack of resources (financial & personnel-wise)

To make reasonable investment decisions it is necessary to quantify saving potential

Energy efficiency measures based on energetic transparency

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Acquired energy data

Acquisition of the measurement values

Checking and evaluation of the measures

Continuous improvement process

Analysis of the data

Planning of energy efficiency measures

Realization of the measures

Improvement according to ISO 50001 with Plan – Do – Check – Act (PDCA)

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SIMATIC Energy Management – Transparency and efficiency from machine to company

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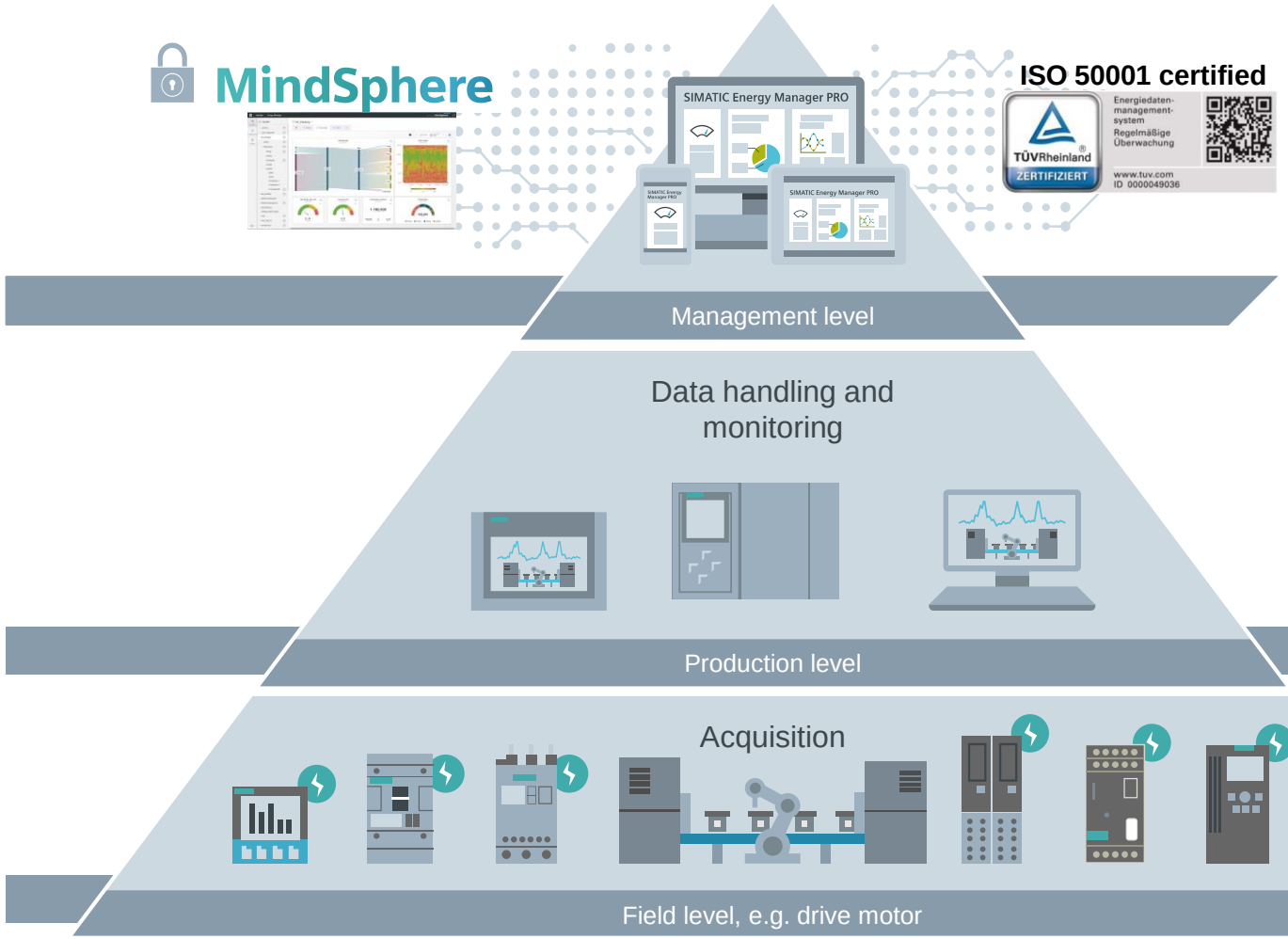

SIMATIC Energy Manager
Plant and company-wide energy analysis

S7 EE-Monitor
Standardized efficiency evaluation of machines

SIMATIC Energy Suite
Simple and integrated –
energy data acquisition and active load management

Integrated energy measurement
Directly in the field: For example
with SIMATIC Energy Meter (ET 200SP)

Energy Management goes production

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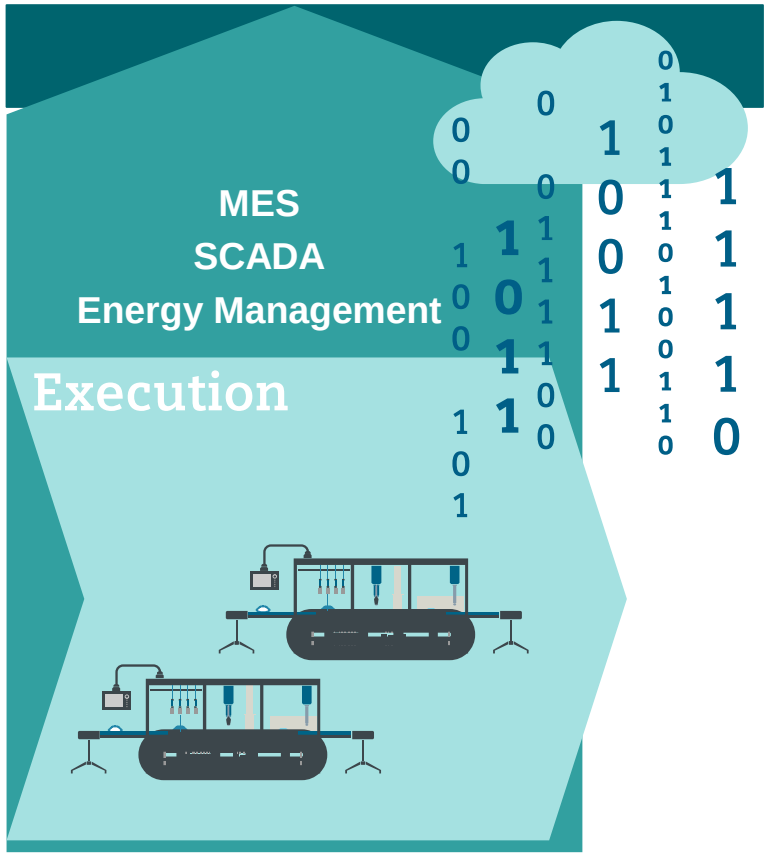
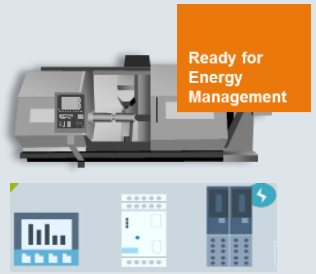


Energy management on factory and enterprise level

- Long term evaluation and energy controlling
- Plant / product / batch related EnPI
- Energy monitoring and reporting
- ISO 50001 conformity

1-15 min

Energy monitoring on machine and plant level



- Short term evaluation allows immediate reaction
- Monitoring, machine related EnPI
- Role-oriented information
- Integrated, cost effective metering

1 sec

Integrated metering

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SIMATIC Energy Management – Transparency and efficiency from machine to enterprise level

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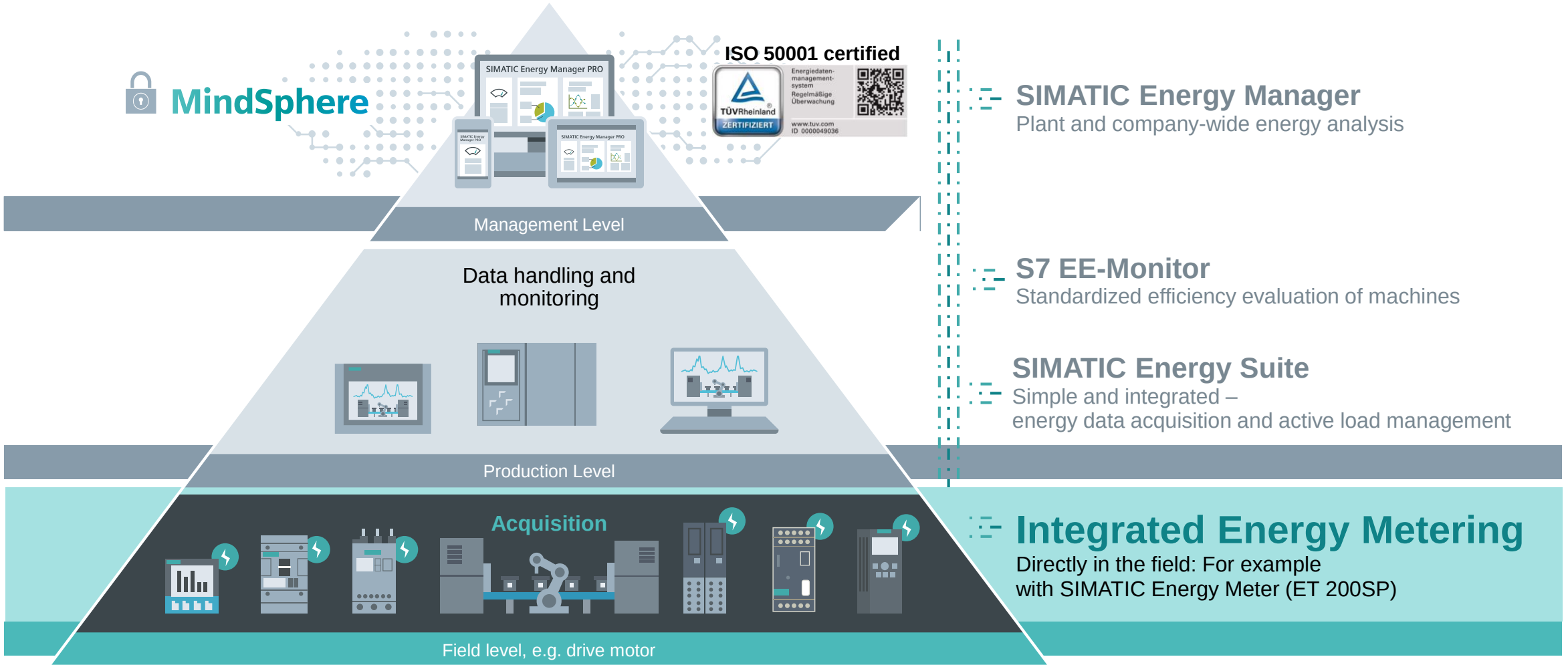

SIMATIC Energy Manager
Plant and company-wide energy analysis

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Standardized efficiency evaluation of machines

SIMATIC Energy Suite
Simple and integrated –
energy data acquisition and active load management

Integrated Energy Metering
Directly in the field: For example
with SIMATIC Energy Meter (ET 200SP)

Measuring all types of energy
Extensive portfolio simply integrated

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	Meters					Metering incorporated in device		
	Electrical Energy			Non-electrical types of energy		Electrical Energy		
Product								
Name	SIMATIC ET 200SP Energy Meter	SIMATIC S7-1200 SM 1238	Sentron 7Kx PAC-Series	SITRANS-Series flowmeters	Water meters WFx 40	Molded Case Circuit Breaker 3VA	SINAMICS-Converters	SIMOCODE pro Motor Management

Comfortable Integration of energy data in automation with SIMATIC Energy Suite

** Measuring Instruments Directive*

Measuring of electrical energy
Application examples

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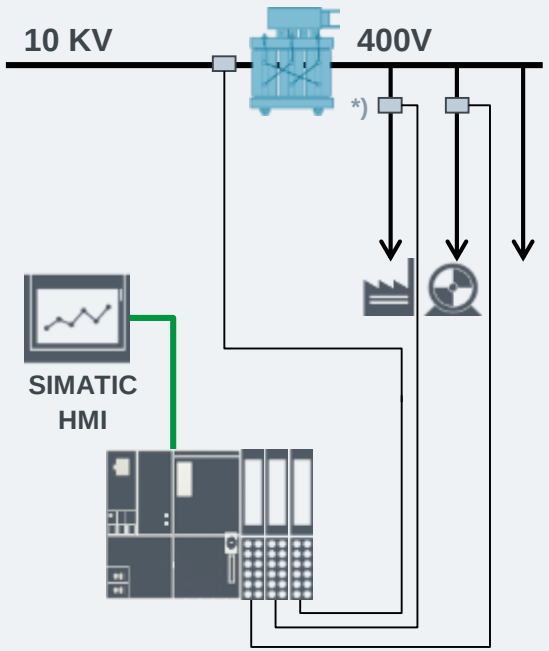
Measuring in control cabinets and in production

Energy distribution



SIMATIC ET 200SP PLC & Energy Meter

*) current transformer

Advantages

Cost-saving thanks to the simplest integration in automation (TIA)

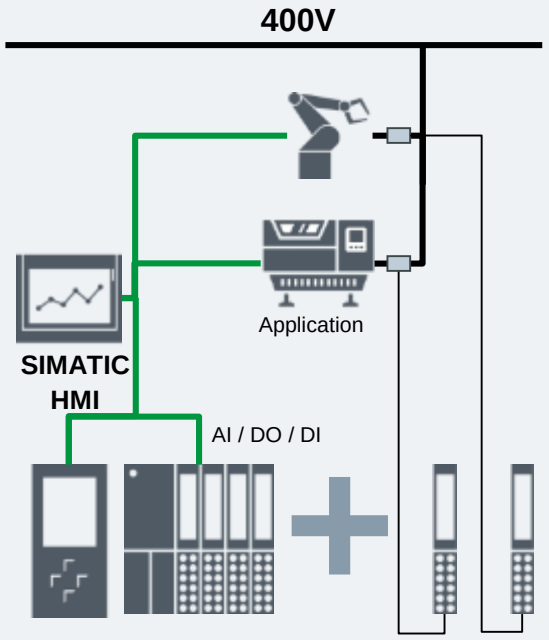
Values **update to 50ms** basis

Flexibility as **support for voltage and current transformers**

Simple configuration through diagnostics and limit monitoring in the meter

Cost-saving due to high ET 200SP **channel density** and use of only one HMI panel

Production machine



ET 200SP AI Energy Meter 480VAC HF
Two new products

Suitable for brown field use

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AI Energy Meter 480VAC CT HF
(6ES7 134-6PA00-0CU0)

Option 1 – for CT use:

- **CT**: **C**urrent **T**ransformer (typical 1A or 5A CTs)

Features Current Transformers:

- ⊕ Cost-efficient
- ⊕ Minimized mounting time and effort when split-core CTs are used

AI Energy Meter 480VAC RC HF
(6ES7 134-6PA20-0CU0)

Option 2 – for current measuring via RC

- **RC**: **R**ogowski **C**oil

Features Rogowski-Coil:

- ⊕ Easy and cost-effective mounting
- ⊕ Typical use in **brownfield** plants
- ⊕ Compares to SENTRON PAC4200

Special features of both alternatives	Measuring down to ~0VAC (phase-to-earth) and for TT, TN, **IT**-grids, due to 24VDC-supply
	Grid analysis functionalities: Harmonics 1. ... 40. (current, voltage), analysis (overvoltage and –current, voltage drop), residual current (I1, I2, I3, IN), distortion factor

What are the advantages of the Integrated energy measurement?

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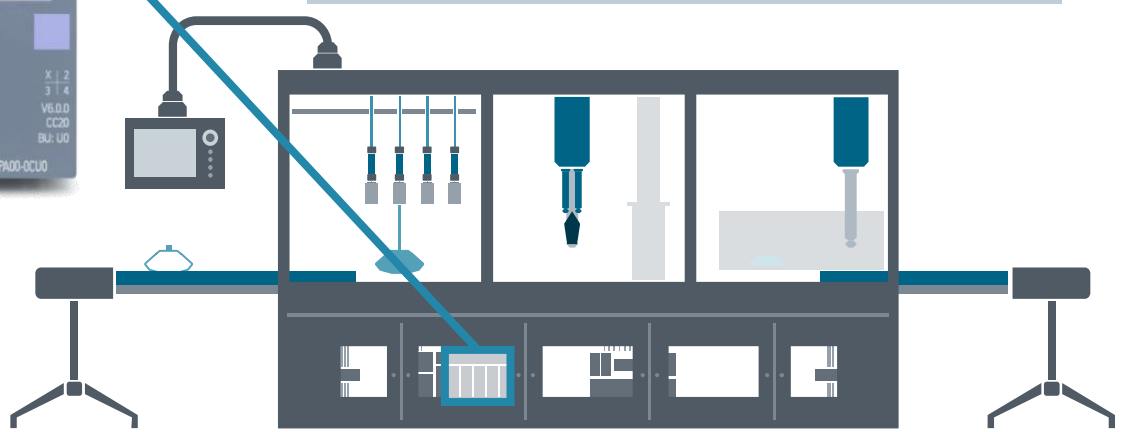
- Correlation of Energy and further data possible (machine status / quantity) +
- No additional IP-addresses necessary +
- Modular expandable: 1 to n measuring points +
- Space-saving +
- Just one engineering tool: TIA Portal +



Measuring devices
Hardware for every application and classification

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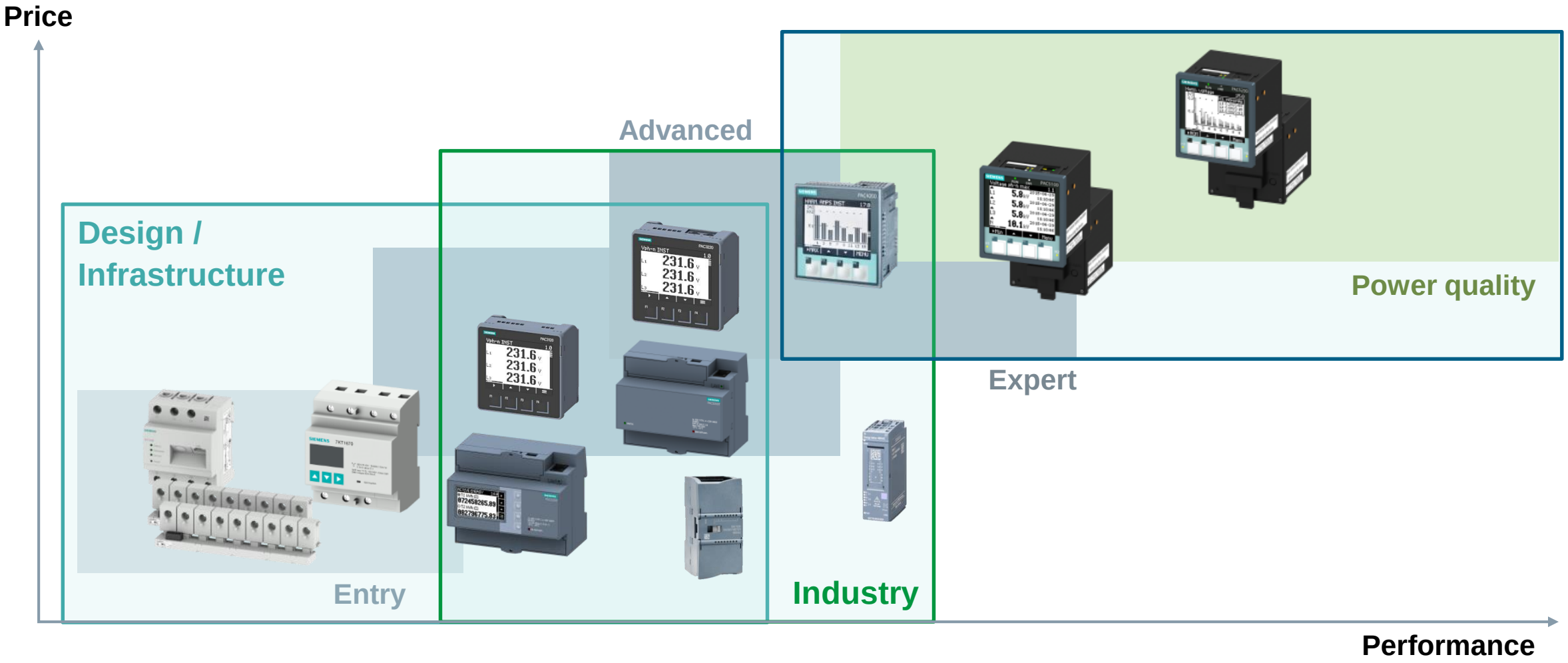

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SIMATIC Energy Management – transparency and efficiency from machine level to company level

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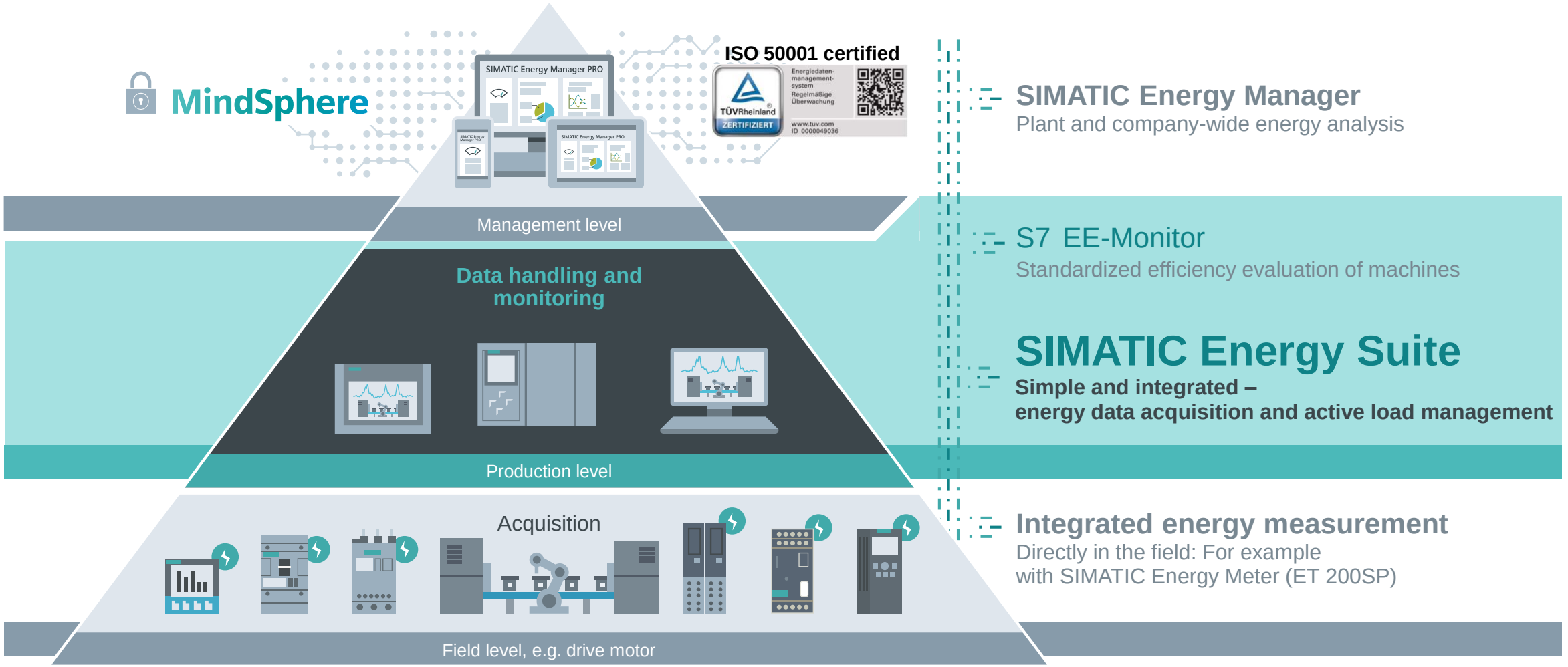

The simple solution for Integration and Monitoring
SIMATIC Energy Suite - Innovative, efficient, easy, quick

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Measuring


SENTRON


SINAMICS


SIMATIC


SIMOCODE

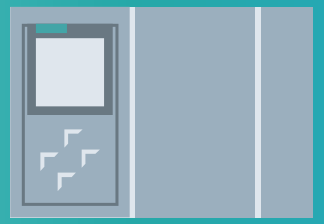

SENTRON


3rd Party

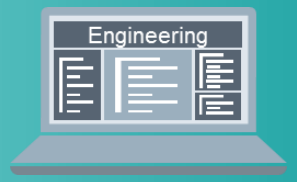
Energy Suite

Easy Integration

Consistent Information

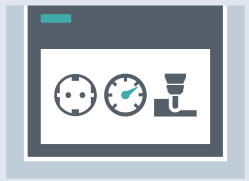


Data buffering at PLC

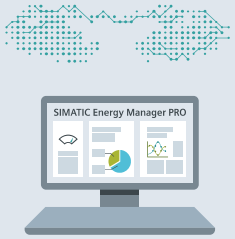


Generation
instead of programming

Visualization
with SIMATIC HMI



Analysis
with SIMATIC Energy Manager



Archiving
with WinCC Professional

SIMATIC Energy Suite V16
Visualization integrated in TIA Portal (Lib)

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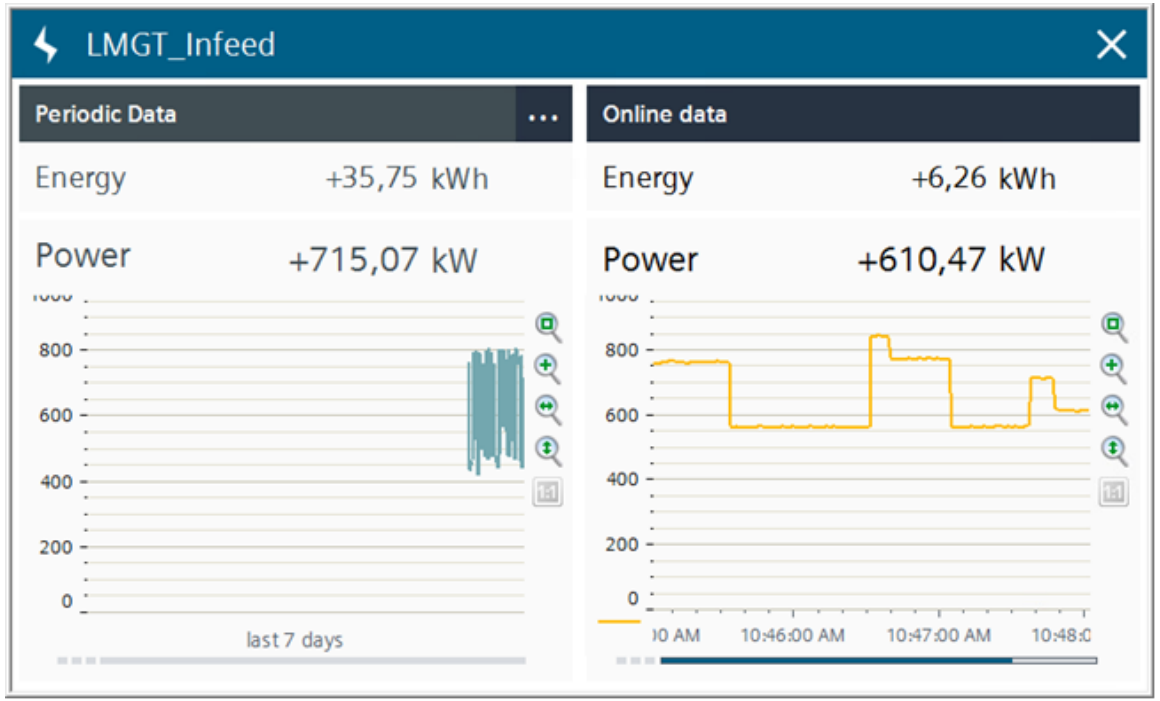

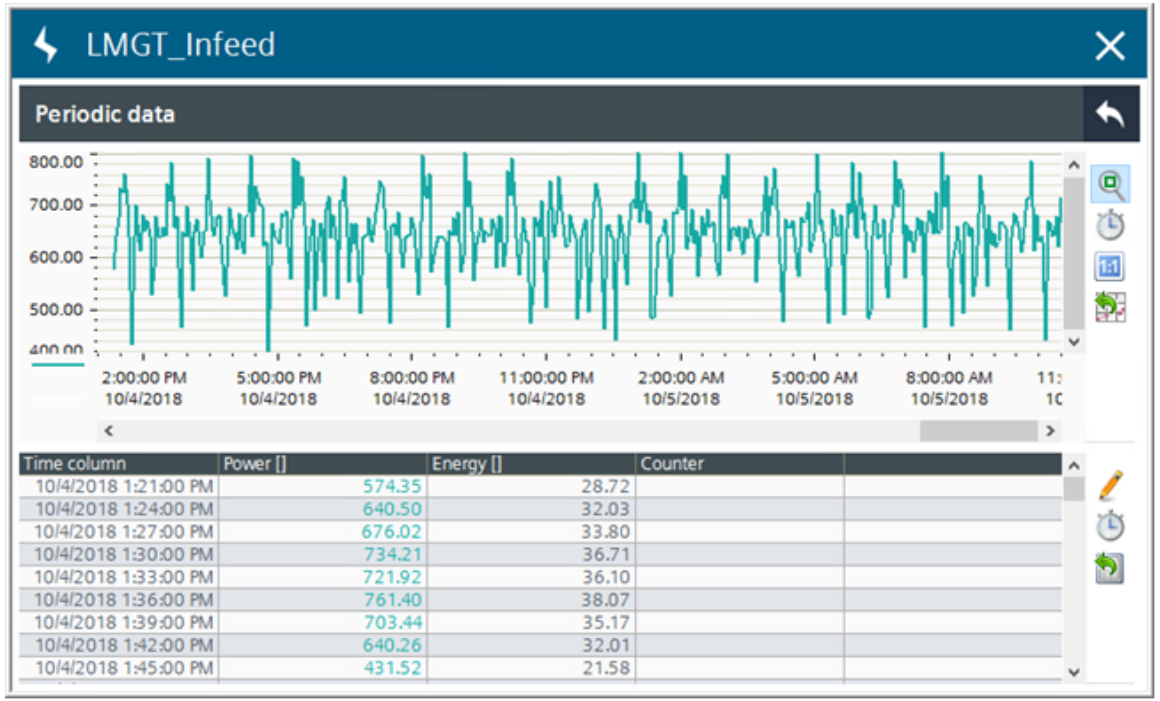

Time and cost savings in energy data collection

SIMATIC Energy Suite V16 – active Load Management
Load peaks reduction

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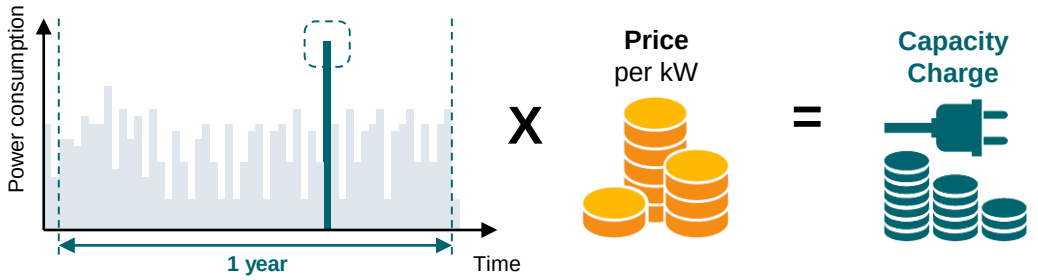
Customer requirements

- **Reduction** of the capacity charge through the avoidance of load peaks and more even power distribution
- Production processes **must not be influenced**
- **Automatic regulation** of the system without external influence
- Response of the system to **feedback** of the production process

Calculation of the Capacity Charge

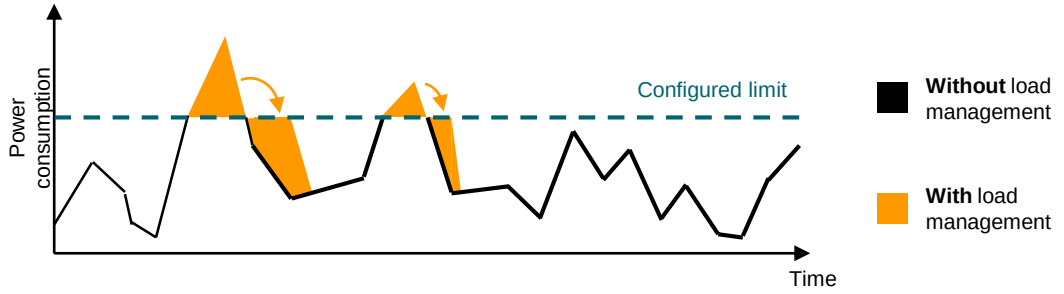
- Determination of the **highest average consumption** (in kW) during a period (usually 15 minutes) within a year
- **Multiplication** of this value by the contractually determined **price per kW** with the energy supplier company



High costs with only a **single** load peak

Siemens offering – SIMATIC Energy Suite with load management

- Direct **integration** into the **production level** due to PLC-based solution
  ➔ No intervention of IT systems in the production level necessary
- Avoidance of load peaks through **integrated prediction algorithm**
- **Smooth load distribution** due to **independent switch** of consumers or activation of generators
- **Future-proof** due to a **modular function block concept**
  ➔ Simple extension of the number of actuators
- **Fast integration** into an existing **visualization** including all relevant data of the actuators and the entire system
- **Archiving** of every switching action and limit violation



SIMATIC Energy Suite V16 – active Load Management
Visualization example

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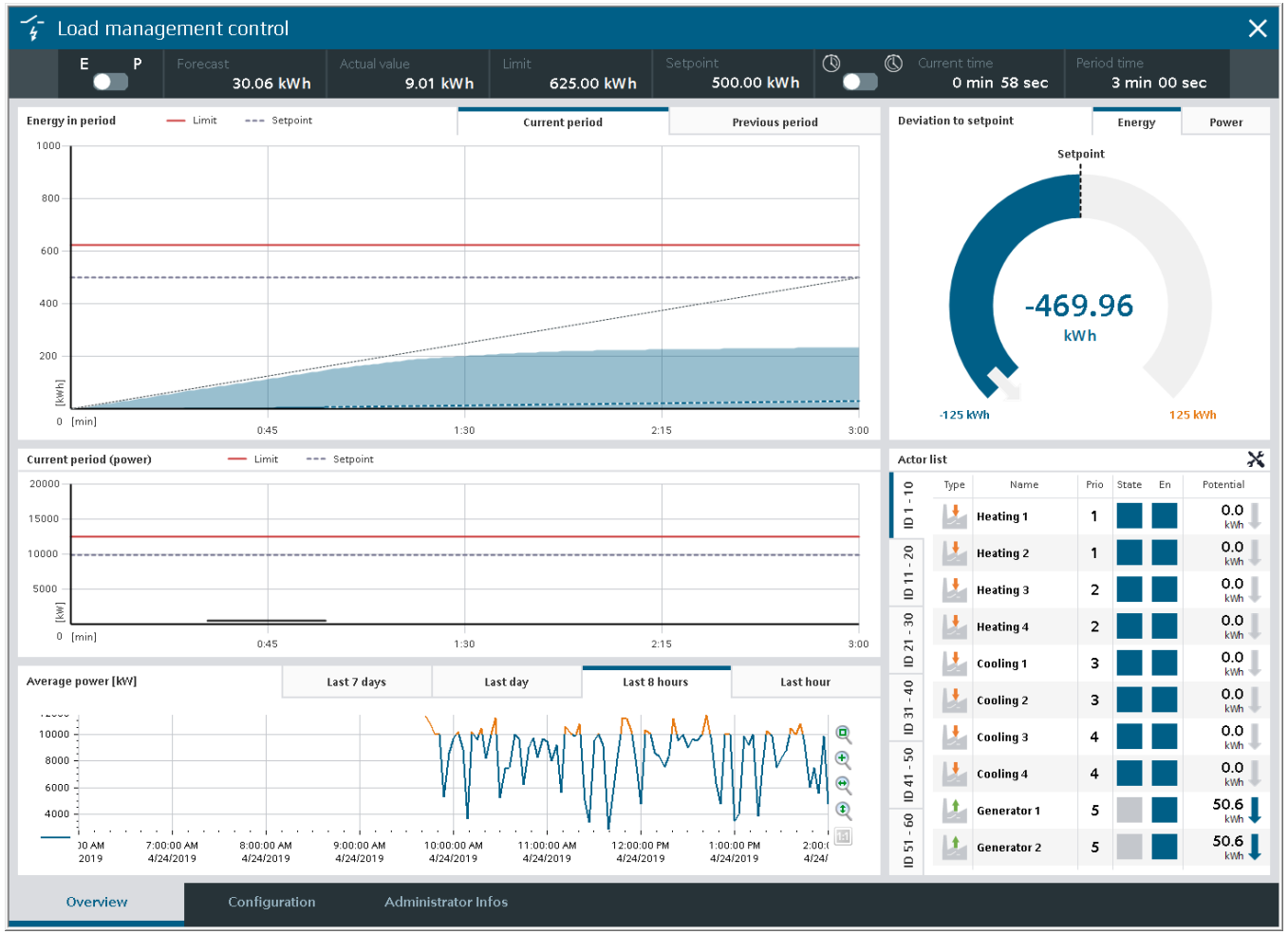

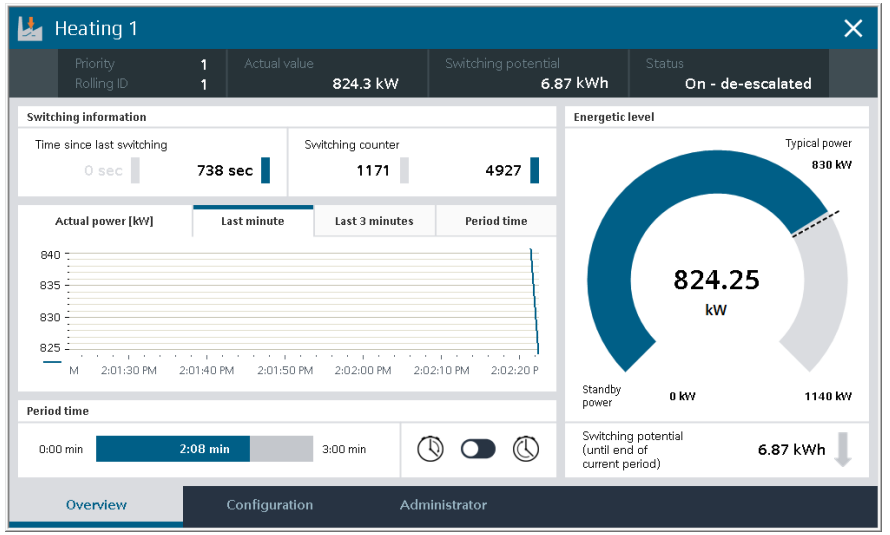

Overview of the load management

- Presentation of the previous and current period using a triangle diagram
- Historical values of the infeed up to 7 days
- List of all actors including status and configuration possibility

Detail view per actuator

- All relevant information at a glance
- Subsequent configuration possible
- Operation of the manual mode

SIMATIC Energy Suite V16 with active Load Management
Advantages

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High time savings due to automatic program generation

Load management is **configured** via user interface in the TIA Portal and the program is then **generated**. The configuration is then completed in the visualization.

Fast and calculable Return of Invest

Through **fixed acquisition costs and predictable savings** through configurable performance limit.

High flexibility for future extensions

When actuators will be **extended in the future**, they can be **created in engineering** and the program can then be **regenerated**.

Short reaction time with fluctuating tariffs

Power limit can be modified **at runtime** and can therefore be adapted to **different tariffs** (e.g. day and night tariff)

Prefabricated visualization

Visualization for WinCC Professional **included in scope of delivery**, which provides all relevant information for the entire system, as well as the actuators, at a glance

SIMATIC Energy Manager PRO pre configuration

for efficient vertical integration into the holistic approach **of energy data management**

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SIMATIC Energy Management – Transparency and efficiency from machine to company

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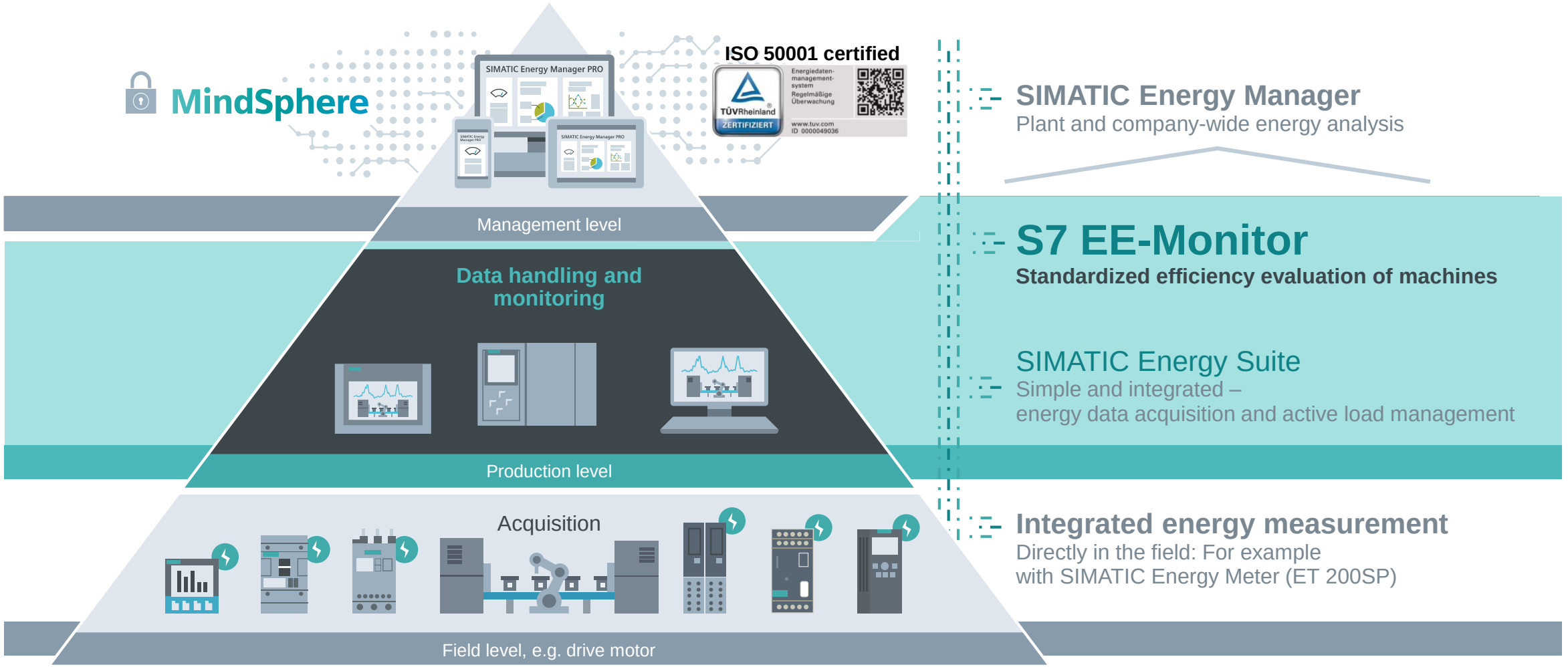

Norms and standards alleviate our everyday way of life

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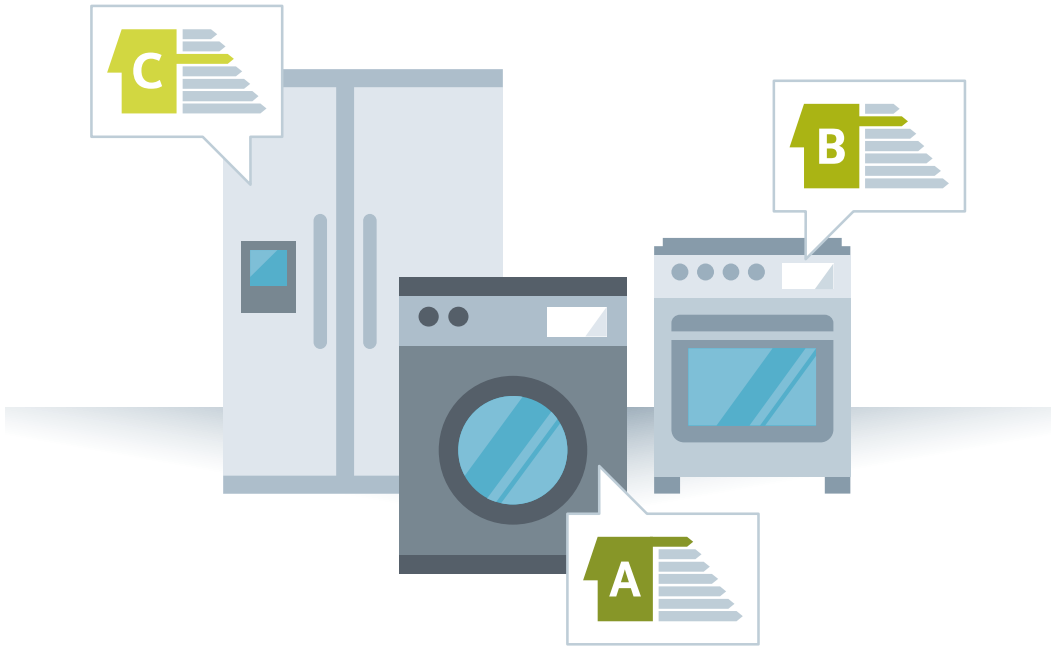
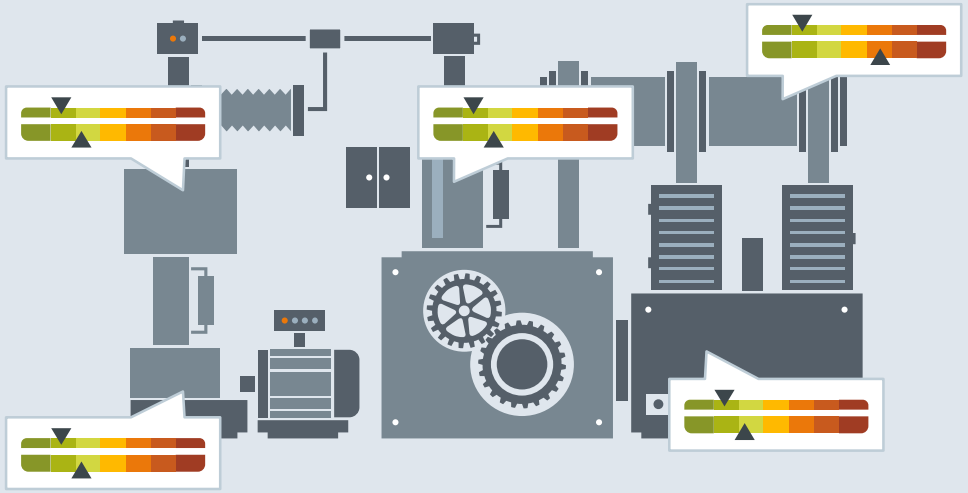
The simple efficiency evaluation of

household appliances is already standard



Now, the reliable

efficiency evaluation for industrial machinery is also possible



This does, however, require expertise and the right tools

Requirements for a comparative and valid energy efficiency evaluation

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Continuous analysis

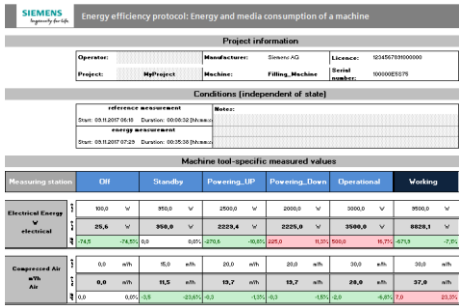
Monitoring of energy efficiency of machines and also in particular an efficient mode of operation of this machine

Status-related energy analysis

From shutdown condition to ongoing operation

Energetic profile

And acceptance form based on the VDMA standard 34179 and energy efficiency report for detailed analysis



Energy efficiency evaluation

Analysis

Independent of the machine type
...through S7 instruction for production-related and standardized determination of energy consumption in machines

Energetic evaluation

Already during the procurement phase
(low life cycle costs)

Determined average performance values

Can be repeatedly checked during production
(automatic long-term measurement as integral part in the TIA Portal)

Efficiency analysis of machines
Two-stage overall concept (S7-EE Monitor, EnMPRO)

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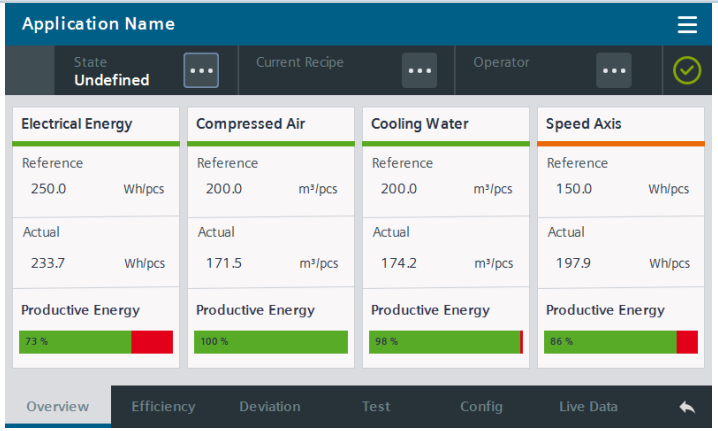
1. Local evaluation on the machine



2. Central evaluation in EnMPRO

Machine builder

Machine operator (End customer)

Efficiency evaluation for machines
Advantages at a glance

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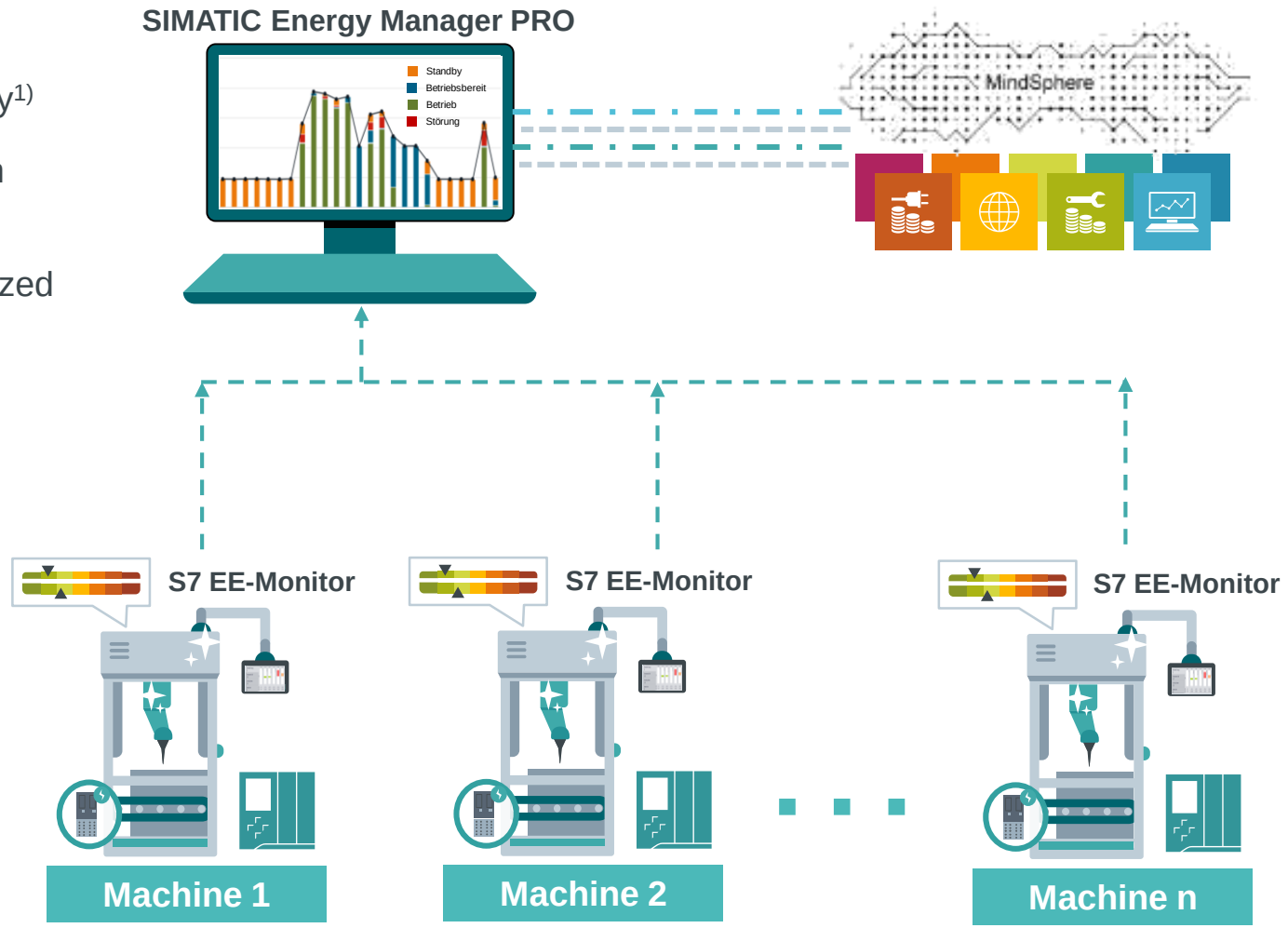
For the machine operator

- Minimum investment - EnMPRO Server necessary only[1)]
- Achieve energy efficiency and conformity in production through equipment specification of machines easily
- Most simple integration of machines through standardized connection and machine templates[2)]

For the machine builder

- **SIMATIC Energy Efficiency Package(EM,PAC)** includes all components for the machine (HW, SW)
- Easy implementation (see S7 EE-Monitor)
- Including rights of use for SIMATIC Energy Manager PRO



1) To be ordered separately: SIMATIC Energy Manager PRO Server (6AV6372-2DF07-2AH0)

2) See SIMATIC Energy Manager PRO system manual (Industry Online Support ID 109748841

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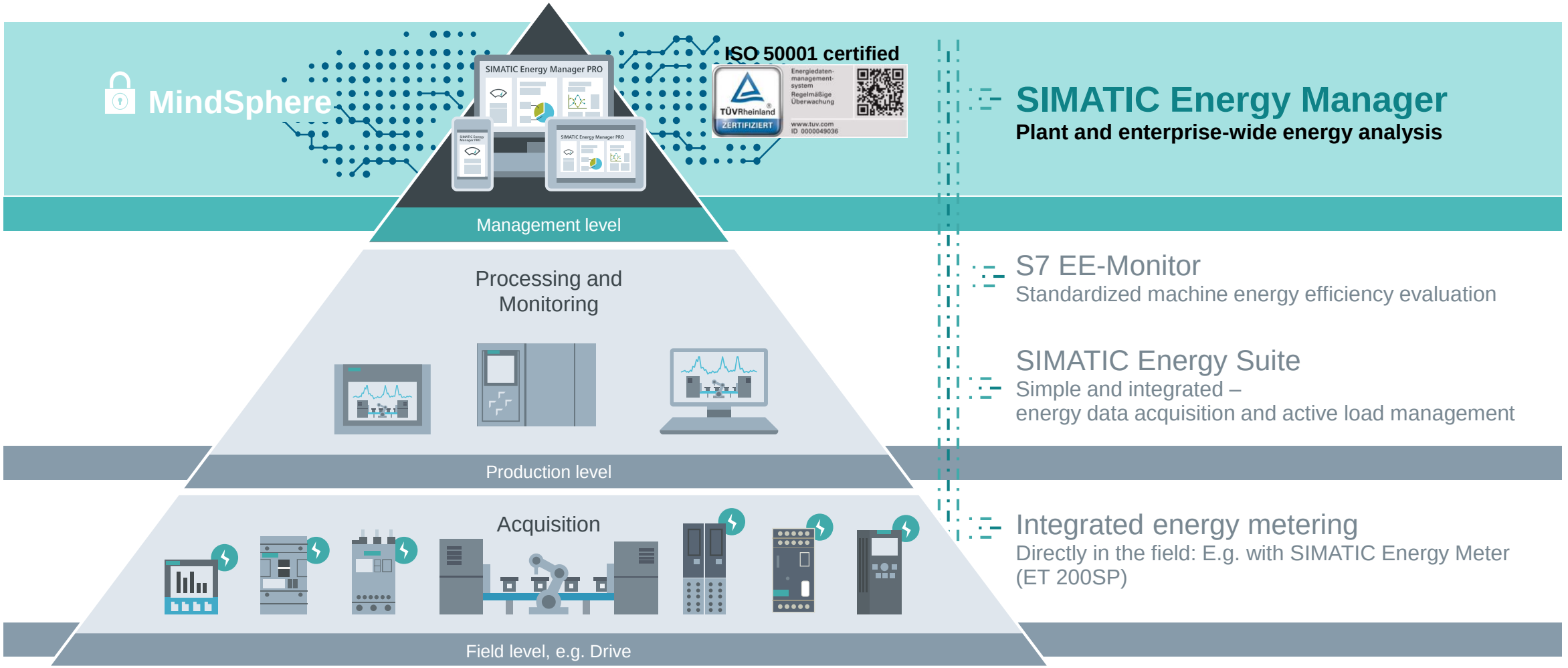
SIMATIC Energy Management – Transparency and Efficiency from machine to plant level



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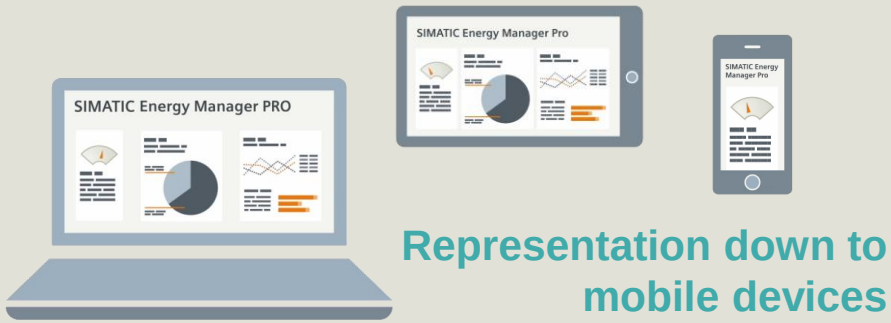
How can I generate information from data?

- Flexible KPI/EnPI definition
- User-specific data preparation
- Integrated statistics functions
- Access to the "right" information with one click
- KPI definition using the drag-and-drop function and flexible representation (widget)



Representation down to mobile devices

Representation of parameters

Display of the data for quick decision-making

SIMATIC Energy Manager
Suitable representation of key figures

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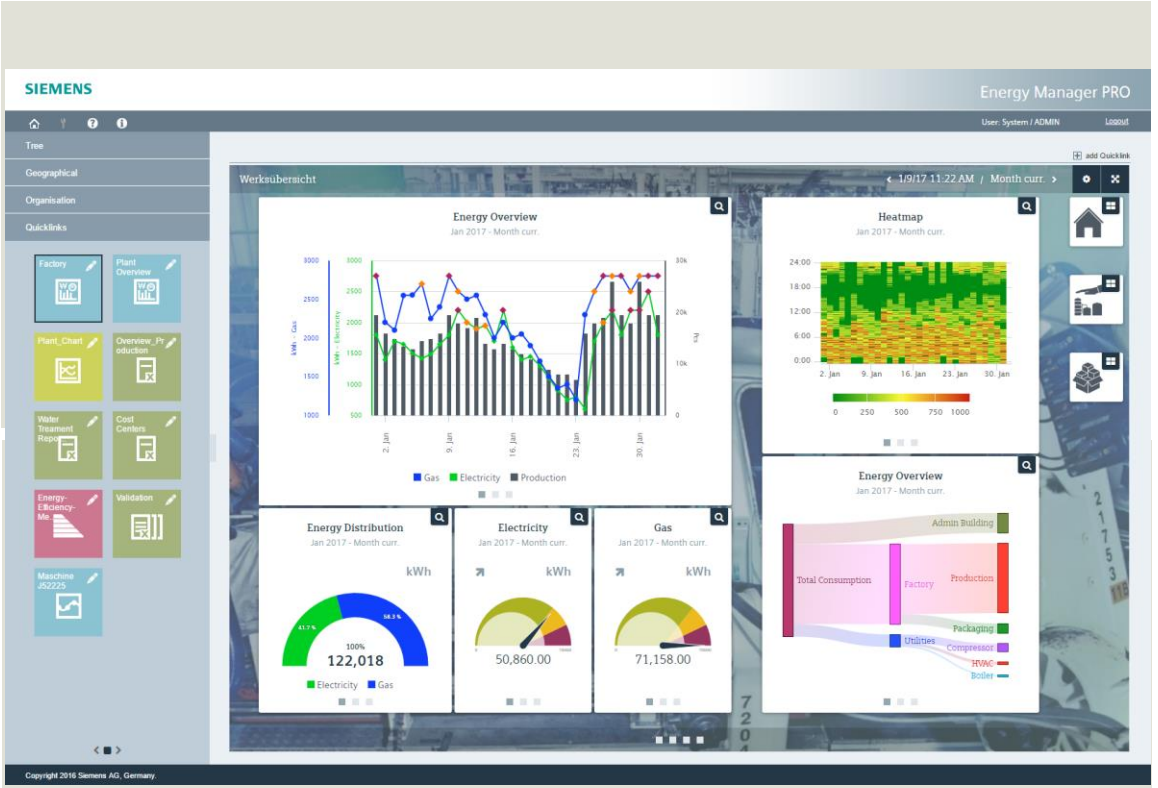
The right displaying option for the appropriate case

- Availability of a very flexible web dashboard
  - Charts like pie, line, bar
  - Gauge, traffic light, Text, Image,
  - Sankey, Head map, Map, Alarms
- Integrated statistic and analysis functionalities



Increasing the acceptance by using the proper displaying option

SIMATIC Energy Manager
Dashboard across several sites

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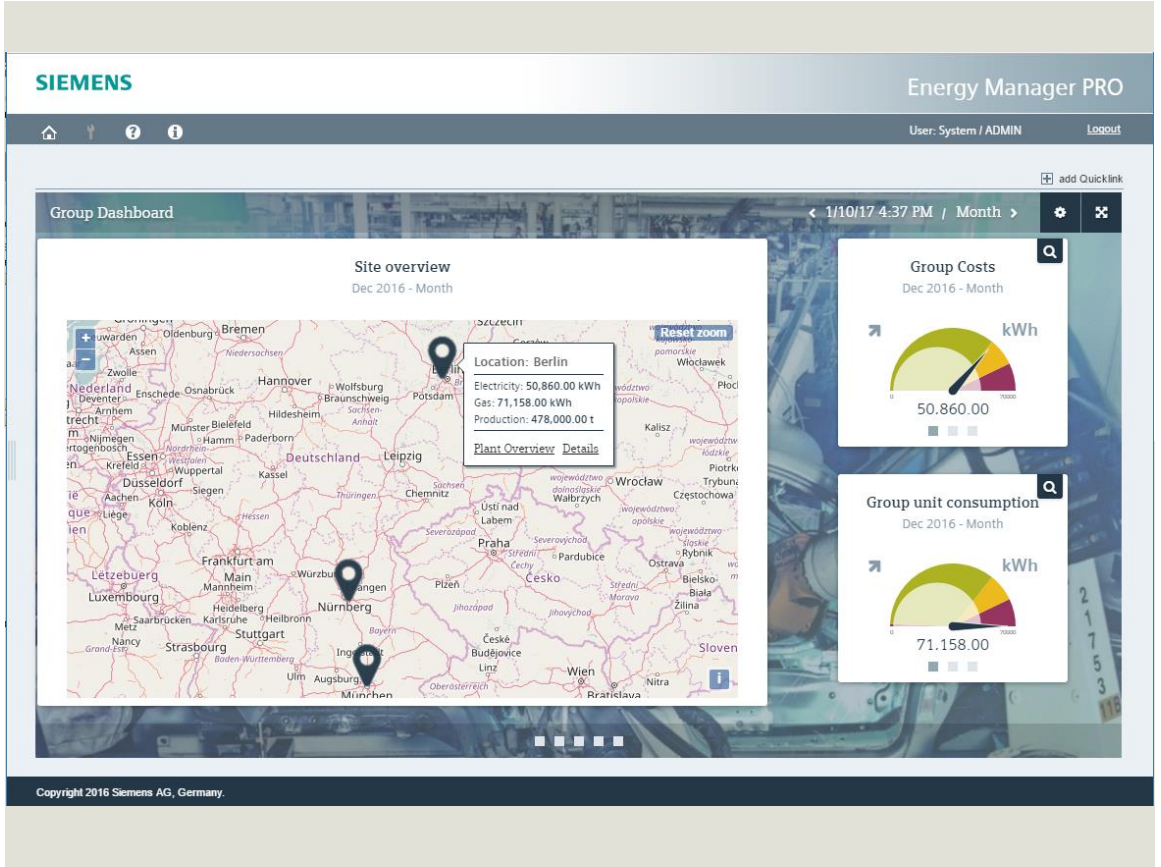
From high level views to the details

- The map widget supports
  - Geographical position of the site
  - Important EnPIs for this site
  - Direct navigation to the e.g. plant dashboard



Fast overview and the possibility performing a deep dive to the appropriate information

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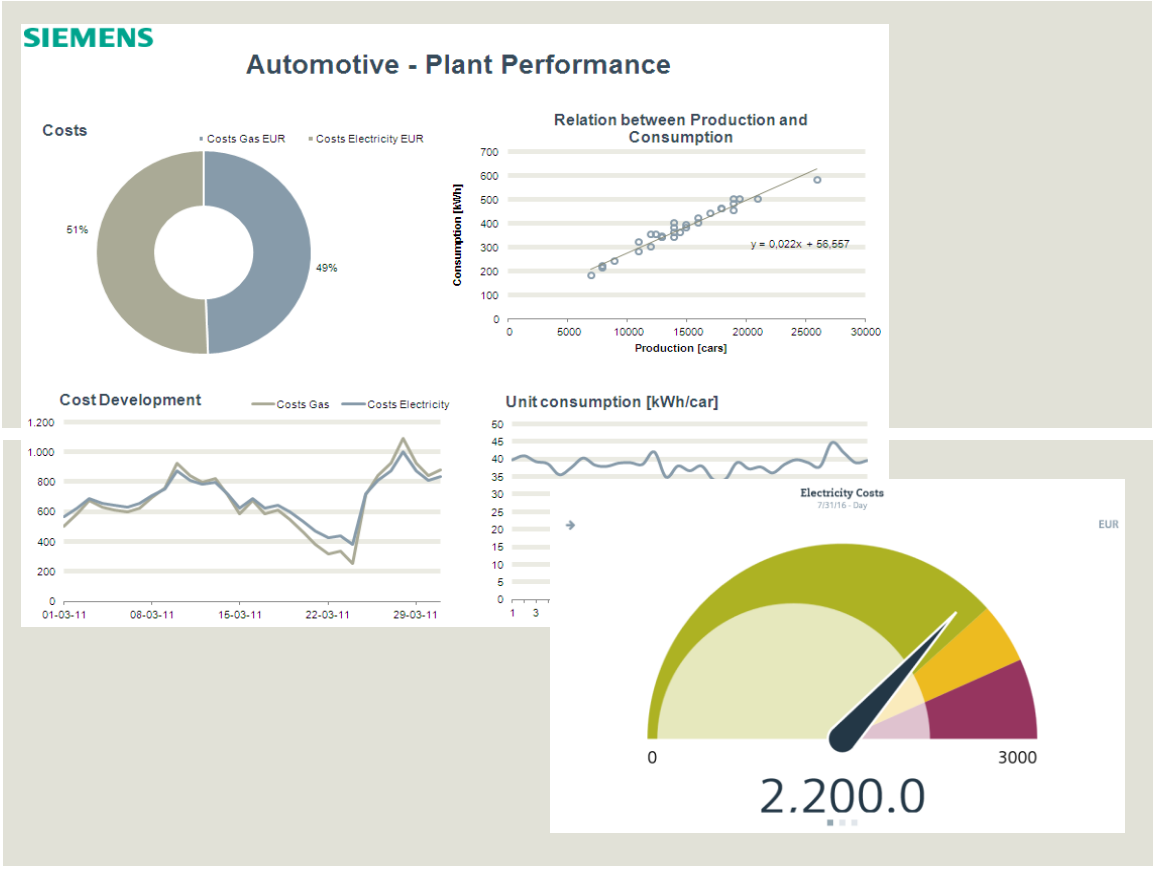
What are the energy controlling requirements?

- Flexible EnPI configuration via drag & drop
- Bringing KPIs in relation to other time frames
- Various displaying possibilities
- Benchmark functionalities
- Sustainability reporting
- Target setting and watching there achievement



Thanks to Energy Performance Indicators you have your energy efficiency under control!

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Why cost causer accounting!

- Change the behavior through cost assignment
- From simple to complex cost assignment models
- Automatic transfer of KPIs to the ERP level.
- Provision of Information through email printer or Web Client

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Kostenaufstellung

Author: BDATA_SYS
Period: 01.09.2011 01.10.2011
Date: 1.26.2012 5:32:43 PM

	BDATA_SYS		Gesamtkosten 70.829.424 €		Gesamtwerk						
	Medium	Energy Costs		Unit	Zellstoff-erzeugung	Stoff-aufbereitung	Papier Produktion	Finishing	Kraftwerk	Abwasser-aufbereitung	Rest
CC 100 % measured	Electrical Energy 81,13%	absolut	57.464.656	€	5.737.315	2.392.838	1.464.065	17.385.802	19.215.889	10.161.547	**1.107.199**
		percentage			10,0%	4,2%	2,5%	30,3%	33,4%	17,7%	1,9%
	Technical Heat 15,97%	absolut	11.311.006	€	621.873	160.079	3.196.412	4.305.899	2.193.153	48.688	**784.903**
		percentage			5,5%	1,4%	28,3%	38,1%	19,4%	0,4%	6,9%
	Room Heat 2,30%	absolut	1.630.400	€	1.061.127	11.576	308.657	85.811	62.658	5.065	**95.506**
		percentage			65,1%	0,7%	18,9%	5,3%	3,8%	0,3%	5,9%
	Natural Gas 0,02%	absolut	17.600	€	1.760	1.467	1.760	3.755	2.933	2.933	**2.992**
		percentage			10,0%	8,3%	10,0%	21,3%	16,7%	16,7%	17,0%
	Sum Rest I	absolut			338.402	59.718	238.872	597.180	557.368	199.060	1.990.599
	Staff Factor I	percentage			17%	3%	12%	30%	28%	10%	
CC < 100 % measured	Compressed Air 0,19%	absolut	131.940	€	397	26.438	39.681	19.345	19.841	19.841	**6.399**
		percentage			0,3%	20,0%	30,1%	14,7%	15,0%	15,0%	4,8%
	Portable Water 0,04%	absolut	28.917	€	53	1.285	3.909	9.639	12.852	129	**1.051**
		percentage			0,2%	4,4%	13,5%	33,3%	44,4%	0,4%	3,6%
	Waste Water 0,35%	absolut	244.906	€	2.675	2.666	210.461	7.786	11.542	7.594	**2.182**
		percentage			1,1%	1,1%	85,9%	3,2%	4,7%	3,1%	0,9%
	Sum Rest II	absolut			258.778	159.248	497.650	398.120	398.120	278.684	9.632
	Staff Factor II	percentage			13%	8%	25%	20%	20%	14%	
	Total Sum	**absolut**	**70.829.424**	**€**	**8.022.381**	**2.815.314**	**5.961.467**	**22.813.334**	**22.474.356**	**10.723.539**	
		percentage			12,44%	48,31%	16,22%	10,03%	3,91%	4,12%	

Cost transparency as fundament for optimization measures!

SIMATIC Energy Manager
Batch Analyses

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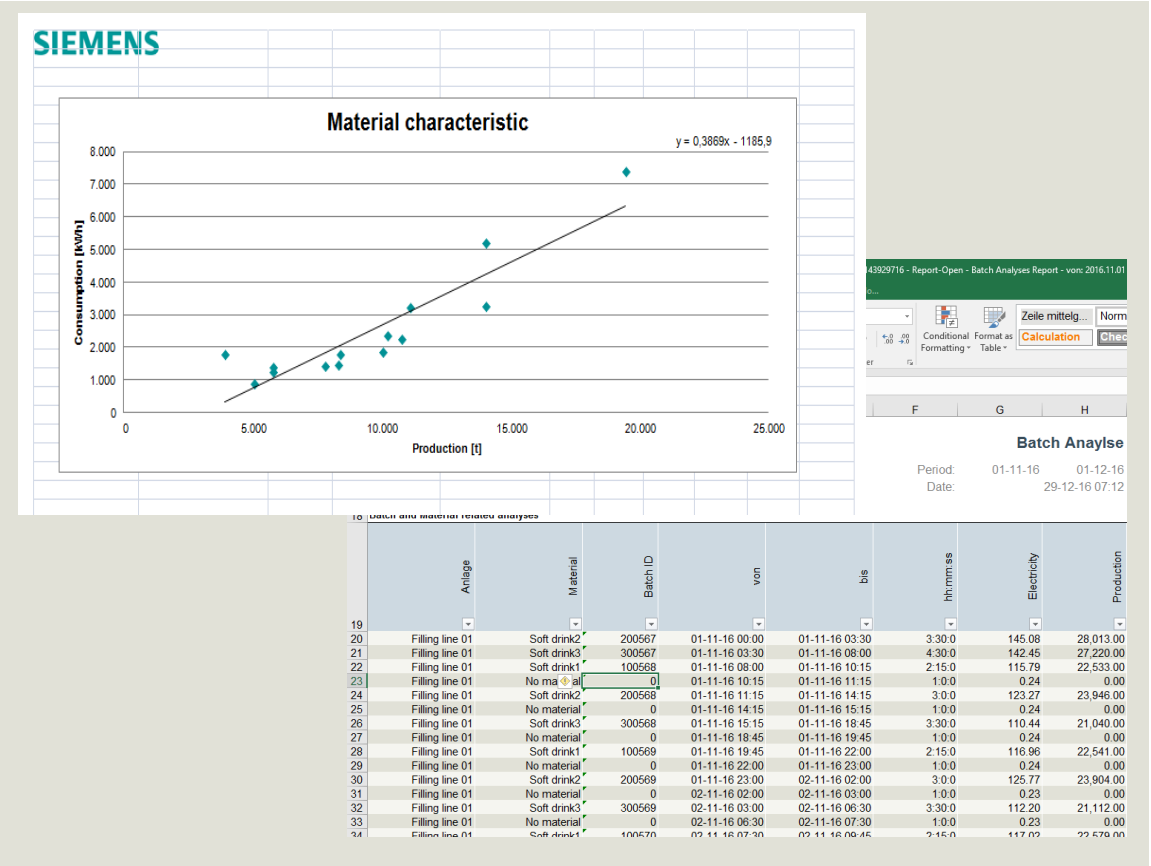
Data analysis on batch, product, or equipment level

- Data analysis based on equipment or materials
- Comparison of products produced by different lines
- Batch related energy balance across the production process



	Anlage	Material	Batch ID	von	bis	hh:mm:ss	Electricity	Production
19								
20	Filling line 01	Soft drink2	200567	01-11-16 00:00	01-11-16 03:30	3:30:0	145.08	28,013.00
21	Filling line 01	Soft drink3	300567	01-11-16 03:30	01-11-16 08:00	4:30:0	142.45	27,220.00
22	Filling line 01	Soft drink1	100568	01-11-16 08:00	01-11-16 10:15	2:15:0	115.79	22,533.00
23	Filling line 01	No material	0	01-11-16 10:15	01-11-16 11:15	1:0:0	0.24	0.00
24	Filling line 01	Soft drink2	200568	01-11-16 11:15	01-11-16 14:15	3:0:0	123.27	23,946.00
25	Filling line 01	No material	0	01-11-16 14:15	01-11-16 15:15	1:0:0	0.24	0.00
26	Filling line 01	Soft drink3	300568	01-11-16 15:15	01-11-16 18:45	3:30:0	110.44	21,040.00
27	Filling line 01	No material	0	01-11-16 18:45	01-11-16 19:45	1:0:0	0.24	0.00
28	Filling line 01	Soft drink1	100569	01-11-16 19:45	01-11-16 22:00	2:15:0	116.96	22,541.00
29	Filling line 01	No material	0	01-11-16 22:00	01-11-16 23:00	1:0:0	0.24	0.00
30	Filling line 01	Soft drink2	200569	01-11-16 23:00	02-11-16 02:00	3:0:0	125.77	23,904.00
31	Filling line 01	No material	0	02-11-16 02:00	02-11-16 03:00	1:0:0	0.23	0.00
32	Filling line 01	Soft drink3	300569	02-11-16 03:00	02-11-16 06:30	3:30:0	112.20	21,112.00
33	Filling line 01	No material	0	02-11-16 06:30	02-11-16 07:30	1:0:0	0.23	0.00

Energy consumption on product level allows CO2 food print calculations

SIMATIC Energy Manager
Baseline Management

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Get the baseline for your plant or equipment

- The baseline is the theoretical energy consumption considering the actual circumstances
- Verifying the deviation between baseline and actual consumption
- Cumulative sum of this deviation shows changes in the energy efficiency

Based on the baseline you can immediately detect inefficiencies

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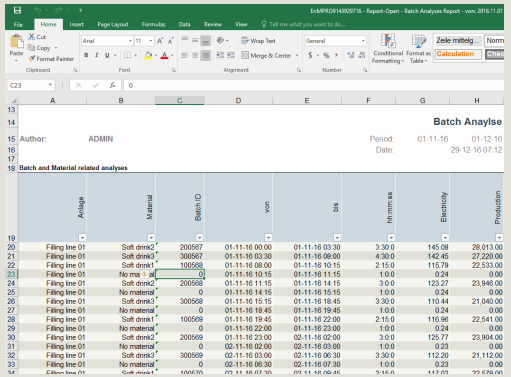
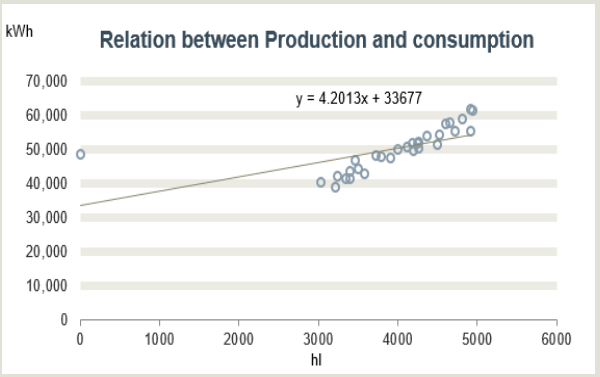
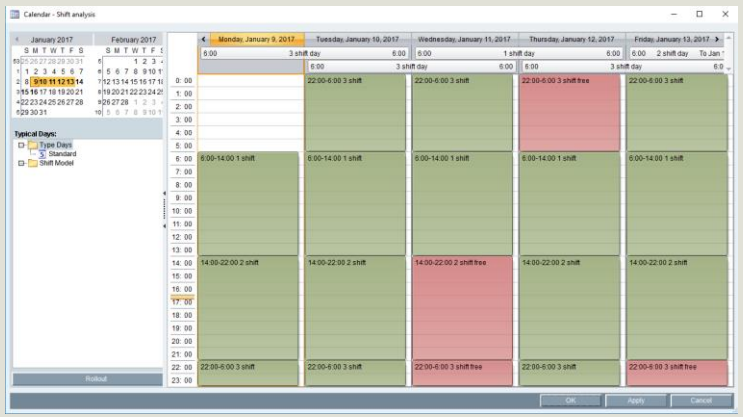
The view to the future with EnMPRO

- The several prediction models can be combined according the requirements
  - Multi linear regression analysis
  - Typical day method
  - Production plan based prediction
- The automatic generated energy schedule can be handed over to the energy supplier







Prediction is a door opener for new way in energy procurement

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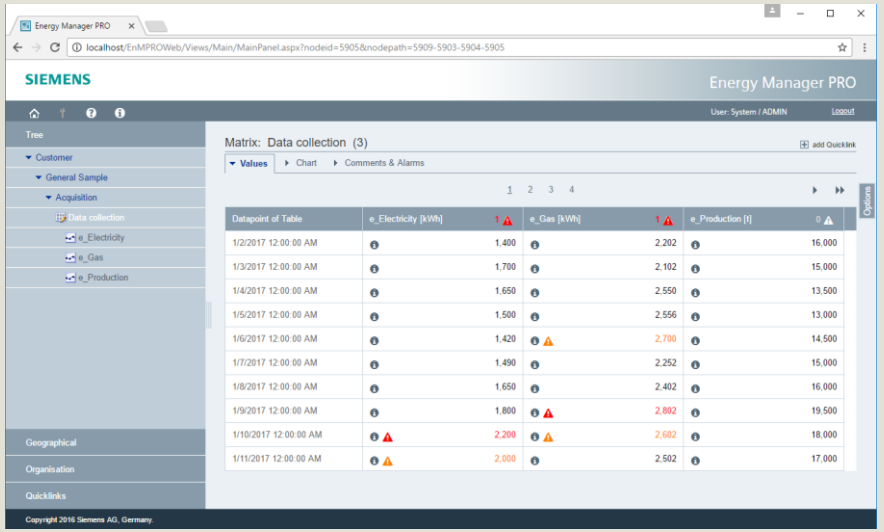
How data can be collected manually?

Not all data is available in an automatic way. Production figures or consumption data can also be entered manually

- Mobile Data Recording with Smart APP
- Matrix (Web, Full Client)
- Automatic data reading form MS Excel



An automatic data recording is not mandatory

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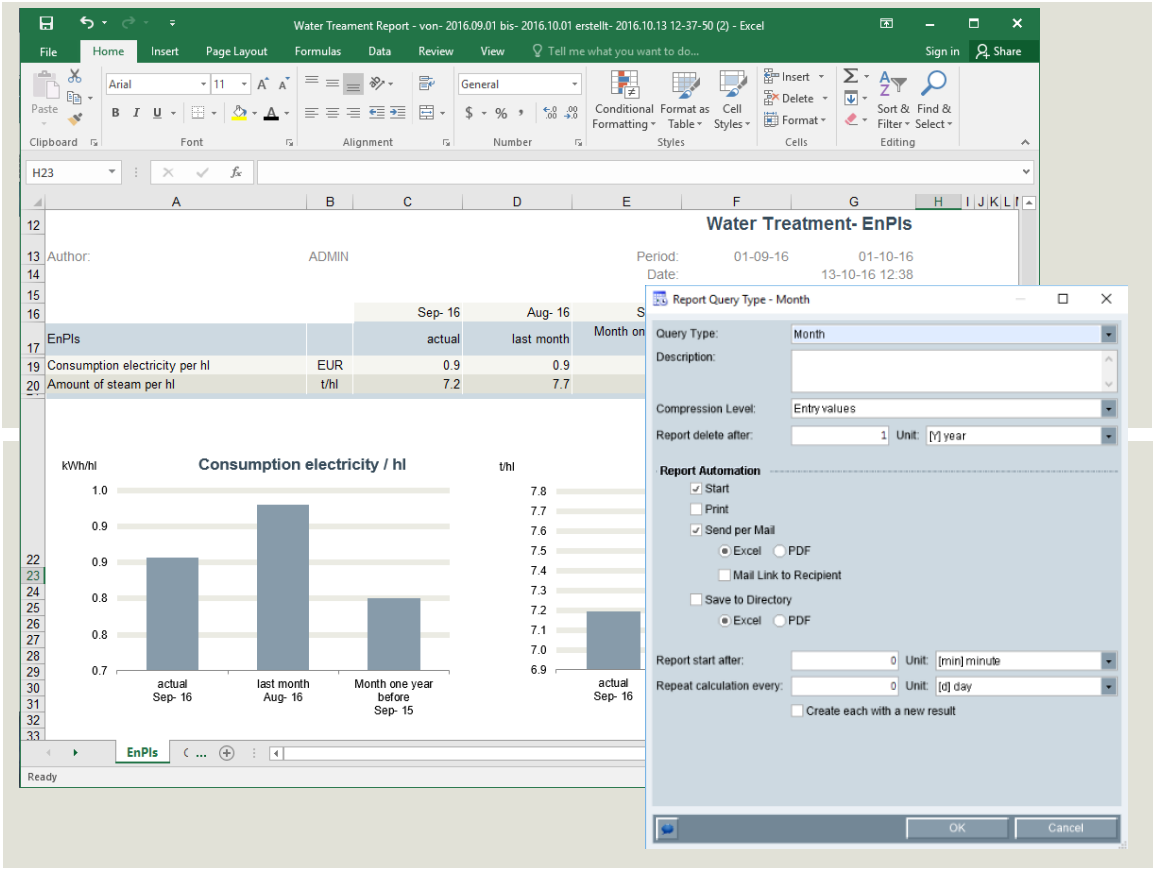
With few clicks to an automatic reporting

- High flexibility in report design (Excel, Word, pdf)
- Simple configuration instead of programming
- Automatic report creation and distribution via email, printer
- Available in the Web Client



The automatic reporting supports in distributing the information

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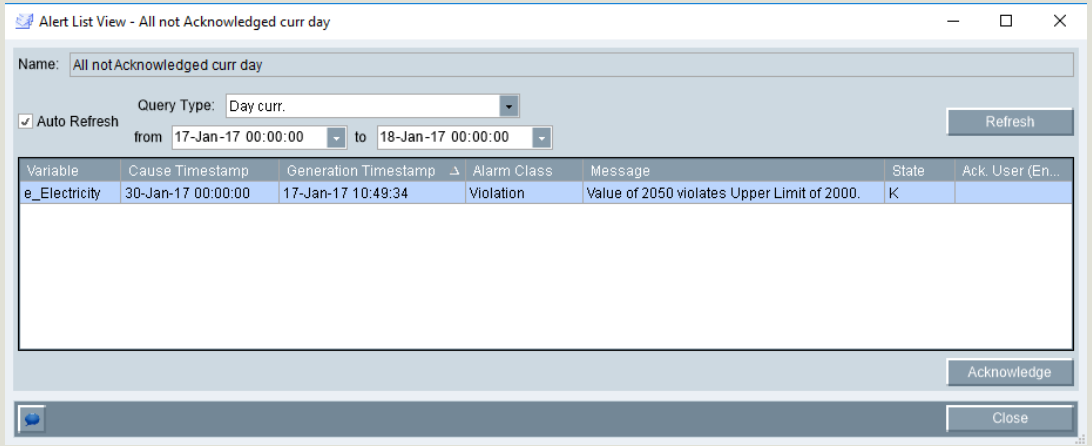
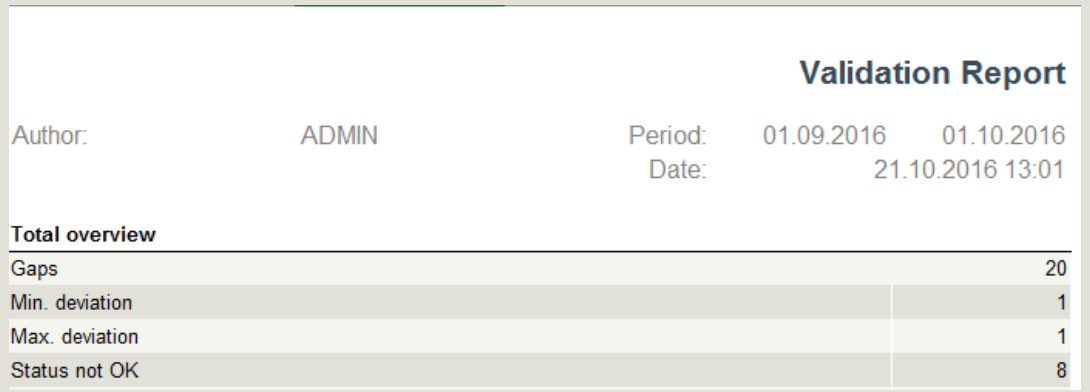
Data monitoring and alarming

- Definition of plausibility limits
- Gap detection of collected data and monitoring of KPI/EnPI-Limits
- Alarming via E-Mail
- Data validation report shows data quality in the system





Validation Report

Author: ADMIN
Period: 01.09.2016 01.10.2016
Date: 21.10.2016 13:01

Total overview

Gaps	20
Min. deviation	1
Max. deviation	1
Status not OK	8

Quick reaction through early fault detection

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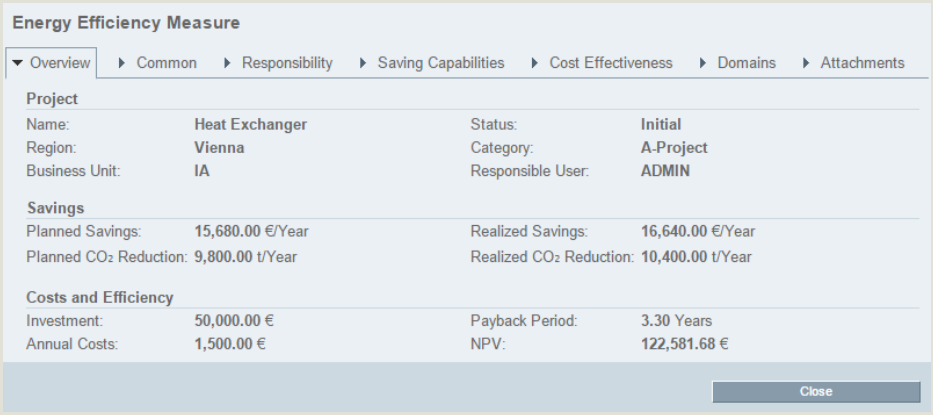
Comply to ISO 50001 Measure Management

- Comply to ISO 50001
- Overview about all energy efficiency measures
- Log real savings for each measure
- Overview about possible savings considering costs and CO2 emissions



Provides information about how much and where you should spend your many

SIMATIC Energy Manager
Horizontal integration of the value chain

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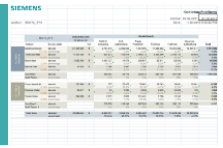
Reporting 

Data analysis with chart 

Dashboard 

Monitoring | Accounting | Controlling | Prognosis Purchase | EE-Measure Management (ISO 50001)

Supported Functionality
- Key Performance Indicators
- Counter management (overflow, change, ...)
- Alarming
- Replacement strategy
- Authority concept

Data collection across all divisions

Supply → Transformation → Distribution → Consumption → Disposal

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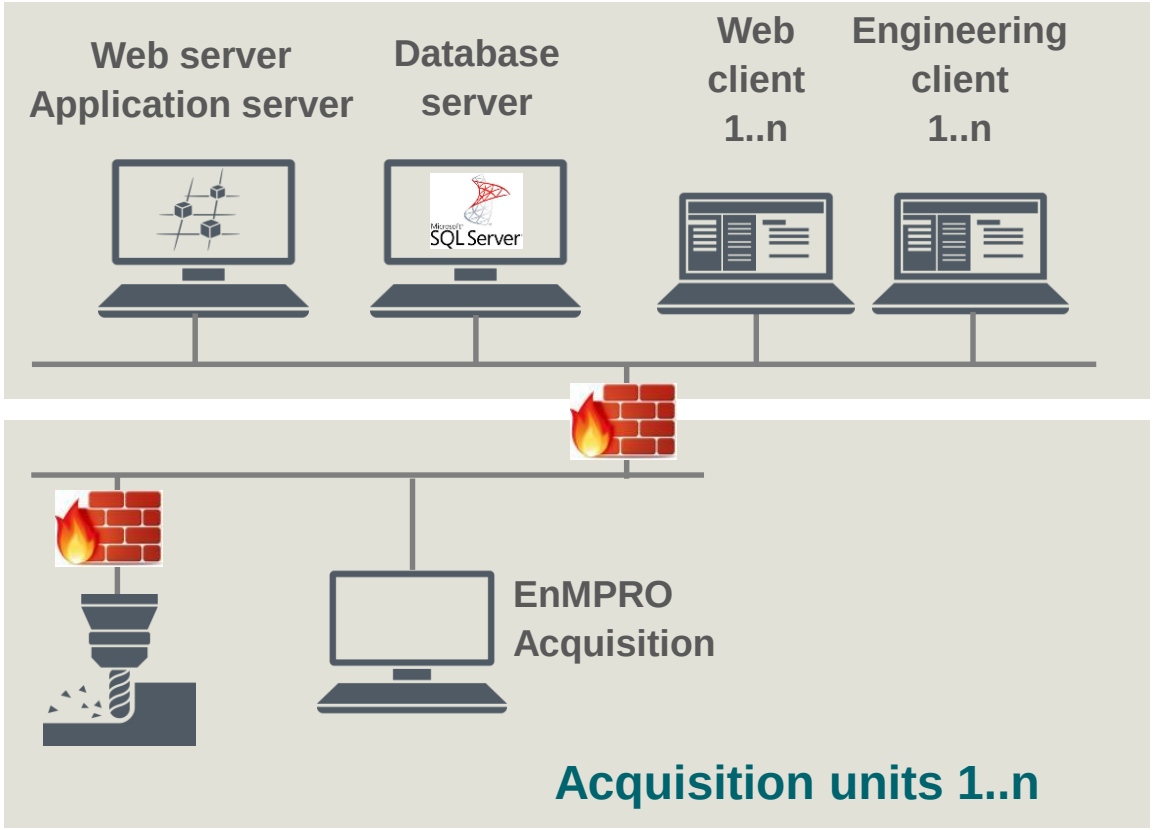
How does the system architecture look like?

- Scalable architecture with up to 30.000 tags
- Distributed Acquisition units
- Windows Server 2016/2019 operating system
- SQL Server 2017 Standard Edition



The suitable architecture for any requirement from a single station to a distributed architecture

Energy Manager PRO Interfaces

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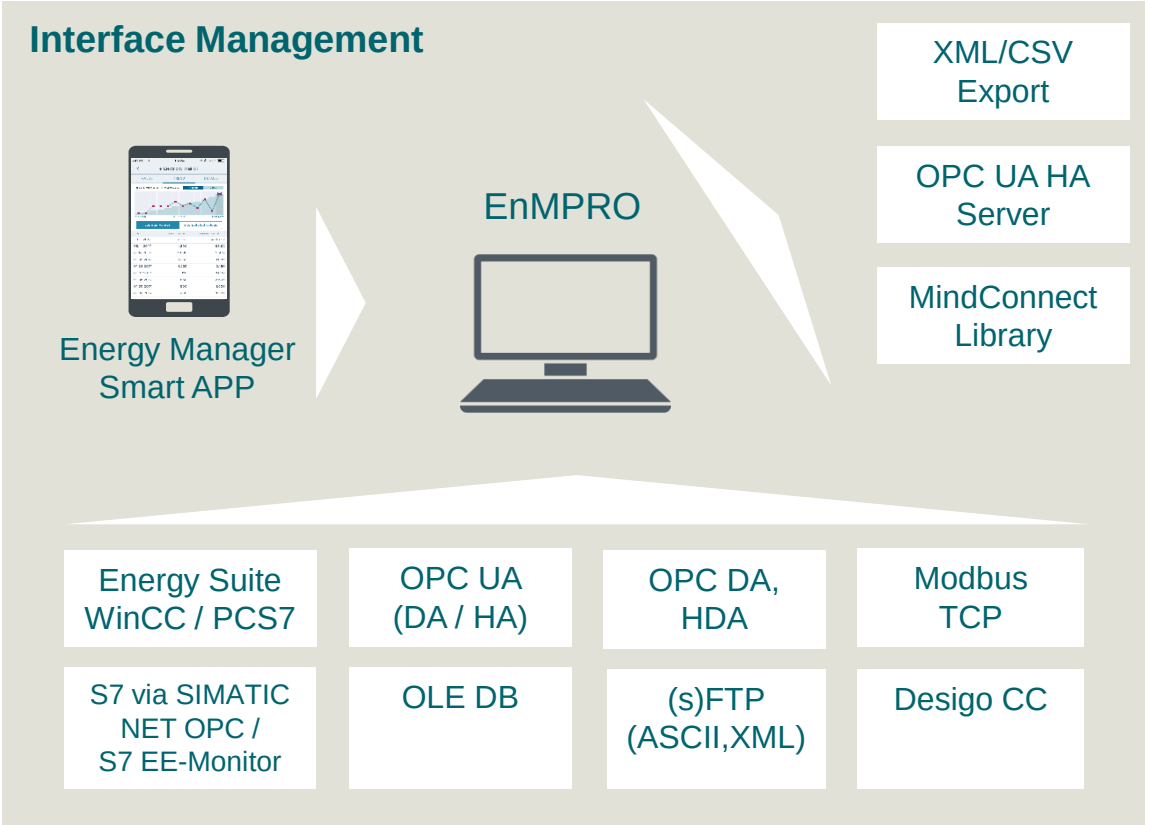
„Connectivity“ in main focus

- Numerous data interfaces to collect the necessary information
- Support of int. standards like OPC UA,..
- Open system to calculate e.g. KPIs/EnPI or costs and provide the results to other systems
- Mobile data acquisition



Openness to collect data for global transparency and export possibility of results

SIMATIC Energy Management
Distributed Data Architecture for additional locations + Cloud

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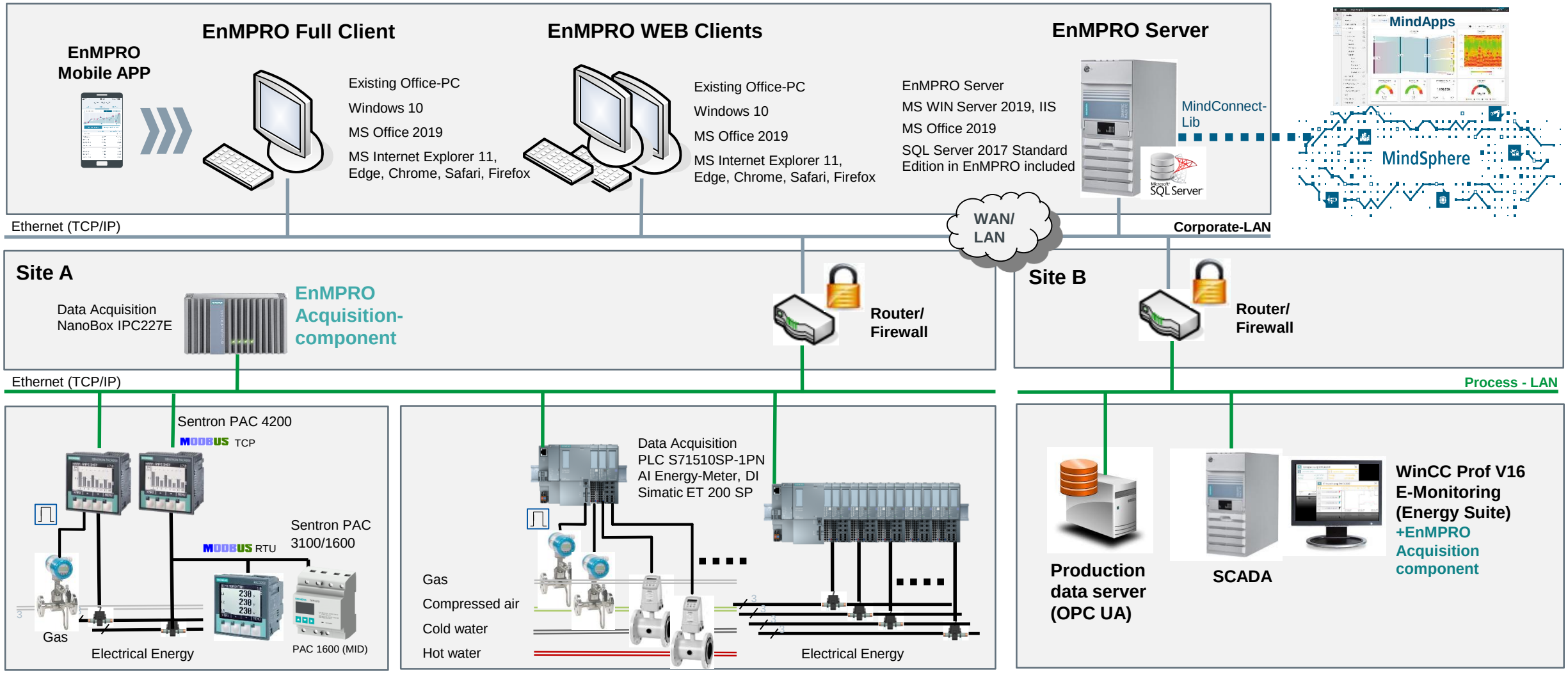

Powered by MindSphere

SIMATIC Energy Manager MindSphere App

Transparency - Obtain the greatest value from data

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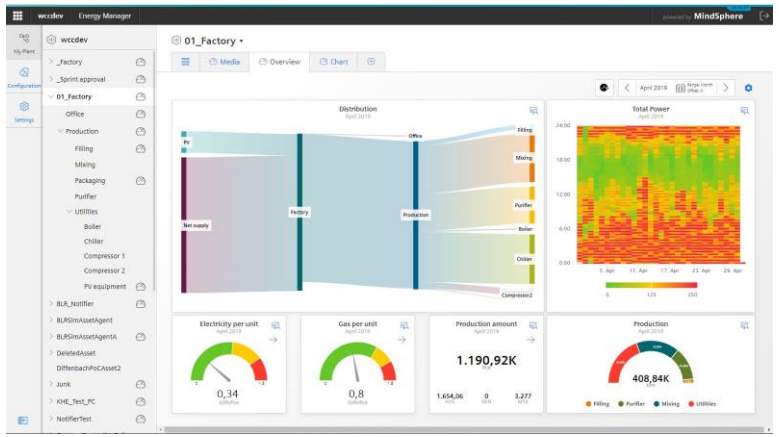

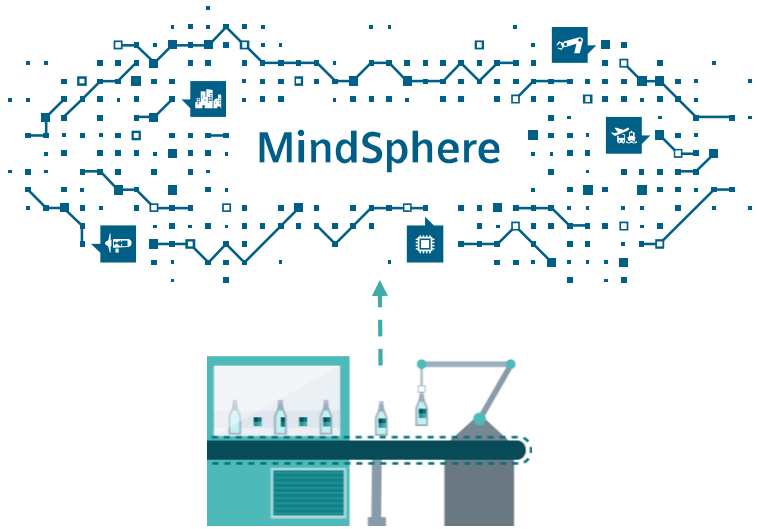

The SIMATIC Energy Manager MindSphere app allows to keep track over global distributed energy consumers. No matter if we talk about machines, lines or whole sites - Everything can be connected to MindSphere and can be accessed worldwide to benchmark energy consumers and to visualize optimization potential.

Benefits

- Energy transparency supporting ISO 50001
- Flexible KPI definition and user specific dashboards providing a holistic view about the energy consumption and can be used to derive energy efficiency measures
- Transparency about energy costs, consumption and CO_2 Emission from the machine level to your sites worldwide
- Get the most valuable information for precise decision-making to optimize energy efficiency

Features

- Out of the box energy media analysis (consumption, costs, CO_2 Emission)
- Flexible dashboard configuration with detail views for fast analysis
- Support of different widgets (charts, pie, gauge, Sankey, heat map) to visualize energy performance indicators

Industry focus

Cross industry based on flexible dashboard and KPI calculation

SIMATIC Energy Management – References
Successful Application Examples

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GF Automotive – automotive supplier industry

- Conclusive **overall concept** from **field devices** to the **management level**
- Distributed and **automatic** energy data acquisition with SIMATIC ET 200SP **Energy Meter**
- Assurance of the energy management process certified according to **DIN EN ISO 50001**
- **Verification** of the **energy efficiency potential** of machines (die-cast machines)
- Tracing and implementation of **saving measures** (e.g. 4,500 m^3 compressed air/WE, 10% CO_2 emissions)

Saint Gobain Oberland – glass industry

- **Savings** in the two-digit **million range** per year – through tax cap for energy-intensive users and renewable energies levy
- **Optimized production** (glass melting tanks)
- Support of **investment considerations** based on energy consumption
- **Automatic** and comfortable **reporting**
- Scalability for **future expansions**

- **www.siemens.com/simatic-energy-management**

Schmitz Werke – textile industry

- Easy **identification** of **energy efficiency measures** (quiescent current and compressed air leakage)
- **Amortization** of the energy management system through identification of energy eaters directly **after installation**
- **Reduced personnel costs** through automatic detection
- Support of additional **cost savings** by 5%

Infratec – industry park

- Annual reduction of operating costs by 380,000 € to **446,000 €** through **savings relating to tax cap for energy-intensive users**
- Expectation of further cost savings through efficient **energy saving measures**
- Considerably **increased energy efficiency**
- Detailed allocation of energy consumptions

More References: www.siemens.com/simatic-energy-management

SIMATIC Energy Manager V7.2
Online – Demoserver at Internet

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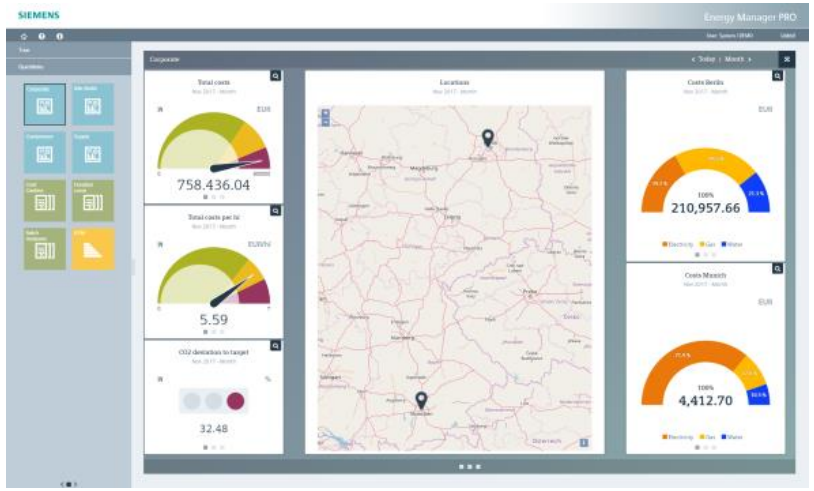

Website

www.siemens.com/enmpro

Guest Login

Demo

Password

!demo123

Thanks for your attention!

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