Real Time Energy Management and Optimization Systems

CIBO Focus Group: Improving Energy Efficiency
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Overview

- History, References, Publications
- What is a Real Time Energy Management and Optimization System (RTEMOS)?
- Energy Watchdog: Case Studies
- Where would RTEMOS bring value in Ken's tiered EM Model?
- A Real Life, Real Time Demo: Rohm & Haas
- RTEMOS for District Energy?
- Conclusions

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Soteica LLC Technologies

- **Energy Management and Optimization Systems**
- Advanced Control Projects
  - Over a dozen DMC implementations
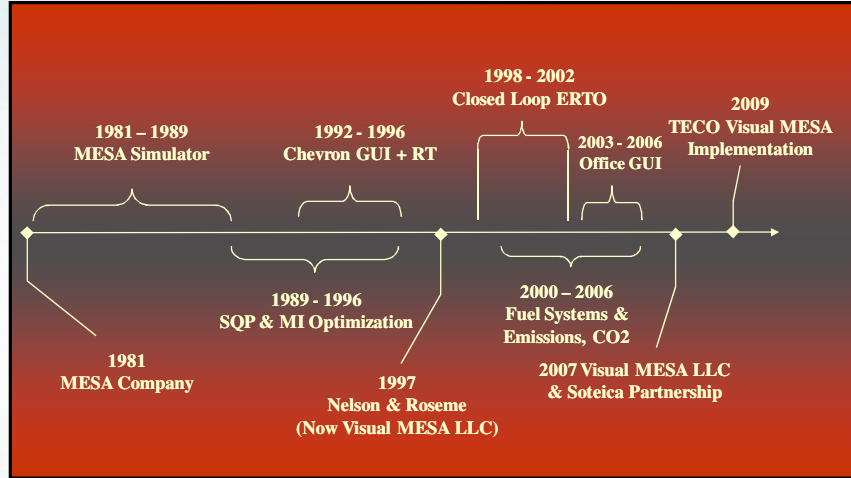- Other Industrial Software Solutions (Production Accounting, Scheduling and Operations Management)

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Soteica Milestones

- **Founded in 1985.** Specialized in process modeling and industrial IT implementations
- **Early 2000's:** Soteica deploys Visual MESA projects as implementation partner. Implements more than 20 sites (refineries and petrochems)
- **2006:** Purchased 50% equity in 3rd product, Visual MESA (for Energy Management and Optimization)
- **2008:** Rohm & Haas KPI project
- **2009:** Visual MESA implementation at Thermal Energy Corporation (TECO) in the Texas Medical Center (in progress)

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Development Timeline

1981 – 1989
MESA Simulator

1992 - 1996
Chevron GUI + RT

1998 - 2002
Closed Loop ERTO

2003 - 2006
Office GUI

2009
TECO Visual MESA
Implementation

1981
MESA Company

1989 - 1996
SQP & MI Optimization

1997
Nelson & Roseme
(Now Visual MESA LLC)

2000 – 2006
Fuel Systems &
Emissions, CO2

2007 Visual MESA LLC
& Soteica Partnership

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Installations

# of Sites	Company	Cogen	GHG
4	Chevron Texaco	X	
2	Chevron Phillips	X	
1	BP		
1	Eastman	X	
4	Shell/Equilon/Motiva		
1	Air Liquide	X	
2	ConocoPhillips	X	X
11	Large Refiner	X	
1	Rohm & Haas		X
1	Cytec		
1	Irving Oil		
1	INEOS		
2	Sunoco	X	X
7	Repsol YPF	X	X
1	Total	X	X
1	Interquisa	X	X
1	ENAP		X
1	Lotos	X	X
In Development	Thermal Energy Corporation	X	X

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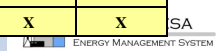
Technical Publications

- A Highly Successful Holistic Approach to a Plant-Wide Energy Management System by Fendt, **Rohm and Haas Co.** Steam Digest 2001
- Energy Real Time Optimization, Uzturk, Franklin, Righi, van Mechelen and Georgiou, **ExxonMobil**. 2006 NPRA Q&A and Technology Forum
- Finding Benefits by Modeling and Optimizing Steam and Power Systems, Reid, Harper and Hayes, **Air Liquide Large Industries U.S. LP.** 2008 Industrial Energy Technology Conference
- Energy Real-Time Optimizer Baytown Refining/Chemical Complex by Maurie Lorenz, **ExxonMobil**. 2009 Industrial Energy Technology Conference
- Many more on our Downloads area of our website

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What is a Real Time Energy Management and Optimization System

- Online, Real time, Site-wide Optimization of all Utilities (chilled water, cogen, steam, GHG emissions, fuel, …)
  - Recommending lowest cost operation to meet current customer demand
  - Including rigorous and detailed cogen models
- Consideration of physical, environmental, contractual, and reliability constraints
- Ensuring recommendations to operations that are safe, accurate, and <u>directly actionable</u>
  - Discrete directions to operators
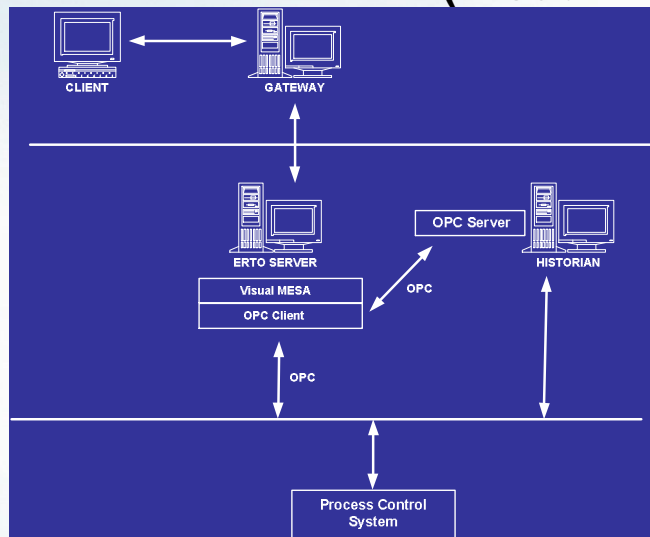- Sustainable energy management for lowest operational cost over time

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Delivering the Value

Continuous Energy Management for the Real Time, Site-wide Optimum

Chilled Water Requirements

Visual MESA finds the current lowest cost operating point in this area

Emissions Constraints

Steam System Operation

Electric Power Consumption/Generation

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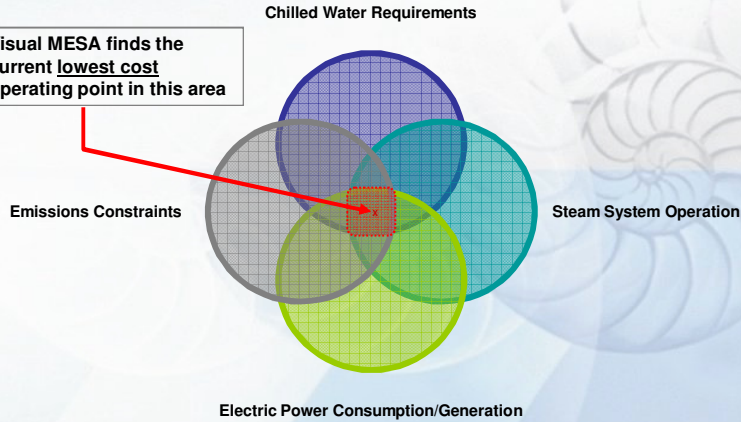
System Architecture (Visual Mesa)

CLIENT

GATEWAY

OPC Server

ERTO SERVER

HISTORIAN

Visual MESA

OPC Client

OPC

OPC

Process Control System

"Energy System Real Time Optimization ", Derya Uztürk, H. Franklin, J. Righi, X. van Mechelen, A. Georgiou. NPRA Conference. Oct 8 – 11, 2006 , Phoenix, AZ (USA).

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RTEMOS Users

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                          RTEMOS

    Utilities
    Operators          Engineering
                                          Soteica LLC

         Other System Operators
         via Monitoring System              I&E
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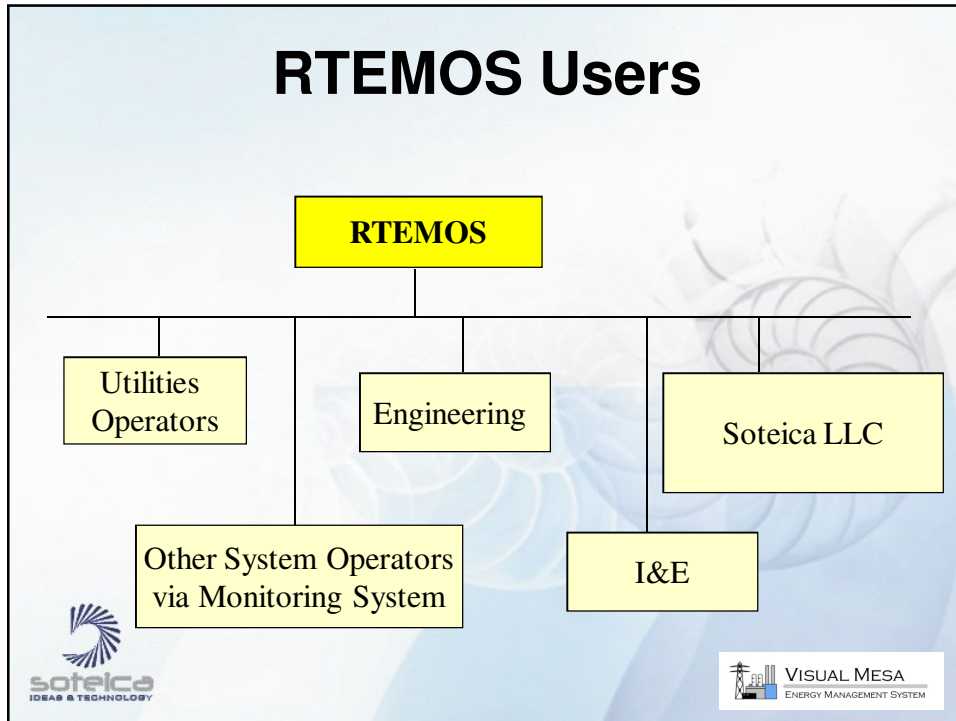
RTEMOS based KPIs Calculation Procedure

- RTEMOS runs every 15 minutes taking and validating real time data from Plant Historian: InSQL, IP21,PI, PHD, etc.
- RTEMOS simulates and finds the optimum cost for the whole site, as well as calculates the KPIs.
- It then writes back the optimum values, KPIs, etc. to Plant Historian, from where they can be retrieved using an Excel spreadsheet, Client tools of Process Historian, etc.

Visual MESA

Plant Historian Server RTDB

Excel, Plant Historian Client Tools

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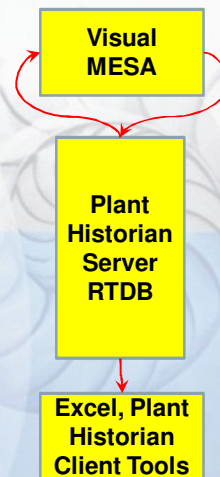
RTEMOS Main Uses

- Monitoring, KPIs
- Auditing and Accounting
- "What-If?" Case Studies
- Optimization

Visual MESA as "Energy Watchdog":
A Case Study from Refining

- Result: **> 2 MM $/year** in documented savings

Optimización Visual Mesa
Ahorros Anuales Predichos - Siguiendo las Sugerencias de Optimización

2,648,089

> 2 MM €/año

Ahorros Obtenidos:

597,313

Ahorros Anuales
Promedio del Período Anterior a la Optimización
Promedio Después de Tomar Acciones de Optimización
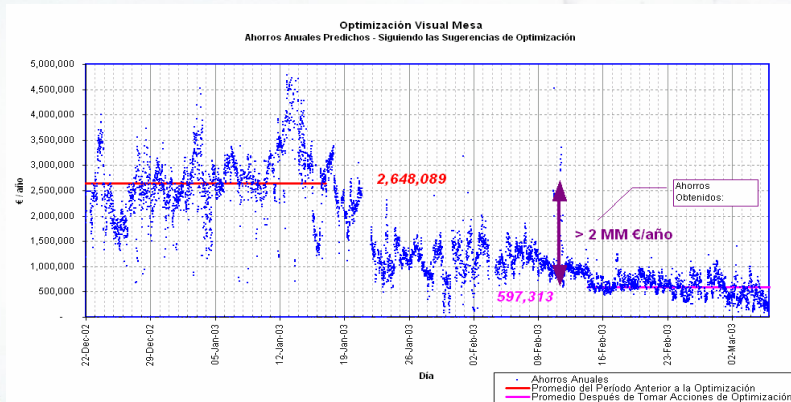
Visual MESA as Energy Watchdog: Example from Industrial Gas

Sustained benefit for Air Liquide with renewed focus on energy

Historical Missed Optimization Opportunity

Trendline shows continued reduction in "Dollars Left on the Table"

Missed Optimization Opportunity (Zoomed)
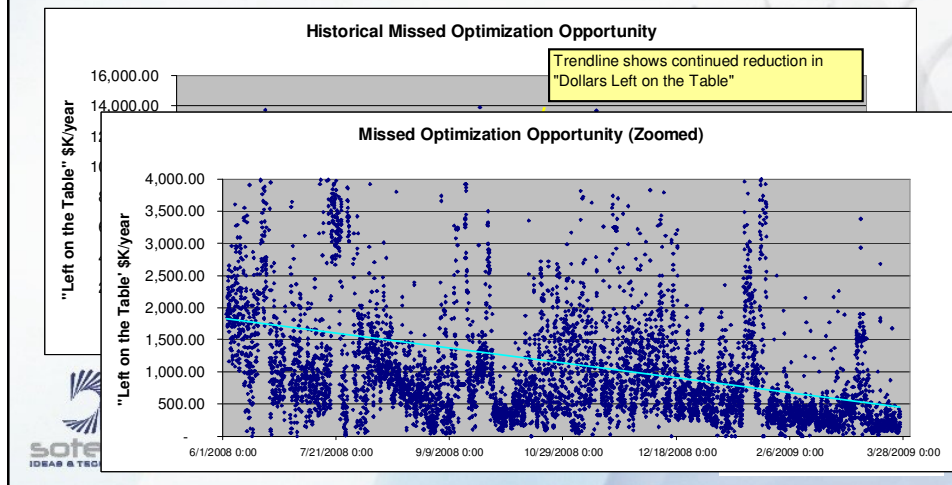
Extending the Benefit

- Immediate efficiency gain by having a "Watchdog" on the system
- Modeling of "time-of-day" power cost, "take-or-pay" requirements, and other contract complexities
- Energy KPI calculation engine (data and calculation validation)
- Continuously vetted model for off-line "what if?" engineering studies
  - Future expansion
  - Operational adjustments for maintenance outages

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Where would RTEMOS bring value in Ken's Tiered EM Model?

- **Tier 0 ? ;-)**
  - Information gathering.
  - Updating P&IDs
  - Putting it all in one single "file": the model!
- **Tier 1: A low to no capital project approach**
  - An RTEMOS is always NO Capital.
  - It helps prioritize where additional instrumentation is needed
  - It is doing the energy balance between the supply and demand

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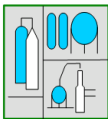
Where would RTEMOS bring value in Ken's Tiered EM Model?

- **Tier 2: Higher capital requirement projects…**
  - You now have a validated model of the sitewide utilities which becomes your objective check against which to run all your proposed projects
- **Tier 3: Operating Discipline approach to EM**
  - An RTEMOS is your Energy Watchdog, keeping everyone focused on minimizing energy cost.
  - It also becomes your Energy KPI calculation engine
- **Tier 4: Long Term "Strategic Intent" with EM**
  - Once you have a validated model in place you can now "push the envelope". Example: Rohm & Haas' "Production Planning for Energy"
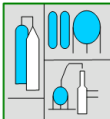
Visual MESA R&H Model
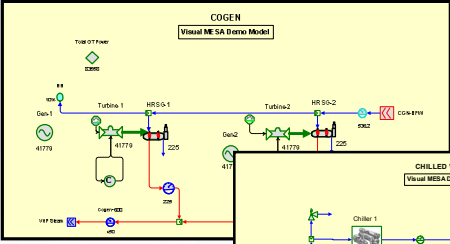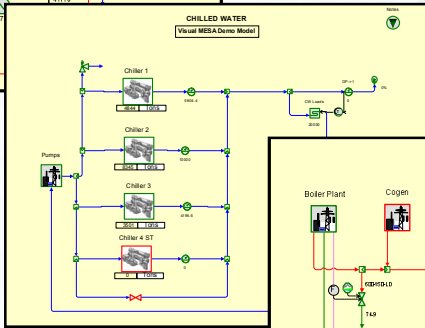
District Energy
(work in progress)
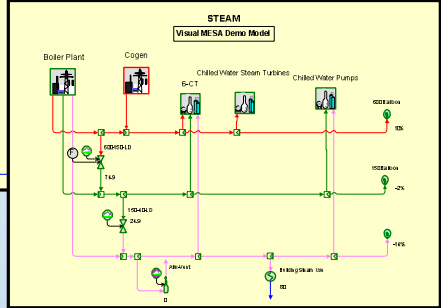
Why RTEMOS for District Energy?

- <u>Core</u>: Utilities are the "business" of District Energy suppliers
- <u>Experience</u>: Long history of well-developed and rigorous thermodynamic modeling
- <u>Flexibility</u>: Necessary modeling "ingredients" already exist for application to District Energy
  - No major modifications required to software to include chiller optimization
- <u>Focus</u>: "Supply-side" improvement
  - Demand-side projects (efficient lighting, improved insulation, etc.) have likely been addressed already
- <u>Sustainability</u>: Model easily modified to accommodate upgrades to system as customer needs change

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Visual MESA Contributions

- Cogen Modeling and Optimization
- Modeling of Greenhouse Gas Emissions
- Modeling of Alternate Fuels

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Cogen

- Detailed Gas Turbine and HRSG modeling
  - Correlations to Ambient Temperature
  - GT-specific
- Power generation optimization based upon current market price
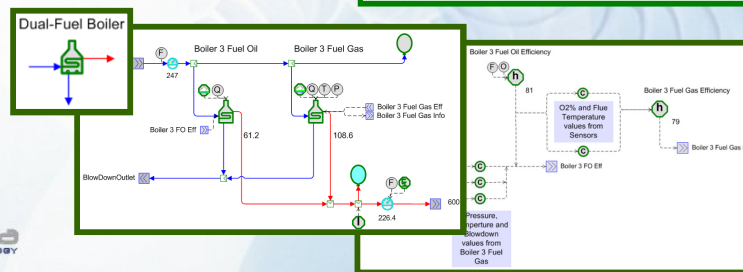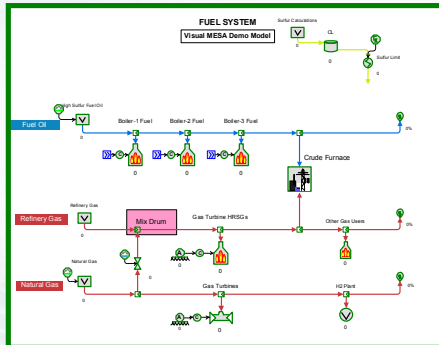- Boiler/HRSG duct firing tradeoff
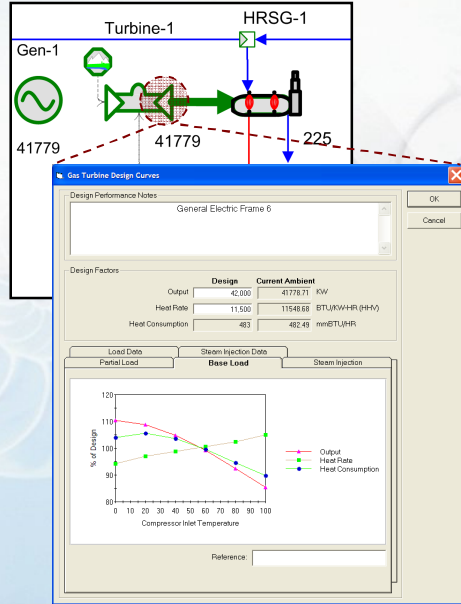
GHG Emissions

- Tracks emissions from Boilers and other sources
  - CO_2
  - NOx
  - SOx
  - Sulfur
- Limits Optimization by Site Emission Limits
- Example shown includes SO_2 and NO_x mass and concentration
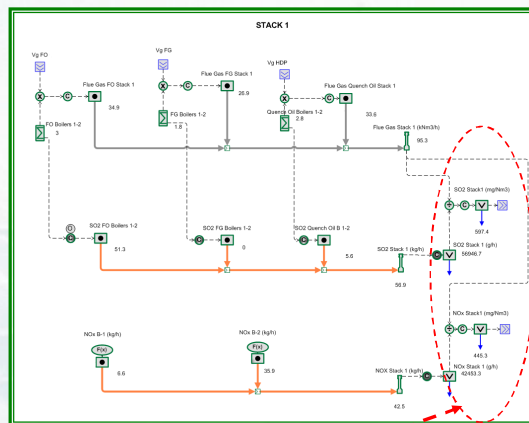
Alternate Fuels

- Boilers and other equipment using
  - Off Gas
  - Fuel Oil
  - Coal
  - Other
- Dual Fuel Boilers

Conclusions

- RTEMOS is a mature technology.
- It helps operations to run at minimum energy cost 24x7x365.
- It ensures that everyone is working with the same information. It's constantly validated model becomes the common checking point for all energy project evaluations.
- It is the foundation of your Energy KPI program.

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Thank you for your time!