Energy Solutions - Meeting the Energy Efficiency Challenge

Sebastian Ferecuş

General Manager South East Europe

EMERSON
Process Management

About Emerson

Emerson at a Glance 2015

US $22.3 Billion in Sales

Headquarters in St. Louis, Missouri USA

Diversified global manufacturer and technology provider

Approximately 110,000 employees worldwide

Manufacturing and/or sales presence in more than **150 countries**

205 manufacturing **locations** around the world

No. 120 on 2015 FORTUNE 500 list of America's largest corporations

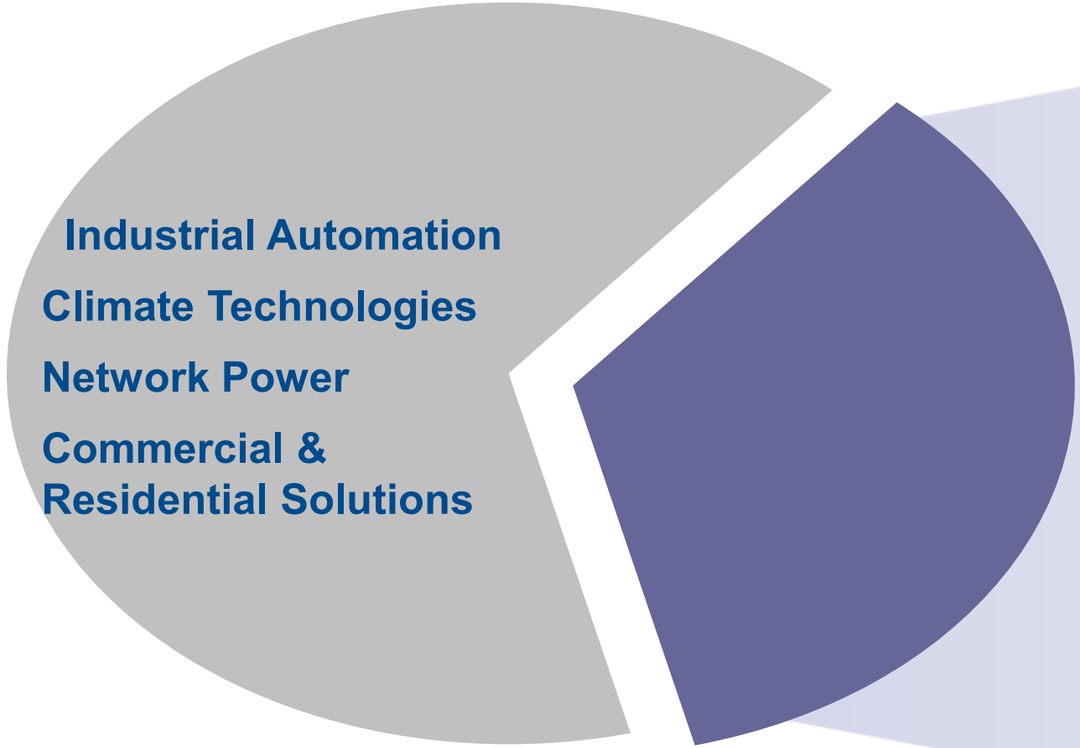
Founded in **1890**

NYSE: **EMR**

EMERSON

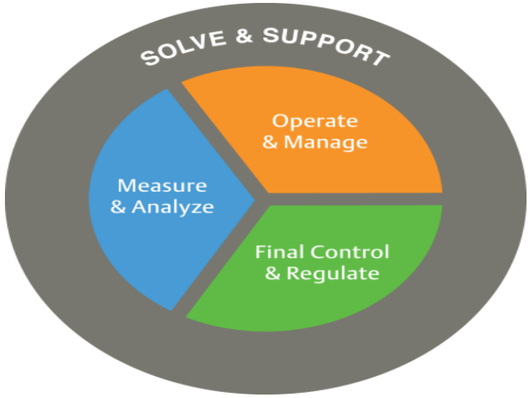
Emerson Process Management

The largest Emerson business segment…
*representing **36%** of the total Emerson business.*



EMERSON™
Process Management

Emerson Process Management Core Offerings



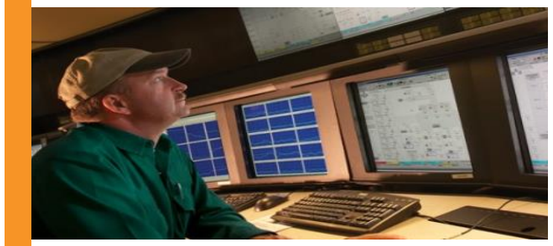
Taking on the industry's toughest challenges, and bringing predictable success any time, any place.

Measure & Analyze

The broadest range of measurement and analytical technologies for process clarity and insight.

Rosemount
Micro Motion
Daniel
Roxar

Operate & Manage



The systems and tools that provide the decision integrity to run your operation at its full potential.

DeltaV
Ovation
AMS Suite

Final Control & Regulate

Highly reliable final control technologies to help you regulate and isolate your process with certainty.

Fisher
Bettis

Solve & Support

Expertise and global resources to help you dependably define, execute and support a strategy throughout the lifecycle of your operation.

Industries We Serve

Chemical

Oil & Gas

Power

Refining

Life Sciences

Marine

Metals & Mining

Industrial Energy

Food & Beverage

Pulp & Paper

Alternative Energy

Water & Wastewater

European Legislation Driving Energy Efficiency

EU CO2 Reduction Targets

20% by 2020

40% by 2030

80-95% by 2050

European Climate Change Policy (ECCP)

Emissions 20%

Efficiency 20%

Renewable 20%

ETS
Phase III (2013-20) Emissions Trading Scheme

EED
Energy Efficiency Directive

Cap & Trade System

1.74%/yr Cap reduction over average total quantity of allowances issued annually in 2008-2012

Legally binding energy efficiency measures. Covers energy transformation, distribution & consumption.

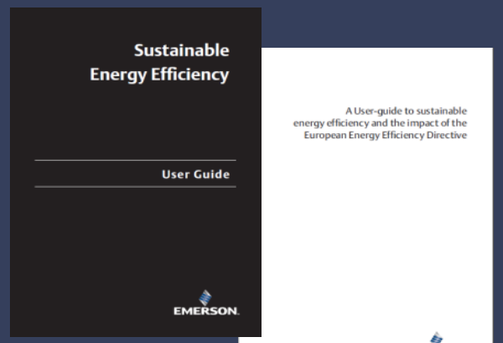
Req energy audit every 4 yrs

Implementation of y-o-y energy saving projects

Source: JRC, Axens, Europia, Envir Agency

EU Directive Encourage Implementation of Energy Management System (EMS)

Implement an Energy Management System



Energy Management System

Energy Management Processes and Procedures

Energy Policy Determine Plan & Goals

Energy Management System Team headed by Energy Manager

Energy Improvement Opportunities Programs & Projects

Energy Monitoring and Reporting Energy Management Information System

www.emersonprocess.com/EEDUserGuide

What is Energy Management?

Energy Management

Energy Monitoring, & Reporting

Energy Improvement Opportunities.

Energy Saving projects.

Visibility

Control

Delivering Sustainable Energy Efficiency

What is Energy Management: Reporting

Energy Management

Energy Monitoring, & Reporting

- Energy Management Information System
- Energy Savings Reporting
- Energy Flow Measurements
- Energy Accounting and Billing (Cost Allocation)
- Energy Loss Measurement and Detection

Energy Improvement Opportunities.

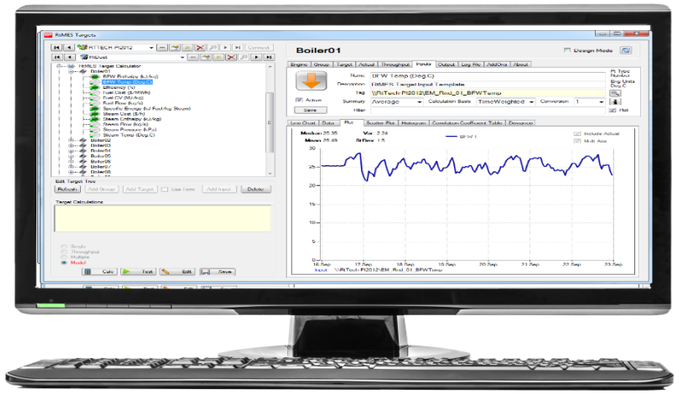
Energy Saving projects.

Get the Full Energy Picture - Real Time Energy Advisor

Detect abnormal changes in energy performance to trigger corrective action **real time**

Identify opportunities to **understand periods of best performance** and make actions repeatable

Move from reactive to **proactive** energy management



1. Choose the level
2. Report type
3. Time-frame
4. Generate

Understand **WHY** energy consumption is not as expected using **Dynamic Energy Targets:** 1st Principle Models, Regression Analysis

Generate Powerful Analytic Reports Identify and monitor Energy Saving Projects

Role based KPI's to drive decision making & culture

Energy Measurement Best Practices
Energy Flow Measurements and Losses

Energy Fluids Measurment

Ideal
Suitable
Not Advisable
Not Suitable
= Lowest installed cost

Energy Measurements	Orifice DP Flow Meters	Annubar DP Flow meters	Vortex	Magnetic	Coriolis
Superheated Steam	Not Advisable	Ideal	Suitable	Not Suitable	Not Suitable
Saturated Steam	Suitable	Ideal	Ideal	Not Suitable	Not Suitable
Compressed Air	Ideal	Ideal	Suitable	Not Suitable	Not Advisable
Condensate Return	Ideal	Suitable	Suitable	Not Advisable	Not Advisable
Process Water	Suitable	Suitable	Suitable	Ideal	Not Advisable
Fuel Gas	Suitable	Suitable	Suitable	Not Suitable	Ideal
Fuel Oil	Suitable	Suitable	Suitable	Not Suitable	Ideal

- Best practice measurement technology for Energy Stream
- Minimize Permanent pressure loss and installation cost
- WirelessHart enabled Energy flow measurement acquisition

Electrical Energy Measurment

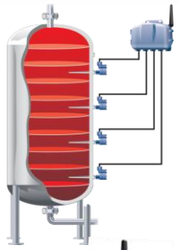
Emerson Climate Technologies

- Energy consumption monitoring kWh, kVAh
- Monitor Unit Health
- Full range of CT sensors

Energy Content Measurement

- Primary Fuel Energy Content Analysis
- Fiscal Accounting
- Improved Quality Finished Product

Energy Loss Measurement

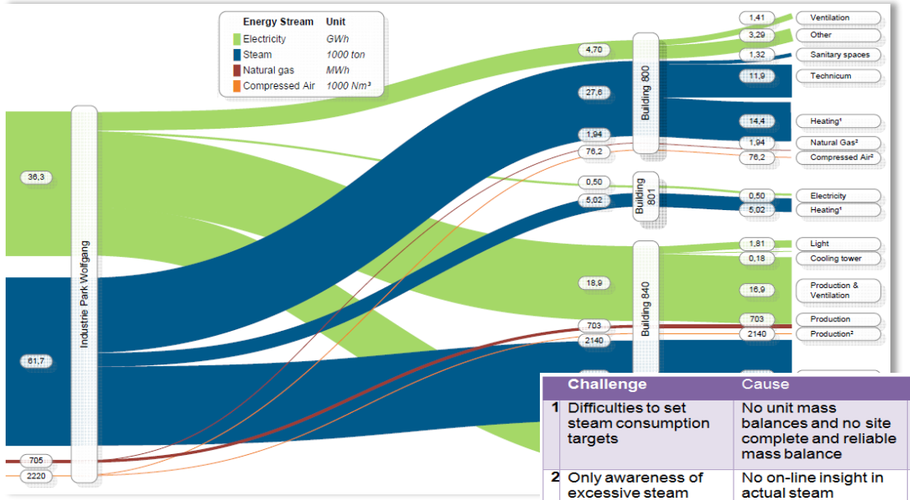


- Stack Heat Loss Measurement
- Final Product Heat Measurement
- Air and Water coolers Losses

Energy Measurement Surveys
Mass & Energy Balances

Mass & Energy Balances

Balance Model
Offline/Online monitoring tool
Identify actual energy consumption vs design
Causes for discrepancy
Actions (cures) leading to energy savings

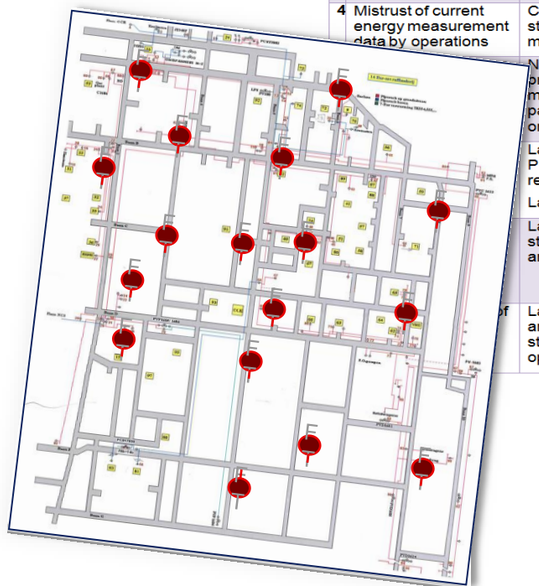


Missing Measurements

Energy Measurements in place providing cost effective energy management insight

Project Management
Documentation Review
Operating Data Review
Current Instrumentation Review
Additional Instrumentation Recommendation
Additional Instrumentation Costing
Survey Report

	Challenge	Cause	Cure
1	Difficulties to set steam consumption targets	No unit mass balances and no site complete and reliable mass balance	Close mass balances for each unit and for the site by audit and identifying mass balance model per unit and for the complete site
2	Only awareness of excessive steam consumption after historical data analysis (too late)	No on-line insight in actual steam consumption and target steam consumption	On-line energy monitoring systems defining actual consumption
3	Inability to define cause of abnormal steam consumptions	No target consumption set and no on-line steam consumption follow up by operations	Mass Balance which is setting normal/target consumption for each unit and on-line energy monitoring systems defining actual consumption will trigger root cause analysis
4	Mistrust of current energy measurement data by operations	Current unreliable state of measurements	Inspect and recalibrate critical measurements
		No focus on steam process measurements in past, difficult to get an on-line view	Put in place missing measurements using new technology reducing installation/implementation cost
		Lack of all necessary PI data to draw report; Lack of report	Get all measurements in PI and draw up reports
		Lack of target, actual steam consumption and analysis	Closed mass balance; measurements in place; follow up through on line monitoring; analysis and study to realise potential
		Lack of quantification and definition of the steam saving opportunities	Energy savings plan for steam with definition of each withheld steam saving project



Methodology to determine effective energy measurement for Real time monitoring is essential

What is Energy Management: Energy Savings

Energy Management

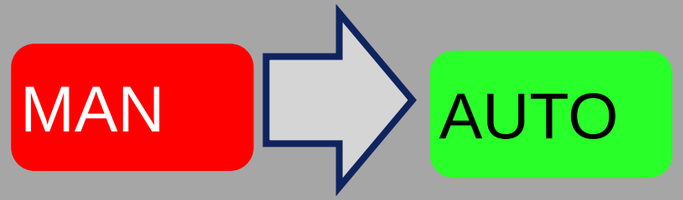
Energy Monitoring & Reporting

Energy Improvement Opportunities.
Energy Saving projects.

- Best Available Technologies
- Implement Best Practices
- Energy Saving opportunities
  e.g. Process Optimisation
- Performance Monitoring
  e.g. EAM, GPA, APM
- Standard Operating Procedure
  Amendment

How Do Energy Saving Projects Deliver Results?

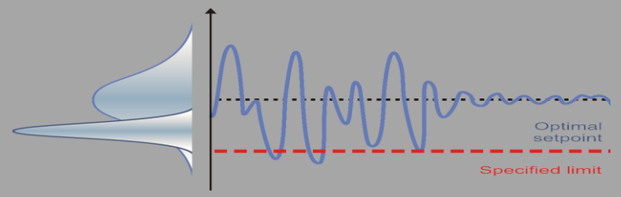
Automate Operation



Improved Regulatory Control

Best Practice

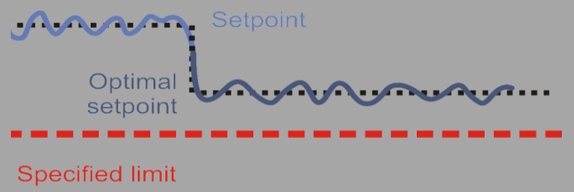
Reduce Variability



Control Audits, Loop Tuning

Best Practice

Operate at Economical Best Point



Model Predictive Control

Best Available Technology

Value & Benefits

- Process Stabilization
- Less Energy Consumed
- Economical Operation
- Increased Throughput
- Improved Product Quality

Energy Performance Improvement - Powerhouse

- Power House Energy (Producer)
  - Combustion Control
  - Multi-fuel, Combustion
  - Economic Dispatch Steam & Electricity
  - Optimisation, Boiler, Header, Soot Blowing
  - Governor Control & Optimisation
  - BMS
  - CEMS
  - Water Treatment
  - Boiler Efficiency
  - Steam Leaks

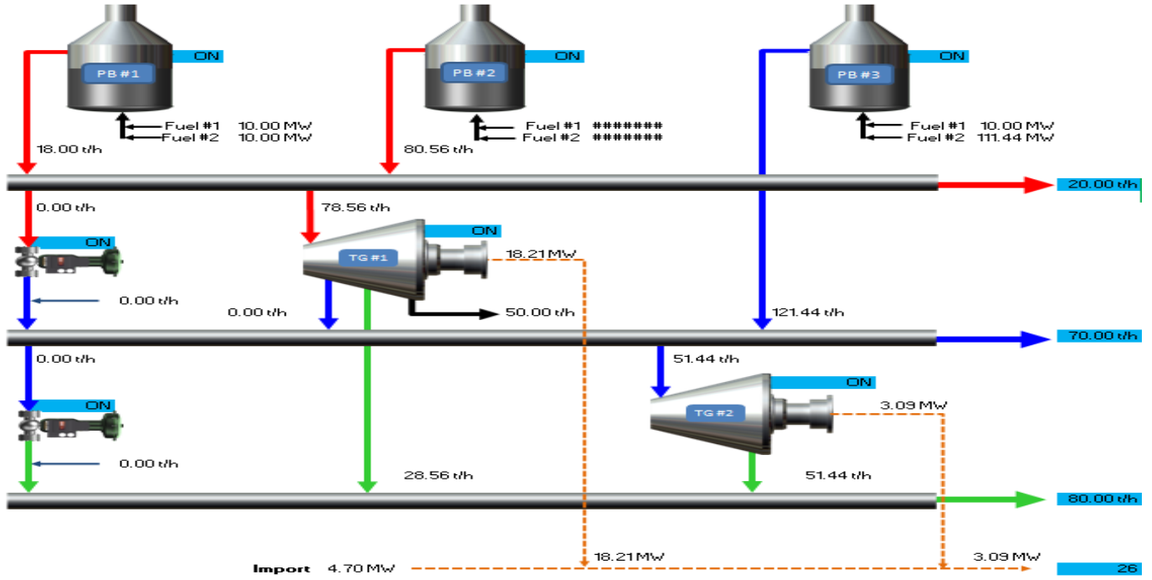
Overall Utility Optimised Power & Energy Management

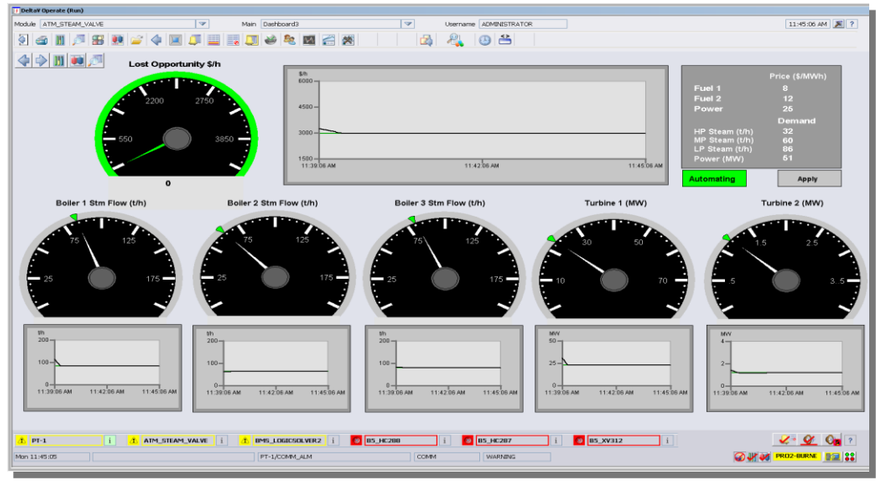
Boiler Optimal Performance

Increase Use of Cost Effective Alternative Fuels

Automatic Header Control, Responsive steam delivery, >MW

Reliable Burner Management Eliminate False Trips





OVATION

SmartProcess®

DELTAV

Our Customers Have Improved Powerhouse Response, Stability and Performance

Improved Boiler Efficiency

EUR Packaging Plant

- HRSG boiler part of Cogen (2 x GT's) supplies steam to manufacturing plant
- Standalone operation NG only, performance variability and poor efficiency.

- Emerson established full automatic control, improved steam stability, and **increased boiler efficiency by 2.7%**

Annual CO2 Reduction circa 5,763 t

Cascade trips eliminated

NA Pulp Mill

- (2) multi-fuel wood boilers and coal boiler
- Unit interaction made powerhouse unstable and difficult to run
- Coal used to manage demand swings

- Emerson greatly improved boiler turndown and overall stability while **reducing coal use by 5 tons/day**

Annual CO2 Reduction circa 5220 t

Boiler stability improved Natural Gas eliminated

EUR Steel Mill

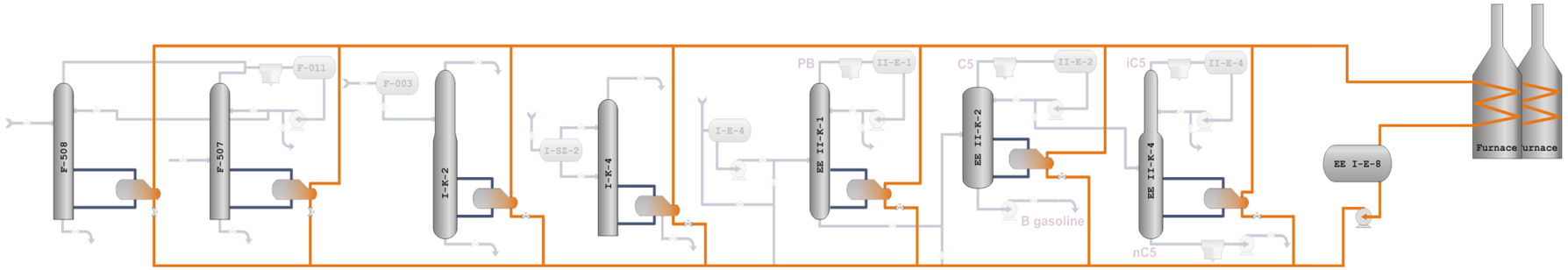
- (7) multi-fuel boilers, (8) steam turbines, (5) steam headers
- Gas, COG, and BFG
- Constant reliability issues and frequent unplanned shutdowns

- Emerson established full automatic control, trips virtually eliminated, and **negated use of Natural Gas** (pilots only) to balance the boilers

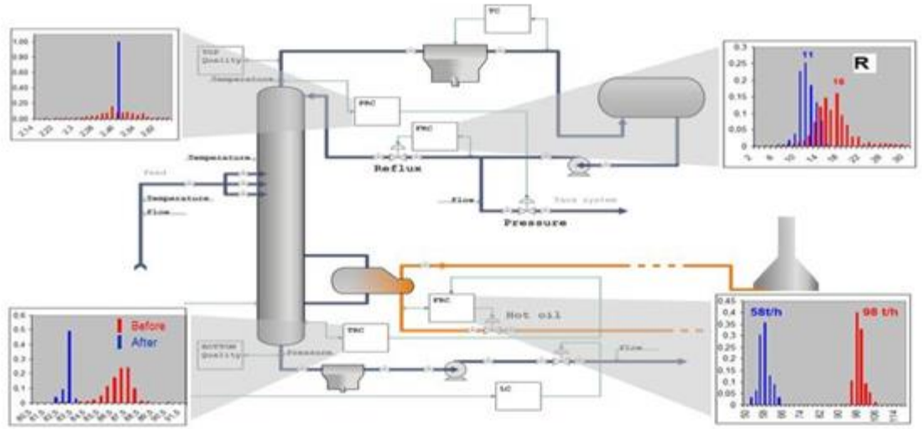
Annual CO2 Reduction circa 250K t

Energy Performance Improvement - Process

- Process Energy (Consumer)
  - Optimisation Distillation etc
  - Model Predictive Control
  - Regulatory Control and Energy Audit
  - Adaptive tuning
  - Control Strategy Design
  - Inferential Measurement
  - Load management
  - Load Balancing
  - Steam Leaks



- **Improved Product Quality**
- **Steady state control Improved Reliability**
- **Reduced Process Fluctuations**
- **Optimised Energy Efficiency**
- **Increased Product Throughput**



SmartProcess®

Our Customers Have Lowered Energy Costs, Increased Throughput and Product Quality

Lower Energy and Process Variability

MOL Gas Processing Hungary

- 2 processing trains, each consisting 3 distillation columns & fired heaters
- Significant manual control
- Issues with product quality due to control variability.

- Emerson Advanced Loop Services optimized reflux ratios, reduced process variability by 84%, increased product quality & reduced energy consumption by 47%

Annual CO2 Reduction circa 11,200 t

Reduced Fuel Consumed Aromatics

GALP Refinery Portugal

- Need to improve variable cost performance of Aromatics
- Reduce process variability (improve product quality) through improved control stability

- Through Emerson DeltaV Advanced Process Control variability considerably reduced saving 20% energy on Aromatics plant €2.1M/year

Annual CO2 Reduction circa 23,600 t

Crude Unit profitability Improvement

Rompetrol Refinery Romania

- Crude Unit Fractionator and Fired Heater performance dependant on operator intervention
- Need to improve product recovery
- Need to reduce fule gas consumption

- Emerson optimization using MPC, lowered utilities energy consumption and increased profitability by $1.8M/year

Annual CO2 Reduction circa 170 t

Pressure Relief Valve & Steam Trap Monitoring

- Real-time visibility into the health of critical steam traps
- Fast and easy to install & maintain
  - No training required; no calibration
  - Non-intrusive steel band mounting
  - No downtime or risk to the process
  - Set & forget 10+ year battery

Energy Loss		Pressure (Bar)					
Connection Size	Orifice Diameter (mm)	3	7	10	20	35	50
DN15 (1/2”)	3	€1,767	€3,134	€4,500	€8,598	€14,062	€20,893
DN20 (3/4”)	5	€4,910	€8,705	€12,499	€23,883	€39,062	€58,034
DN25 (1”)	7.5	€11,048	€19,585	€28,123	€53,737	€87,888	€130,577
DN32 (1¼”)	9	€15,037	€26,657	€38,279	€73,142	€119,625	€177,730
DN40 (1½”)	10	€19,639	€34,818	€49,997	€95,531	€156,245	€232,138
DN50 (2”)	12.5	€30,687	€54,403	€78,120	€149,268	€244,133	€362,715

Fluor Global Services

CHALLENGE

Continually reduce environmental impact by reducing energy usage, but unable to determine how much energy they were wasting.

SOLUTION

Monitoring of 187 steam traps and 63 pressure relief valves to ensure proper operation, avoiding equipment damage and wasted energy via lost steam.

RESULTS

The first audit showed **25% of steam traps were failing, that were unknown.**

Payback in one year in energy savings by correcting issue.

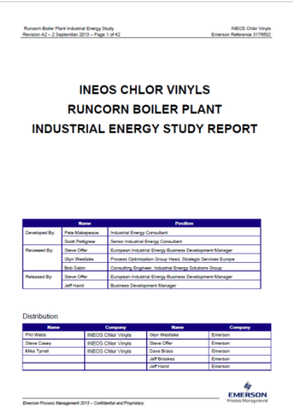
Building the Business Case

Column		T-301	T-302	T-303	T-450	T-350	T-351	
Duty		DeC2	DeC3	DeC4	C4 Split	DeC5	C5 Split	Total
Current Reboiler Duty	kW	300	1,190	465	2,600	780	1,820	7,155
	k$/yr	162	642	251	1,403	421	1,424	4,302
Energy Saving from Quality	%	0%	10%	0%	10%	100%	10%	
	kW	-	119	-	260	780	182	1,341
	k$/yr	-	64	-	140	421	98	723
Energy Saving From Pressure	%	0%	20%	10%	25%	0%	20%	
	kW	-	238	47	650	-	364	1,299
	k$/yr	-	128	25	351	-	196	701
Top Yield Saving	k$/yr	137	-	-	-	-	228	365
Base Yield Saving	k$/yr	-	-	-	-	94	49	143
Total	k$/yr	137	193	25	491	515	572	1,932
Total Energy Saving		37%		2,640	kW		1,424	k$/yr
Total Yield Saving							508	k$/yr
Total Benefit							1,932	k$/yr

Collaborative Approach

Process:

- Identify areas of high energy usage
- Perform an evaluation (data gathering)
- Develop a detailed business case
  - Recommendations
  - Cost savings
  - Investment required
  - ROI and IRR
  - Additional benefits (availability, product quality improvements)
- Implementation
- Measure effectiveness



Runcorn Boiler Plant Industrial Energy Study — INEOS Chlor Vinyls
Revision A2 – 2 September 2013 – Page 1 of 42 — Emerson Reference 317892

INEOS CHLOR VINYLS
RUNCORN BOILER PLANT
INDUSTRIAL ENERGY STUDY REPORT

	Name	Position
Developed By:	Pete Makepeace	Industrial Energy Consultant
	Scott Pettyjone	Senior Industrial Energy Consultant
Reviewed By:	Steve Offer	European Industrial Energy Business Development Manager
	Glyn Westlake	Process Optimization Group Head: Strategic Services Europe
	Bob Salim	Consulting Engineer, Industrial Energy Solutions Group
Released By:	Steve Offer	European Industrial Energy Business Development Manager
	Jeff Hand	Business Development Manager

Distribution

Name	Company	Name	Company
Phil Webb	INEOS Chlor Vinyls	Glyn Westlake	Emerson
Steve Casey	INEOS Chlor Vinyls	Steve Offer	Emerson
Mike Tyrrell	INEOS Chlor Vinyls	Dave Brass	Emerson
		Jeff Brookes	Emerson
		Jeff Hand	Emerson

Emerson Process Management 2013 – Confidential and Proprietary — EMERSON Process Management

Emerson Energy Management Solutions

Delivering Energy Efficiency

Energy specialists. Perceptive technology. Proven advantage.

LEGISLATION COMPLIANCE

- Making the Emissions Trading Scheme work for you, Additional Revenue Stream
- Compliance with the Energy Efficiency Directive
- ISO 50001 implementation consultancy
- Energy Efficiency Roadmaps to Achieve Corporate Energy Objectives

FULL ENERGY PICTURE

- Energy Management Monitoring and Reporting accessible by all = energy culture
- Pervasive sensing, cost effective implementation of additional missing energy measurements and Leak Detection
  - Instrument Surveys
  - Instrument Application Best practice

ENERGY SAVING SOLUTIONS

- Boiler Combustion, Powerhouse Optimization and Coordinated Dispatch
- Process Energy Improvements, improved Reliability, increased Production Throughput, utilizing Advanced Loop Tuning services and Model Predictive Control

ENERGY CONSULTACY SERVICE

- Energy saving Evaluations and Studies, investment justifications and ROI
- Mass and Energy Balances
- Utilization of Best practices and Best available technologies

Emerson Energy Consultancy, Services and Solutions Deliver

Significant Sustainable Energy Efficiency savings,

compliance to energy legislation and an increased bottom line

Questions?

Thank you!

CONTACT:

Sebastian.ferecus@emerson.com

ro.linkedin.com/in/sebastianferecus