CHP Project Design

Don't Overlook the Details

Presented at: IDEA2017, Scottsdale AZ
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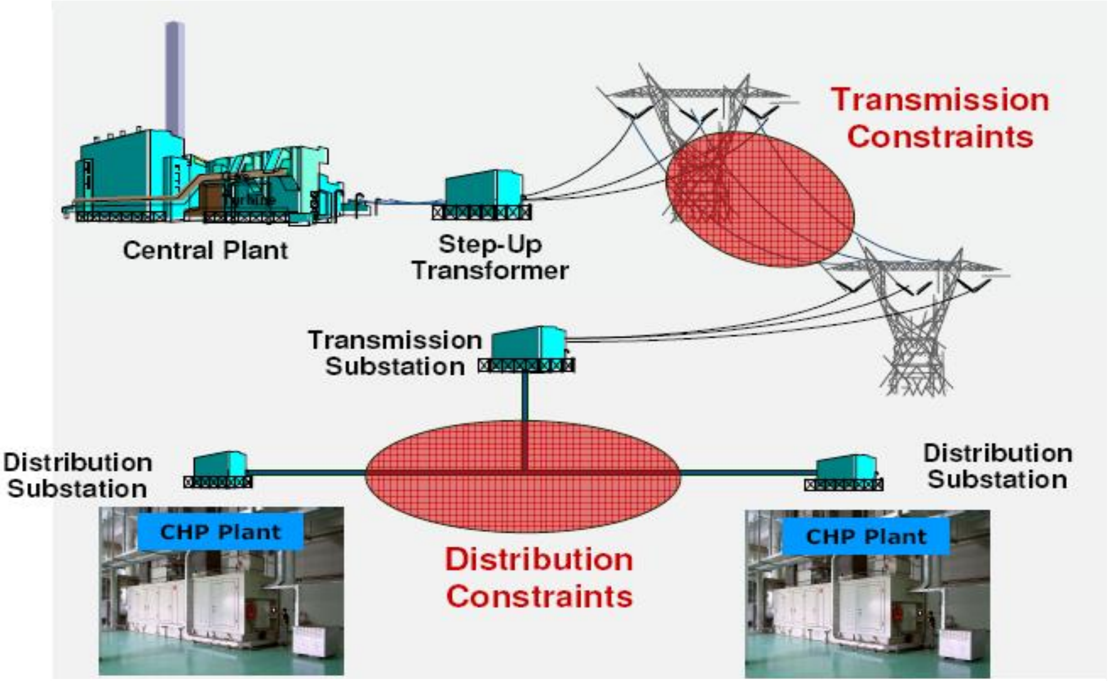
Kinect Energy Group

Topics

- The Case for CHP
- High Level (First Cut) CHP Analysis
- Project Sizing and Operating Strategies
- Next Level CHP Analysis
- But, ***"Don't Forget the Details"***
- Summary

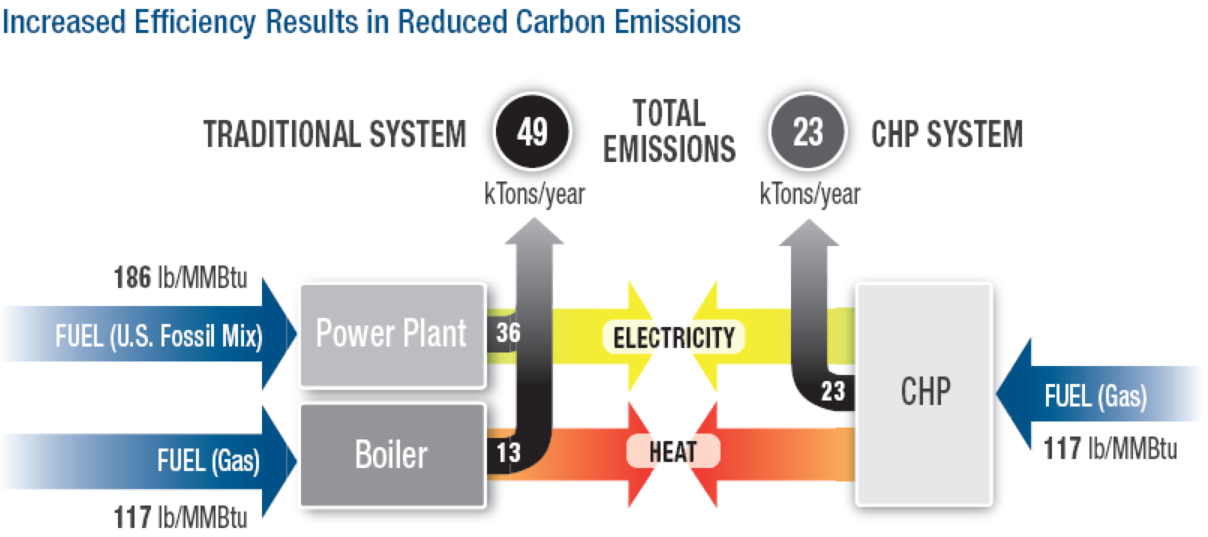
The Case for CHP

- CHP Provides Grid Support



The Case for CHP

- Increased Energy Efficiency Results in Reduced Carbon Emissions



Example of the CO_2 savings potential of CHP based on a 5 MW gas turbine CHP system with 75% overall efficiency operating at 8,500 hours per year providing steam and power on-site compared to separate heat and power comprised of an 80% efficient on-site natural gas boiler and average fossil based electricity generation with 7% T&D losses.

Source: ICF International

The Case for CHP

- **Basic Drivers for good CHP Projects**
  - High electricity costs (Ideally > $0.07 / kWh)
  - Low natural gas costs (Ideally < $8 / MMBtu delivered)
  - Constant Thermal Load (Ideally 24 x 7 - Year Round)
    - Central Chilled Water Plant in place of non-heating thermal load through steam driven chillers or absorption chillers
- **Additional Drivers** (*can overcome above, such as lower elec rates*) :
  - Carbon Reduction Goals or Incentives
  - Production Growth requiring additional steam / hot water supply
  - Aging boilers in need of significant repair or replacement
  - Federal, State, Local and Utility Incentives
  - Grid Reliability concerns
  - *"I just hate my local utility!"*

The Case for CHP

- **“Outside the Box” Option: Third Party PPA**
  - Designs Builds Owns Operates and Maintains
  - No Capital required by host facility
  - Immediate Savings
  - Requires Long Term Commitment *(typically 10 – 15 years or more)*
  - Third Party may oversize and sell power into the grid (Wholesale Market)

High Level (First Cut) CHP Analysis

Combined Heat & Power (CHP) Analysis

Description - e.g., expected operation versus load, sell back, incremental purchase, etc.

Ethan Ole Fuels
1234 Hickory Rd, Small Town MN 99999
Ye Ol' Stubborn REC

6/13/2017

Assumptions / Inputs

Current Annual Peak Demand (kW)	10,000	*per CY2016 usage history*
Current Annual Electric Usage (kWh)	73,200,000	*per CY2016 usage history*
Current Annual Natural Gas Usage (MMBtu)	2,949,000	*per CY2016 usage history*
Current Minimum Monthly Natural Gas Usage (MMBtu)	214,000	*per CY2016 usage history*
Current Minimum Daily Natural Gas Usage	*7,130*	*(MMBtu/day)*
Proposed Power to be Generated (kW)	9,845	*Estimate*
Generator Capacity Factor (driven by thermal load)	97.5%	*Estimate - Assumes Electric Load Following*
Heat Rate (Btu/kWh) - LHV	7,774	*per Recip Engine Spec Sheet from Siemens/Dresser Rand*
Conversion Factor *[Heat Rate @ 100% Efficiency (Btu/kWh)]*	3,412	*Industry Standard*
Delivered Natural Gas Unit Cost ($/MMBtu)	$4.100	*per Historical Cost & Usage*
Delivered Electric Unit Cost ($/kWh)	$0.066	*per Historical Cost & Usage, 1.03 Annual Cost Escalation Factor*
Standby Power ($/kW-mo)	$1.80	*Weighted Avg Seasonal Capacity Reservation Charge*
Installed Equipment Cost ($/kW)	$1,750	*Estimate*
Interest Rate	5.00%	*Assumed*
Term (years)	10	*Assumed*
Maintenance Cost ($/kWh)	$0.012	*Estimate*
Engine Thermal Efficiency	46.3%	*per Recip Engine Spec Sheet from Siemens/Dresser Rand*
Boiler Efficiency	85%	*Assumed*
Waste Heat Utilization	100%	*Assumed*
Forward Price or Utility Buy Back Rate ($/kWh)	$0.050	*Estimate*

5 Units at 1,969 kW

High Level (First Cut) CHP Analysis

Results / Output

Outputs

Annual Electric Energy to be Produced (kWh)	**84,086,145**	
Electric Efficiency	43.9%	
Heat Rate (Btu/kWh) - HHV	8,551	MMBtu/hr:
Capital Equipment Cost (Installed)	$17,228,750	82
Heat Recovery		
Annual Gas Consumed by Generator *(based on HHV)*	719,100	(MMBtu/yr)
	1,970	*(MMBtu/day)*
Heat Available for Recovery *(based on LHV)*	302,700	(MMBtu/yr)
Waste Heat Utilized (MMBtu)	302,700	42.1%
Boiler Heat Displaced (MMBtu)	356,100	
	980	*(MMBtu/day)*
Incremental Natural Gas Consumption	363,000	(MMBtu/yr)
	990	*(MMBtu/day)*
Incremental Natural Gas Cost	$1,488,300	

Electric Cost Breakdown	**Annual Cost**	**Unit Cost**
Natural Gas for Engine	**$2,948,300**	**$0.0351**
Maintenance Cost	**$1,009,000**	**$0.0120**
Standby Power Cost	**$212,700**	**$0.0025**
Debt Service	**$2,192,900**	**$0.0261**
Total Cost (without Heat Recovery)	**$6,362,900**	**$0.0757**
Fuel Credit (Heat Recovery)	**($1,460,000)**	**($0.0174)**
Net Cost Chargeable to Power	**$4,902,900**	**$0.0583**

Current Cost for Purchased Electric	**$4,831,200**
Value of Excess Generation	**$544,300**
Future Electric Cost *(excluding Debt Service)*	**$2,710,000**
NET ELECTRIC COST SAVINGS =	**($2,665,500)**

SIMPLE PAYBACK (without CA Sales) **6.5 Years**

Simple Payback is not great

High Level (First Cut) CHP Analysis

Simple Payback Sensitivity Analysis (Years)

Varying Natural Gas & Electric Prices

Delivered Electric Cost	Delivered Natural Gas Cost: $3.10	$3.60	$4.10	$4.60	$5.10
$0.0610	6.5	6.9	7.5	8.1	8.9
$0.0660	5.7	6.1	6.5	6.9	7.5
$0.0710	5.1	5.4	5.7	6.0	6.5
$0.0760	4.6	4.8	5.1	5.4	5.7
$0.0810	4.2	4.4	4.6	4.8	5.1

KEY ASSUMPTIONS

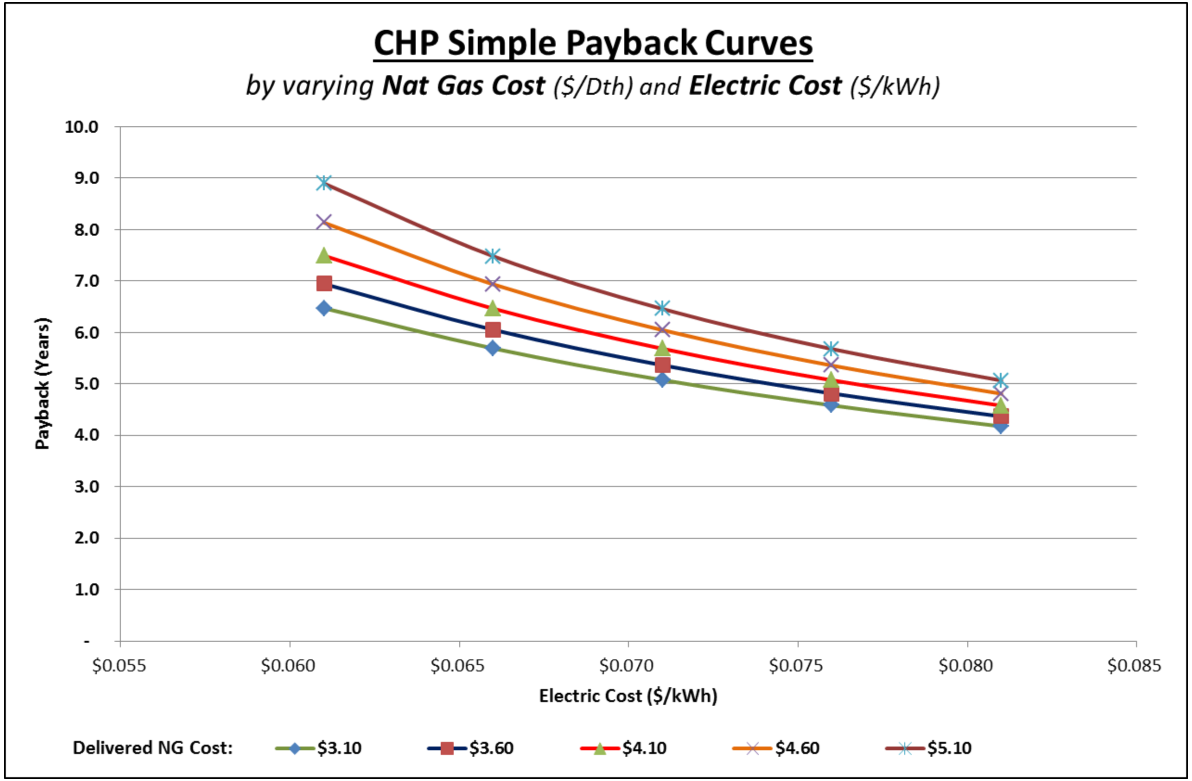
Delivered NG Cost ($/MMBtu)	$4.10
Delivered EL Cost ($/kWh)	$0.066
Assumed Standby Cost ($/kW)	**$ 1.80**
Assumed Capital Cost ($/kW)	**$ 1,500**
Maintenance Cost ($/kW)	**$ 0.012**
Avg Annual Rate Incr (4 Yrs)	**0.0%**
Unit Cost Variance	
Natural Gas ($/MMBtu)	***$ 0.500***
Electric ($/kWh)	***$ 0.005***

High Level (First Cut) CHP Analysis

NOTE that Average Electric Price Impacts Payback much more than Average Natural Gas Price

NG Price Variance of 67% *($3 - $5)* impacts Payback by 1 Yr – 2.5 Yrs

EL Price Variance of 33% *($.06 - $.08)* impacts Payback by 2.5 Yrs – 4 Yrs



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Simple Payback Sensitivity Analysis (Years)

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Better Payback

KEY ASSUMPTIONS

Delivered NG Cost ($/MMBtu)	$4.10
Delivered EL Cost ($/kWh)	$0.075
Assumed Standby Cost ($/kW)	**$ 1.80**
Assumed Capital Cost ($/kW)	**$ 1,500**
Maintenance Cost ($/kW)	**$ 0.012**
Avg Annual Rate Incr (4 Yrs)	**3.0%**
Unit Cost Variance	
Natural Gas ($/MMBtu)	***$ 0.500***
Electric ($/kWh)	***$ 0.005***

Project Sizing and Operating Strategies

- Size to meet Electric Load?
  - Baseload vs Peak Load?
  - Seasonality?
- Size to meet Thermal Load?
  - Baseload vs Peak Load?
  - Seasonality?
- For Typical Ethanol Production Facility – Thermal Load can support at least 5X Electric Load
  - For Example,
    - 100 MGPY Plant Has Typical Electric Load of 8 – 10 MW
    - Thermal Load Can Support 40 MW – 60 MW Generation CHP Plant

Project Sizing and Operating Strategies

Size to meet Electric Load? Let's Revisit our High Level Assessment

Combined Heat & Power (CHP) Analysis

Description - e.g., expected operation versus load, sell back, incremental purchase, etc.

Ethan Ole Fuels
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Ye Ol' Stubborn REC

6/13/2017

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Forward Price or Utility Buy Back Rate ($/kWh)	$0.050	*Estimate*

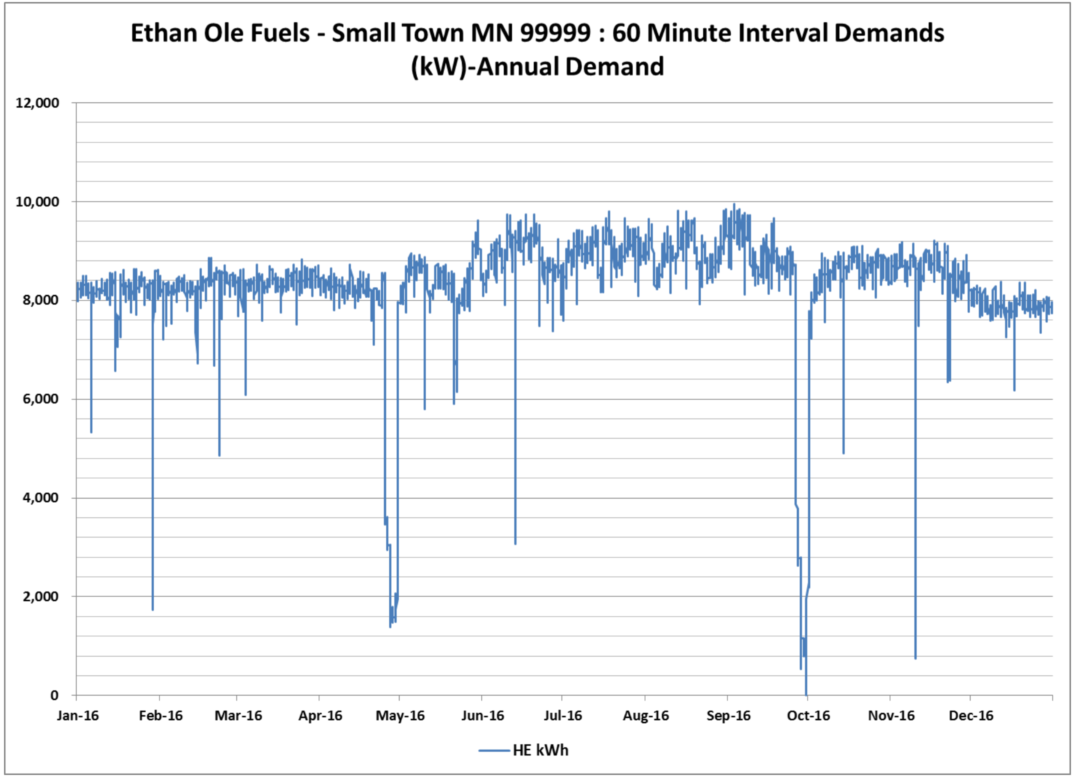
Project Sizing and Operating Strategies

Typical Ethanol Plant ➔ High Load Factor ➔ Hourly Loads for a Year, *below*

Client: Ethan Ole Fuels
City/State: Small Town MN 99999
LDC: Ye Ol' Stubborn REC
Supplier: *Slick Rick's Electric Brokerage*
Region: MISO

Monthly Historical Consumption

Calendar Month	Total Usage (kWh)	Demand (kW)	Load Factor Hours Use	Load Factor %
Jan-16	6,052,012	8,637	701	94%
Feb-16	5,712,957	8,867	644	96%
Mar-16	6,213,615	8,826	704	95%
Apr-16	5,200,451	8,729	596	83%
May-16	6,243,132	9,617	649	87%
Jun-16	6,393,398	9,742	656	91%
Jul-16	6,697,912	9,796	684	92%
Aug-16	6,697,191	9,839	681	91%
Sep-16	5,695,199	9,955	572	79%
Oct-16	6,278,059	9,110	689	93%
Nov-16	6,139,989	9,210	667	93%
Dec-16	5,878,670	8,375	702	94%
Annual Total:	**73,202,585**	**9,955**	**7,353**	**84%**
Monthly Avg:	*6,100,215*	*9,225*	*662*	*91%*

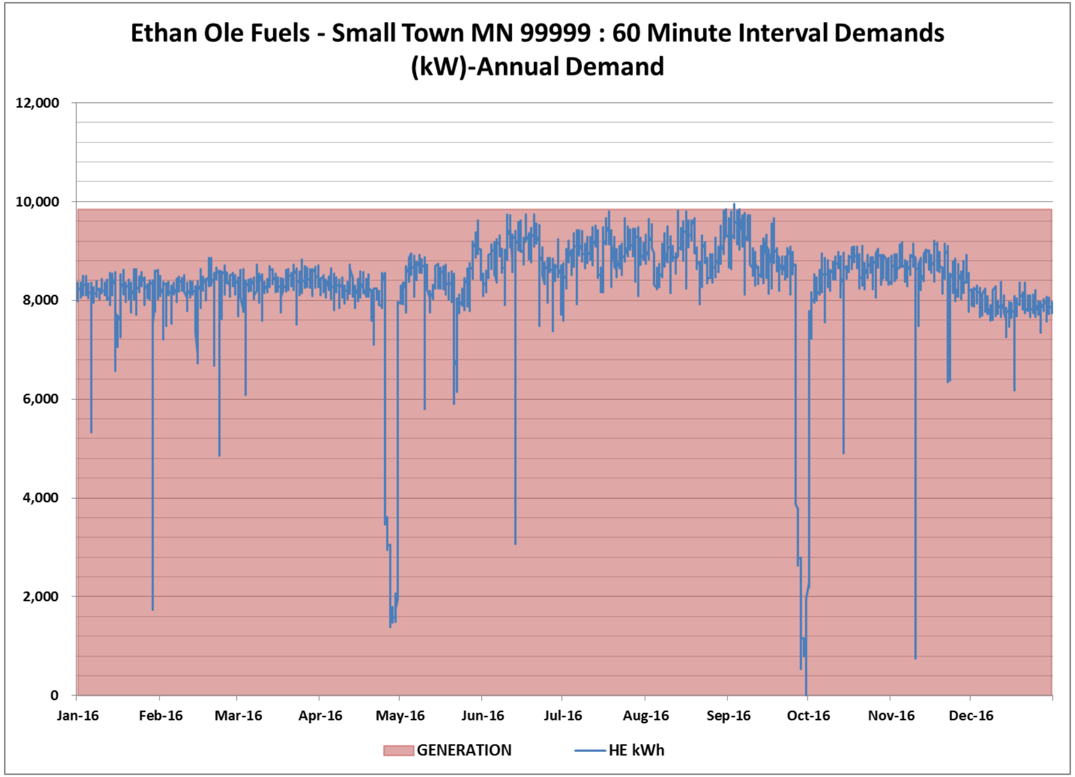


Project Sizing and Operating Strategies

- Typical Ethanol Plant has High Load Factor → But that 10MW is just a PEAK

Whoaaaaaa….

9,845 kW vs 10 MW Peak = Too Much Generation

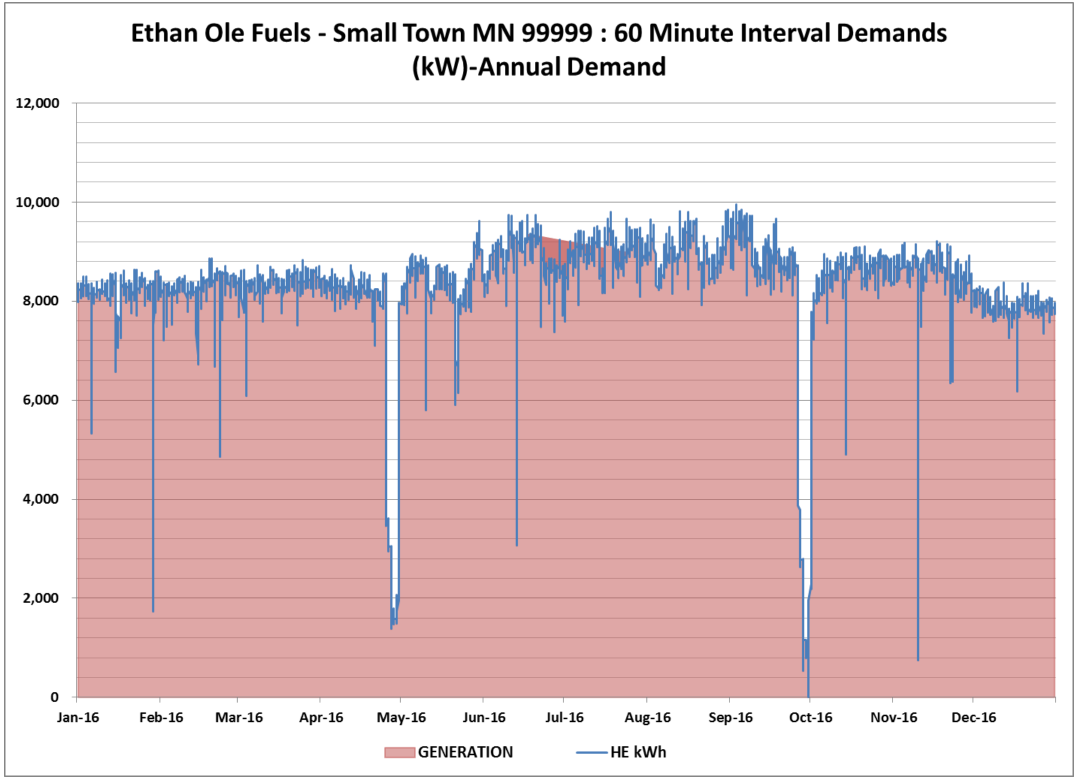


Project Sizing and Operating Strategies

Ahhhhhh….

Ok, that's better…

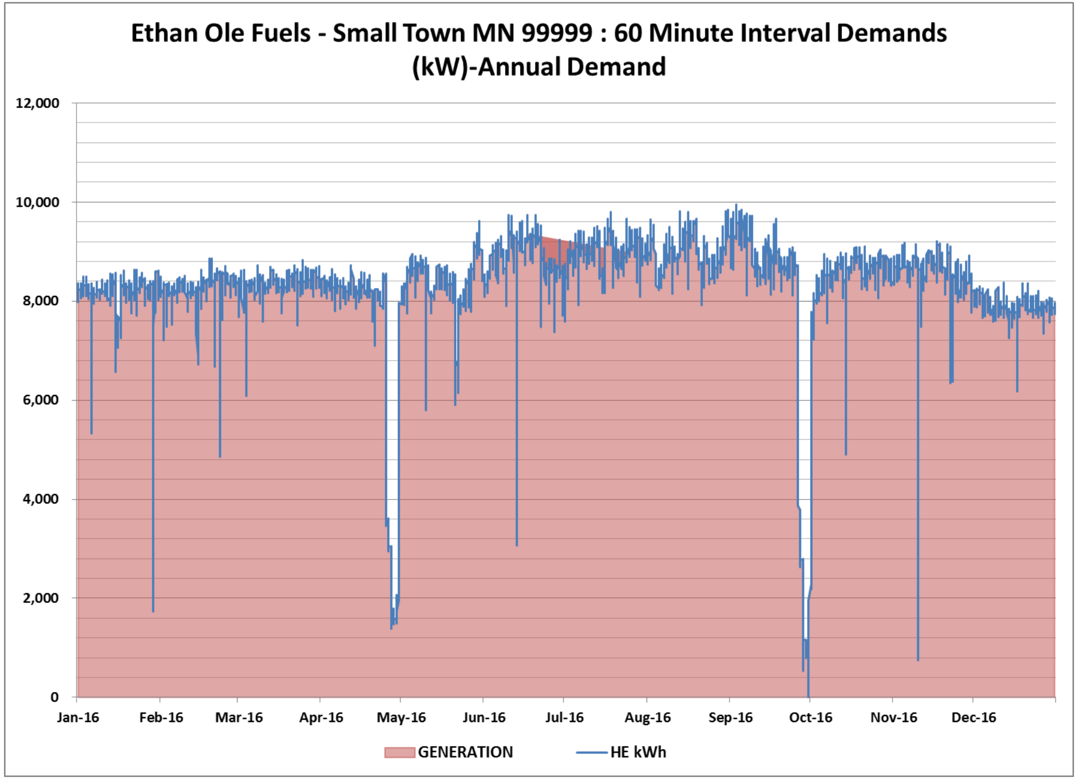
We'll only run it to match our load…



Project Sizing and Operating Strategies

GENERATION vs PURCHASE					
GENERATION @ 100% Production	LOAD FOLLOWING GENERATION	GEN Prod Factor	% ELEC GEN	PURCHASE	% ELEC PURCH
7,324,680	6,052,012	*82.6%*	*100.0%*	0	*0.0%*
6,852,120	5,712,957	*83.4%*	*100.0%*	0	*0.0%*
7,324,680	6,213,615	*84.8%*	*100.0%*	0	*0.0%*
7,088,400	5,200,451	*73.4%*	*100.0%*	0	*0.0%*
7,324,680	6,243,132	*85.2%*	*100.0%*	0	*0.0%*
7,088,400	6,393,398	*90.2%*	*100.0%*	0	*0.0%*
7,324,680	6,697,912	*91.4%*	*100.0%*	0	*0.0%*
7,324,680	6,697,191	*91.4%*	*100.0%*	0	*0.0%*
7,088,400	5,695,045	*80.3%*	*100.0%*	0	*0.0%*
7,324,680	6,278,059	*85.7%*	*100.0%*	0	*0.0%*
7,088,400	6,139,989	*86.6%*	*100.0%*	0	*0.0%*
7,324,680	5,878,670	*80.3%*	*100.0%*	0	*0.0%*
86,478,480	**73,202,431**	***84.6%***	***100.0%***	**0**	***0.0%***
7,206,540	*6,100,203*	*84.6%*	*100.0%*	*0*	*0.0%*

Ugh!!! 85% - Not a great Production Factor... Wasting 15% of my asset!



Project Sizing and Operating Strategies

- *Reduce Generators from 5 units (9.845 MW) to 4 units (7.876 MW)*

Proposed CHP Capacity:		
Generator Unit Size (kWh)	1,969	
No. of Generating Units	4	
TOTAL Generating Capacity (MW)	7,876	
Annual Generation	*67,479*	*92.2%*
Excess Hourly Generation	*0*	*0.0%*

Hey hey hey - 97.5% Production Factor…
That's much better use of my asset!

And I'm producing >92% of my plant electrical needs!

CHP Capacity Sensitivity					
GENERATION CAPACITY		ANNUAL GEN @ Max *(100%)* Prod		ANNUAL GEN Load Following	
(kW)	(MW)	(MWh)	(% Usage)	(MWh)	(% Max Prod)
1,969	1.97	17,248	24%	17,151	99.4%
3,938	3.94	34,497	47%	34,039	98.7%
5,907	5.91	51,745	71%	50,795	98.2%
7,876	7.88	68,994	94%	67,290	97.5%
9,845	9.85	86,242	118%	72,968	84.6%
11,814	11.81	103,491	141%	72,923	70.5%
13,783	13.78	120,739	165%	72,878	60.4%
15,752	15.75	137,988	189%	72,832	52.8%
17,721	17.72	155,236	212%	72,787	46.9%
19,690	19.69	172,484	236%	72,742	42.2%
21,659	21.66	189,733	259%	72,697	38.3%
23,628	23.63	206,981	283%	72,651	35.1%

- ***Awesome! Great Asset Utilization… Great Match to Electric Load…***

Project Sizing and Operating Strategies

▼ Remember our High Level Assessment?

Combined Heat & Power (CHP) Analysis

Description - e.g., expected operation versus load, sell back, incremental purchase, etc.

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We learned this is too much generation…

Delivered Natural Gas Cost

Delivered Electric Cost	$3.10	$3.60	$4.10	$4.60	$5.10
$0.0700	5.2	5.5	5.8	6.2	6.6
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$0.0850	3.9	4.1	4.2	4.4	4.7
$0.0900	3.6	3.7	3.9	4.1	4.2

And the payback was ok, but…

Project Sizing and Operating Strategies

Now with our "Right-sized" Generation…

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Description - e.g., expected operation versus load, sell back, incremental purchase, etc.

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With our "right-sized" generation… 7.88 MW

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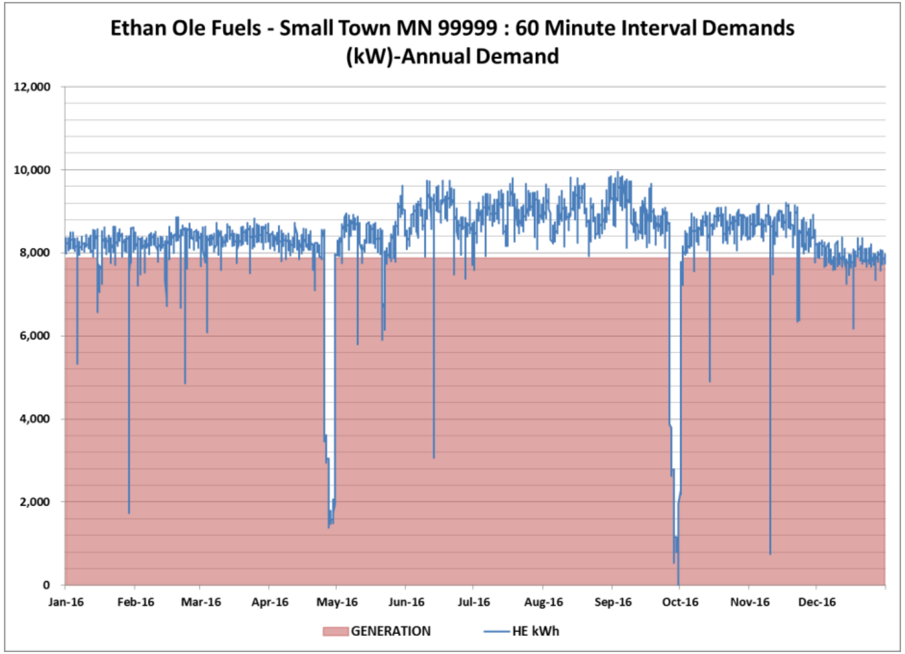
Simple Payback is better… *due to Better Asset Utilization*

Project Sizing and Operating Strategies

- **Alrighty then… We've right-sized the CHP Generation and we plan to Match Operation to Load…** ***Simple Payback < 5 Years…   What's next?***

GENERATION vs PURCHASE

GENERATION @ 100% Production	LOAD FOLLOWING GENERATION	GEN Prod Factor	% ELEC GEN	PURCHASE	% ELEC PURCH
5,859,744	5,807,196	*99.1%*	*96.0%*	244,816	*4.0%*
5,481,696	5,429,100	*99.0%*	*95.0%*	283,857	*5.0%*
5,859,744	5,852,933	*99.9%*	*94.2%*	360,682	*5.8%*
5,670,720	4,989,754	*88.0%*	*95.9%*	210,697	*4.1%*
5,859,744	5,820,869	*99.3%*	*93.2%*	422,263	*6.8%*
5,670,720	5,653,811	*99.7%*	*88.4%*	739,587	*11.6%*
5,859,744	5,859,447	*100.0%*	*87.5%*	838,465	*12.5%*
5,859,744	5,859,744	*100.0%*	*87.5%*	837,447	*12.5%*
5,670,720	5,010,386	*88.4%*	*88.0%*	684,813	*12.0%*
5,859,744	5,752,757	*98.2%*	*91.6%*	525,302	*8.4%*
5,670,720	5,622,674	*99.2%*	*91.6%*	517,315	*8.4%*
5,859,744	5,820,614	*99.3%*	*99.0%*	58,055	*1.0%*
69,182,784	**67,479,285**	***97.5%***	***92.2%***	**5,723,300**	***7.8%***
5,765,232	*5,623,274*	*97.5%*	*92.3%*	*476,942*	*7.7%*



Next Level CHP Analysis

- *Simple Payback < 5 Years…*
- *But is it really?*
- *This was based on average cost*
- *Much more accurate to look at CHP Operation impact on purchases*
  - *Resulting Marginal Cost Impact*
  - *Backup Power Costs*
- *And is Simple Payback really the way to make a decision?*
- *How about ROI? Cash Flow?*
- *What other Values or Costs should be considered?*

Next Level CHP Analysis

- ***Simple Payback < 5 Years…***
- ***But is it really?***
- ***This was based on average cost***
- ***Much more accurate to look at CHP Operation impact on purchases***
  - ***Model the hourly generation against the hourly load***
  - ***Derive new monthly usage and peak demand***
  - ***Resulting new monthly LDC bill*** *(true* ***Marginal Cost*** *Impact)*
  - ***Model and Add in Backup Power Costs***
- ***Also, is Simple Payback really the way to make a decision?***
  - ***How about ROI?***
  - ***How about Cash Flow Analysis?***

Next Level CHP Analysis

So we did all that and got the following results:

- **Ethanol Plant Consumption = 73,200 MWh** and **10.0 MW Peak Demand**

- **Annual CHP Generation = 67,480 MWh**
  - ***Avg Cost of Generated Power = $0.0333/kWh***

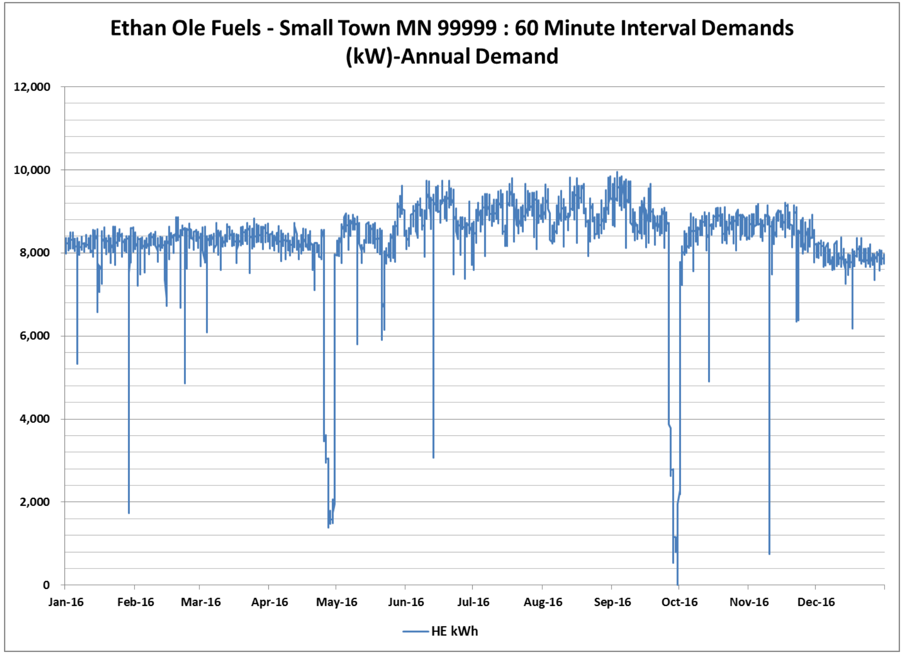
    (including: Fuel, O&M, Overhauls every 4 yrs, Backup Power, Est'd Property Taxes)

- **Annual LDC Purchases = 5,720 MWh** and **2.1 MW Peak**
  - ***Avg Cost of Purchased Elec is now $0.097/kWh*** ***(WTH!?!?)***

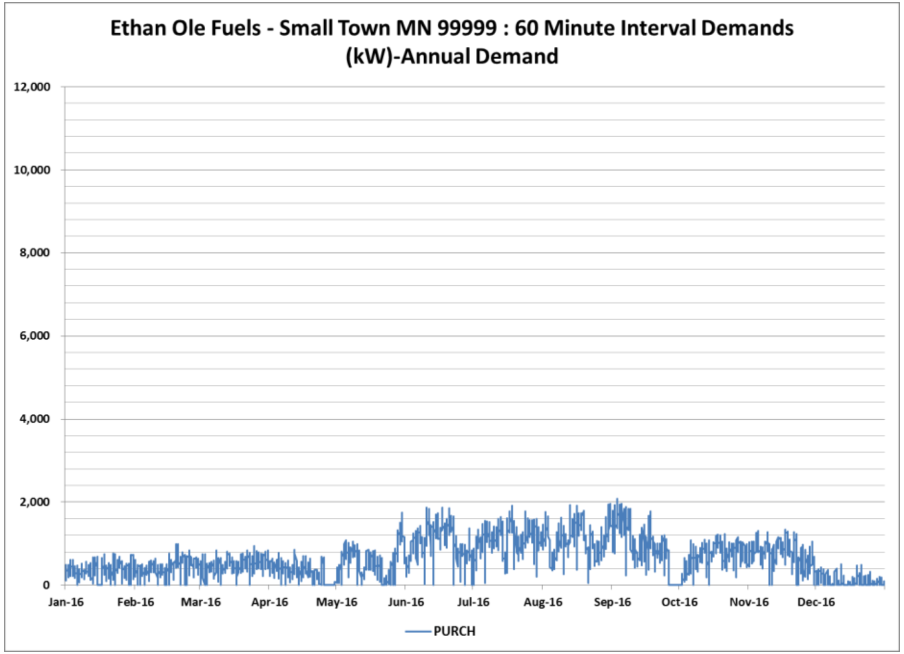
    But remember, this is for only 7.8% of total plant electric consumption

Purchased Electric Hourly Profile

Before CHP

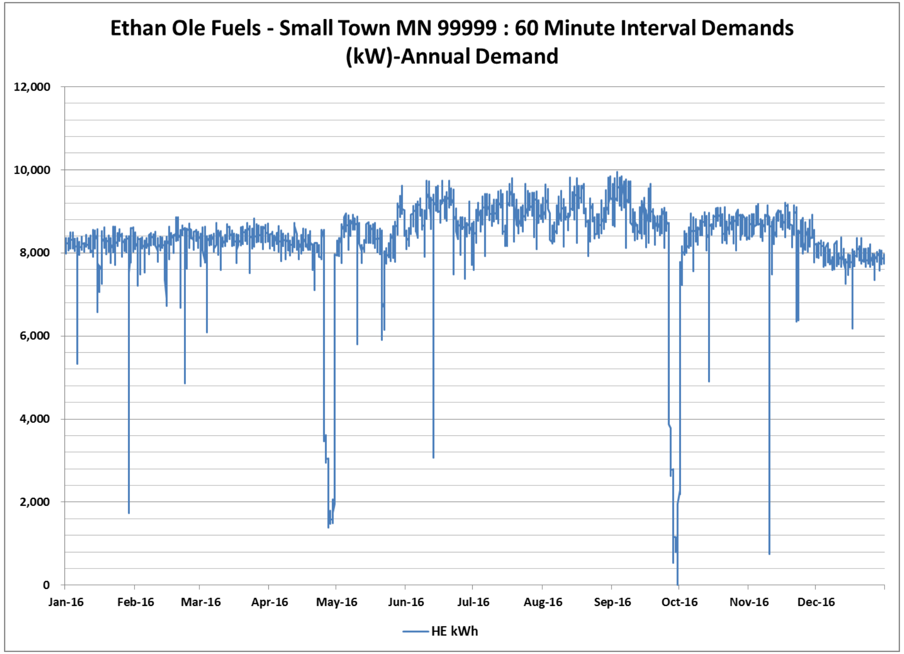


After CHP

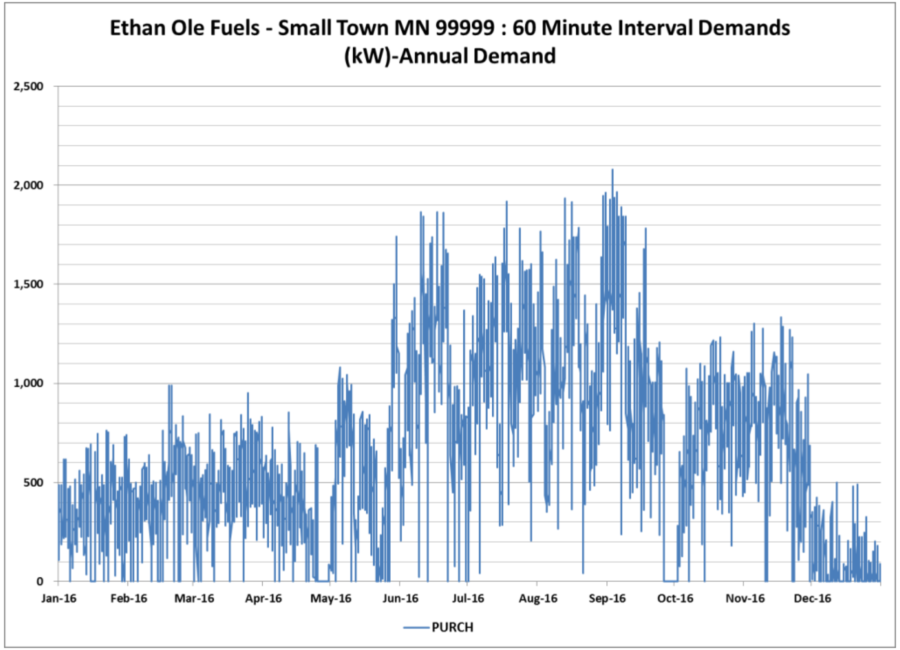


Purchased Electric Hourly Profile

Before CHP



After CHP



Purchased Electric Hourly Profile

Before CHP

Monthly Historical Consumption				
			Load Factor	
Calendar Month	Total Usage (kWh)	Demand (kW)	Hours Use	%
Jan-16	6,052,012	8,637	701	94%
Feb-16	5,712,957	8,867	644	96%
Mar-16	6,213,615	8,826	704	95%
Apr-16	5,200,451	8,729	596	83%
May-16	6,243,132	9,617	649	87%
Jun-16	6,393,398	9,742	656	91%
Jul-16	6,697,912	9,796	684	92%
Aug-16	6,697,191	9,839	681	91%
Sep-16	5,695,199	9,955	572	79%
Oct-16	6,278,059	9,110	689	93%
Nov-16	6,139,989	9,210	667	93%
Dec-16	5,878,670	8,375	702	94%
Annual Total:	**73,202,585**	**9,955**	**7,353**	**84%**
Monthly Avg:	*6,100,215*	*9,225*	*662*	*91%*

After CHP

Post-CHP Purchased			
		Load Factor	
LDC Purchased kWh	LDC Purchased kW	Hours Use	%
244,816	761	322	43%
283,857	991	286	43%
360,682	950	380	51%
210,697	853	247	34%
422,263	1,741	242	33%
739,587	1,866	396	55%
838,465	1,920	437	59%
837,447	1,963	427	57%
684,813	2,079	329	46%
525,302	1,234	426	57%
517,315	1,334	388	54%
58,055	499	116	16%
5,723,300	**2,079**	**2,753**	**31%**
476,942	*1,349*	*333*	*46%*

Next Level CHP Analysis

So we did all that and got the following results:

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Operating Cash Flow	($13,783,000)	$2,924,960	$3,101,360	$3,237,160	$608,259	$3,493,660
Net Cash	$13,783,000	$10,858,040	$7,756,679	$4,519,519	$3,911,260	$417,599
Payback *(years)*	5.1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*

	Year 6	Year 7	Year 8	Year 9	Year 10
Operating Cash Flow	$3,620,660	$3,746,160	$1,116,459	$4,004,460	$4,137,560
Net Cash	$0	$0	$0	$0	$0
Payback *(years)*	*0.12*	*0.00*	*0.00*	*0.00*	*0.00*

	5 Years	10 Years	15 Years
Internal Rate of Return (IRR)	-1.05%	16.49%	20.27%
Annualized ROI	-0.61%	11.76%	17.32%
Net Present Value (NPV)	($964,556)	$13,562,736	$29,422,486
Simple Payback (years)	5.1		

Cool! So are we good now?

Uh oh… We never checked our Natural Gas pressure

- **It turns out our pipeline can only guarantee 50 psig**
- **Either we stick with Recip Engines or we add a 250 hp compressor, which serves as a derate to our net electric output**

But… *Don't Forget the Details!*

Wellllllll…. *Not Exactly*

- ***We just learned there is a Minimum Contract Demand of 9,000 kW***

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Operating Cash Flow	**($13,783,000)**	**$2,083,160**	**$2,234,360**	**$2,344,060**	**($311,541)**	**$2,546,260**
Net Cash	**$13,783,000**	**$11,699,840**	**$9,465,480**	**$7,121,420**	**$7,432,961**	**$4,886,701**
Payback *(years)*	**6.8**	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*

	Year 6	Year 7	Year 8	Year 9	Year 10
Operating Cash Flow	**$2,644,860**	**$2,741,060**	**$81,159**	**$2,938,060**	**$3,039,260**
Net Cash	**$2,241,841**	**$0**	**$0**	**$0**	**$0**
Payback *(years)*	*1.00*	*0.82*	*0.00*	*0.00*	*0.00*

	5 Years	10 Years	15 Years
Internal Rate of Return (IRR)	**-13.63%**	**7.40%**	**12.59%**
Annualized ROI	**-7.09%**	**4.76%**	**9.74%**
Net Present Value (NPV)	**($5,172,503)**	**$4,826,596**	**$15,813,669**
Simple Payback (years)	**6.8**		

Crap! Now What?

But… *Don't Forget the Details!*

Oh! Oh!!… But Wait…

- ***We just learned the Minimum Contract Demand expires in 12 months!***
  - ***Heck, it will take longer than that to build the CHP plant → No problem***

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Operating Cash Flow	**($13,783,000)**	**$2,924,960**	**$3,101,360**	**$3,237,160**	**$608,259**	**$3,493,660**
Net Cash	**$13,783,000**	**$10,858,040**	**$7,756,679**	**$4,519,519**	**$3,911,260**	**$417,599**
Payback *(years)*	**5.1**	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*

	Year 6	Year 7	Year 8	Year 9	Year 10
Operating Cash Flow	**$3,620,660**	**$3,746,160**	**$1,116,459**	**$4,004,460**	**$4,137,560**
Net Cash	**$0**	**$0**	**$0**	**$0**	**$0**
Payback *(years)*	*0.12*	*0.00*	*0.00*	*0.00*	*0.00*

	5 Years	10 Years	15 Years
Internal Rate of Return (IRR)	**-1.05%**	**16.49%**	**20.27%**
Annualized ROI	**-0.61%**	**11.76%**	**17.32%**
Net Present Value (NPV)	**($964,556)**	**$13,562,736**	**$29,422,486**
Simple Payback (years)	**5.1**		

Cool!! Are we good now?

But… *Don't Forget the Details!*

Well dammit, We Just Re-Read the Tariff

- ***There's an 11 Month Demand Ratchet***
  - ***Which changes adds $737K to the first year cost!***

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Operating Cash Flow	($13,783,000)	$2,187,168	$3,101,360	$3,237,160	$608,259	$3,493,660
Net Cash	$13,783,000	$11,595,832	$8,494,472	$5,257,312	$4,649,052	$1,155,392
Payback *(years)*	5.3	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*

	Year 6	Year 7	Year 8	Year 9	Year 10
Operating Cash Flow	$3,620,660	$3,746,160	$1,116,459	$4,004,460	$4,137,560
Net Cash	$0	$0	$0	$0	$0
Payback *(years)*	*0.32*	*0.00*	*0.00*	*0.00*	*0.00*

	5 Years	10 Years	15 Years
Internal Rate of Return (IRR)	-2.84%	15.31%	19.29%
Annualized ROI	-1.68%	11.22%	16.96%
Net Present Value (NPV)	($1,680,703)	$12,846,589	$28,706,340
Simple Payback (years)	5.3		

Well, the impact isn't too bad….

Are we good to go?

But… *Don't Forget the Details!*

Hey Hey Hey, We just learned there are incentives!!

- ***$1 million each from the Electric Utility and the Nat Gas Utility!!!***

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Operating Cash Flow	**($13,783,000)**	**$4,187,169**	**$3,101,360**	**$3,237,160**	**$608,259**	**$3,493,660**
Net Cash	**$13,783,000**	**$9,595,831**	**$6,494,471**	**$3,257,311**	**$2,649,051**	**$0**
Payback *(years)*	**4.8**	*1.00*	*1.00*	*1.00*	*1.00*	*0.76*

Year 6	Year 7	Year 8	Year 9	Year 10
$3,620,660	**$3,746,160**	**$1,116,459**	**$4,004,460**	**$4,137,560**
$0	**$0**	**$0**	**$0**	**$0**
0.00	*0.00*	*0.00*	*0.00*	*0.00*

	5 Years	10 Years	15 Years
Internal Rate of Return (IRR)	2.22%	18.65%	22.09%
Annualized ROI	1.23%	12.67%	17.93%
Net Present Value (NPV)	$260,622	$14,787,913	$30,647,664
Simple Payback (years)	4.8		

Great!! That helps…

Uh oh… We never checked our Natural Gas availability

- It turns out our pipeline is capacity constrained
- The incremental natural gas we need to burn isn’t available!

Next Level CHP Analysis

Hey Hey Hey, after contacting the utility, we learn they have a project to increase pipeline capacity in this area!

- It will take 18 months to complete
- So we can push back the construction and in-service date
- But in fact, the constraint is only during winter
- So we can start-up in May as planned!

CHP - Don't Forget the Details

- ***Average Cost is okay for High Level First Cut Assessments, but don't make a decision from it***
- ***Use Interval Data for Proper Sizing***
- ***Model Utility Rates for Actual Cost Impact***
- ***Account for Special Contracts, Ratchets, other nuances***
- ***Look for Incentives***
- ***Look for other Benefits – such as Carbon Reduction benefits***
- ***Check your Natural Gas supply for Capacity and Pressure***
- ***If you can't justify the investment, Consider Third Party PPA***

Kinect ENERGY GROUP

CHP Projects

Don’t Forget the Details!

Thank you!

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