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Sigmafine Value Pyramid for the Power Industry

Sigmafine Industry Stories

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Agenda
Generating Value At Every Step...

- Sigmafine Value in the Power Industry

- Single Measurement Validation

- Mass and Energy Balance

- KPI Calculations and Data Transformations

- Business Rules

- Business Analysis

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Sigmafine Value Pyramid
For Power Plants

Business Analysis

Business Rules

KPI Calculations and Data Transformations

Mass and Energy Balance

Single Measurement Validation

V A L U E

LEVEL 1   LEVEL 2   LEVEL 3   LEVEL 4   LEVEL 5

Total Cost of Ownership

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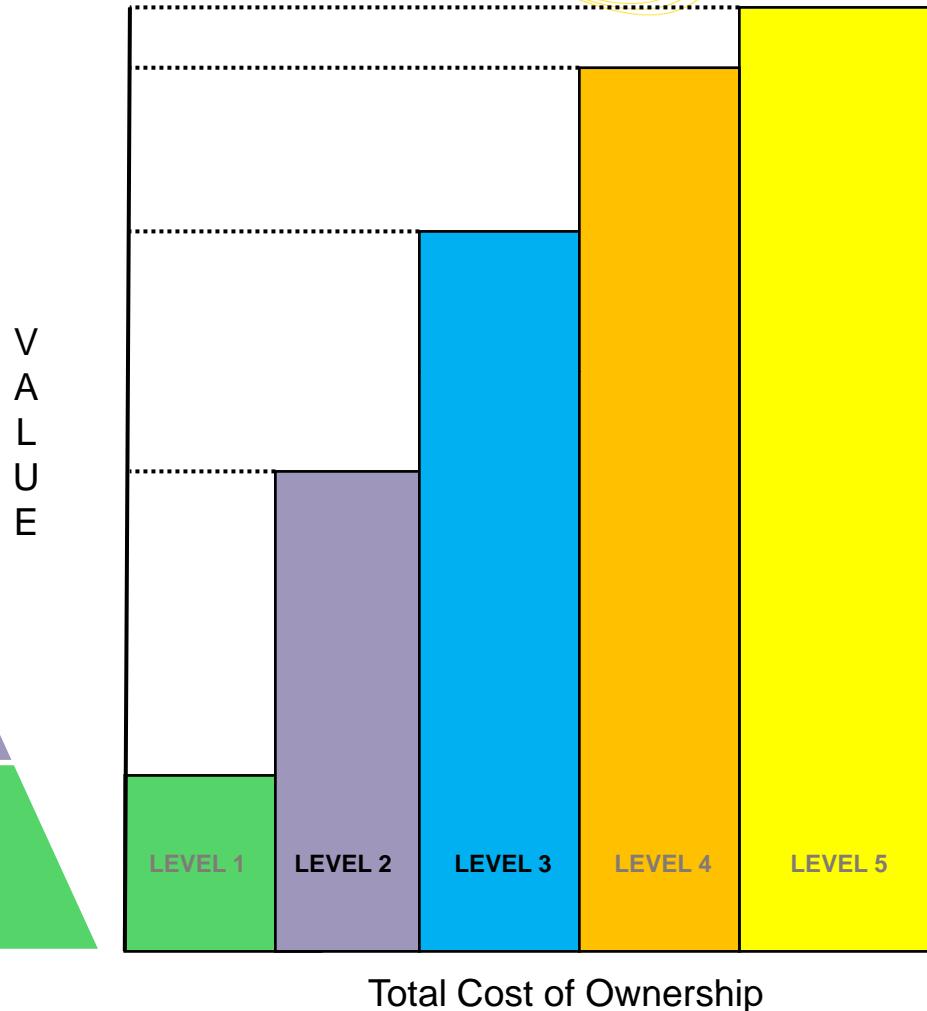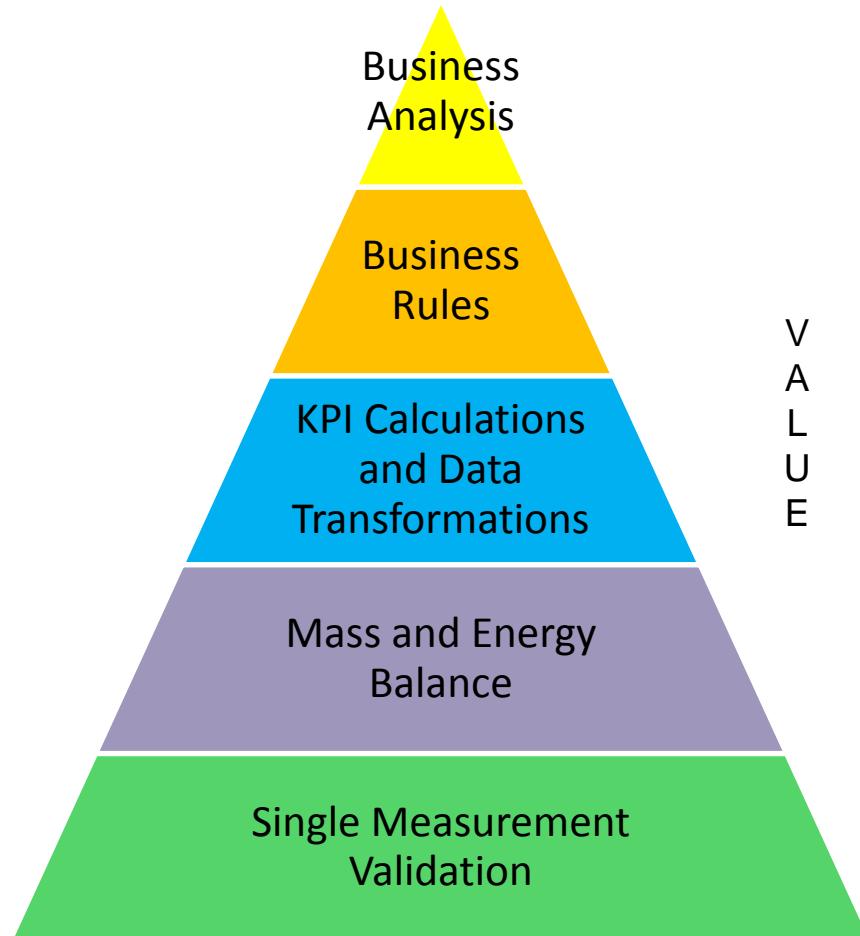
Single Measurement Data Validation
Basic Analysis
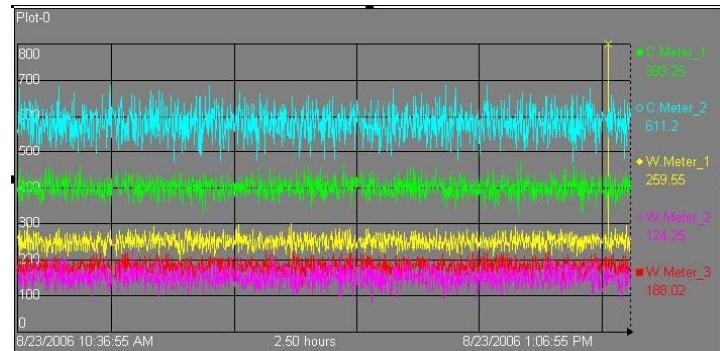
Single Validation

- Data monitoring against normal statistics
  - ✓ Data References
  - ✓ Analysis Rules
  - ✓ Sigmafine tables
  - ✓ Automatic scheduling
- Find if measurement in steady state
  - ✓ Steady State Detector
- Write results back to Sigmafine cases or historian
- Notify critical problems of data ranges

Examples:

- Validation of all temperatures and pressure according to correct operation conditions

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Mass and Energy Balance
Aggregation and First Principles

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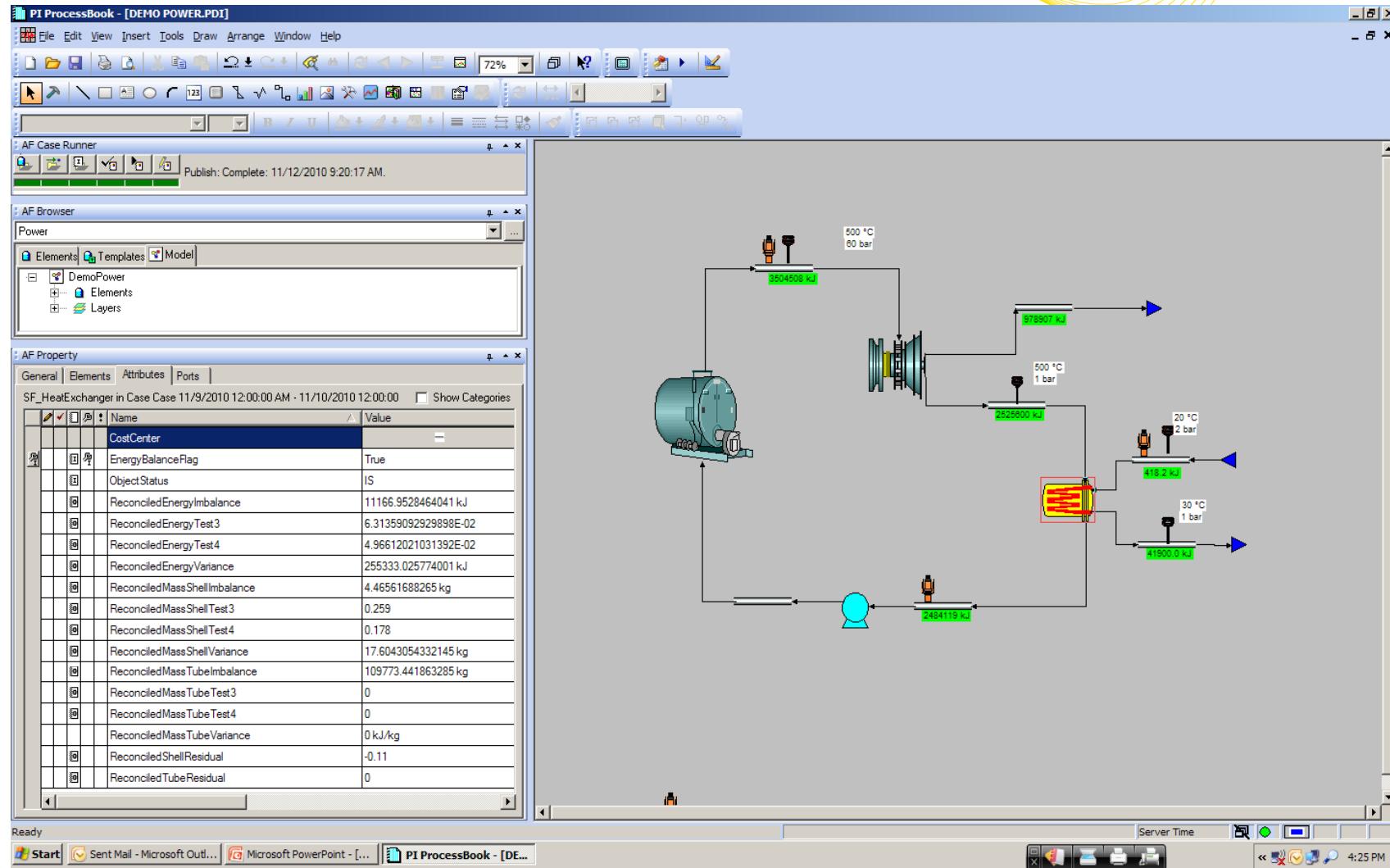
- Key Benefits
  - ✓ Cross checking of measurements based on connectivity models
  - ✓ Estimates for unmeasured variables, providing more information for analysis
  - ✓ Reconciled KPI
  - ✓ Inventory and fuel consumption cross check
- Methodology
  - ✓ Best estimates based on data reconciliation principles
  - ✓ Steam tables calculations are used for energy and efficiency calculations
  - ✓ Automated and unattended reconciliation only during steady process
- Main Tools
  - ✓ Sigmafine energy balance
  - ✓ Steam table data reference
  - ✓ Sigmafine data reference
  - ✓ Scheduler

Mass and Energy Balance
Advanced Diagnostics

Meter Performance Management
Advanced Diagnostics

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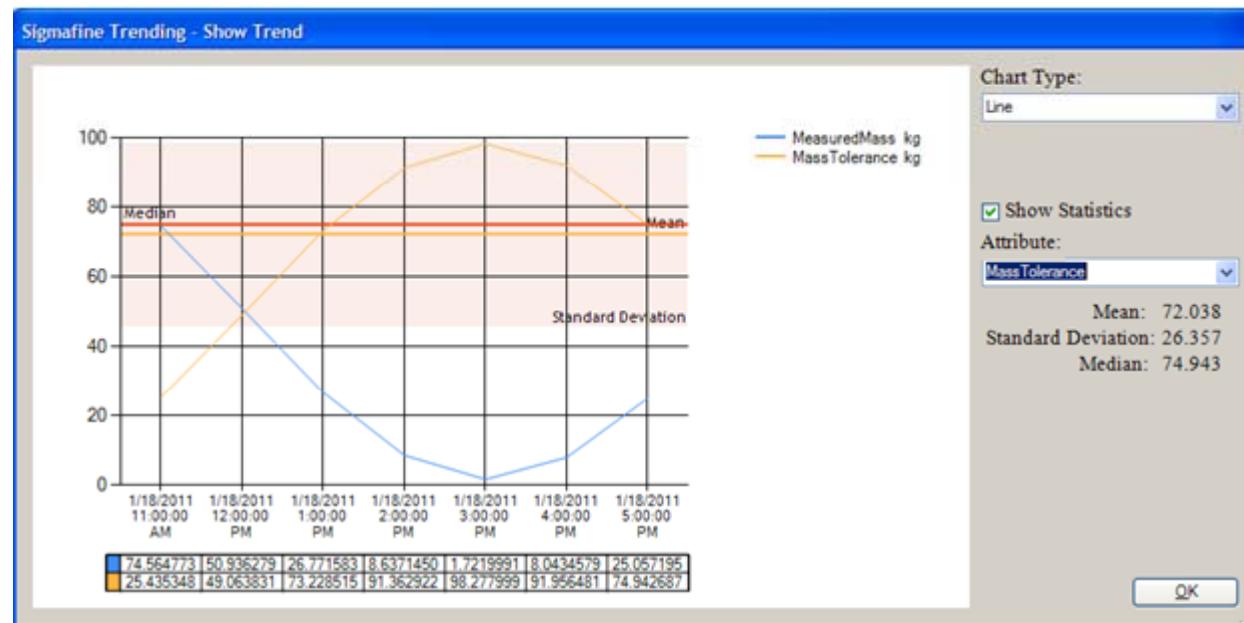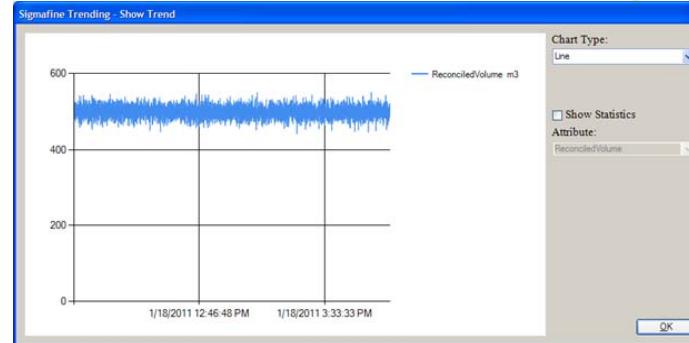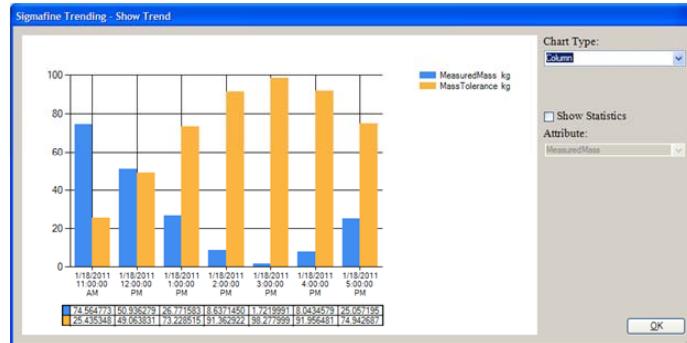
KPI Calculations and Data Transformations
Monitor Conditioned Variables
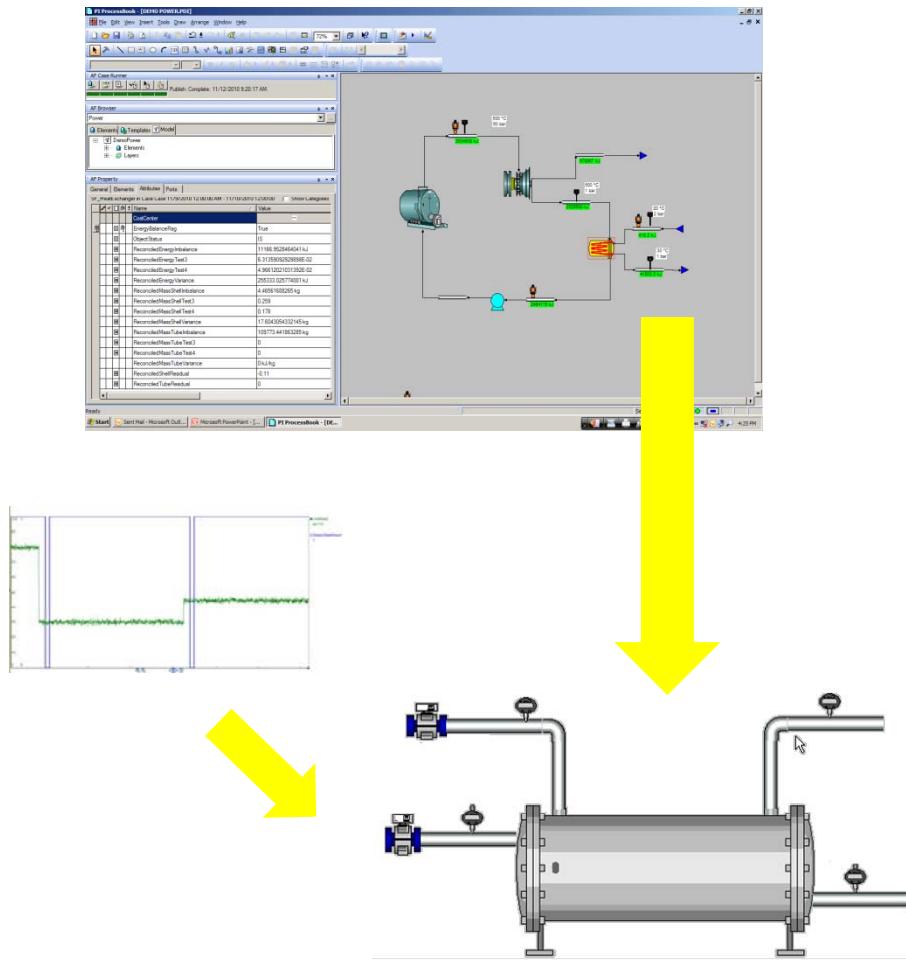
Equipment KPI Calculation

Heat Exchanger Example

- Collect Data
  - ✓ Data References
- Run Steady State Detector
- Perform data transformations
  - ✓ Temperature, pressure to enthalpy using Sigmafine steam tables
  - ✓ Perform Efficiency Calculations using Sigmafine libraries
- Publish Efficiency for Data Analysis
- Notify Appropriate Users
- Other Examples:
  - ✓ Turbine Efficiency
  - ✓ Pump Curve Analysis
  - ✓ Boiler Efficiency

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Data Transformations
Steam Tables
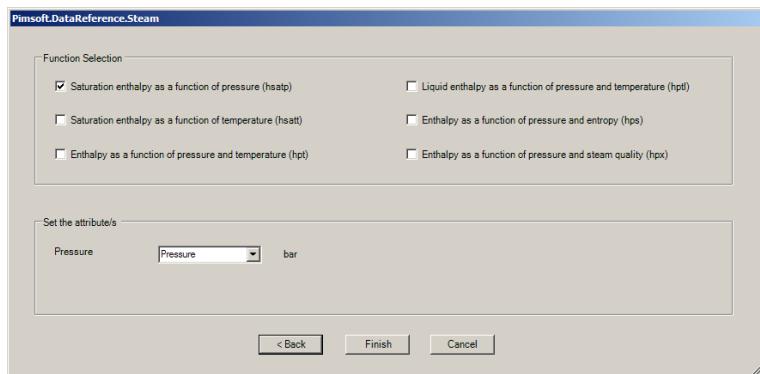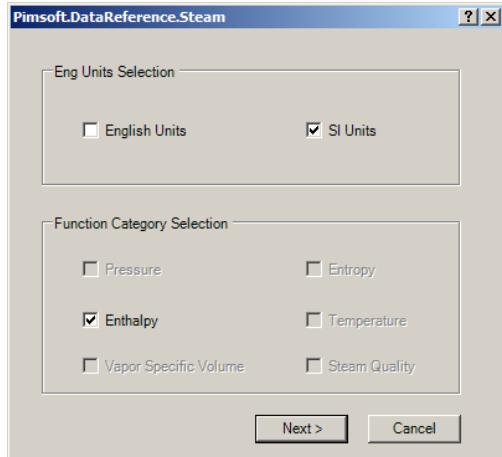
Efficiency Calculations

- Turbines

- Boilers

- Available Properties:
  - ✓ Enthalpy
 - ✓ Entropy

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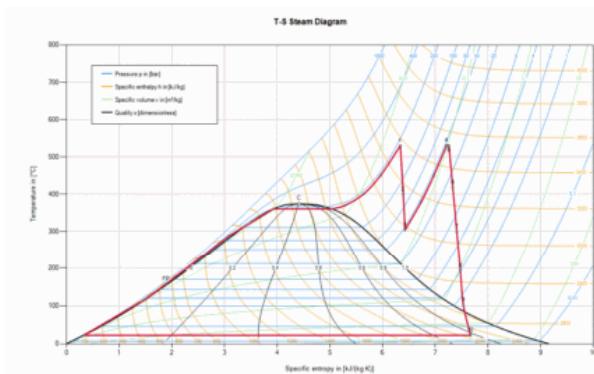
## Data Transformations
Steady State Detection
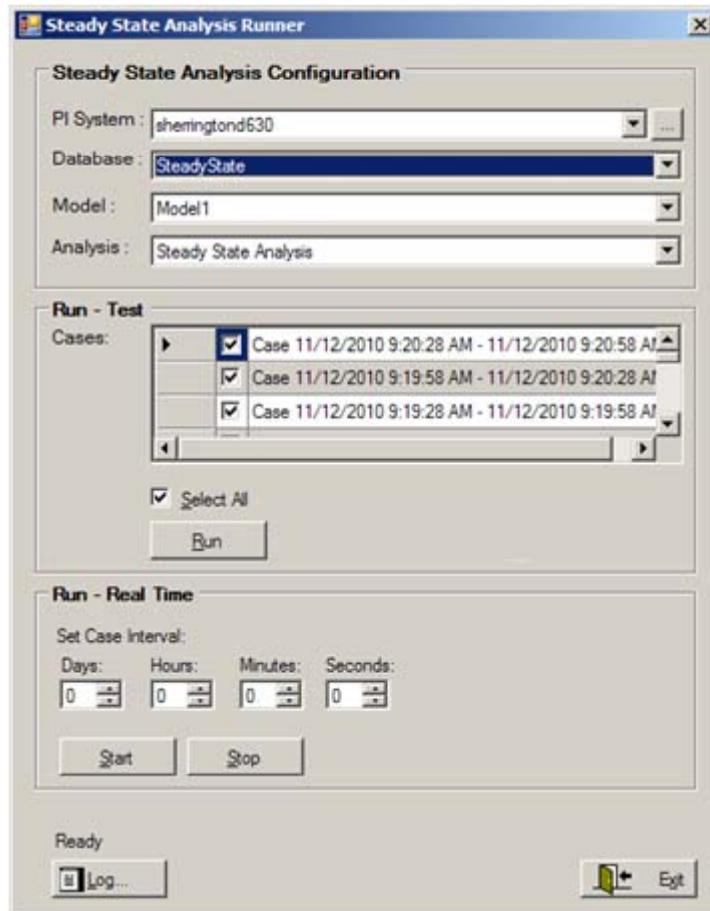
Perform calculations under steady conditions

- Smooth calculations of coefficients for heat exchangers and other equipment

- Perform meter corrections under steady conditions (i.e., not real gross errors)

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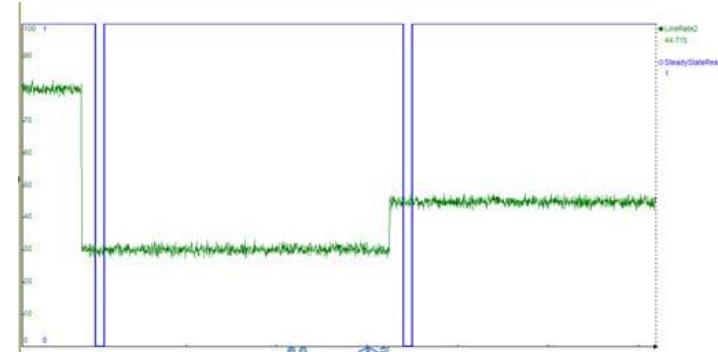
## Fuel Inventory Normalization
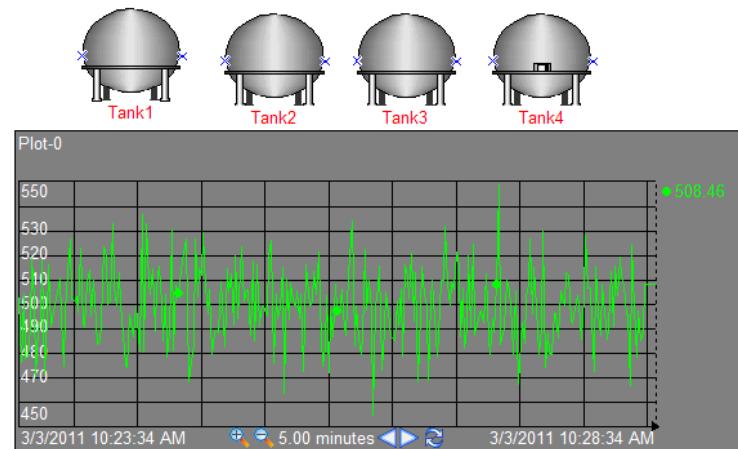
From gross volume to standard conditions

- Gauge to Volume
    - ✓ Strapping
    - ✓ Geometrical
- Volume Correction Factors based on ASTM and API
- Volume to Mass Conversion

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Data Exposure
Daily Initial Inventory Positions

Data Exposure
Logging of Fuel Receipts

Business Rules
## Objective Functions and Constraints
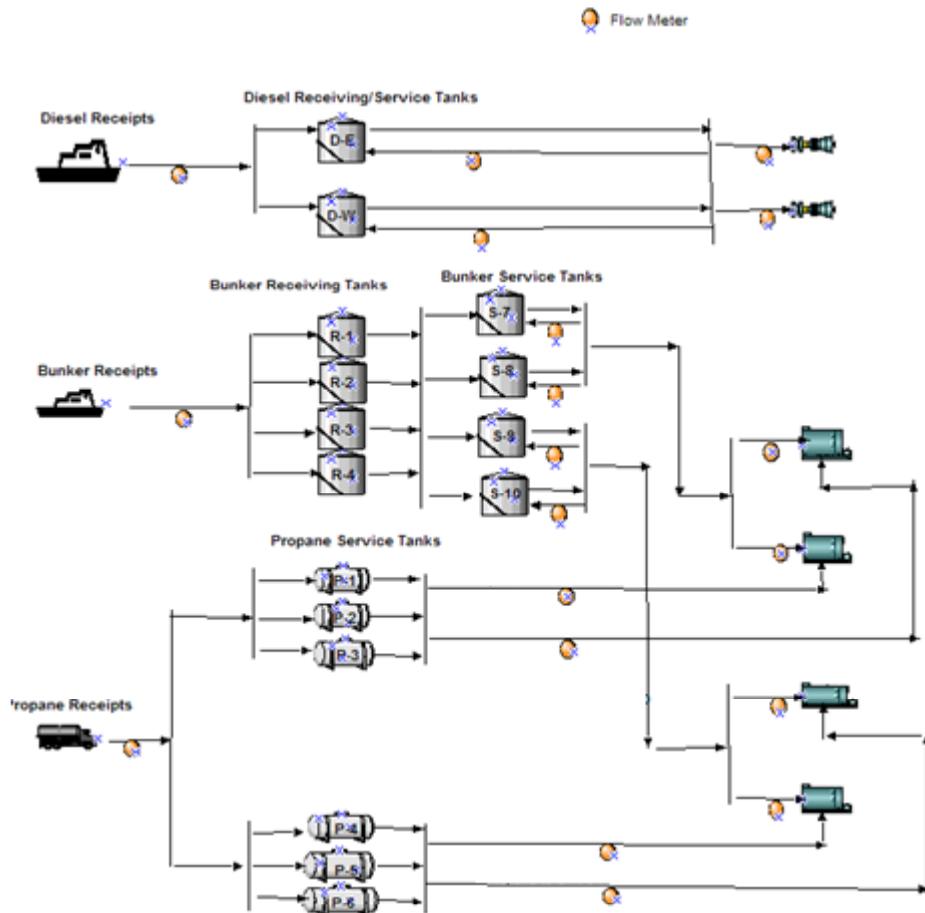
Comply with Business Requirements

- Track movements and prices
- Connect to business systems
- Balance inventory and movements
- Notify discrepancies
- Provide estimates of fuel prices
- Add specific business rules
  - ✓ Fuel price pool
  - ✓ Apply API methodology
  - ✓ Compute capacity and inventory "running" days

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Business Rule Example
Example
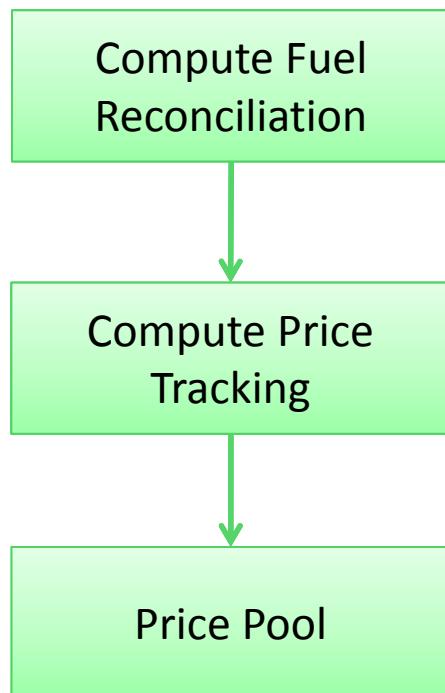
Business Requirement	Sigmafine Module	Methodology

Business Requirement

Compute Fuel Reconciliation

↓

Compute Price Tracking

↓

Price Pool

Sigmafine Module

Sigmafine AR

↓

Price Tracking AR

Methodology

Data Reconciliation

↓

Mixing Model of Price

↓

Apply Price Pool

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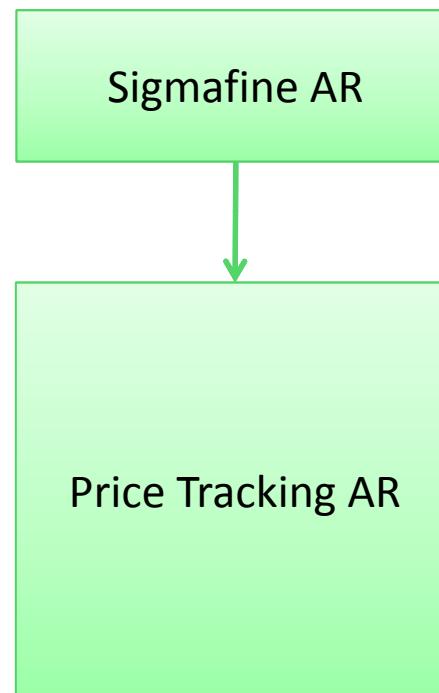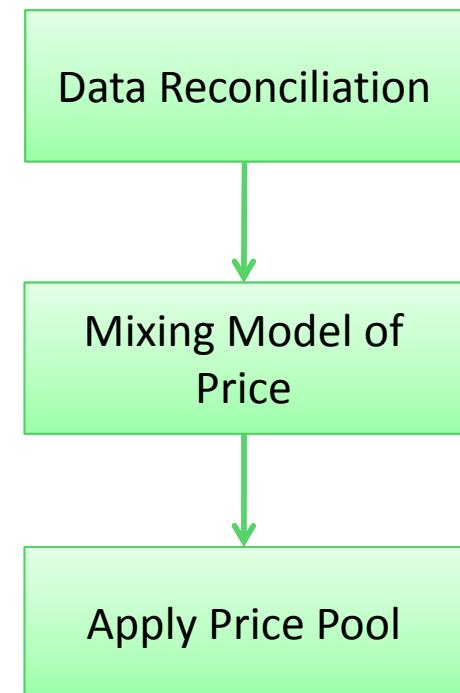
Automatic Generation of Models and Formulations

- **Mass Reconciliation**

$$\min_{x}(y-x)^T\sum(y-x)$$
$$s.t.Ax=c$$

- **Price Tracking**

$$p*_i = x_i p_i; Ap* = c$$

- **Price Pool**

$$x_p = \frac{\sum x_i p_i}{\sum x_i}$$

Business Analysis
Integration and Wide Audience Data Exposure

- Compare current operation versus planned
  - ✓ Integration with other business systems
- Use Sigmafine information for planning and purchasing of fuel
- Benchmarking between different operation units
  - ✓ Assessment of KPIs and Cost
- Optimize working capital based on planned demand
- Seasonal Analysis of Fuel Consumption

Thank you!

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