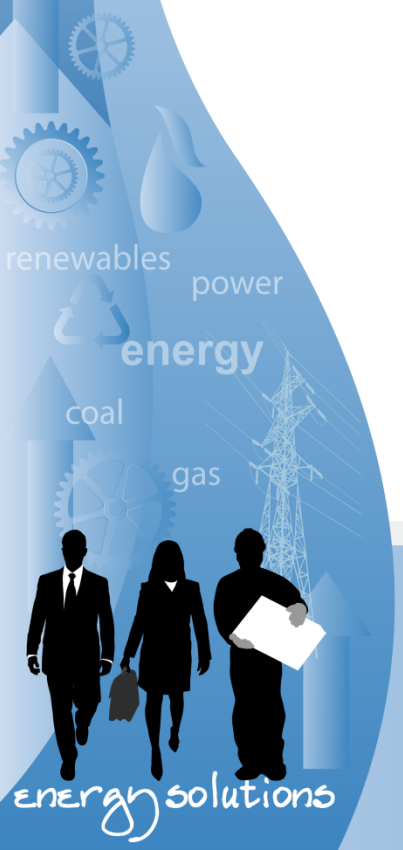
DTE Energy®

IDEA Annual Conference 2016

CHP & District Energy

CHP Fuel Switching & Re-contracting at a multi-tenant chemical campus

June 22, 2016

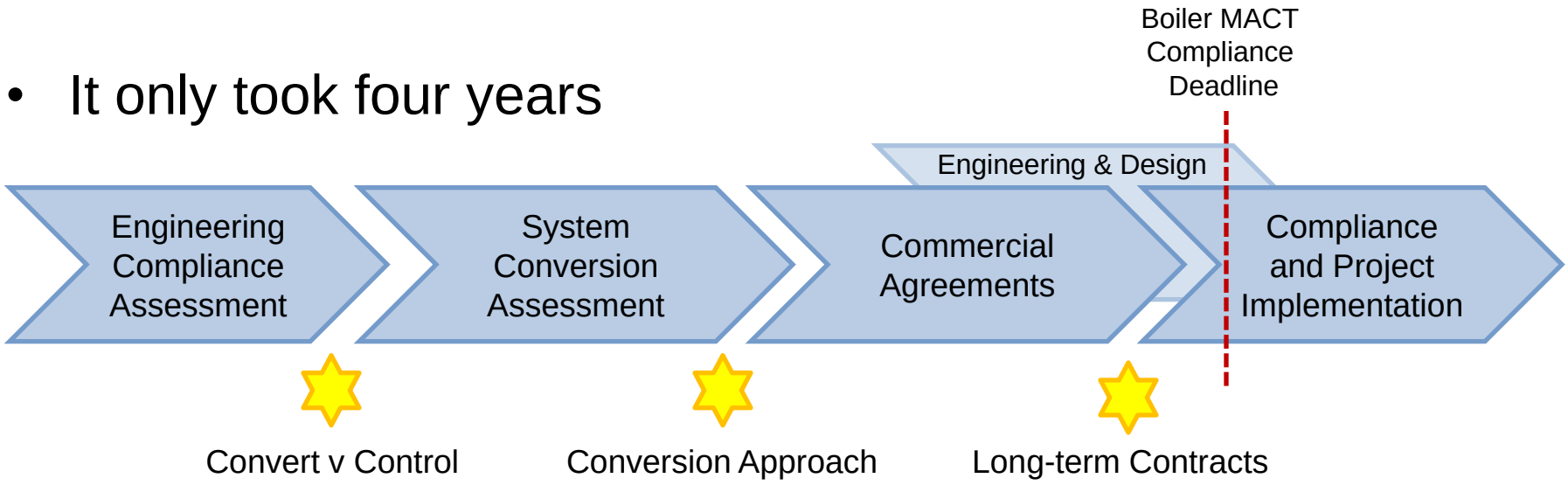


Providing fully integrated, comprehensive energy solutions

Introduction

- DTE Energy Services collaborated with its four customers at a multi-tenant chemical facility to convert a coal-fired CHP system into a natural gas-fired system, achieve compliance with the Boiler MACT, invest in the long-term reliability of the plant and…

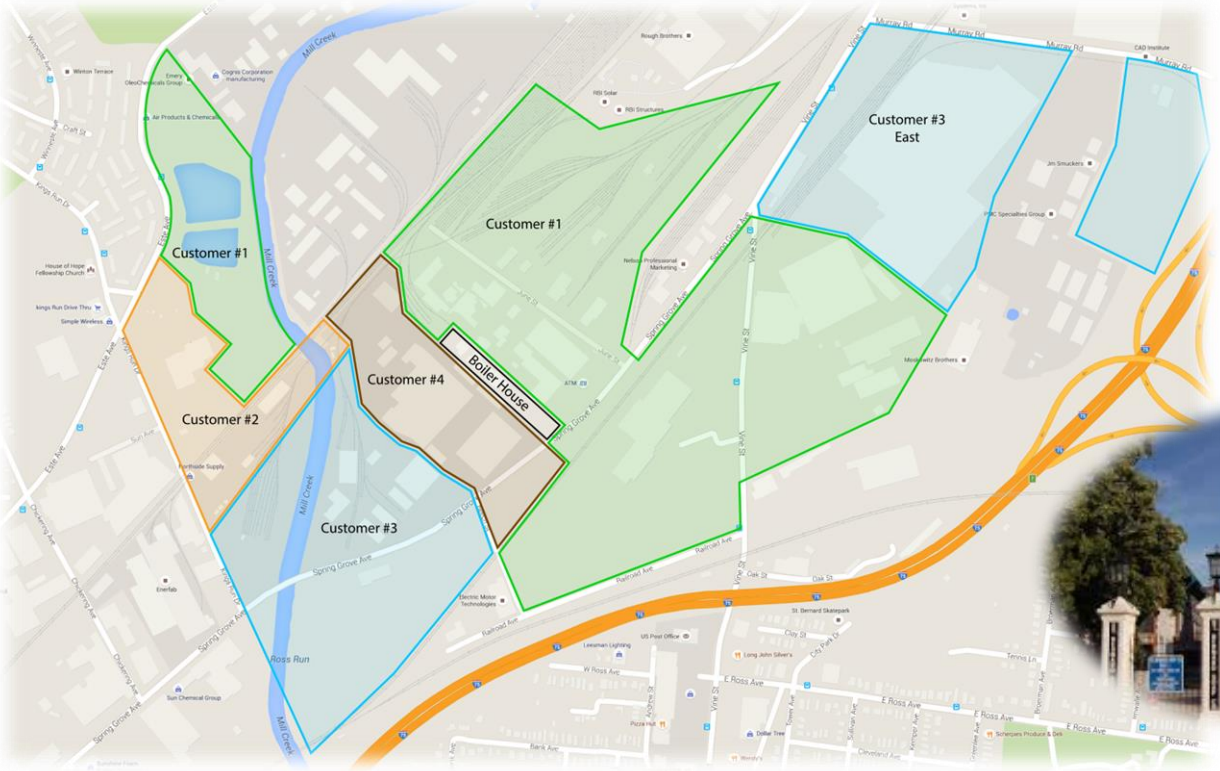
- It only took four years



The Ivorydale facility in St. Bernard, OH is one the oldest industrial sites in the U.S.

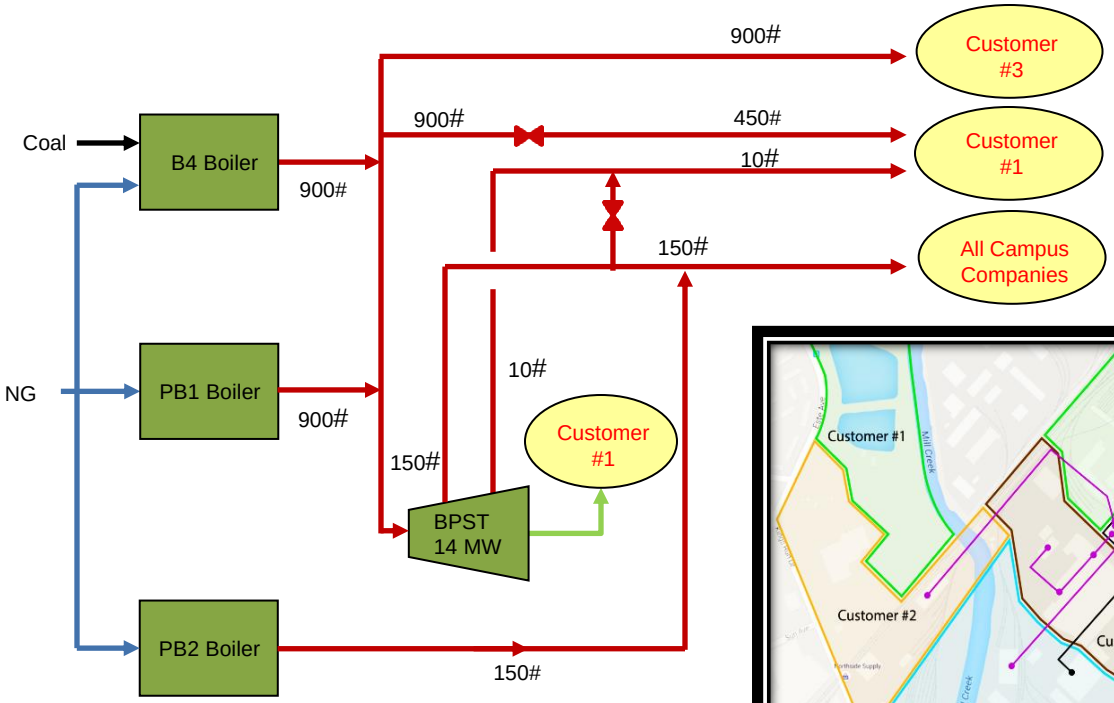
Originally developed and operated by Procter & Gamble, the Ivorydale facility has seen its share of changes

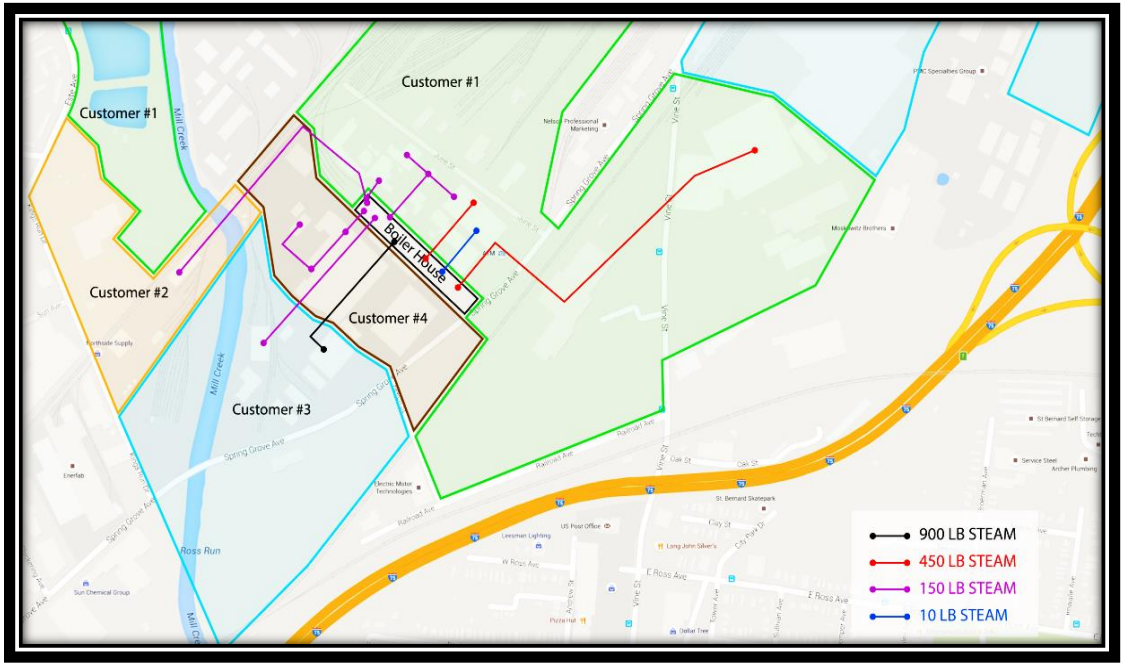
The Ivorydale facility in St. Bernard, OH is one the oldest industrial sites in the U.S.



Including, over the last 20-yrs, transitioning into a multi- tenant chemical campus that receives its energy services from the original, centrally-located boiler house

For years, site partners' steam loads were met via a ~300 kpph coal-fired boiler, with natural gas back-up, and delivered through a campus-wide distribution network





As the multi-tenant site evolved, P&G contracted with a third party for energy services supplied from the boiler house and acted as a tolling agent to deliver those services out to the other tenants

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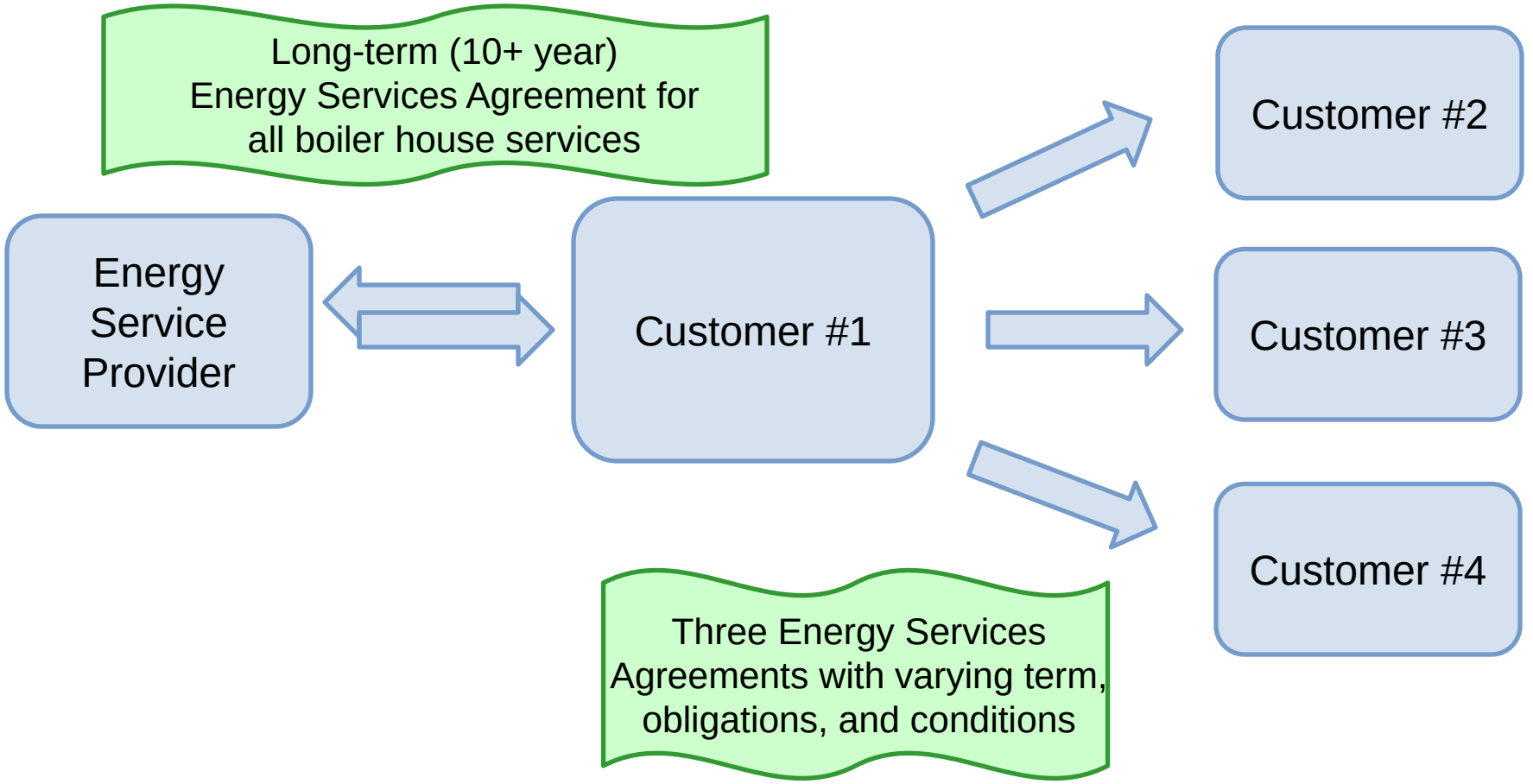


Boiler MACT compliance provided an opportunity for the site to evaluate its long-term options for steam service

Boiler MACT Compliance Options

Post-combustion emissions controls?

Y → …

N

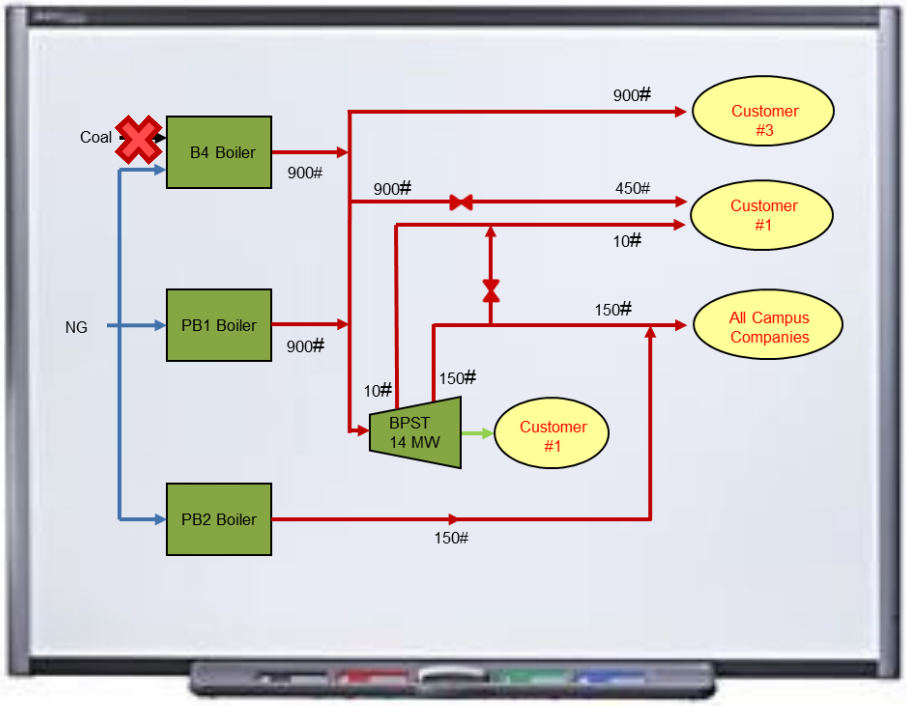
Convert or Replace?

3RD party engineering study for initial view on capital costs, operating costs and carbon footprint

Move on from Coal to… ???

Supply Side

- What are the options for producing steam and power?
- How to best maximize efficiency?
- How to best maximize reliability?
- How to minimize carbon impact?



Demand Side

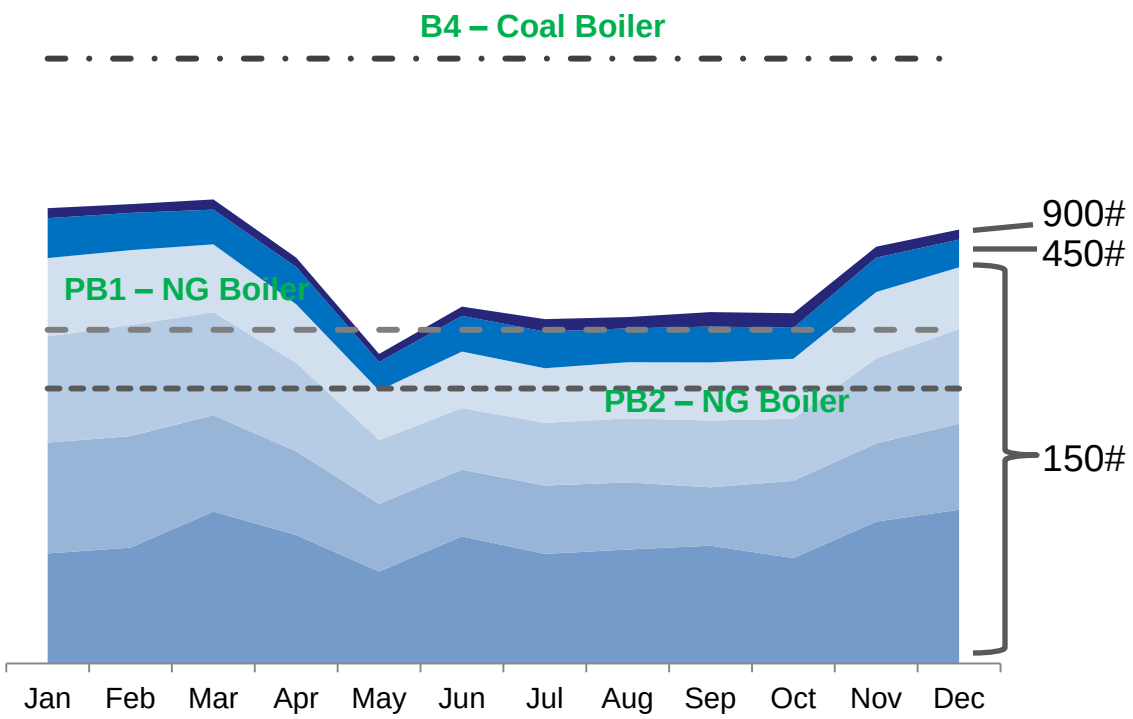
- Which customers want to stay on the loop?
- Which grades of steam are best served from the boiler house?
- Eliminate power?
- Expand power?

The goal

go from a blank white board to a campus-wide supported, technical solution for providing long-term services from the boiler house

P&G and DTEES kicked off an assessment that looked at, initially, four potential long-term peak load scenarios

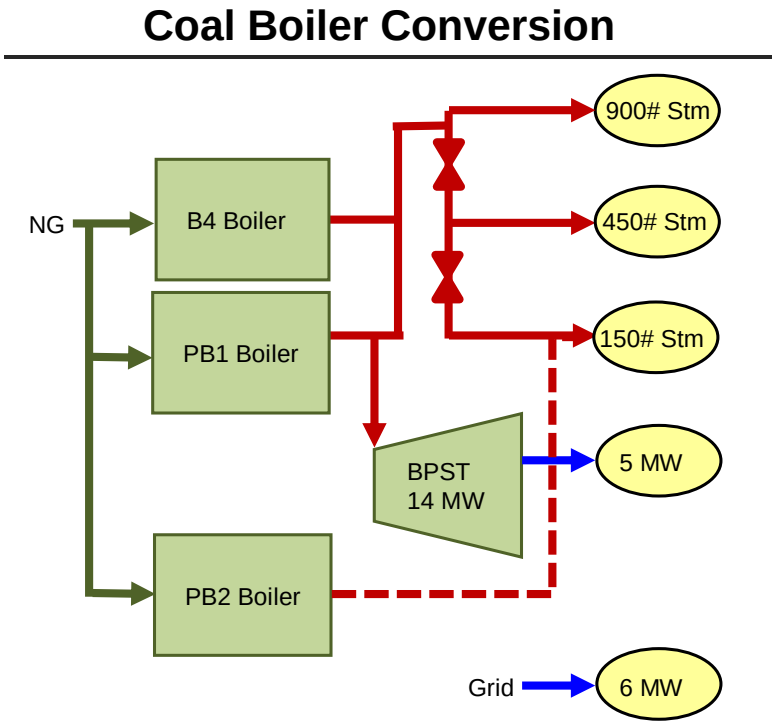
Steam Load Curves w/ Unit Capacity (kpph)



Looked at recent historical loads and made initial growth/reduction assumptions to develop a long-term view on service levels

Load Scenario	Steam Required	Power Required
High Steam / Low Power	170 kpph	11 MW
Low Steam / Low Power	120 kpph	11 MW
High Steam / High Power	170 kpph	16 MW
Low Steam / High Power	120 kpph	16 MW

And then developed several system configurations to meet those load scenarios



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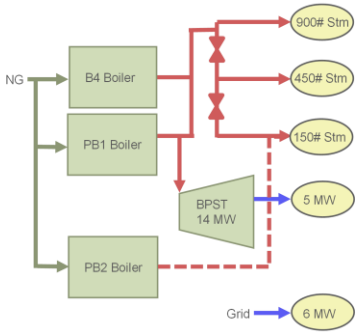
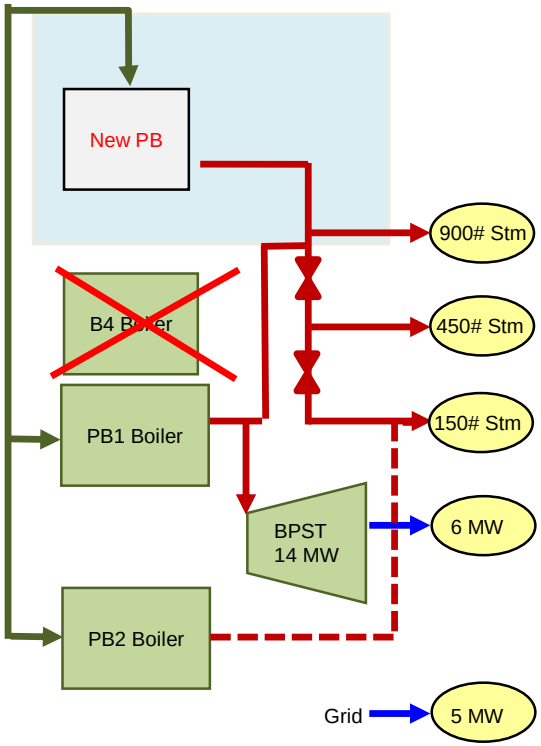
Coal Boiler Conversion



New Small Package Boiler



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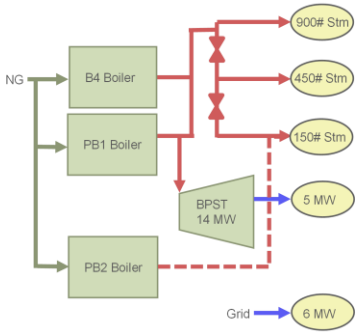
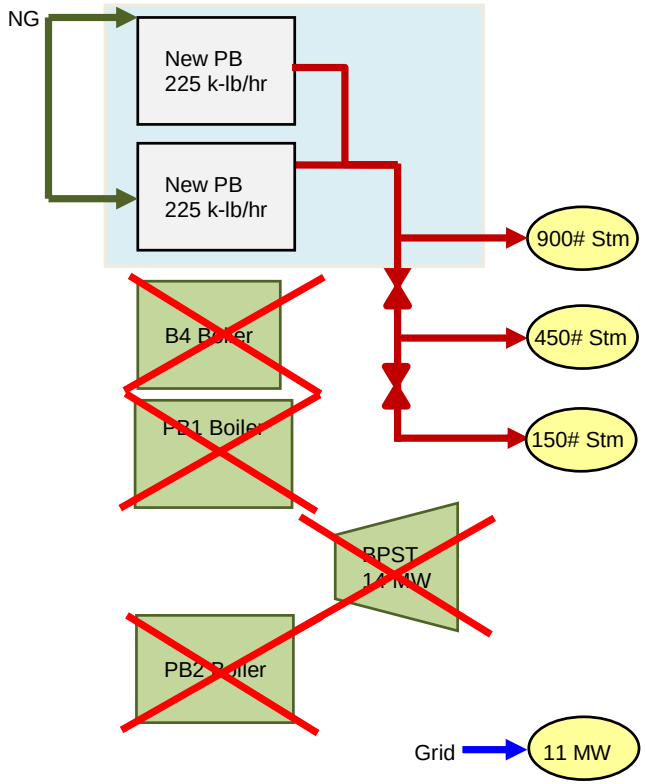


Steam Only



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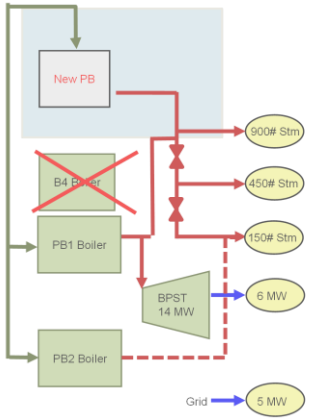

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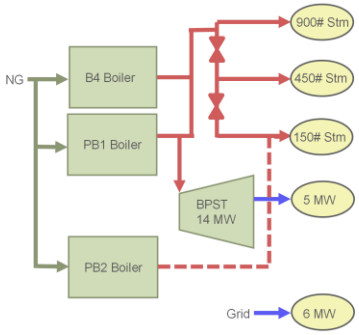
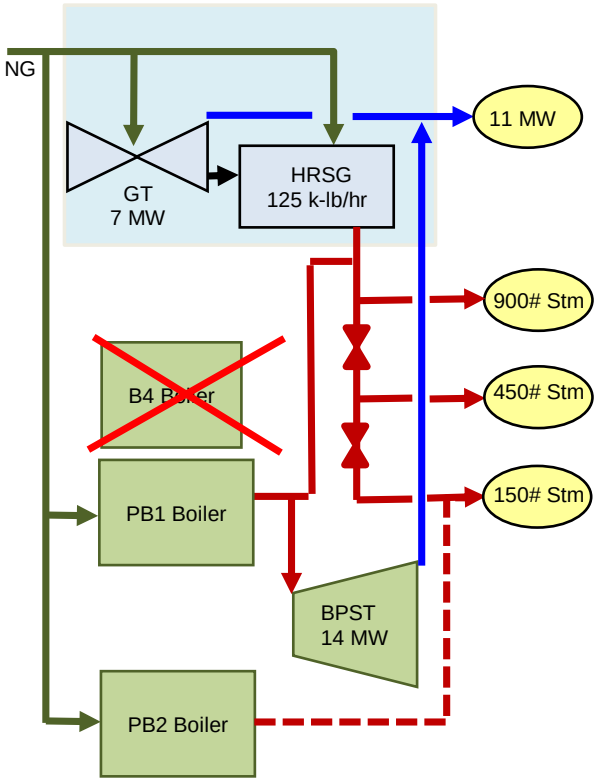


Small Gas Turbine CHP



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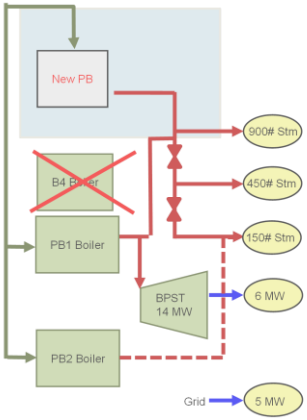

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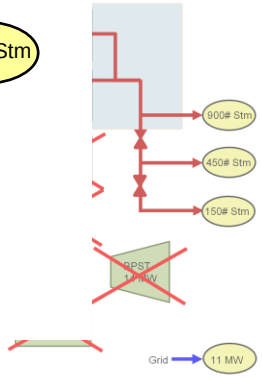

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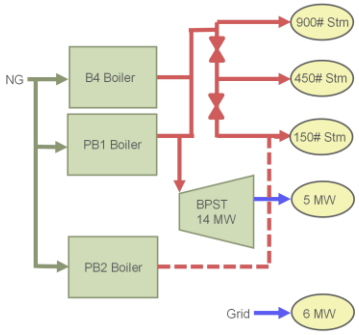
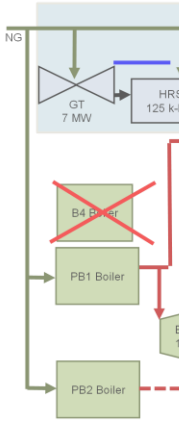
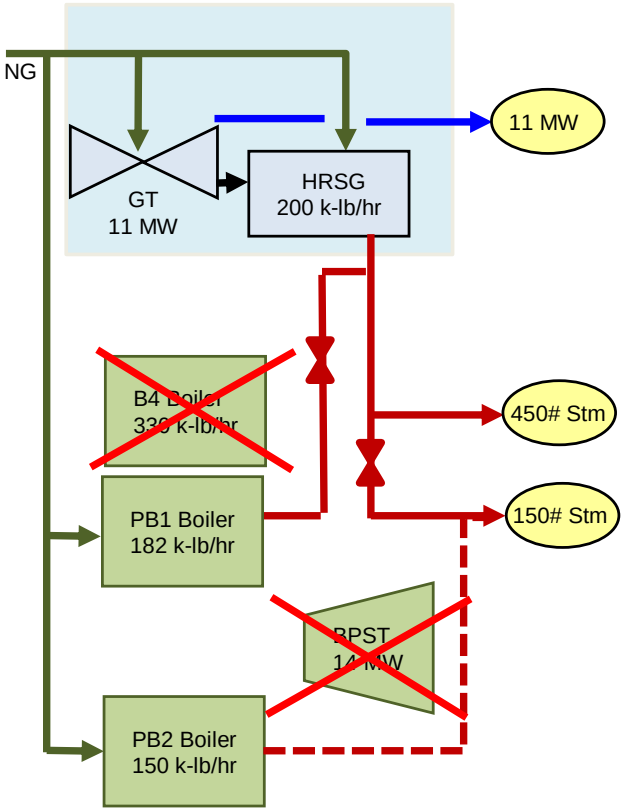


Small Gas Turb



Large Gas Turbine CHP



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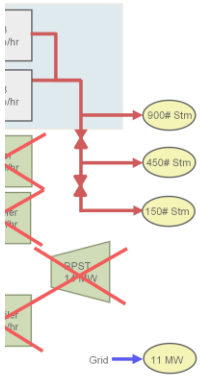

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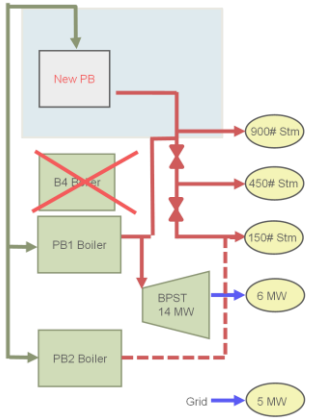

The screening analysis, while still fairly high level, accounted for a number of critical factors

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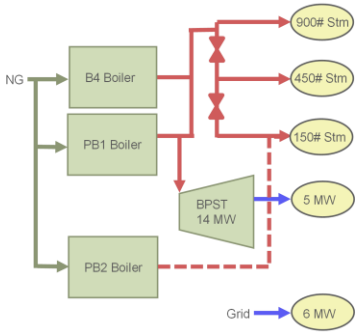
Coal Boiler Conversion



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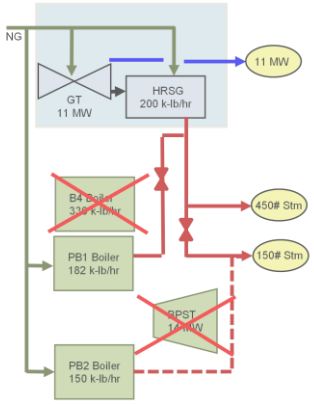

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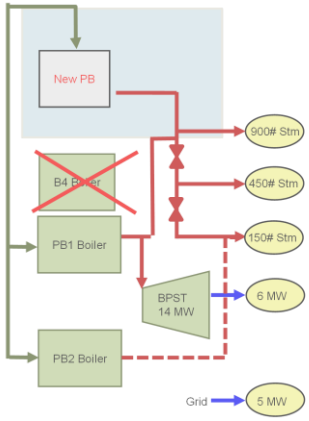

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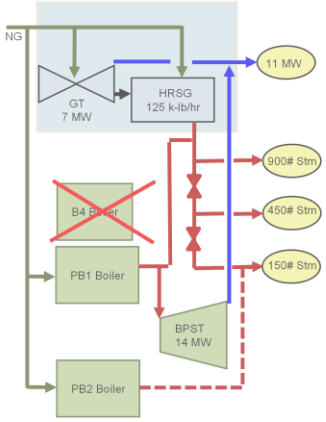
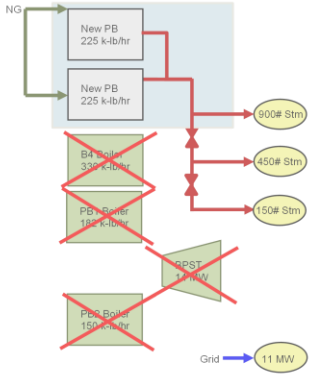


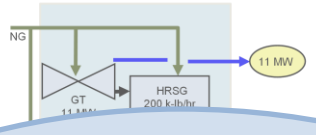
Steam Only

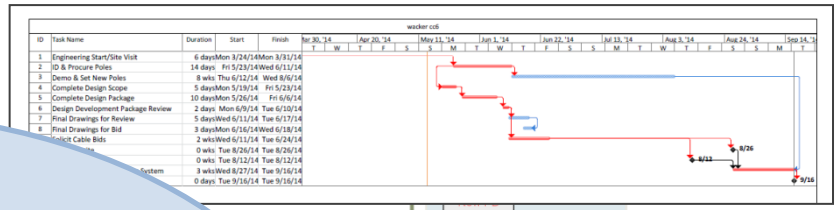


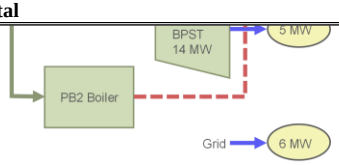
The screening analysis, while still fairly high level, accounted for a number of critical factors

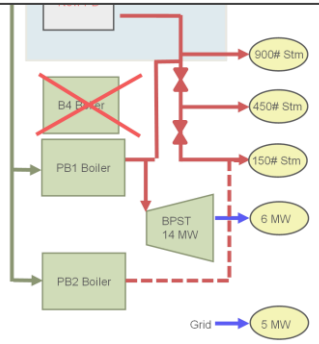
	Case 1-1
Gas Turbine/Engine	$0
Package Boiler	$0
HRSG	$0
BOP	$0
Demolition	$2,000,000
Controls	$3,000,000
Fuel Oil	$2,700,000
Install, Commodity, Building, Engineering	$1,000,000
Startup	$750,000
Development	$200,000
Contingency	$965
Total	$

Large Gas Turbine CHP



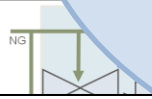




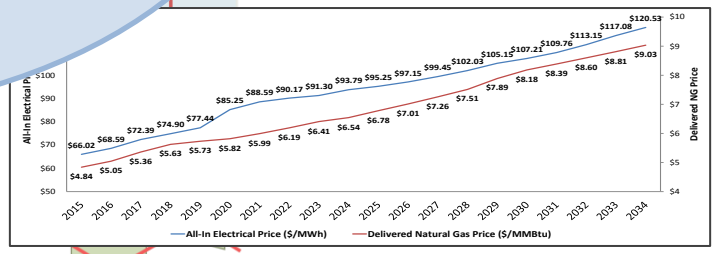


Book Impact
Demo Costs
Schedule
O&M Costs
Capital
Reliability
CO2 Emissions
Performance
Efficiency
Commodity Forecasts
Term

Small



Gross Steam (k-lb)	2,
Net 900 psig Steam (k-lb)	42,386
Net 450 psig Steam (k-lb)	100,278
Net 150 psig Steam (k-lb)	1,364,613
Self-Generated Gross Power (MWh)	53,537
Self-Generated Net Power (MWh)	40,469
Purchased Power (MWh)	55,891
Natural Gas Usage (MMBtu)	2,610,010
Effective CO2 Emissions (tons)	175,693



For each configuration and each load scenario, the screening analysis produced a set of outputs in order to make the comparative assessment

DTE Energy

Summary Table for Each Case

Case	1-4	2-4	3-4	3A-4	4-4	5-4
Capital Cost ($000)						
Effective CO2 Emissions (ton/yr)						
Est. First Year Costs ($000)						
Fixed System Maintenance Costs						
NG Fuel Cost						
Net Electricity Costs						
Consumables						
Water & Sewer Costs						
Feedwater Costs						
Total						
Avg Annual Costs ($000)						
Fixed System Maintenance Costs						
NG Fuel Cost						
Net Electricity Costs						
Consumables						
Water & Sewer Costs						
Feedwater Costs						
Total						

Total Cost Sensitivity to Commodity Pricing

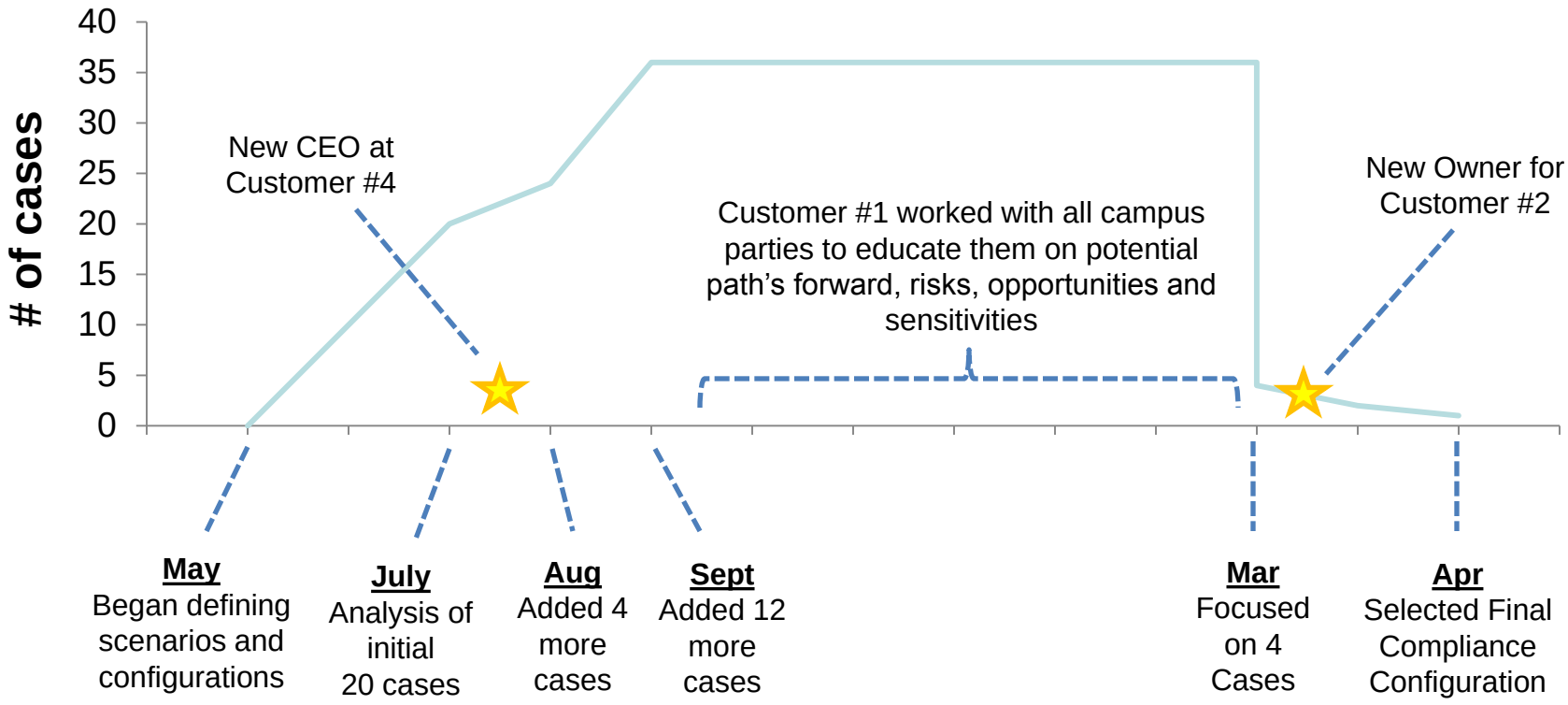
First Year Cost ($000/Yr) w/ DTE Investment							
		First Year Delivered Gas Price ($/MMBTU)					
		$3.50	$4.00	$4.50	$5.00	$5.50	$6.00
First Year Electrical Price ($/MWh)	$50	24,598	25,789	26,981	28,172	29,364	30,555
	$60	24,766	25,958	27,149	28,341	29,532	30,724
	$70	24,935	26,127	27,318	28,510	29,701	30,893
	$80	25,104	26,295	27,487	28,678	29,870	31,061
	$90	25,273	26,464	27,656	28,847	30,039	31,230
	$100	25,441	26,633	27,824	29,016	30,207	31,399

Project Life Average Annual Cost ($000/Yr) w/ DTE Investment							
		First Year Delivered Gas Price ($/MMBTU)					
		$3.50	$4.00	$4.50	$5.00	$5.50	$6.00
First Year Electrical Price ($/MWh)	$50	31,056	32,743	34,430	36,117	37,804	39,491
	$60	31,296	32,983	34,670	36,356	38,043	39,730
	$70	31,536	33,222	34,909	36,596	38,283	39,970
	$80	31,775	33,462	35,149	36,836	38,523	40,209
	$90	32,015	33,702	35,389	37,075	38,762	40,449
	$100	32,254	33,941	35,628	37,315	39,002	40,689

- At this stage, we were focusing primarily on order of magnitude total costs, comparative value proposition between the various configurations and complexity.
- We were producing long-term cash flow strips in order to evaluate on an NPV Basis

Load scenarios defined. Configurations considered. Initial assumptions and inputs gathered…

Time to Iterate



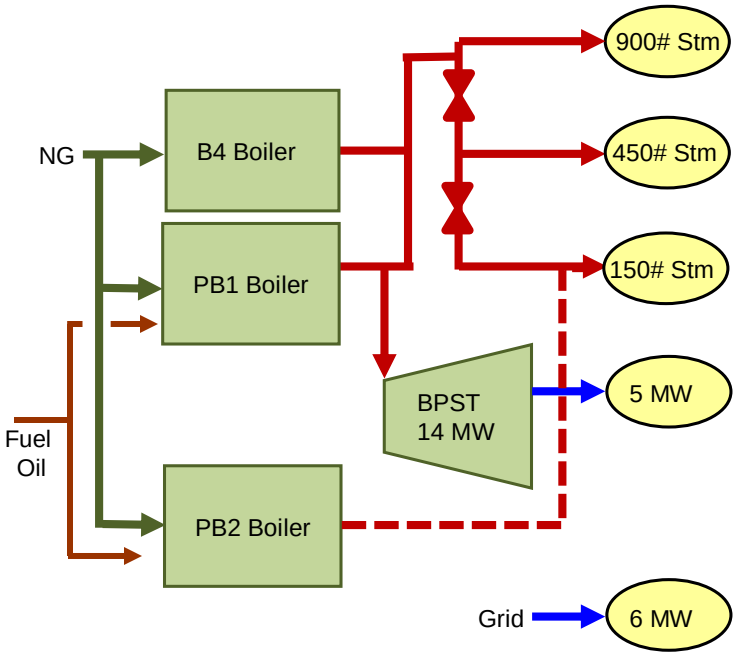
At the time of the analysis, coal was still cheaper than NG, customers had varying views on short-term v. long-term issues, and all were looking for efficiency improvements and lower annual costs

The campus elected to convert the existing equipment to burn natural gas with fuel oil as a back-up

Supply Side

- Modify B4 to burn primarily NG
- Install a back-up Fuel Oil system for reliability
- Invest in a controls package upgrade

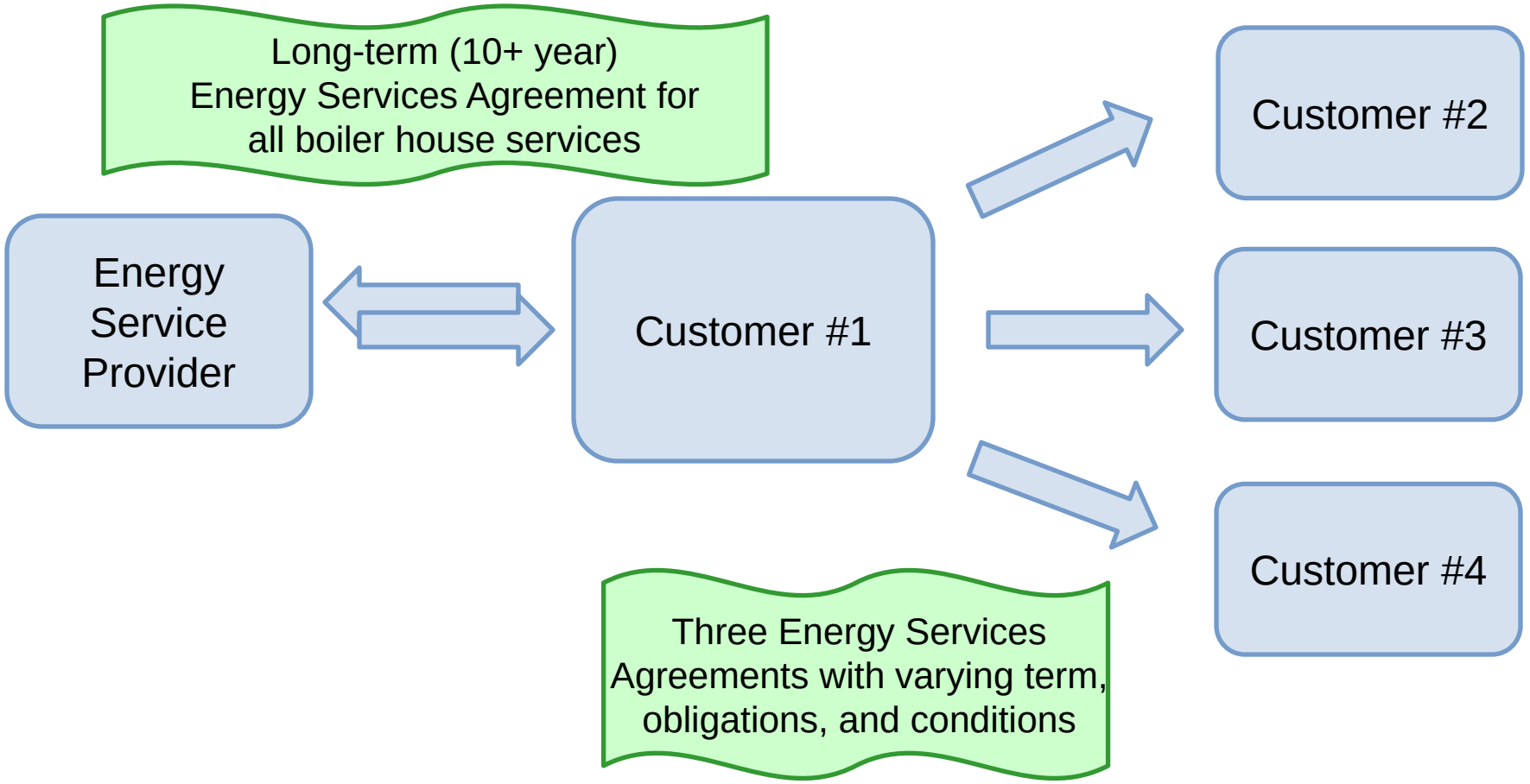
Coal Boiler Conversion



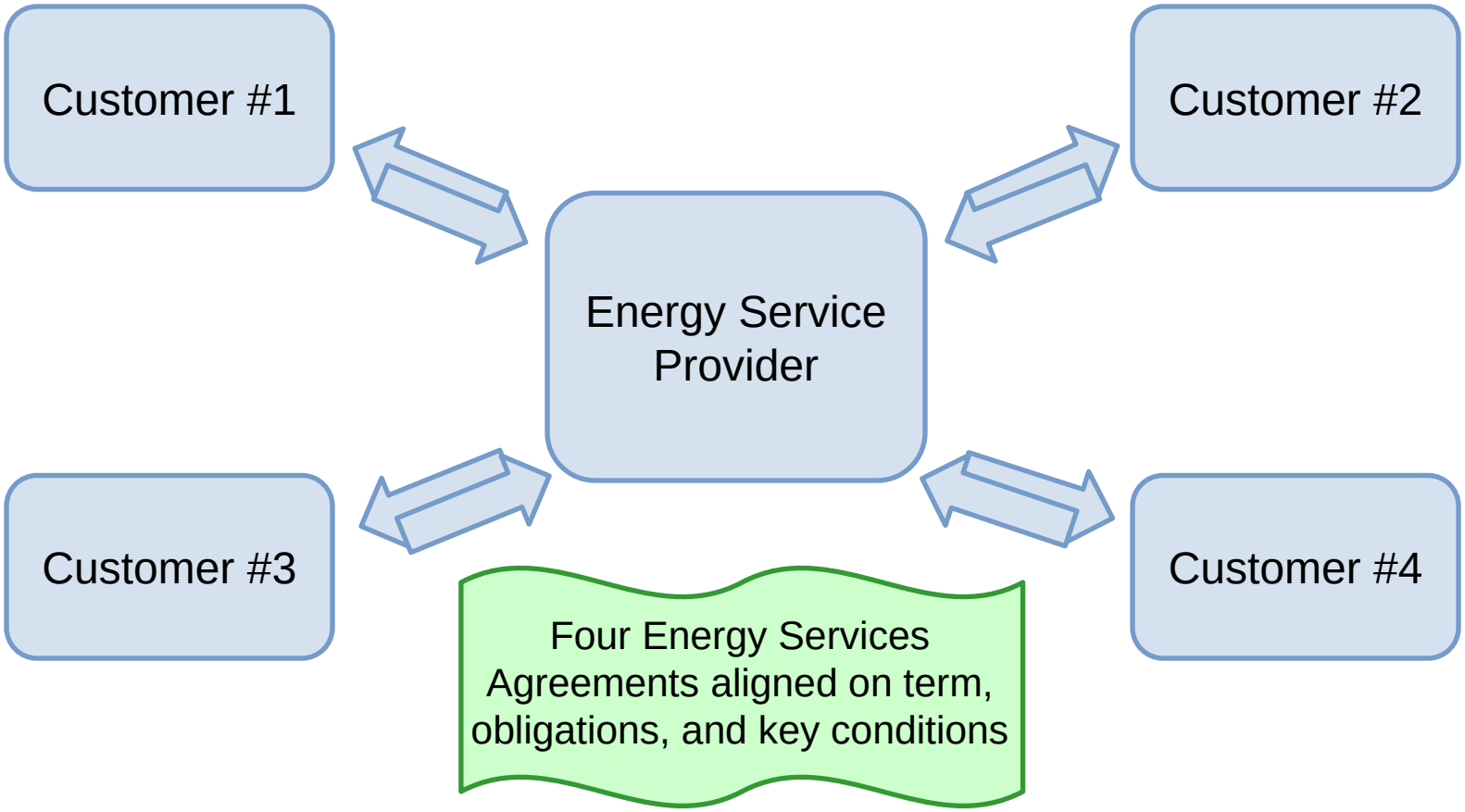
Demand Side

- Maximum of 7 years for term of modified contract
- No forecasted significant changes in load
- Trade fixed O&M reductions from removal of coal system with expected increases in commodity costs

So we had the preferred technical solution defined, now we just need to amend the contract…



Except…
The campus was ready to transition to a model where the energy service provider had direct relationships with all the campus partners



Except…
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DTE Energy

Customer #1

Customer #2

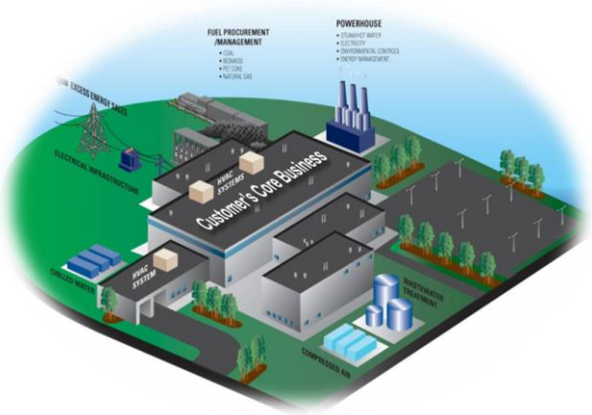
We are still on the clock!

Customer #3

Customer #4

Agreements aligned on term, obligations and key conditions

Who is DTE Energy Services? and What are you offering?

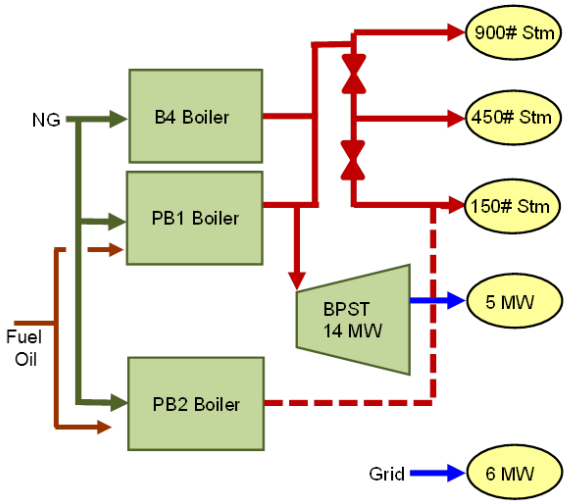


- P&G introductions to key decision makers
- Leverage long-term operating relationships at the campus
- Form relationships with customer teams that expand beyond St. Bernard site
- Introduce DTE Energy Services skills, experience and breadth

- Pick-up conversation from where P&G had left it
- Communicate the technical solution and the proposed commercial arrangement (w/ pricing)
- Provide an analysis of each customer's savings and value over the current configuration
- Capital Project Timing – Compliance and Cold Season Reliability

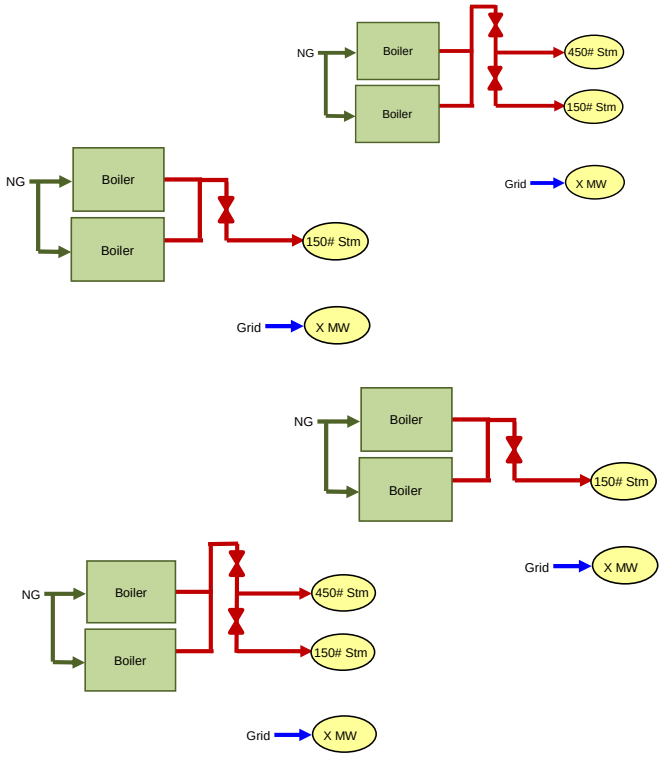
Value Prop Analysis – Make v. Buy?

Campus Solution



- Capital Investment
- Reliability
- Operating and Maintenance Costs
- Timing
- Commodity Prices
- Control
- Transferability
- Pay back
- Siting
- Distribution

Customer's Own Solution



Negotiations and Approval

- Four teams of commercial, operational, engineering and legal, representing each side, began working through each contract as a stand alone document
- Four customers having four different sets of drivers, risk tolerances, interest in optionality, and urgency

- The form of the contracts and the issues, risks and obligations covered were materially changing for some customers
- Contracts longer than 12-months were new for some customers

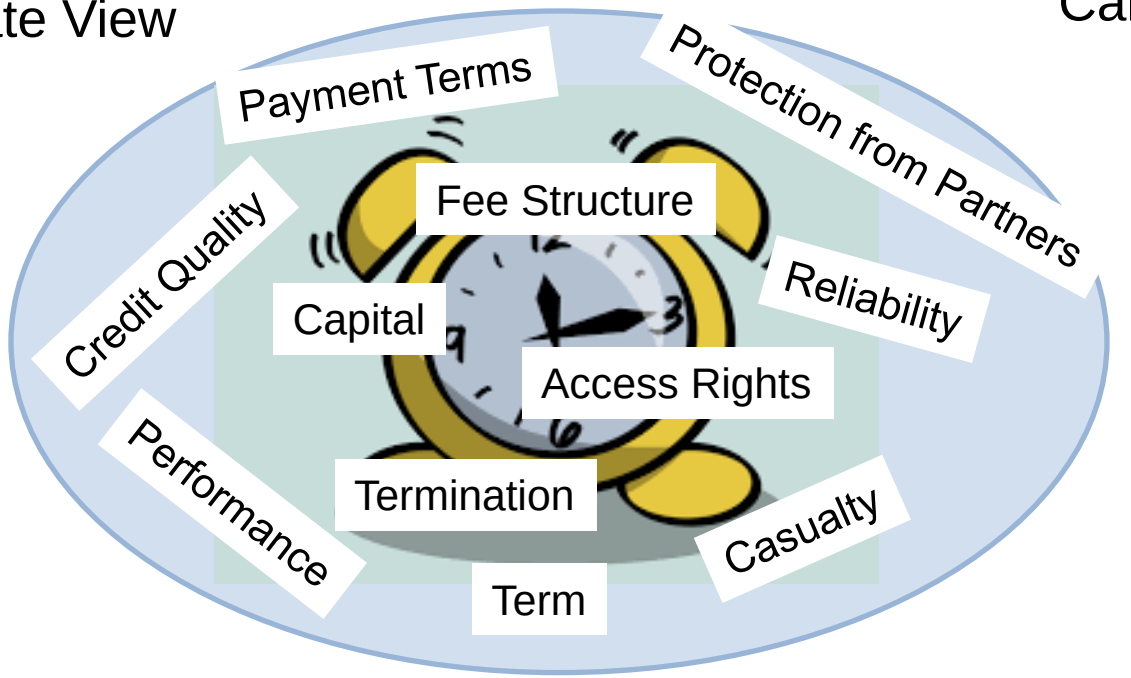
- Each campus partner had its own unique capital or long-term contract approval process
- Level of engineering performed to this point fell short of some partners' approval requirements

- To keep up the clock, as a campus, we began spending on engineering to align comfort on capital costs with partners' requirements

This is complex stuff!

Corporate View

Campus View



Site View

Legal View

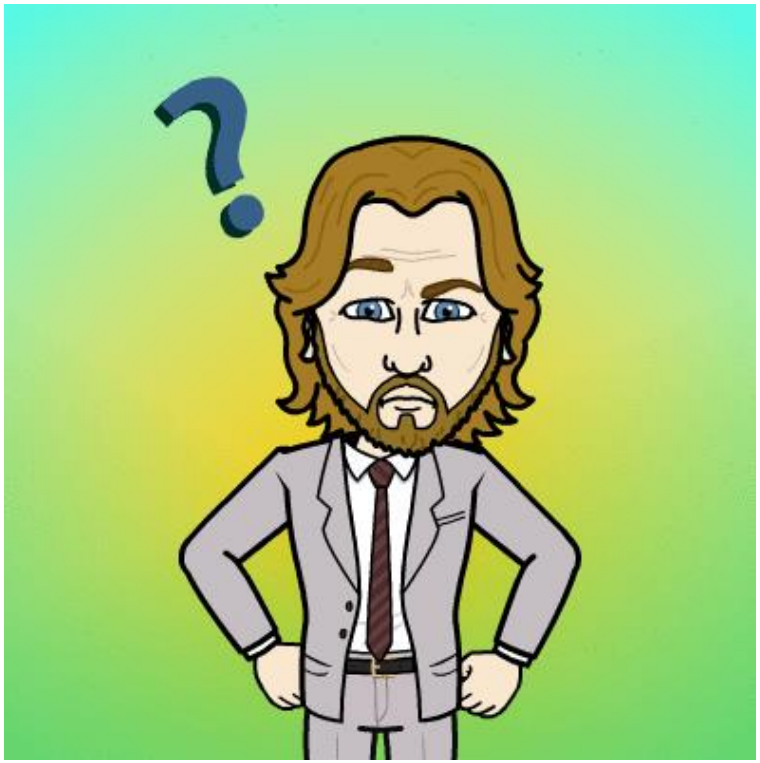
Procurement View

DTEES View

Ivorydale is a Campus of Partners

- This took the focus and dedication of dozens of people over the course of a long period of time to get to close
- Customers got the least cost, highest reliable solution for their post-Boiler MACT steam and power loads
- Boiler MACT was, undoubtedly, a significant driver to bringing the parties together to evaluate and coordinate around the on-going campus-wide solution

And just to prove we did what we said we would – construction pictures!



Any questions?

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No?