VEOLIA
SourceOne
A Veolia Energy Company

DRIVING TO OPTIMUM EFFICIENCY

Inception and development of the Veolia Efficiency Optimization System

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Introduction

Agenda

- Project Background
- Scope of Work
- Metering Evaluation
- Efficiency Curves
- Dashboard Development
- Questions and Answers

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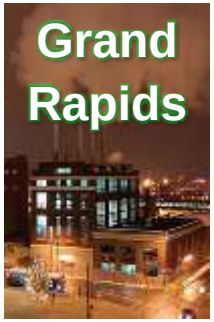
Project Background: District Energy Across the Nation



A single entity operates and maintains district energy infrastructure in 12 major cities across the United States.

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Project Background: Universal Application

Plant and Equipment Types

- Water-tube Boilers
- Package Boilers
- Electric Chillers
- Steam-Driven Chillers
- Reciprocating Engines
- Combustion Turbines
- Heat Recovery Steam Generator
- Steam Turbines
- Combined Cycle
- Combined Heat and Power (CHP)

Energy Inputs and Outputs

- Natural Gas
- #6 Fuel Oil
- Ultra Low Sulphur Diesel
- Coal
- Superheated Steam
- Saturated Steam
- Hot Water
- Chilled Water
- Electrical Distribution Inputs
- Electrical Transmission Outputs

District energy fleet includes central plants of differing types and vintages with varying fuel sources and energy outputs.

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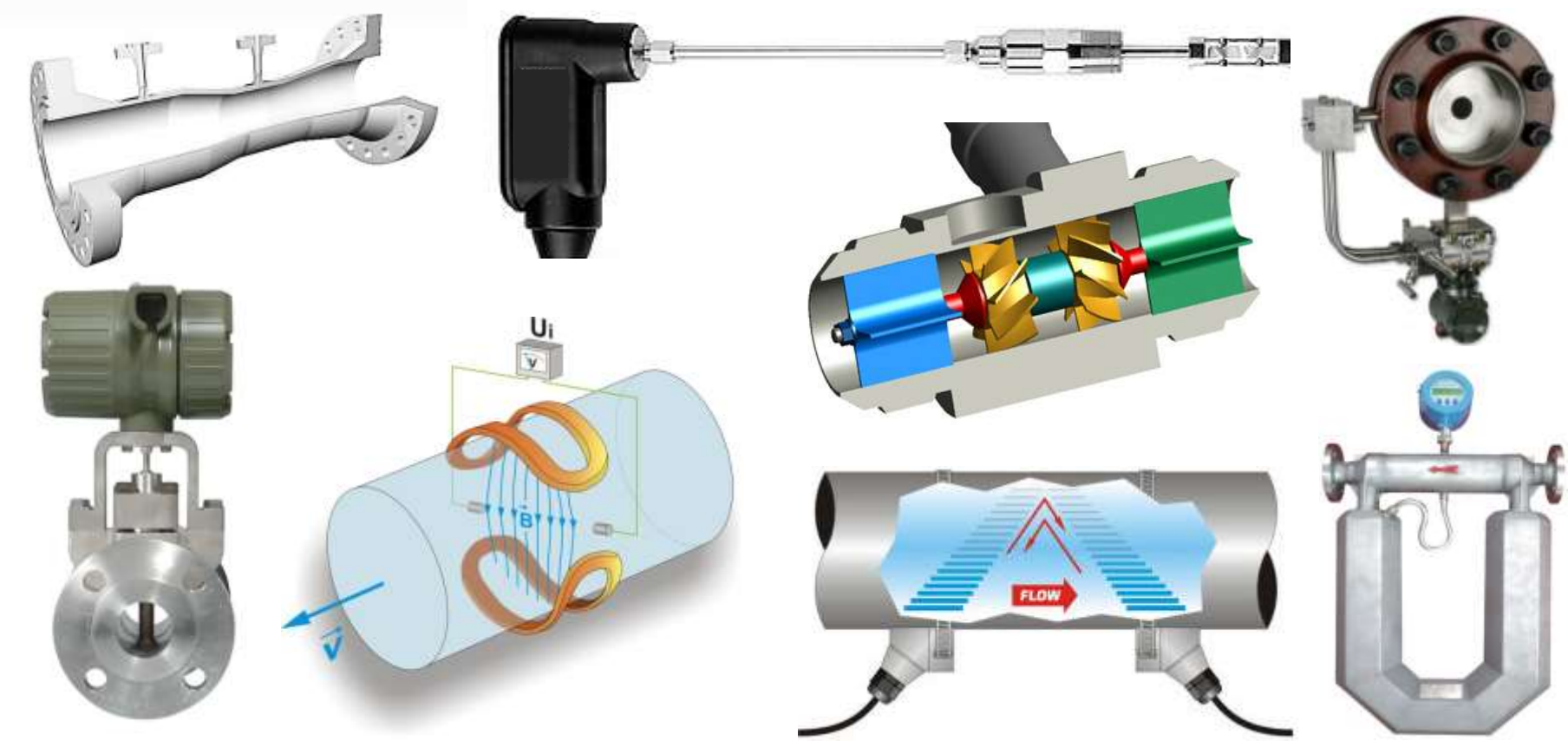
Project Background: Metering Innovation



Energy flow streams are measured using a medley of both cutting-edge and tried-and-true instrument technologies.

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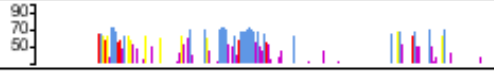
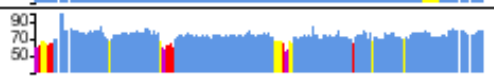
Project Background: Better Together

Steam		SendOut MLb	Eff	Eff Target	Fuel / Sendout	Fuel / Sales	Dist. Loss %	Efficiency
Baltimore	Balt STM	9,070	**31.1%**	-74.9%	3.75	.61	155.0%	
	CA STM	14,047	**74.4%**	26.9%	1.57	1.19	.2%	
Boston	BOSTON STM	44,976	**272.1%**	55.0%	.43	.15	220.5%	
Grand Rapids	GR STM	35,390	**76.2%**	73.0%	1.31	2.63	50.1%	
Kansas City	Grand Avenue STM	134,069	**74.5%**	71.0%	1.63	2.05	20.9%	
Oklahoma City	Oklahoma City STM	13,011	**67.9%**	50.0%	1.77	2.65	33.3%	
Philadelphia	VEPI STM	235,671	**85.2%**	81.0%	1.41	1.77	20.5%	
St Louis	St Louis STM	27,448	**75.8%**	60.0%	1.54	4.53	66.7%	
Tulsa	Tulsa STM	15,269	**59.8%**	1.2%	1.95	2.29	21.9%	

Standardization of efficiency modeling has not been pursued since the formation of the Veolia fleet.

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Project Background: Mission Statement

The Veolia Efficiency Optimization System will extract and consolidate pertinent information to provide a centralized platform to evaluate and optimize the performance of the company's assets.

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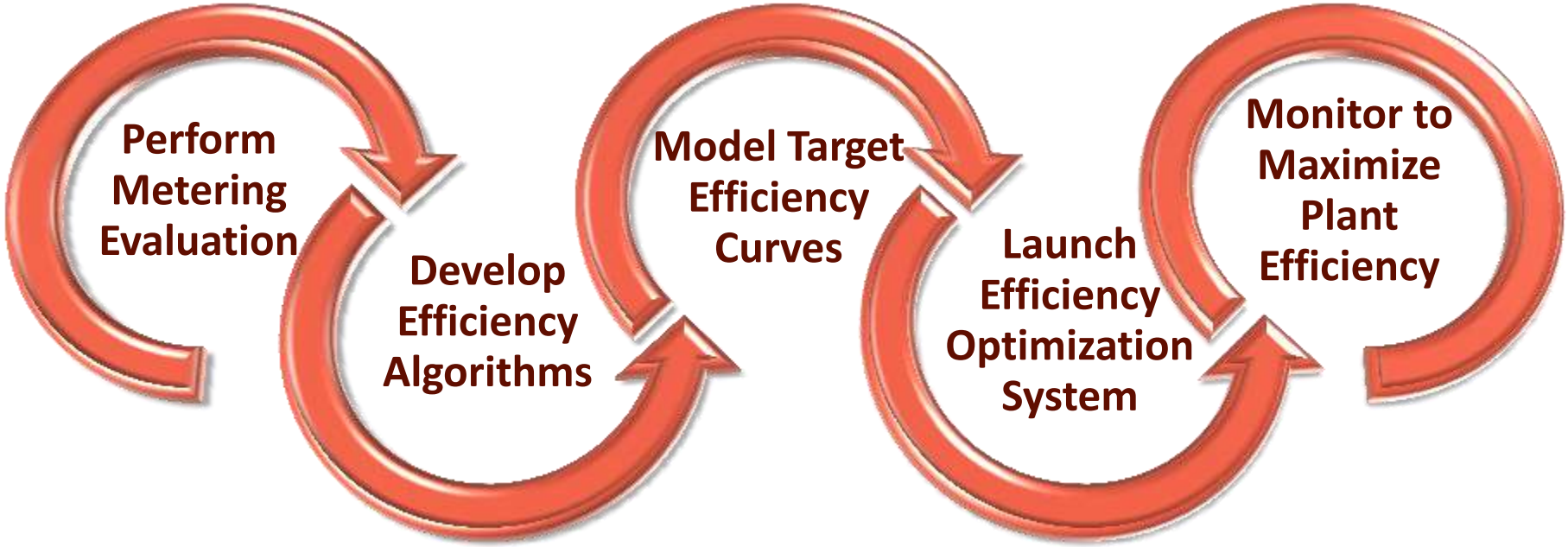
Project Scope



Equipment and plant efficiencies will be maximized by optimizing dispatch and identifying degrading trends.

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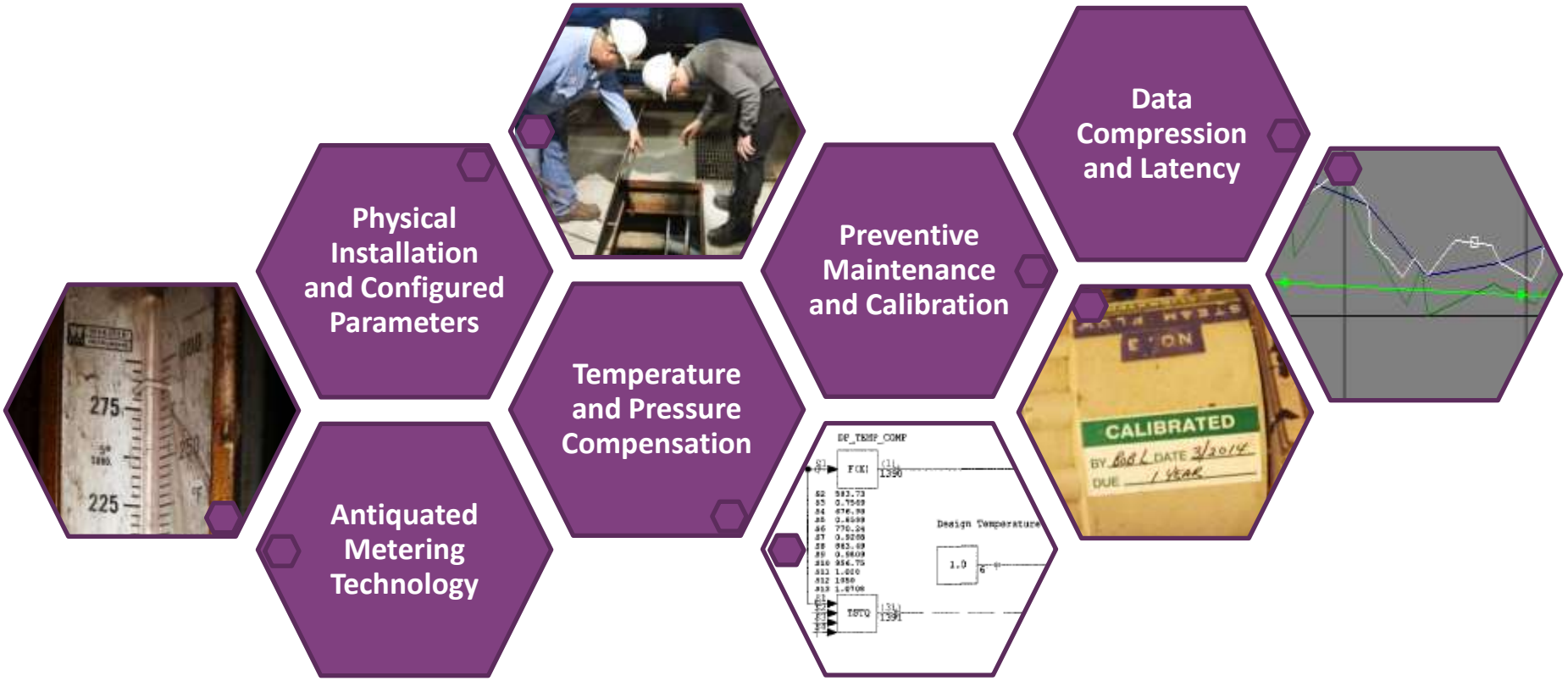
Metering Evaluation: Top 5 Focus Areas



Experience has yielded strategic focus areas and targeted top recurring setup issues to maximize survey productivity.

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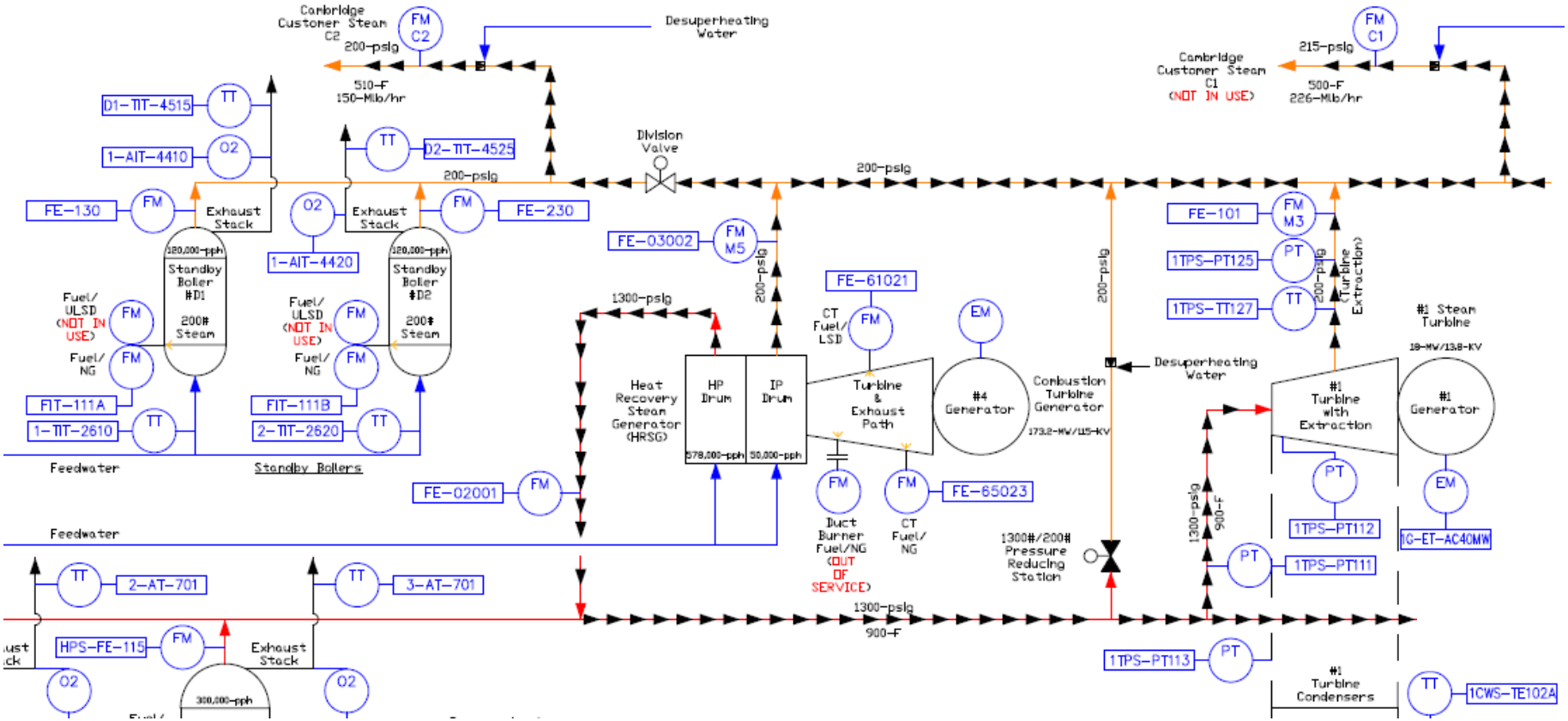
Metering Evaluation: Site Survey



Site surveys are necessary to document the current configuration and identify required metering enhancements.

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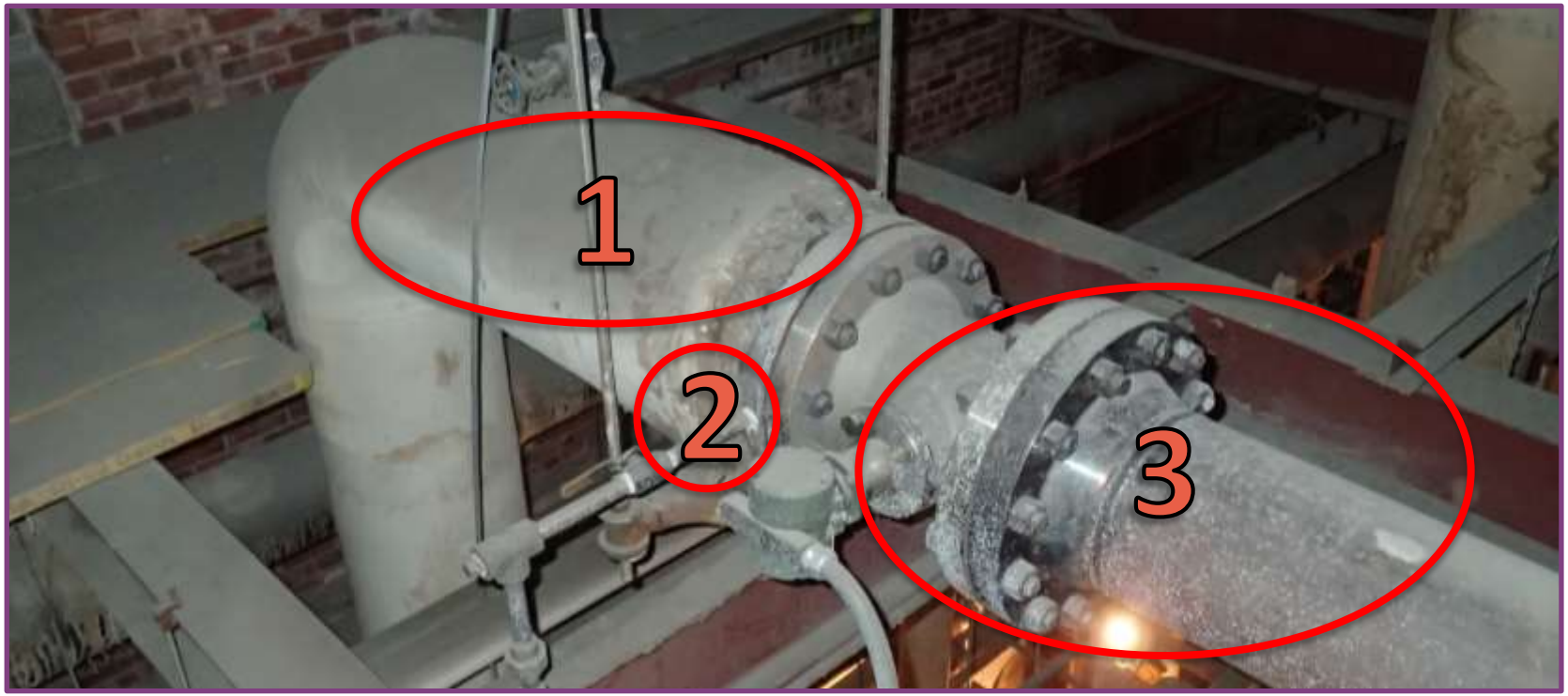
Metering Evaluation: What's Wrong With This Meter?



(1) Insufficient Straight Length of Downstream Pipe

(2) Insufficient Distance to Pressure Point

(3) Lack of Insulation

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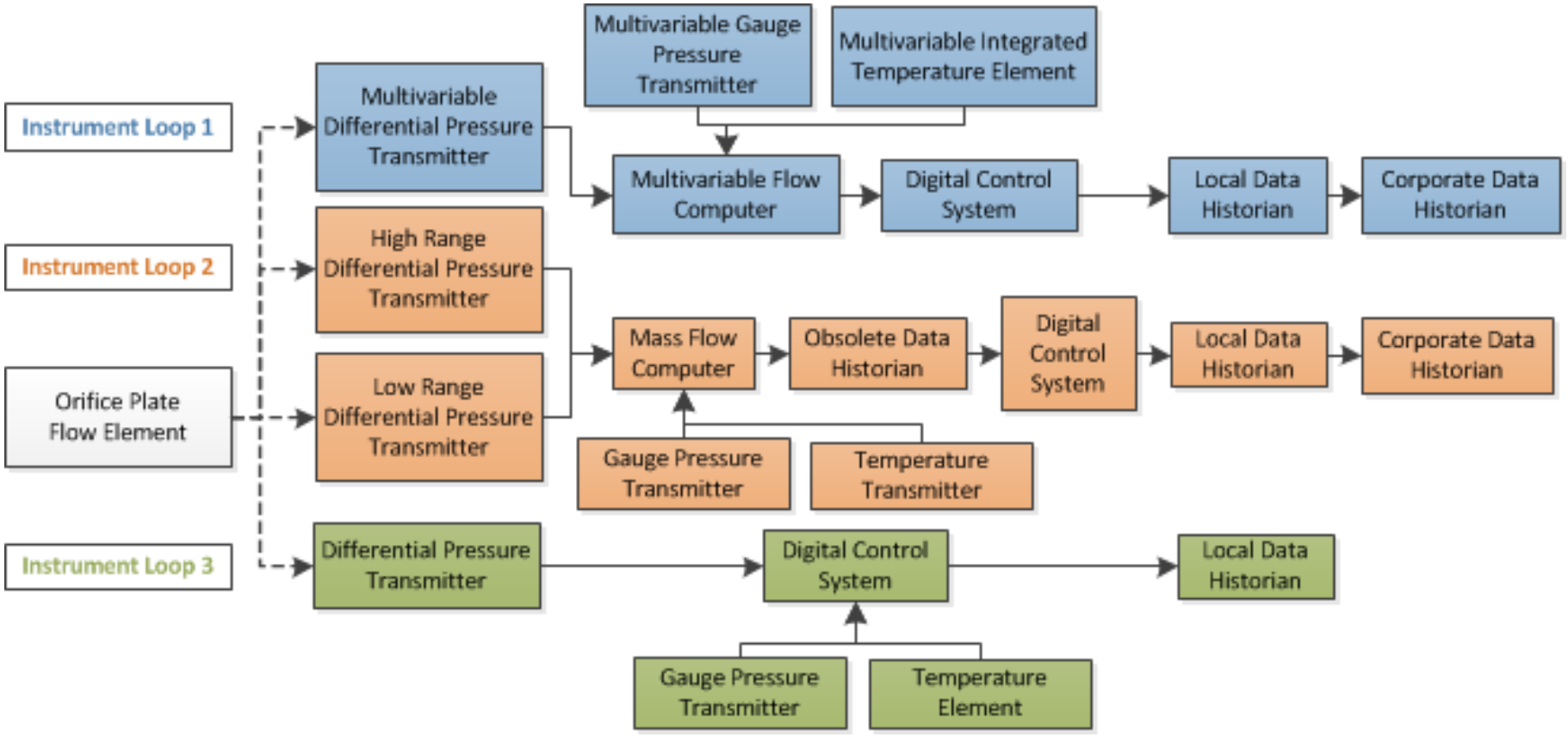
Metering Evaluation: Instrument Loop Nuances



All components that feed into the flow measurement are evaluated to ensure proper setup and determine total error.

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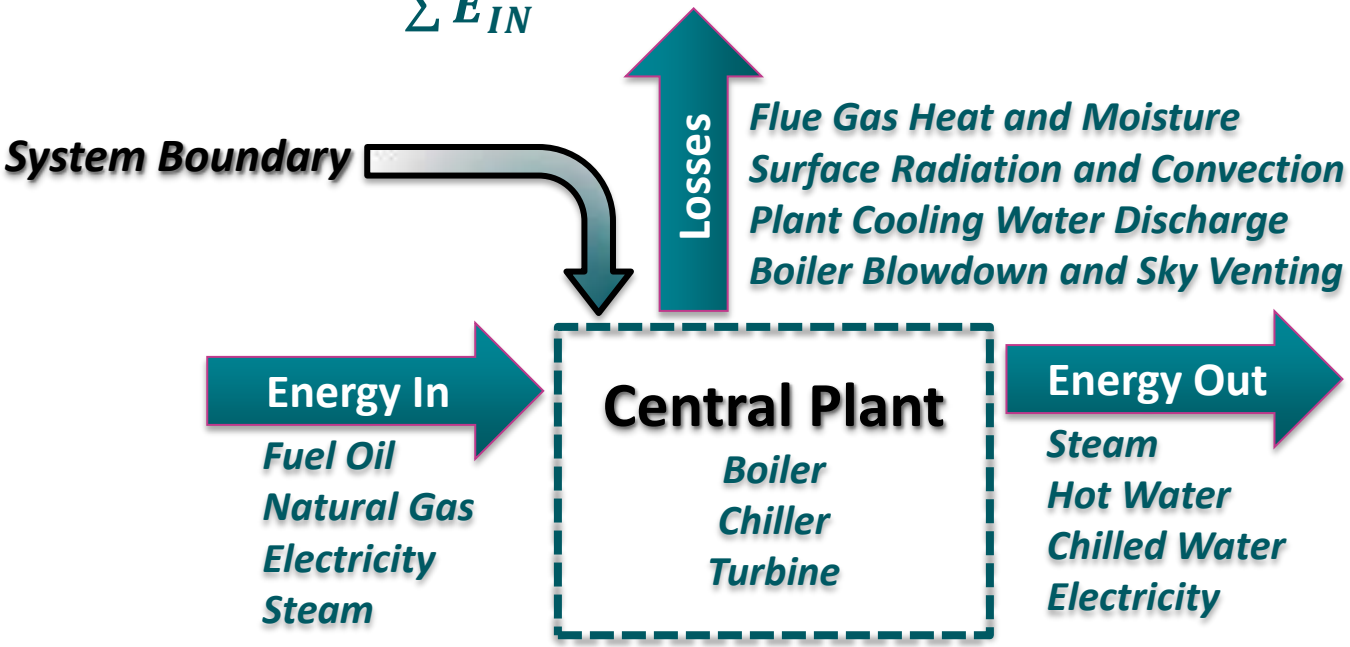
Efficiency Curve Modeling: Methodology

Direct Method (Input-Output)

$$Efficiency\ (\eta) = \frac{\sum E_{OUT}}{\sum E_{IN}}$$

Indirect Method (Energy Balance)

$$Efficiency\ (\eta) = 100\% - \frac{\sum E_{LOSS}}{\sum E_{IN}}$$



Metering for direct method calculations is less accurate whereas the indirect method requires more assumptions.

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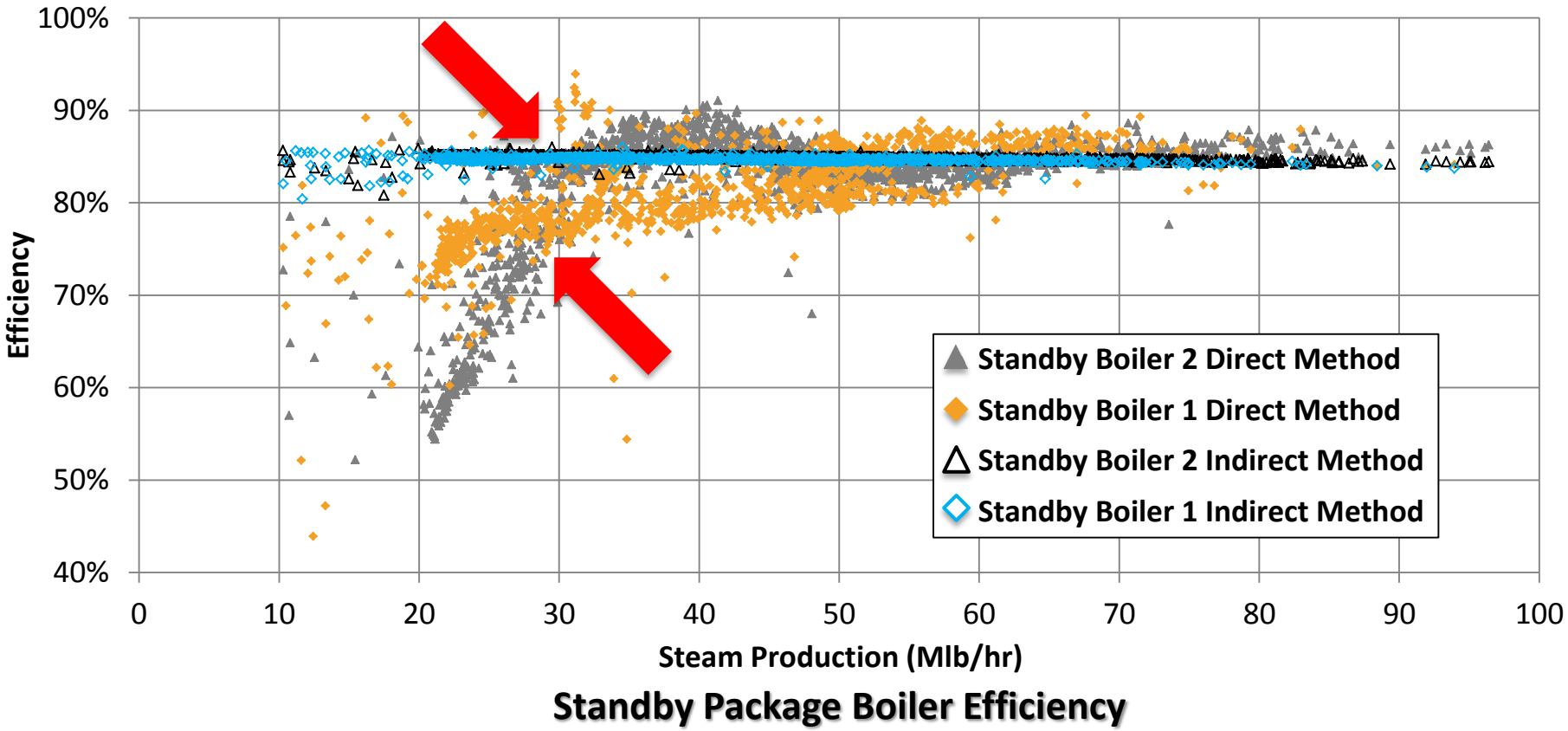
Efficiency Curve Modeling: Direct v. Indirect



Standby Boilers 1 & 2 are identical and efficiency disparities may be either metering issues or real equipment issues.

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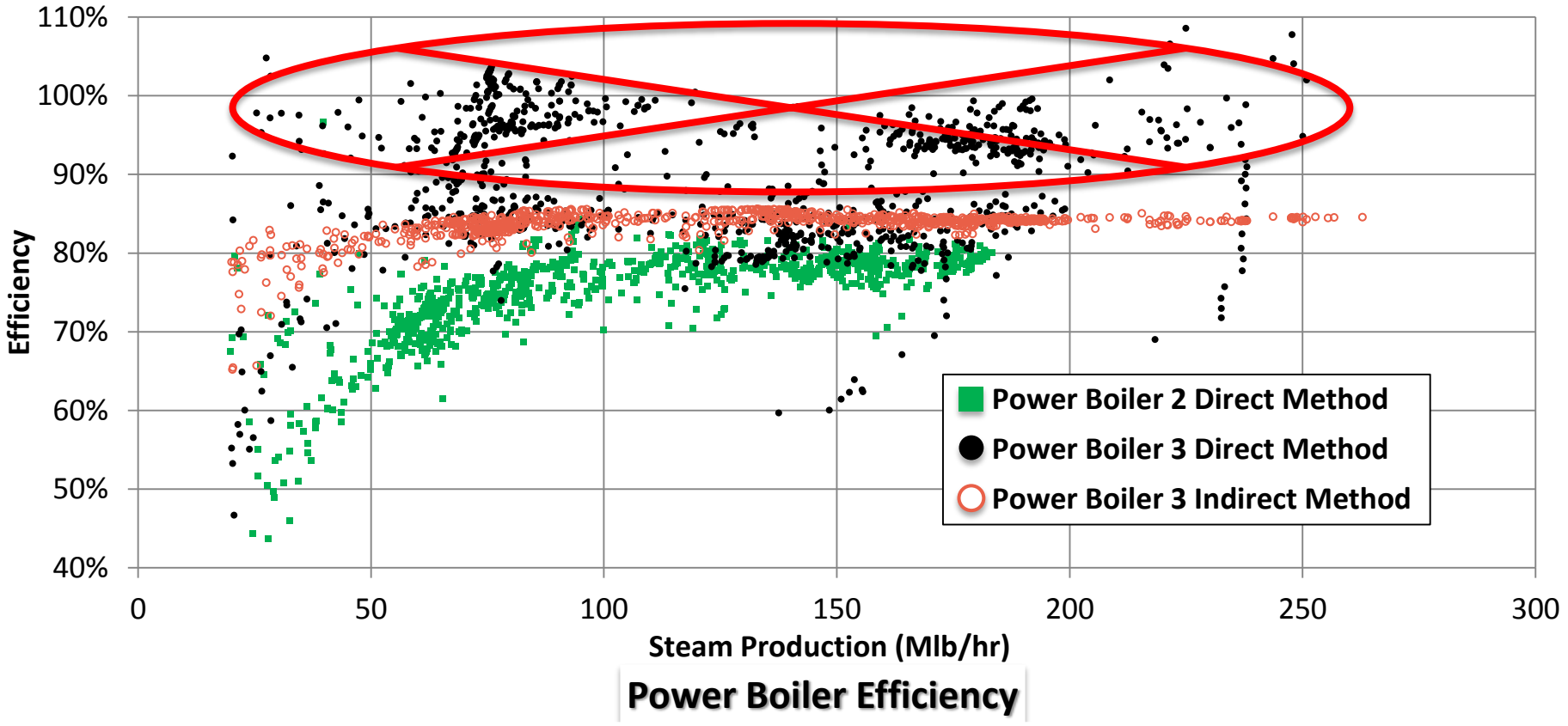
Efficiency Curve Modeling: 110% Efficient



Efficiency values >100% indicate a metering issue.
Instrumentation for both methods is not always available.

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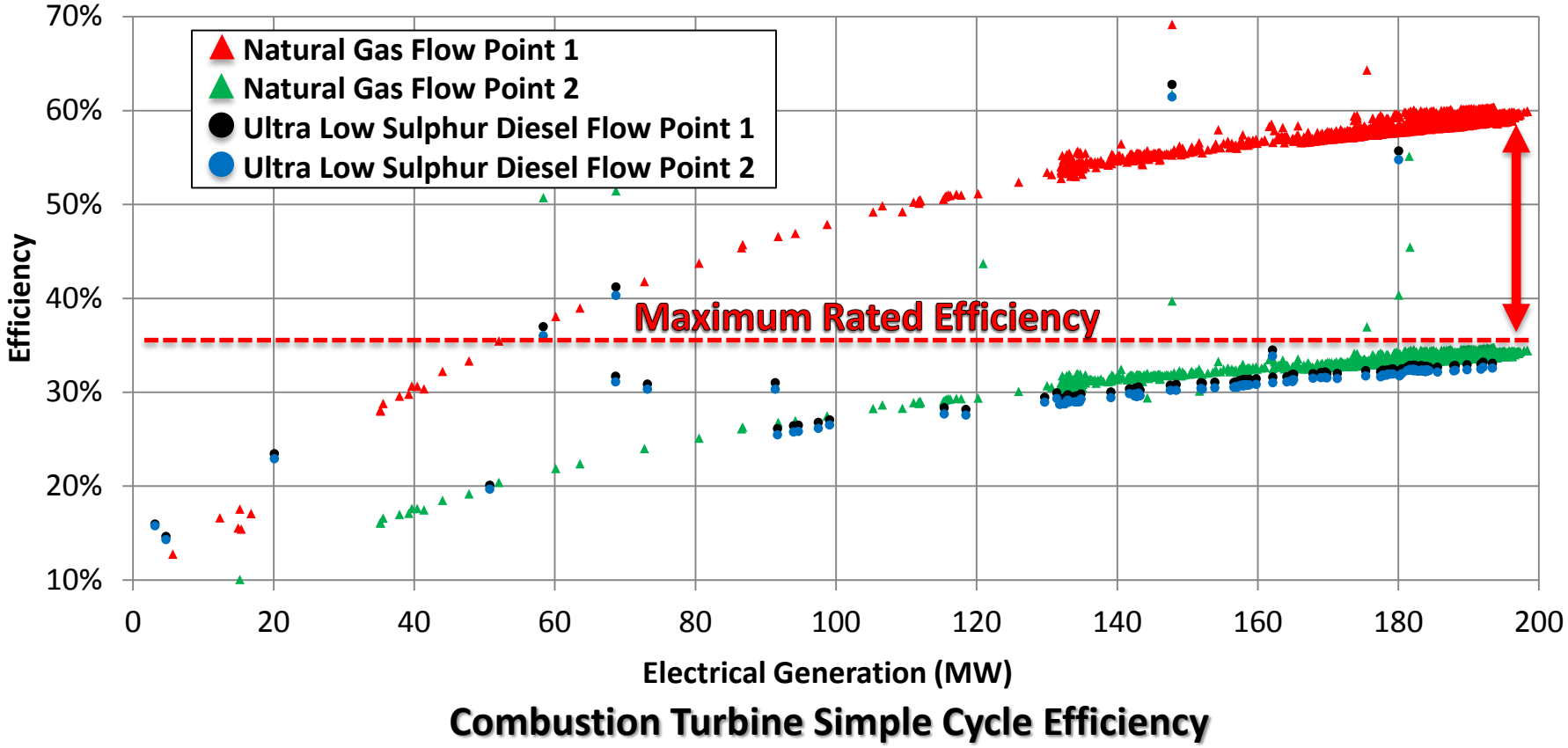
Efficiency Curve Modeling: Nominal Performance



Evaluation of efficiency calculations against equipment specifications provides insight into accuracy of metering.

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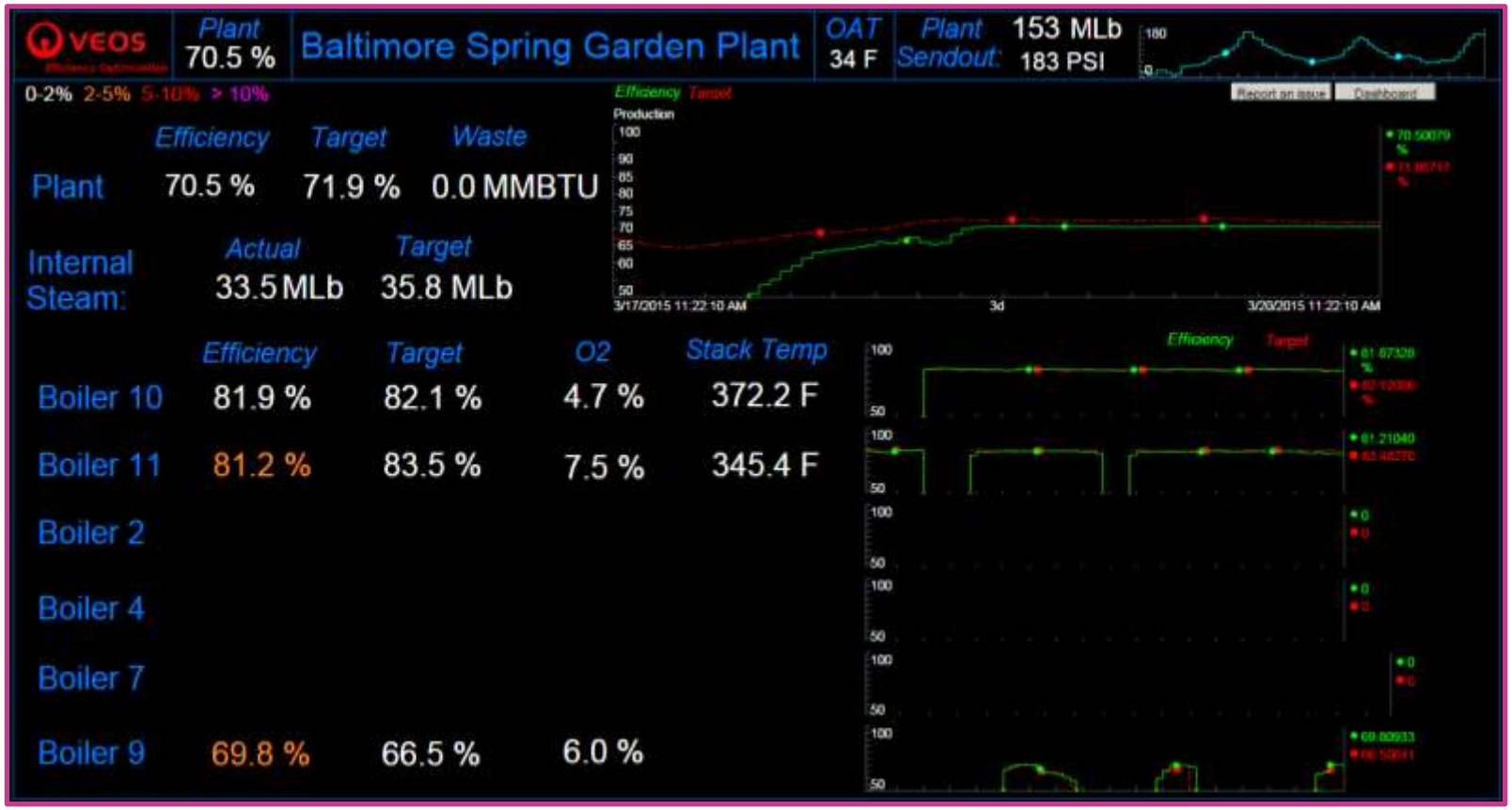
Dashboard Development: District Steam Central Plant



The VEOS dashboard will provide an integrated view of equipment and plant efficiency monitoring across the fleet.

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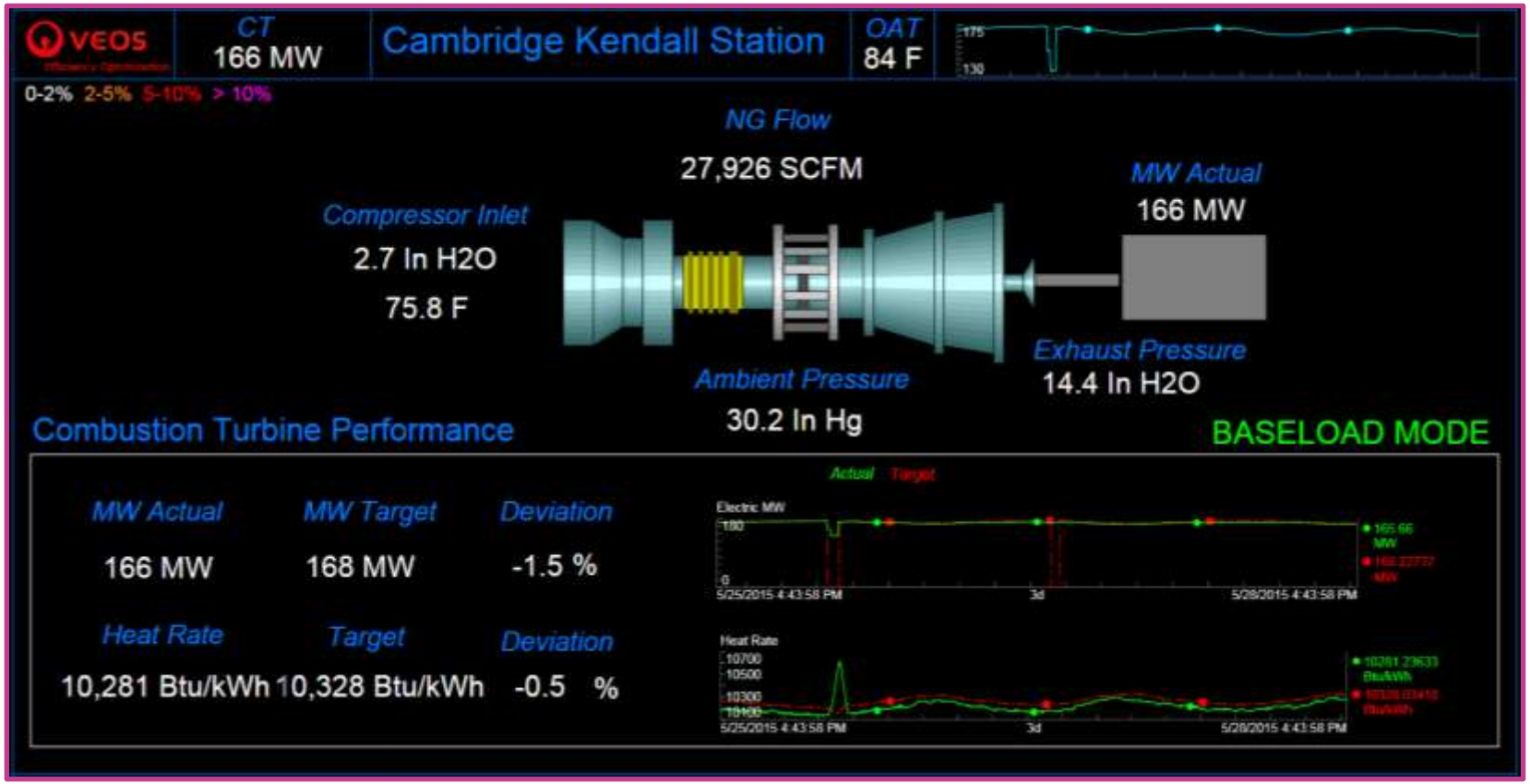
Dashboard Development: Simple Cycle Heat Rate



Information will be consolidated to a single source for plant operators, district managers, and corporate oversight.

THANK YOU

Questions?