YOKOGAWA

Co-innovating tomorrow™

Snel besparen op energie, kosten én CO2

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Smart Manufacturing specialist

24.01.23

Productie Proces Automatisering

The influences of energy loss

Utilities

Production Process

Facilities/HVAC/Lighting

Recycle Energy

	Central energy generation - utilities - acquisition	Energy distribution	Energy conversion	Process energy usage
Components	• Steam plant • CoGen • Fossil energy • Non-fossil energy • Renewable energy • Purchased energy	• Steam piping • Fuel piping • Transmission lines	• Process heating • Process cooling • Refrigeration • Electro chemical • Machines / Drives • On-site transportation	• Distillation • Separation • Furnaces • Drying • Mixing • Forming
Energy loss	• Loss in boilers • Electricity losses • Usage • Demurrage • Value exchanges	• Leakage in pipes / valves / transmission lines etc.	• Equipment inefficiencies • Conversion inefficiencies etc.	• Waste heat • Flaring • Insulation • By-products • Radiation

Return on investment

If energy costs are **20%** of all production costs,

and If gross profit is at **15%** of all production costs,

and if **10%** Improvement of energy performance is achieved…

THE RESULT IS

2% Decrease in production costs

13.33% Increase in profit

(all other factors assumed to remain constant)

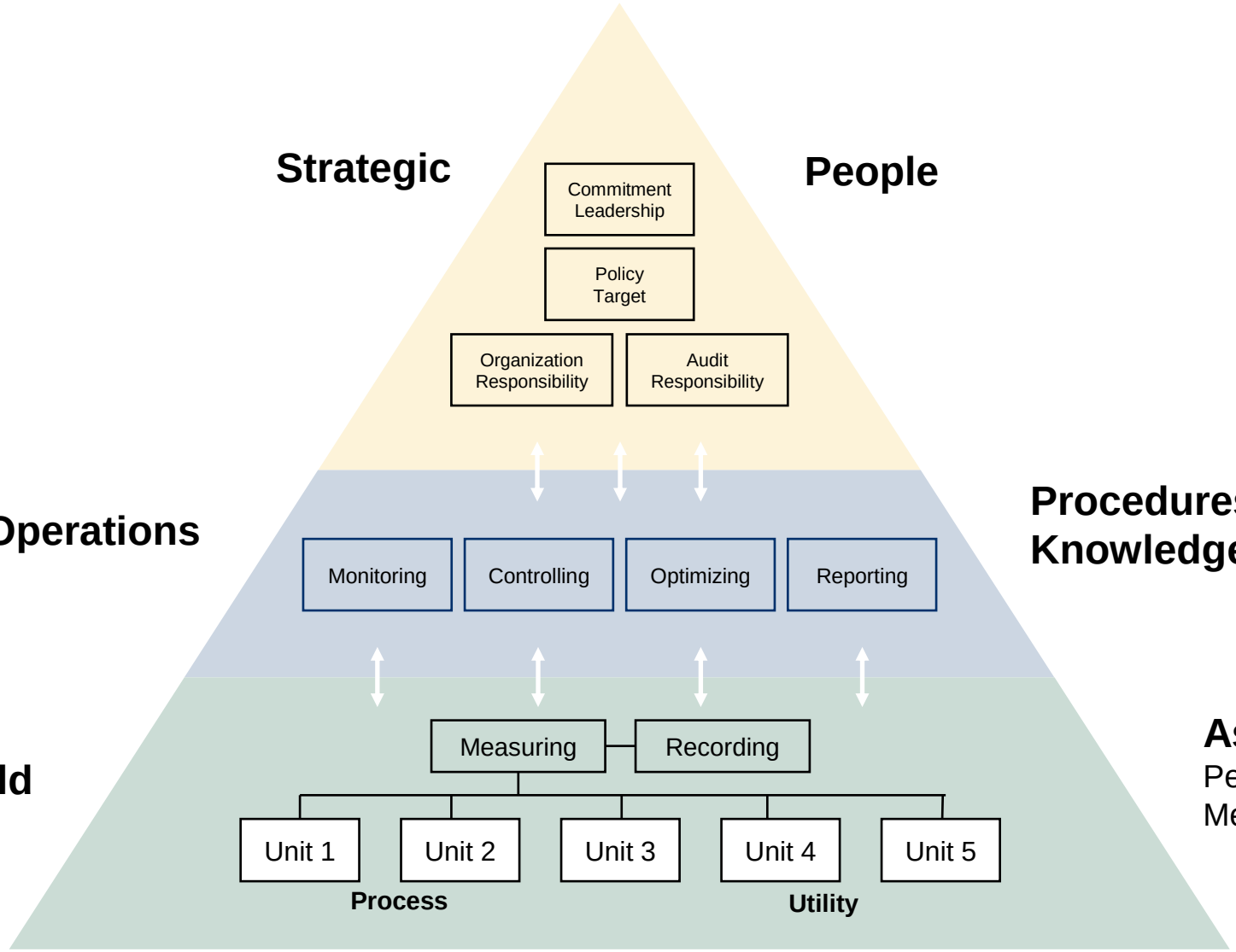
Energy and environmental management structure

Plant-wide Energy Monitoring System

Utilities Optimization

Unit-wide Energy Optimizer

Single solutions such as APC



Communication challenges

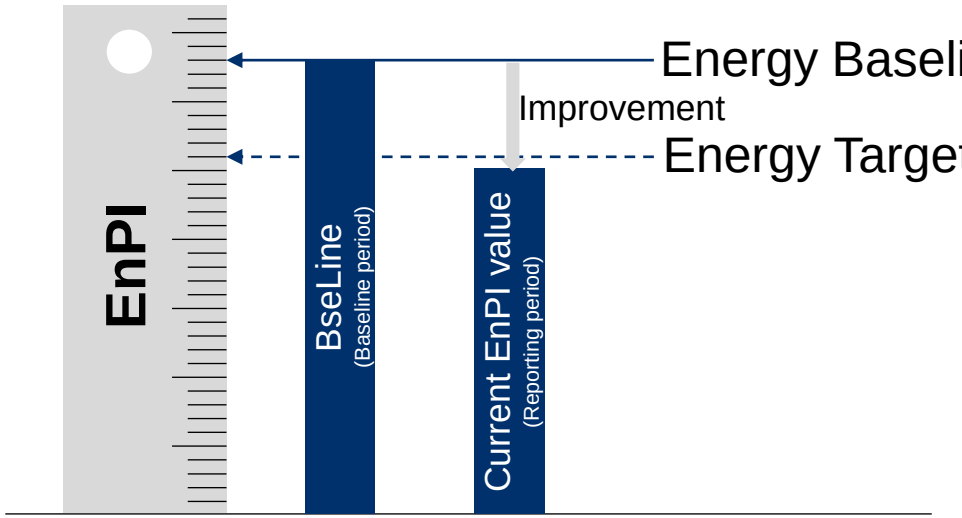
Key management items in accordance with ISO50001

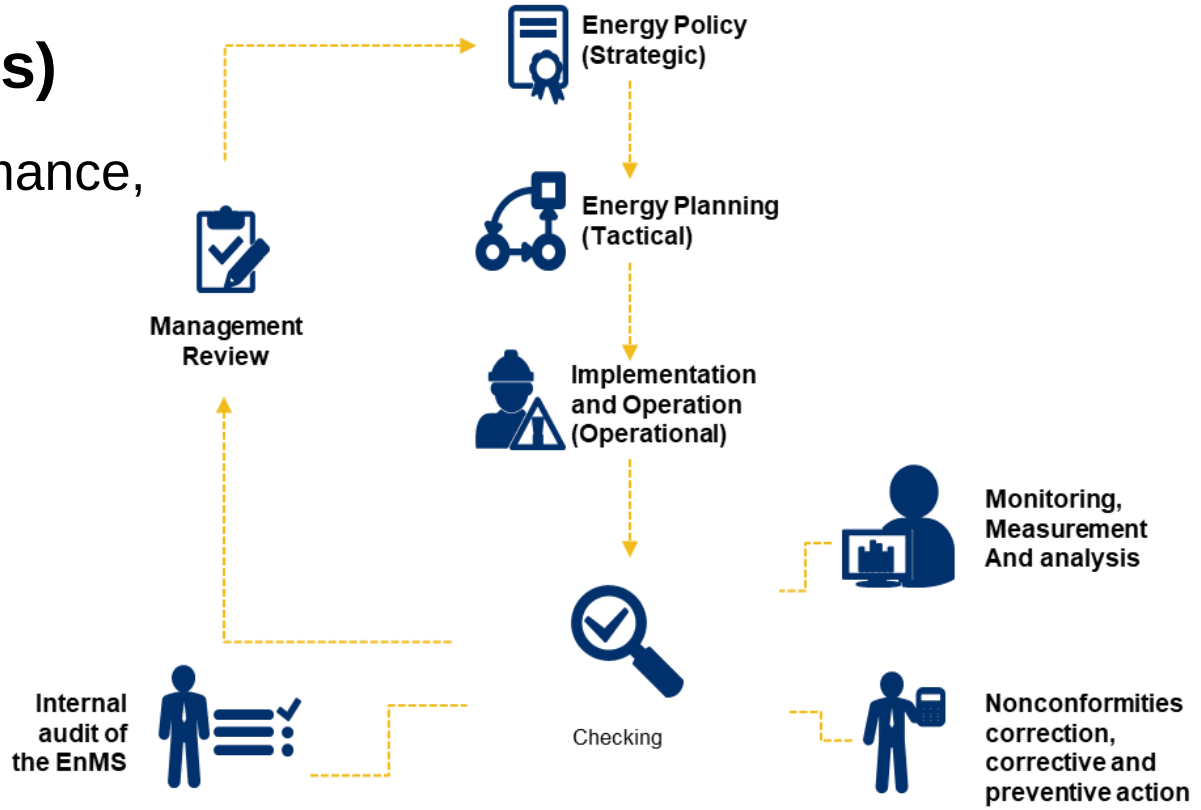
- **EnPIs (Energy Performance Indicators)**

  Quantitative value or measure of energy performance, as defined by the organization

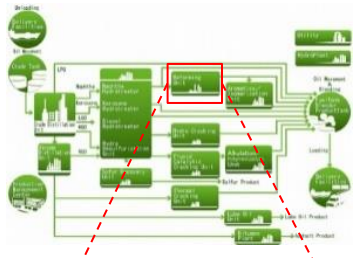
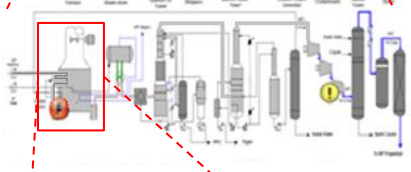
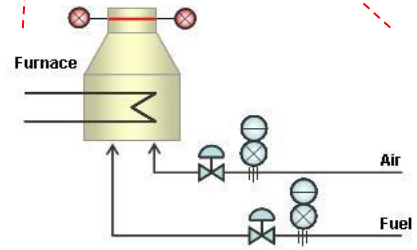
- **Energy Baseline**

  Quantitative reference(s) providing a basis for comparison of energy performance



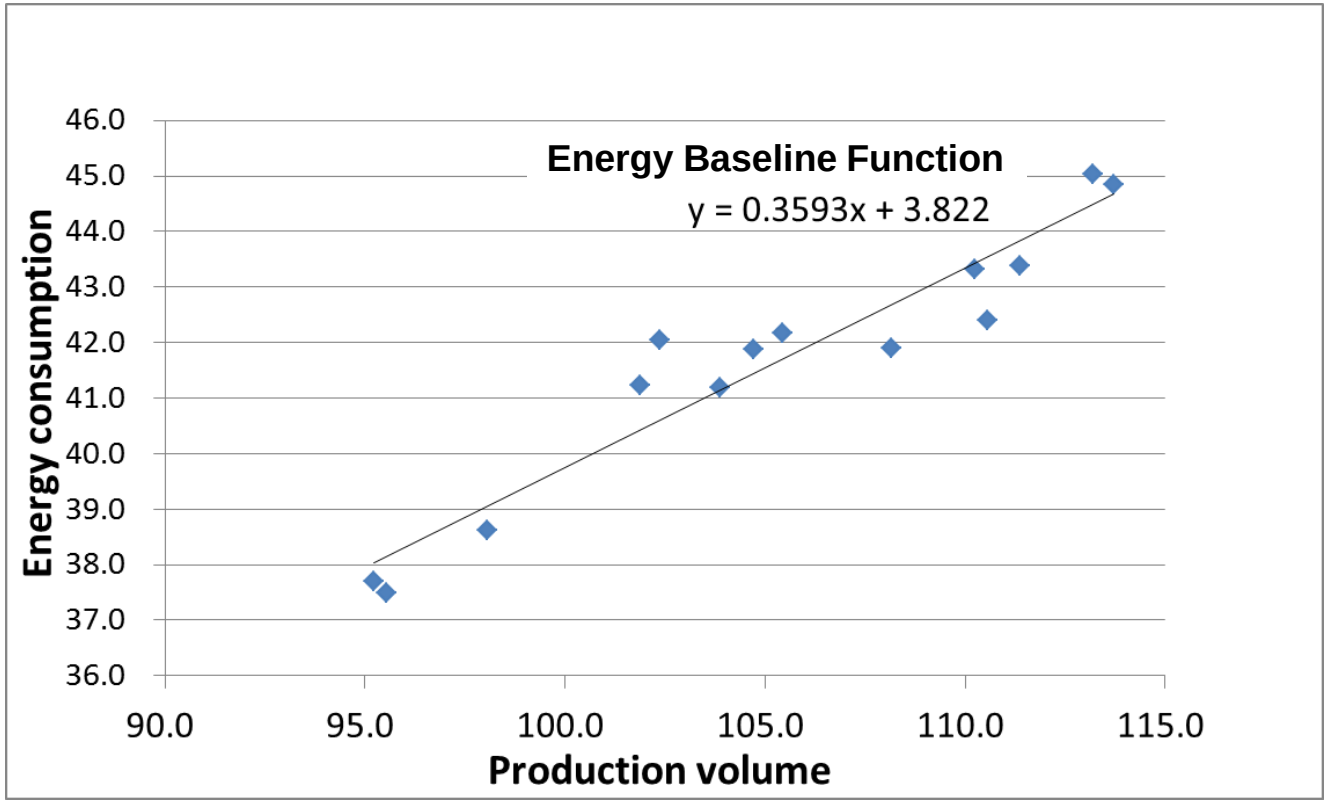


Sample of EnPIs

Layer	Boundary	EnPIs
Plant	Refinery 	・Oil refinery energy intensity = (energy consumption of entire oil refinery) / (topping plant conversion throughput of the entire oil refinery) ・The topping plant conversion throughput of the entire oil refinery = total {(CF value for every unit) *} (throughput for every unit)
Unit	Reforming 	・Energy intensity = (input energy consumption) / (the amount of feed) ・Energy utilization efficiency ・The rate of the heat recovery ・Capacity usage ratio
Device	Furnace 	・Energy efficiency = (feed heating value) / (combustion heat quantity) ・Heat conduction efficiency ・Coil path balance ・Air fuel ratio ・Exhaust gas O2 concentration

Energy Baseline

"Energy Baseline function is defined from historical track record of energy use and analysis with statistical method*"



* It can be done by an energy specialist

Digital Twin

Traditional Systems		Real-time Digital Twin
Particular operating case	→	Full range of asset operation, with auto-adaptation in real-time
History/snapshot	→	History, real-time and **future**
Ad-hoc basis to answer a question	→	Automated to consider business workflows
Owned and used by isolated groups	→	Centralized single version of the truth, used by everyone
Specific tools for different silos	→	Single integrated twin for energy, utilities and related systems

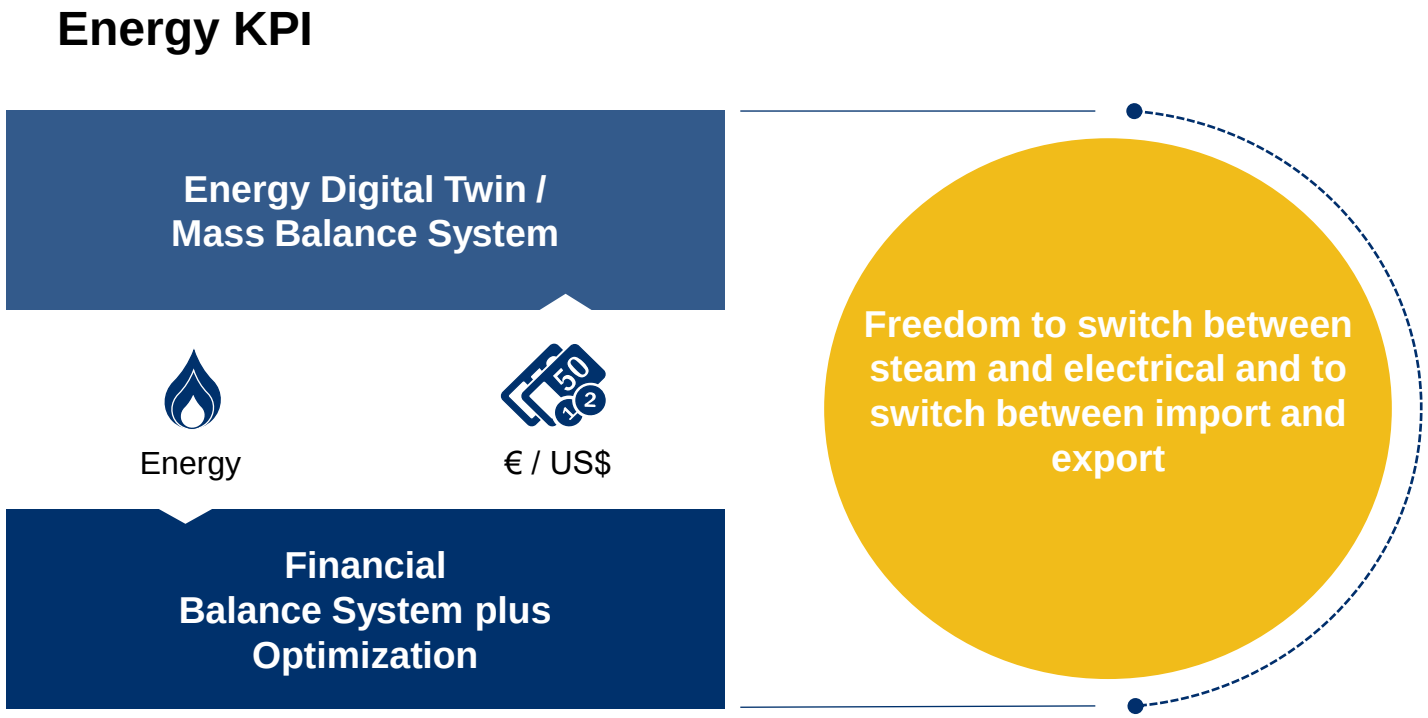
Energy Digital Twin

Energy Digital Twin

- Real time mass balance
- Real time energy consumption
- Real time energy efficiency
- Real time emissions
- Run if then else scenarios
- KPI reporting

Real-time Energy Optimizer

- Real time cost calculation
- Real time cost savings
- Real time operator instructions

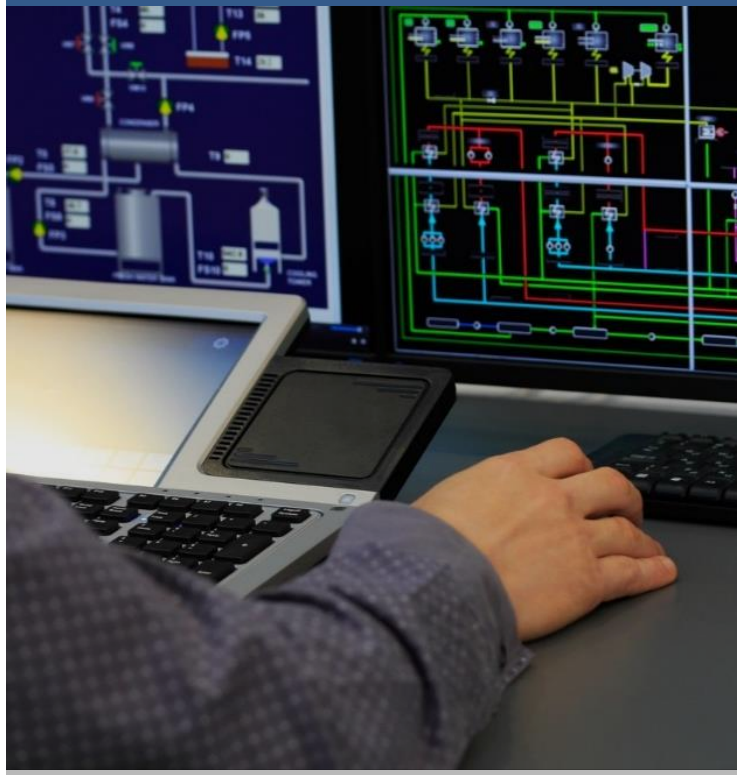


Energy Digital Twin Functions

PAST

MONITORING & REPORTING

PRESENT



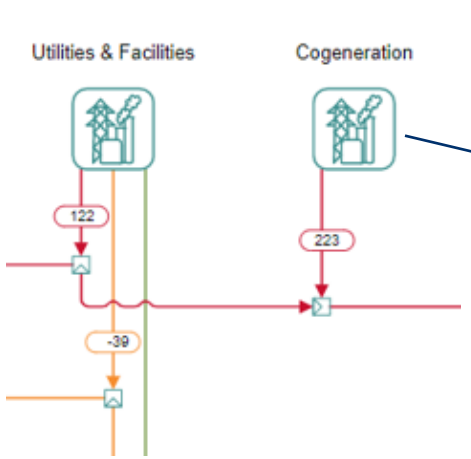
OPTIMIZATION

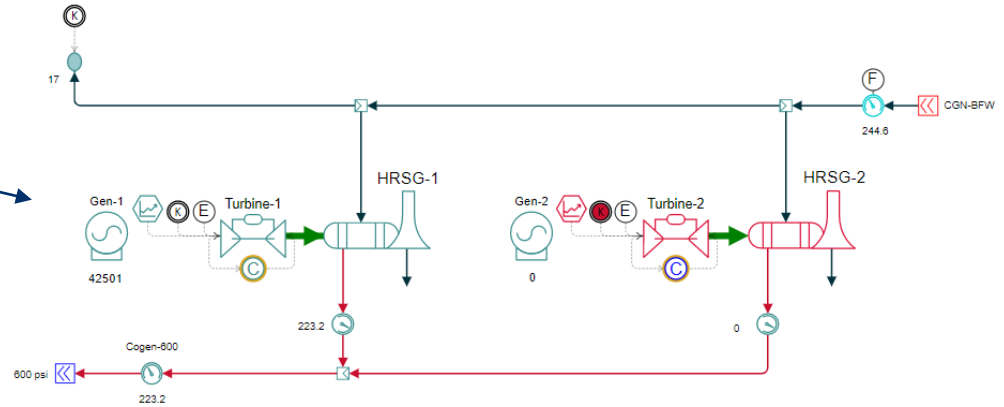
FUTURE

SCHEDULING & PLANNING

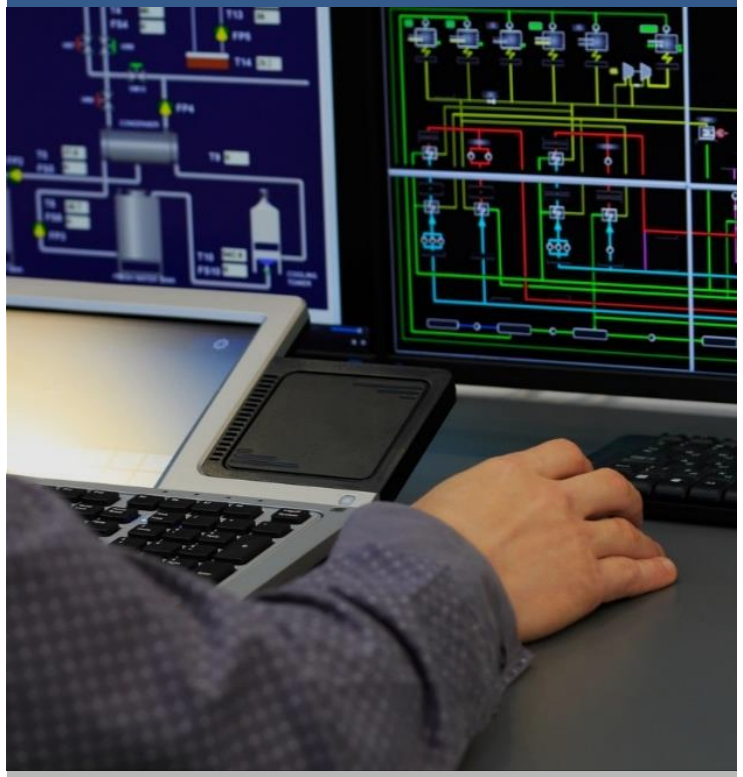
Monitoring and Reporting

- **Accounting** and auditing of utilities
- **Emissions** management and monitoring
- Equipment **performance** monitoring
- Energy system **evaluation**
- **Corporate/site-wide visibility** to energy system

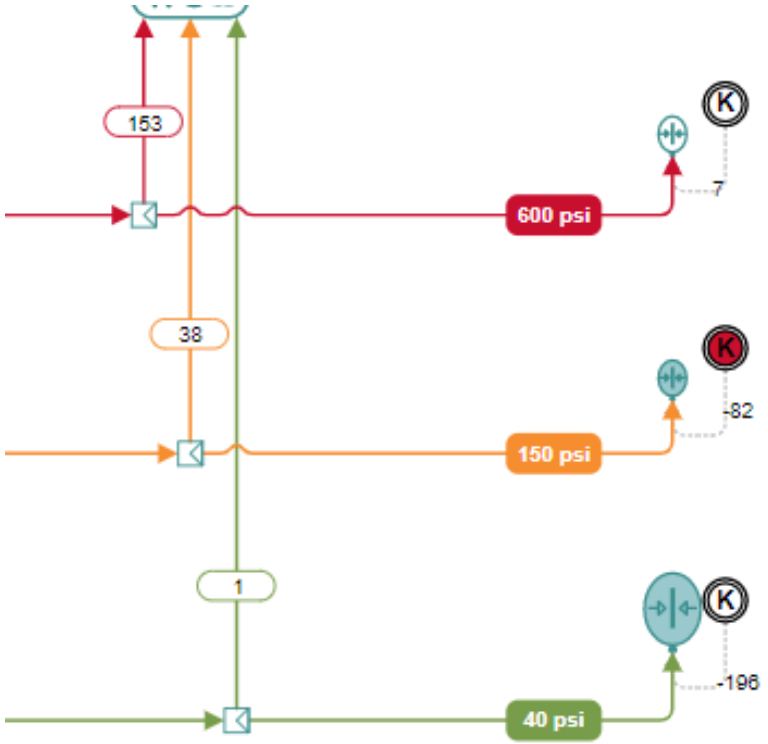




Optimization



- Real-time **emissions and KPIs**
- Real-time **imbalances**
- **Utilities Real Time Optimizer**



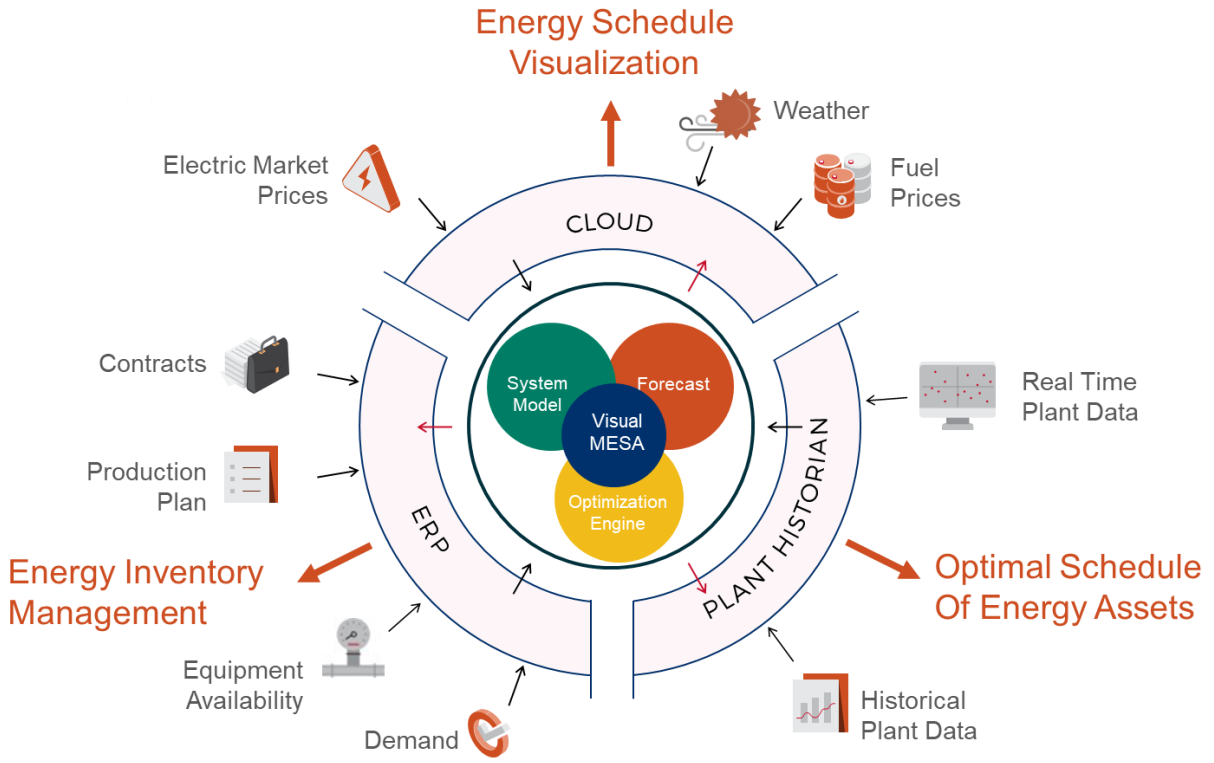
	Actual	Optimized	Delta	
Boiler Plant				
Boiler-1 FG (MSCF/HR)	100.1	31.2	-68.9	↓
Boiler-2 Steam (KLB/HR)	106.0	61.4	-44.7	↓
Boiler-3 FG (MSCF/HR)	72.6	69.6	-3.1	↓
GTs				
Turbine-1 Electric power (MW)	41.0	42.2	1.2	↑
HRSG-1 Steam (KLB/HR)	223.1	355.1	132.0	↑
Turbine-2 Power (MW)	0.0	0.0	0.0	=
HRSG-2 Steam (KLB/HR)	0.0	0.0	0.0	=
Re-Gasification Plant Compressors				
BOG C-101 Extraction (KLB/HR)	350.4	350.4	0.0	=
C-102 Extraction (KLB/HR)	85.1	108.5	23.4	↑

Turbines and Motors Swaps **Total T/M Swaps: 4**

Unit	Driver	Actual Status	Optimized Status
CRUDE	TP-5103	Stopped	Running
CRUDE	MP-5103A	Running	Stopped
CRUDE	TP-5155A	Running	Stopped
CRUDE	MP-5155	Stopped	Running
CT-PUMPS	TP-104	Stopped	Running
CT-PUMPS	MP-104	Running	Stopped
6-CT	6P-1	Stopped	Running
6-CT	6P-4	Running	Stopped

Scheduling and Planning

- Investment planning and **basic engineering**
- Support of decision making in complex environment



Energy real time optimizer (ERTO)

VISUAL MESA
ENERGY MANAGEMENT SYSTEM

CLOSED-LOOP
signals to
control systems

OPEN-LOOP
advisory reports to
operators

Emissions Regulations

MEASUREMENTS

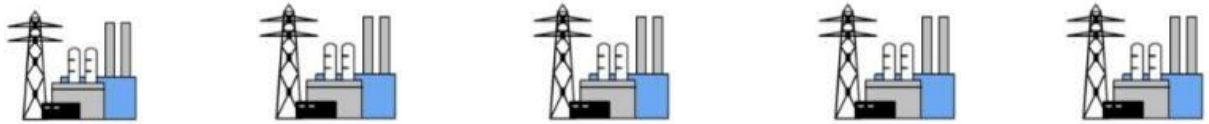
OPTIMUM SET POINTS

Optimum Operations Report

INDUSTRIAL SITE

Utilities Systems

Hydrogen | Fuel | Steam | Water | Electricity

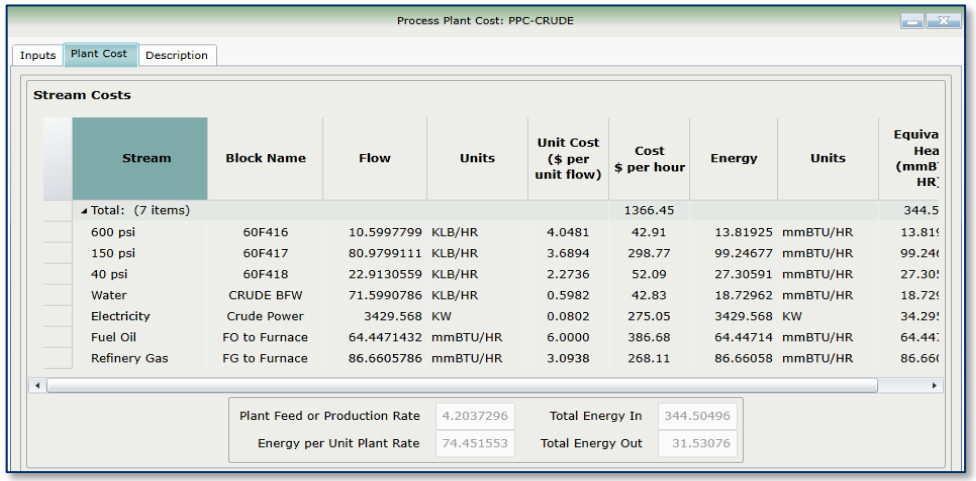


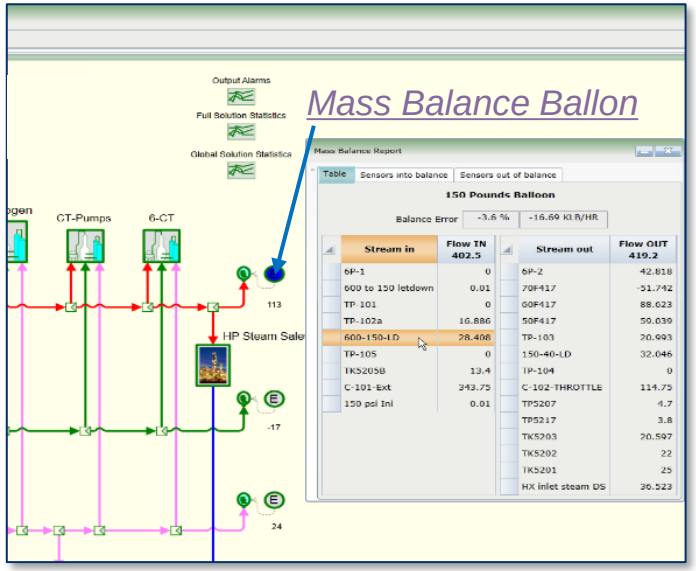
Process

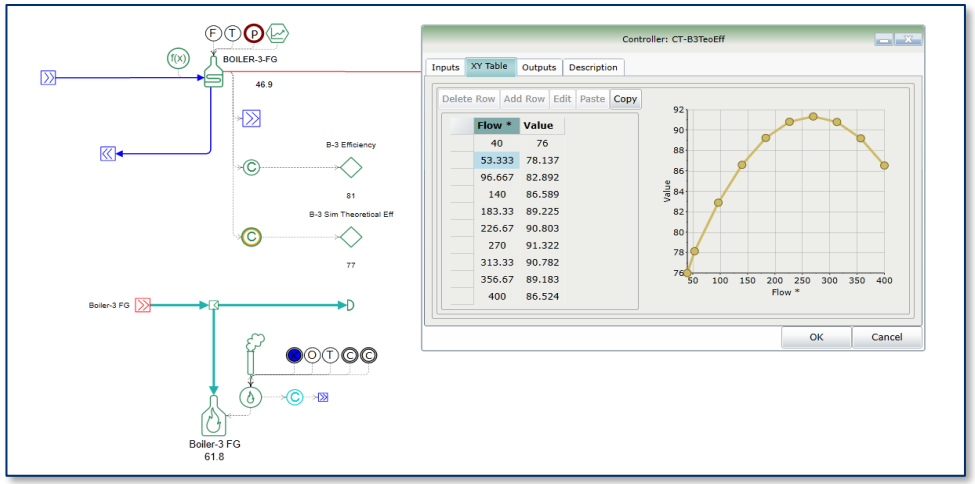
Energy and Emissions KPIs Monitoring
KPI reports
Management dashboard

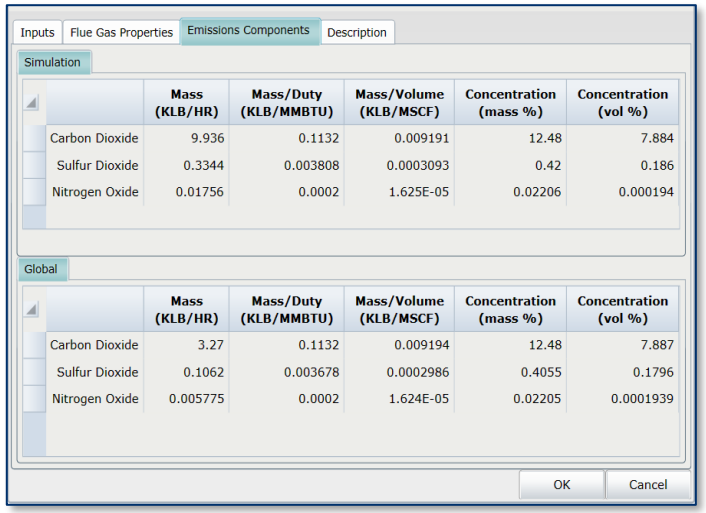
The digital twin model shows

- Imbalances
- Efficiencies
- Consumptions
- Emissions
- Sensor validation
- Cost calculation
- Alarms
- Reporting

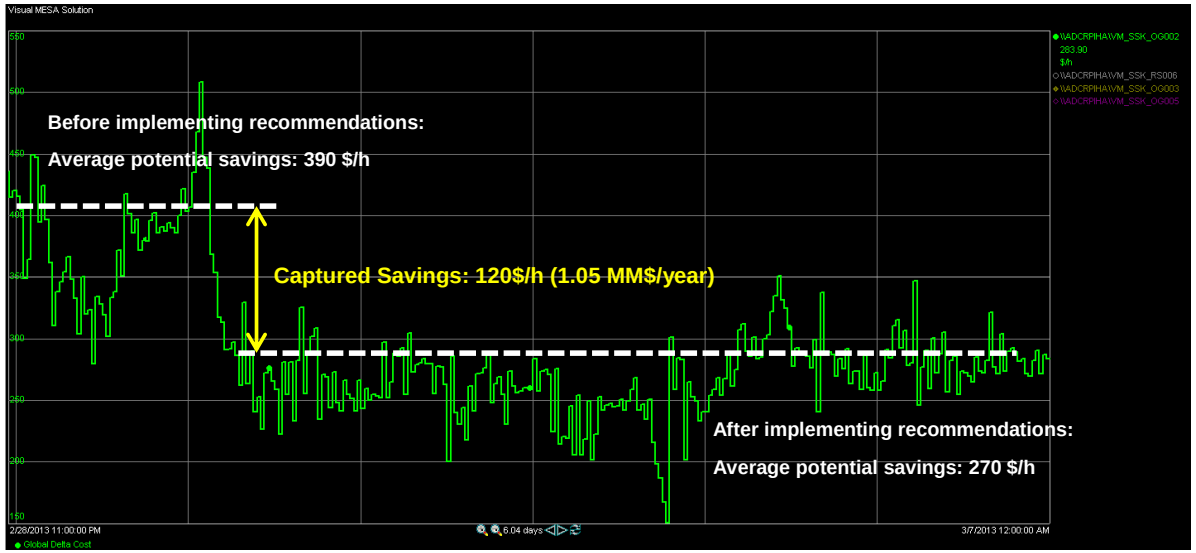








Proactively energy saving advice



Around 3:00 AM on March 2nd, Operators applied one of the optimization actions calculated by the RTEMS and 1.05 MM$/year of savings were immediately captured (i.e., the predicted savings trend drops)

Extraction-Condensing Turbines in the Olefins plant (t/h)

KT-13001 VHP Steam Inlet	171	362	191	
KT-13001 HP Steam Extraction	0	243	243	Manual Action
KT-13001 Outlet Condensate	121	69	-52	
KT-15010 VHP Steam Inlet	194	315	121	
KT-15010 MP Steam Extraction	46	260	214	Manual Action
KT-15010 Outlet Condensate	142	48	-94	
KT-15020 HP Steam Inlet	211	240	29	
KT-15020 LP Steam Extraction	46	106	60	Manual Action
KT-15020 Outlet Condensate	141	111	-30	

Turbines and Motors Swaps Total T/M Swaps: 2

Area	Unit	Driver	Name	Power (HP)	Steam Levels	Action to be taken
U&O	711	Turbine	BO-71102D-BLT01	885	HP to MP	Turn Turbine OFF
U&O	711	Motor	BO-71102D-BLM01	885		Turn Motor ON
U&O	722	Turbine	PT-72201B	3500	HP to LP	Turn Turbine ON
U&O	722	Motor	PM-72201E	3500		Turn Motor OFF

Visual MESA Recommendations Report is available to everyone through the Web Browser

At that time, before SK operators took any action, Visual MESA was suggesting two turbine and motors swaps and increasing the extraction in all three extraction-condensing turbines at Olefins plant

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Bedankt voor uw aandacht!

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