Business Decisions in Reality: CHP at Hexion

Lecture 11

eDMP: 14.43 / 15.031 / 21A.341/11.161

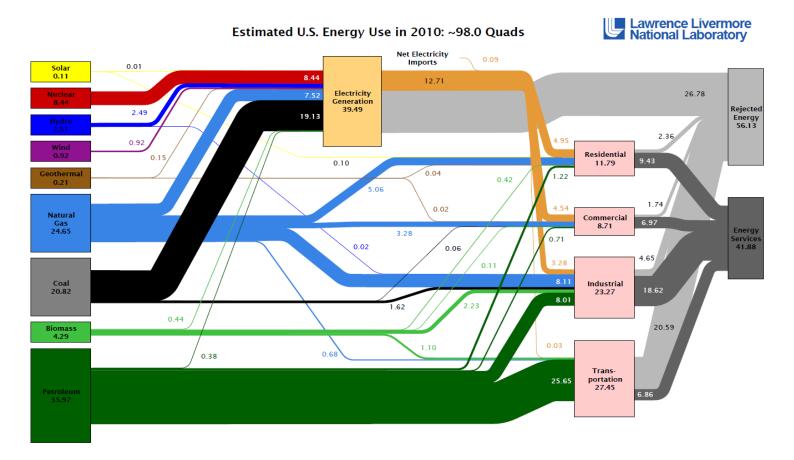
New "What is Business For?" Issue: Political Campaigns & Super PACs

- Before the Supreme Court's 2010 *Citizens United* decision, campaign contributions by corporations & unions were barred, as was "electioneering" – "independent" ads near elections
- Now, corporations, unions, & individuals can give any amount of money to Super PACs, Political Action Committees that can run any sort of ads at any time in any amount – freedom of speech...
 - Ordinary PACs funded by limited "voluntary" individual contributions can make limited campaign contributions
- <u>Should</u> publicly-held corporations give to Super PACs?
- In fact (Sunlight Foundation), most corporations that make significant Super PAC contributions seem to be privately held
 - One exception is Consol, a coal producer, \$125k for Romney; not obviously in shareholders' interest... Captive board?
 - Lots of private corporations, individuals, law firms, unions, etc.

Hexion, 2003

- Where is this plant located, what does it do?
- What problem/opportunity is Darren considering?
- What options has he considered?
- Why has he focused on CHP?
- Would the CHP proposal have a big profit impact?

Waste/Rejected Energy in the US



Waste ("Rejected")/Total: Transportation 75%, Electricity 32%, Residential \approx Commercial \approx Industrial \approx 20%

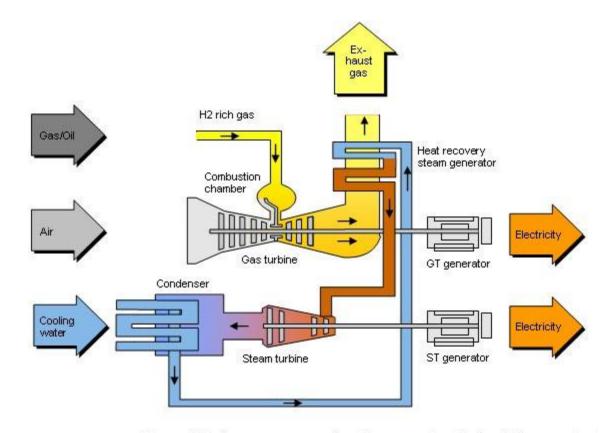
What form does waste energy generally take?

Courtesy of Lawrence Livermore National Laboratory. Used with permission.

Two Main Forms of CHP

- <u>District heating</u>: use waste heat from electricity generation heat water, piped to heat nearby buildings – Denmark, Soviet Union
 - Needs powerplants in urban areas not too popular
 - Also needs a relatively cold climate...
 - 1978 PURPA subsidies in the US didn't do much
- <u>Electricity generation</u>: use waste heat to make steam to drive a turbine needs "high quality" heat, large ΔT
 - In generation, combined cycle plants are very efficient
 - In industrial settings, capture heat from various sources

Basic CCGT Story:



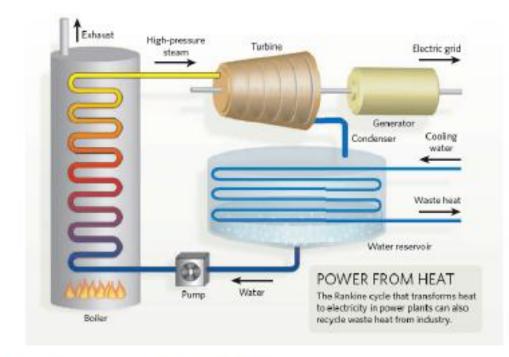


Courtesy of Siemens. Used with permission.

The proposal before Hexion – but what was the source of heat here?

Figure 1

Waste Heat Recovery Process Flow Being Considered at Hexion



Source: Tom Casten, "Energy Should Always Work Twice," Nature, March 2009.

Reprinted by permission from Macmillan Publishers Ltd: [Nature] Lindley, David. "The Energy Should Always Work Twice." *Nature* (2009): 138-41, copyright 2009.

Major Benefits of CHP in General

Benefits										
Financial	Operational	Environmental								
Reduce primary energy costs by up to 30%	Improve the security of electrical supply	Reduce fossil fuel usage								
Reduce energy expenses by up to 20%	Reduce or eliminate utility power purchases	Increase energy efficiency								
Stabilize the risks associated with rising energy prices	Improve the security of heat supply	Reduce GHG emissions								
Provide potential additional revenues through sales of excess power	Provide electricity, heat, and cooling simultaneously	Prevent dispensing hot water into natural waterways								

Case mentions two alternatives to NPV

• Cash flows
$$C_t$$
: $NPV(\vec{c}, r) \equiv \sum_{t=0}^{\infty} \frac{C_t}{(1+r)^t}$

- Payback period: Smallest T such that $\sum_{i=0}^{t} c_i > 0$
 - Suppose T = 2 but the project then dies lousy investment!
 - Need to consider what happens AFTER T!
- Internal rate of return, IRR: (Smallest) r* such that $NPV(\vec{c}, r^*) = 0$
 - <u>IF</u> only one root (negative flows followed by positive), means that NPV > 0 for r < r*; deals with opportunity cost uncertainty
 - But ranking projects by their IRR makes little sense...

Darren's CHP NPV Analysis

South Glens Falls, New York, USA																		
Turbosteam																		
Assumptions																		
Annual Electrical Savings		\$89,300																
Average price of electricity in 2003 (per Kwh)		7%																
KWh saved per year		\$1,275,714																
Inflation	Electricity		2%															
	Maintenance		2%															
	H2O Chemicals		2%															
Discount Rate for Net Present Value		10%																
Depreciation Life (tax)	7 Year straight lin	ne																
Federal Tax Rate		35%																
State Marginal Tax Rate		5.50%																
I	Year ending:	Dec-04	Dec-04	Dec-05	Dec-06	Dec-07	Dec-08	Dec-09	Dec-10	Dec-11	Dec-12	Dec-13	Dec-14	Dec-15	Dec-16	Dec-17	Dec-18	Dec-19
Savings		-	i															
Electricity			\$89,300	\$91,086	\$92,908	\$94,766	\$96,661	\$98,594	\$100,566	\$102,578	\$104,629	\$106,722	\$108,856	\$111,033	\$113,254	\$115,519	\$117,829	\$120,186
Maintenance			\$7,200	\$7,344	\$7,491	\$7,641	\$7,794	\$7,949	\$8,108	\$8,271	\$8,436	\$8,605	\$8,777	\$8,952	\$9,131	\$9,314	\$9,500	\$9,690
Chemicals			\$8,000	\$8,160	\$8,323	\$8,490	\$8,659	\$8,833	\$9,009	\$9,189	\$9,373	\$9,561	\$9,752	\$9,947	\$10,146	\$10,349	\$10,556	\$10,767
TOTAL SAVINGS			\$104,500	\$106,590	\$108,722	\$110,896	\$113,114	\$115,376	\$117,684	\$120,038	\$122,438	\$124,887	\$127,385	\$129,933	\$132,531	\$135,182	\$137,886	\$140,643
EXPENSES																		
Steam Turbine Generator Set		\$345,000 Com	nplete System (as	described in the	proposal)													
NYSERDA matching grant		-\$172,500																
Startup Cost		\$22,000Com	nplete Startup (as o	described in the	proposal)													
Installation Cost			s is an estimate on															
Installed Cost:		\$294,500																
Maintenance			\$2,000	\$2,040	\$2,081	\$2,122	\$2,165	\$2,208	\$2,252	\$2,297	\$2,343	\$2,390	\$2,438	\$2,487	\$2,536	\$2,587	\$2,639	\$2,692
TOTAL EXPENSES (TAX BASIS)			\$2,000	\$2,040	\$2,081	\$2,122	\$2,165	\$2,208	\$2,252	\$2,297	\$2,343	\$2,390	\$2,438	\$2,487	\$2,536	\$2,587	\$2,639	\$2,692
GROSS MARGIN FROM OPERATION (EBITDA)		\$0	\$102,500	\$104,550	\$106,641	\$108,774	\$110,949	\$113,168	\$115,432	\$117,740	\$120,095	\$122,497	\$124,947	\$127,446	\$129,995	\$132,595	\$135,247	\$137,952
- Depreciation		\$0	\$0	\$42,071	\$42,071	\$42,071	\$42,071	\$42,071	\$42,071	\$42,071	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		\$0		000 180														
EARNINGS BEFORE TAXES		\$0	\$102,500	\$62,479	\$64,570	\$66,702	\$68,878	\$71,097	\$73,360	\$75,669	\$120,095	\$122,497	\$124,947	\$127,446	\$129,995	\$132,595	\$135,247	\$137,952
- State Taxes		\$0	\$5,638	\$3,436	\$3,551	\$3,669	\$3,788	\$3,910	\$4,035	\$4,162	\$6,605	\$6,737	\$6,872	\$7,010	\$7,150	\$7,293	\$7,439	\$7,587
- State Taxes - Federal Taxes		\$0 \$0	\$5,638 \$35,875	\$3,436 \$21,868	\$3,551 \$22,599	\$3,669 \$23,346	\$3,788 \$24,107	\$3,910 \$24,884	\$4,035 \$25,676	\$4,162 \$26,484	\$6,605 \$42,033	\$6,737 \$42,874	\$6,872 \$43,731	\$7,010 \$44,606	\$7,150 \$45,498	\$7,293 \$46,408	\$7,439 \$47,336	\$7,587 \$48,283
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		\$0	\$60,988	\$37,175	\$38,419	\$39,688	\$40,982	\$42,303	\$43,649	\$45,023	\$71,457	\$72,886	\$74,343	\$75,830	\$77,347	\$78,894	\$80,472	\$82,081
+ Depreciation		\$0	\$0	\$42,071	\$42,071	\$42,071	\$42,071	\$42,071	\$42,071	\$42,071	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
AFTER TAX NET CASH FLOW		-\$294,500	\$60,988	\$79,246	\$80,490	\$81,759	\$83,054	\$84,374	\$85,721	\$87,094	\$71,457	\$72,886	\$74,343	\$75,830	\$77,347	\$78,894	\$80,472	\$82,081
DETER TAX NET CAON FLOW	\$286,817.11	-\$2.94,000	\$00,968	\$13,240	300,430	\$01,739	-900,004	304,374	\$03,721	\$07,094	\$71,437	\$12,000	\$14,343	\$10,030	\$11,347	\$10,034	-900,47Z	\$02,081
	25%																	
	Net Present \ \$286,817.1110%	Value at																
	φ200,017.11μ0/0																	
	3.94Year Paybac	k					10											
							10											
	25%IRR																	

Darren's Formulas:

South Glens Falls, New York, USA														
Turbosteam				1										
Assumptions	<u></u>	1		1		('	í				i	+	l	1
Annual Electrical Savings	89300	<u></u>	<u> </u>		'	<u>←−−−′</u>	<u> </u>			'	<u> </u>		[]	
Annual Electrical Savings Average price of electricity in 2003 (per kwh)	89300 0.07	<u> </u>	<u> </u> '			<u> </u>	<u> </u>				<u> </u>		()	1
	=B4/(B5)	<u> </u>	<u> </u>			{'	t			'	ł	++	<u> </u>	
KWh saved per year		1	<u>.</u>			<i>↓</i> ′	+			·	<u> </u>	41	(]	
Inflation		0.02	<u>.</u>			{'	t			'	ł	++	<u> </u>	Į
		0.02	<u>.</u>			{'	t			'	ł	++	<u> </u>	Į
Discount Rate for Net Present Value	H2U Chemicais	0.02	ł'			('	t			·	t	++		1
	7 year straight line	+	t'	+	+	(t			+	<u> </u>	++		1
Federal Tax Rate	0.35	++	f'	+		('	t				t	++		1
State Marginal Tax Rate	0.055	++		+					+			++	· · · · · · · · · · · · · · · · · · ·	
Year ending:		38352	=C14+365	=D14+365	=E14+365	=F14+365	=G14+365	=H14+365	=114+365	=J14+365	=K14+365	=L14+365	=M14+365	=N14+365
Savings	00002	00002	-0111011				-01.101				-111-000			
Electricity		89300	=C16*(1+\$C\$7)	=D16*(1+\$C\$7)	=E16*(1+\$C\$7)	=F16*(1+\$C\$7)	=G16*(1+\$C\$7)	=H16*(1+\$C\$7)	=I16*(1+\$C\$7)	=J16*(1+\$C\$7)	=K16*(1+\$C\$7)	=L16*(1+\$C\$7)	=M16*(1+\$C\$7)	=N16*(1+\$C\$7)
Maintenance			=C17*(1+\$C\$8)	=D17*(1+\$C\$7)		=F17*(1+\$C\$7)	=G17*(1+\$C\$7)	=H17*(1+\$C\$7)	=I17*(1+\$C\$7)					=N17*(1+\$C\$7)
Chemicals			=C18*(1+\$C\$9)	=D18*(1+\$C\$9)		=F18*(1+\$C\$9)	=G18*(1+\$C\$9)	=H18*(1+\$C\$9)	=I18*(1+\$C\$9)			(111)	(111)	=N18*(1+\$C\$9)
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TOTAL SAVINGS		=SUM(C16:C18)	=SUM(D16:D18)	=SUM(E16:E18)	=SUM(F16:F18)	=SUM(G16:G18)	=SUM(H16:H18)	=SUM(I16:I18)	=SUM(J16:J18)	=SUM(K16:K18)	=SUM(L16:L18)	=SUM(M16:M18)	=SUM(N16:N18)	=SUM(O16:O18)
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EXPENSES	·	بيبيا	<u> </u> '	Ļ	!	<u> '</u>	<u> </u>		· · · · · · · · · · · · · · · · · · ·	<u> </u> '	<u> </u>	ļ		ļ
Steam Turbine Generator Set	345000	Complete Syster	4		·	<u> </u>	1		<u> </u>	<u> </u>	1	<u> </u>		<u> </u>
NYSERDA matching grant	-172500		<u> </u>		<u> </u>	<u> </u>		<u> </u>	<u> </u>	<u> </u>	<u> </u>			<u> </u>
Startup Cost	22000	Complete Startu			<u> </u>	<u> </u>		<u> </u>	<u> </u>	<u> </u>	<u> </u>			<u> </u>
Installation Cost	100000	This is an estima	4		<u> </u>	<u> </u>		<u> </u>	<u> </u>	<u> </u>	<u> </u>			<u> </u>
Installed Cost:	=SUM(B24:B27)	<u> </u>												<u> </u>
Maintenance							=G29*(1+\$C\$8)							=N29*(1+\$C\$8)
Maintenance TOTAL EXPENSES (TAX BASIS)							=G29*(1+\$C\$8) =H29							=N29*(1+\$C\$8) =O29
TOTAL EXPENSES (TAX BASIS)		=C29	=D29	=E29	=F29	=G29	=H29	=129	=J29	=K29	=L29	=M29	=N29	=029
		=C29	=D29	=E29	=F29	=G29		=129	=J29	=K29	=L29	=M29	=N29	
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA)	=B21-B30	=C29 =C21-C30	=D29 =D21-D30	=E29 =E21-E30	=F29 =F21-F30	=G29 =G21-G30	=H29 =H21-H30	=129 =121-130	=J29 =J21-J30	=K29 =K21-K30	=L29 =L21-L30	=M29 =M21-M30	=N29 =N21-N30	=O29 =O21-O30
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA)	=B21-B30	=C29 =C21-C30	=D29	=E29	=F29 =F21-F30	=G29 =G21-G30	=H29	=129 =121-130	=J29 =J21-J30	=K29 =K21-K30	=L29 =L21-L30	=M29 =M21-M30	=N29 =N21-N30	=029
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation	=B21-B30 0	=C29 =C21-C30 0	=D29 =D21-D30 =(B28)/7	=E29 =E21-E30 =D34	=F29 =F21-F30 =E34	=G29 =G21-G30 =F34	=H29 =H21-H30 =G34	=I29 =I21-I30 =H34	=J29 =J21-J30 =I34	=K29 =K21-K30 0	=L29 =L21-L30 0	=M29 =M21-M30	=N29 =N21-N30 0	=029 =021-030 0
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA)	=B21-B30 0	=C29 =C21-C30 0	=D29 =D21-D30 =(B28)/7	=E29 =E21-E30	=F29 =F21-F30 =E34	=G29 =G21-G30 =F34	=H29 =H21-H30	=I29 =I21-I30 =H34	=J29 =J21-J30 =I34	=K29 =K21-K30 0	=L29 =L21-L30 0	=M29 =M21-M30	=N29 =N21-N30 0	=O29 =O21-O30
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation EARNINGS BEFORE TAXES	=B21-B30 0 =B32-B34	=C29 =C21-C30 0 =C32-C34	=D29 =D21-D30 =(B28)/7 =D32-D34	=E29 =E21-E30 =D34 =E32-E34	=F29 =F21-F30 =E34 =F32-F34	=G29 =G21-G30 =F34 =G32-G34	=H29 =H21-H30 =G34 =H32-H34	=129 =121-130 =H34 =132-134	=J29 =J21-J30 =I34 =J32-J34	=K29 =K21-K30 0 =K32-K34	=L29 =L21-L30 0 =L32-L34	=M29 =M21-M30 0 =M32-M34	=N29 =N21-N30 0 =N32-N34	=O29 =O21-O30 0 =O32-O34
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation EARNINGS BEFORE TAXES - State Taxes	=B21-B30 0 =B32-B34 =B36*5.5%	=C29 =C21-C30 0 =C32-C34 =C36*\$B\$13	=D29 =D21-D30 =(B28)/7 =D32-D34 =D36*\$B\$13	=E29 =E21-E30 =D34 =E32-E34 =E36*\$B\$13	=F29 =F21-F30 =E34 =F32-F34 =F36*\$B\$13	=G29 =G21-G30 =F34 =G32-G34 =G36*\$B\$13	=H29 =H21-H30 =G34 =H32-H34 =H36*\$B\$13	=129 =121-130 =H34 =132-134 =136*\$B\$13	=J29 =J21-J30 =I34 =J32-J34 =J36*\$B\$13	=K29 =K21-K30 0 =K32-K34 =K36*\$B\$13	=L29 =L21-L30 0 =L32-L34 =L36*\$B\$13	=M29 =M21-M30 0 =M32-M34 =M36*\$B\$13	=N29 =N21-N30 0 =N32-N34 =N36*\$B\$13	=O29 =O21-O30 0 =O32-O34 =O36*\$B\$13
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation EARNINGS BEFORE TAXES	=B21-B30 0 =B32-B34 =B36*5.5%	=C29 =C21-C30 0 =C32-C34 =C36*\$B\$13	=D29 =D21-D30 =(B28)/7 =D32-D34 =D36*\$B\$13	=E29 =E21-E30 =D34 =E32-E34	=F29 =F21-F30 =E34 =F32-F34 =F36*\$B\$13	=G29 =G21-G30 =F34 =G32-G34 =G36*\$B\$13	=H29 =H21-H30 =G34 =H32-H34	=129 =121-130 =H34 =132-134 =136*\$B\$13	=J29 =J21-J30 =I34 =J32-J34	=K29 =K21-K30 0 =K32-K34 =K36*\$B\$13	=L29 =L21-L30 0 =L32-L34 =L36*\$B\$13	=M29 =M21-M30 0 =M32-M34 =M36*\$B\$13	=N29 =N21-N30 0 =N32-N34 =N36*\$B\$13	=O29 =O21-O30 0 =O32-O34
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation EARNINGS BEFORE TAXES - State Taxes	=B21-B30 0 =B32-B34 =B36*5.5% =B36*35%	=C29 =C21-C30 0 =C32-C34 =C36*\$B\$13 =C36*\$B\$12	=D29 =D21-D30 =(B28)/7 =D32-D34 =D36*\$B\$13 =D36*\$B\$12	=E29 =E21-E30 =D34 =E32-E34 =E36*\$B\$13 =E36*\$B\$12	=F29 =F21-F30 =E34 =F32-F34 =F36*\$B\$13 =F36*\$B\$12	=G29 =G21-G30 =F34 =G32-G34 =G36*\$B\$13 =G36*\$B\$12	=H29 =H21-H30 =G34 =H32-H34 =H36*\$B\$13	=129 =121-130 =H34 =132-134 =136*\$B\$13 =136*\$B\$12	=J29 =J21-J30 =I34 =J32-J34 =J36*\$B\$13	=K29 =K21-K30 0 =K32-K34 =K36*\$B\$13 =K36*\$B\$12	=L29 =L21-L30 0 =L32-L34 =L36*\$B\$13 =L36*\$B\$12	=M29 =M21-M30 0 =M32-M34 =M36*\$B\$13 =M36*\$B\$12	=N29 =N21-N30 0 =N32-N34 =N36*\$B\$13 =N36*\$B\$12	=O29 =O21-O30 0 =O32-O34 =O36*\$B\$13
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation EARNINGS BEFORE TAXES - State Taxes - Federal Taxes	=B21-B30 0 =B32-B34 =B36*5.5% =B36*35%	=C29 =C21-C30 0 =C32-C34 =C36*\$B\$13 =C36*\$B\$12	=D29 =D21-D30 =(B28)/7 =D32-D34 =D36*\$B\$13 =D36*\$B\$12	=E29 =E21-E30 =D34 =E32-E34 =E36*\$B\$13 =E36*\$B\$12	=F29 =F21-F30 =E34 =F32-F34 =F36*\$B\$13 =F36*\$B\$12	=G29 =G21-G30 =F34 =G32-G34 =G36*\$B\$13 =G36*\$B\$12	=H29 =H21-H30 =G34 =H32-H34 =H36*\$B\$13 =H36*\$B\$12	=129 =121-130 =H34 =132-134 =136*\$B\$13 =136*\$B\$12	=J29 =J21-J30 =I34 =J32-J34 =J36*\$B\$13 =J36*\$B\$12	=K29 =K21-K30 0 =K32-K34 =K36*\$B\$13 =K36*\$B\$12	=L29 =L21-L30 0 =L32-L34 =L36*\$B\$13 =L36*\$B\$12	=M29 =M21-M30 0 =M32-M34 =M36*\$B\$13 =M36*\$B\$12	=N29 =N21-N30 0 =N32-N34 =N36*\$B\$13 =N36*\$B\$12	=029 =021-030 0 =032-034 =036*\$B\$13 =036*\$B\$12
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation EARNINGS BEFORE TAXES - State Taxes - Federal Taxes	=B21-B30 0 =B32-B34 =B36*5.5% =B36*35% =B36*B38-B39	=C29 =C21-C30 0 =C32-C34 =C36*\$B\$13 =C36*\$B\$12 =C36*\$B\$12 =C36-C38-C39	=D29 =D21-D30 =(B28)/7 =D32-D34 =D36*\$B\$13 =D36*\$B\$12	=E29 =E21-E30 =D34 =E32-E34 =E36*\$B\$13 =E36*\$B\$12	=F29 =F21-F30 =E34 =F32-F34 =F36*\$B\$13 =F36*\$B\$12 =F36-F38-F39	=G29 =G21-G30 =F34 =G32-G34 =G36*\$B\$13 =G36*\$B\$12 =G36-G38-G39	=H29 =H21-H30 =G34 =H32-H34 =H36*\$B\$13 =H36*\$B\$12	=129 =121-130 =+134 =132-134 =136*\$B\$13 =136*\$B\$12 =136*3B\$12	=J29 =J21-J30 =I34 =J32-J34 =J36*\$B\$13 =J36*\$B\$12	=K29 =K21-K30 0 =K32-K34 =K36*\$B\$13 =K36*\$B\$12 =K36*\$B\$12	=L29 =L21-L30 0 =L32-L34 =L36*\$B\$13 =L36*\$B\$12 =L36*L38-L39	=M29 =M21-M30 0 =M32-M34 =M36*\$8\$13 =M36*\$8\$12 =M36-M38-M39	=N29 =N21-N30 0 =N32-N34 =N36*\$B\$13 =N36*\$B\$12 =N36*\$B\$12 =N36*N39	=029 =021-030 0 =032-034 =036*\$B\$13 =036*\$B\$12
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation EARNINGS BEFORE TAXES - State Taxes - Federal Taxes NET INCOME + Depreciation	=B21-B30 0 =B32-B34 =B36*5.5% =B36*35% =B36*B38-B39 =B34	=C29 =C21-C30 0 =C32-C34 =C36*\$B\$13 =C36*\$B\$12 =C36-C38-C39 =C34	=D29 =D21-D30 =(B28)/7 =D32-D34 =D36*\$B\$13 =D36*\$B\$12 =D36-5B\$-D39 =D34	=E29 =E21-E30 =D34 =E32-E34 =E36*\$B\$13 =E36*\$B\$12 =E36-E38-E39 =E34	=F29 =F21-F30 =E34 =F32-F34 =F36*\$B\$13 =F36*\$B\$12 =F36 -F38-F39 =F34	=G29 =G21-G30 =F34 =G32-G34 =G36*\$B\$13 =G36*\$B\$12 =G36-G38-G39 =G34	=H29 =H21-H30 =G34 =H32-H34 =H36'\$B\$13 =H36'\$B\$12 =H36'H38-H39 =H34	=129 =121-130 =H34 =132-134 =136*\$B\$13 =136*\$B\$13 =136*\$B\$12 =136-138-139 =134	= J29 = J21-J30 = I34 = J32-J34 = J36*\$B\$13 = J36*\$B\$12 = J36-J38-J39 = J34	=K29 =K21-K30 0 =K32-K34 =K36*\$B\$13 =K36*\$B\$12 =K36-K38-K39 =K34	=L29 =L21-L30 0 =L32-L34 =L36*\$B\$13 =L36*\$B\$12 =L36-\$B\$12 =L36-L38-L39 =L34	=M29 =M21-M30 0 =M32-M34 =M36*\$B\$13 =M36*\$B\$12 =M36* B \$12 =M36-M38-M39 =M34	=N29 =N21-N30 0 =N32-N34 =N36*\$B\$13 =N36*\$B\$12 =N36-\$B\$12 =N36-N38-N39 =N34	=029 =021-030 0 =032-034 =036*\$B\$13 =036*\$B\$12 =036-038-039 =034
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation EARNINGS BEFORE TAXES - State Taxes - Federal Taxes NET INCOME	=B21-B30 0 =B32-B34 =B36*5.5% =B36*35% =B36*B38-B39 =B34	=C29 =C21-C30 0 =C32-C34 =C36*\$B\$13 =C36*\$B\$12 =C36*\$B\$12 =C36-C38-C39 =C34	=D29 =D21-D30 =(B28)/7 =D32-D34 =D36*\$B\$13 =D36*\$B\$12 =D36-D38-D39 =D34	=E29 =E21-E30 =D34 =E32-E34 =E36*\$B\$13 =E36*\$B\$12 =E36-E38-E39	=F29 =F21-F30 =E34 =F32-F34 =F36*\$B\$13 =F36*\$B\$12 =F36 -F38-F39 =F34	=G29 =G21-G30 =F34 =G32-G34 =G36*\$B\$13 =G36*\$B\$12 =G36-G38-G39 =G34	=H29 =H21-H30 =G34 =H32-H34 =H36*\$B\$13 =H36*\$B\$12 =H36-H38-H39	=129 =121-130 =H34 =132-134 =136*\$B\$13 =136*\$B\$13 =136*\$B\$12 =136-138-139 =134	=J29 =J21-J30 =J34 =J32-J34 =J36*\$B\$13 =J36*\$B\$12 =J36-J38-J39	=K29 =K21-K30 0 =K32-K34 =K36*\$B\$13 =K36*\$B\$12 =K36-K38-K39 =K34	=L29 =L21-L30 0 =L32-L34 =L36*\$B\$13 =L36*\$B\$12 =L36-\$B\$12 =L36-L38-L39 =L34	=M29 =M21-M30 0 =M32-M34 =M36*\$B\$13 =M36*\$B\$12 =M36* B \$12 =M36-M38-M39 =M34	=N29 =N21-N30 0 =N32-N34 =N36*\$B\$13 =N36*\$B\$12 =N36-\$B\$12 =N36-N38-N39 =N34	=029 =021-030 0 =032-034 =036*\$B\$13 =036*\$B\$12 =036-038-039
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation EARNINGS BEFORE TAXES - State Taxes - Federal Taxes NET INCOME + Depreciation AFTER TAX NET CASH FLOW	=B21-B30 0 =B32-B34 =B36*5.5% =B36*35% =B36*35% =B36-B38-B39 =B34 =B41+B43	=C29 =C21-C30 0 =C32-C34 =C36*\$B\$13 =C36*\$B\$12 =C36*\$B\$12 =C36-C38-C39 =C34 =C34	=D29 =D21-D30 =(B28)/7 =D32-D34 =D36*\$B\$13 =D36*\$B\$13 =D36*\$B\$12 =D36-D38-D39 =D34 =D41+D43	=E29 =E21-E30 =D34 =E32-E34 =E36*\$B\$13 =E36*\$B\$12 =E36 - \$38-E39 =E34 =E41+E43	=F29 =F21-F30 =E34 =F32-F34 =F36*\$B\$13 =F36*\$B\$13 =F36*\$B\$12 =F36-F38-F39 =F34 =F34	=G29 =G21-G30 =F34 =G32-G34 =G36*\$B\$13 =G36*\$B\$12 =G36-G38-G39 =G34 =G41+G43	=H29 =H21-H30 =G34 =H32-H34 =H36*\$B\$13 =H36*\$B\$13 =H36*\$B\$12 =H36+H38-H39 =H34 =H41+H43	=129 =121-130 =132-134 =136*\$B\$13 =136*\$B\$13 =136*\$B\$12 =136-138-139 =134 =134	= J29 = J21-J30 = J32-J34 = J32-J34 = J36'\$B\$13 = J36'\$B\$12 = J36-J38-J39 = J34 = J34	=K29 =K21-K30 0 =K32-K34 =K36*\$B\$13 =K36*\$B\$12 =K36*\$B\$12 =K36+K38-K39 =K34 =K41+K43	=L29 =L21-L30 0 =L32-L34 =L36*\$B\$13 =L36*\$B\$12 =L36-\$B\$12 =L34 =L34 =L41+L43	=M29 =M21-M30 0 =M32-M34 =M32-M34 =M36*\$B\$13 =M36*\$B\$12 =M36*M38-M39 =M34 =M41+M43	=N29 =N21-N30 0 =N32-N34 =N36*\$B\$13 =N36*\$B\$12 =N36*\$B\$12 =N36-N38-N39 =N34 =N34	=029 =021-030 0 =032-034 =036*\$B\$13 =036*\$B\$13 =036*\$B\$12 =036*038*039 =034 =034
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation EARNINGS BEFORE TAXES - State Taxes - Federal Taxes NET INCOME + Depreciation	=B21-B30 0 =B32-B34 =B36*5.5% =B36*35% =B36*35% =B36-B38-B39 =B34 =B41+B43	=C29 =C21-C30 0 =C32-C34 =C36*\$B\$13 =C36*\$B\$12 =C36-C38-C39 =C34	=D29 =D21-D30 =(B28)/7 =D32-D34 =D36*\$B\$13 =D36*\$B\$13 =D36*\$B\$12 =D36-D38-D39 =D34 =D41+D43	=E29 =E21-E30 =D34 =E32-E34 =E36*\$B\$13 =E36*\$B\$12 =E36-E38-E39 =E34	=F29 =F21-F30 =E34 =F32-F34 =F36*\$B\$13 =F36*\$B\$13 =F36*\$B\$12 =F36-F38-F39 =F34 =F34	=G29 =G21-G30 =F34 =G32-G34 =G36*\$B\$13 =G36*\$B\$12 =G36-G38-G39 =G34 =G41+G43	=H29 =H21-H30 =G34 =H32-H34 =H36'\$B\$13 =H36'\$B\$12 =H36'H38-H39 =H34	=129 =121-130 =132-134 =136*\$B\$13 =136*\$B\$13 =136*\$B\$12 =136-138-139 =134 =134	= J29 = J21-J30 = J32-J34 = J32-J34 = J36'\$B\$13 = J36'\$B\$12 = J36-J38-J39 = J34 = J34	=K29 =K21-K30 0 =K32-K34 =K36*\$B\$13 =K36*\$B\$12 =K36*\$B\$12 =K36+K38-K39 =K34 =K41+K43	=L29 =L21-L30 0 =L32-L34 =L36*\$B\$13 =L36*\$B\$12 =L36-\$B\$12 =L34 =L34 =L41+L43	=M29 =M21-M30 0 =M32-M34 =M36*\$B\$13 =M36*\$B\$12 =M36* B \$12 =M36-M38-M39 =M34	=N29 =N21-N30 0 =N32-N34 =N36*\$B\$13 =N36*\$B\$12 =N36*\$B\$12 =N36-N38-N39 =N34 =N34	=029 =021-030 0 =032-034 =036*\$B\$13 =036*\$B\$12 =036-038-039 =034
ITOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation EARNINGS BEFORE TAXES - State Taxes - Federal Taxes NET INCOME + Depreciation AFTER TAX NET CASH FLOW + Taxes	=B21-B30 0 =B32-B34 =B36*5.5% =B36*35% =B36*35% =B36-B38-B39 =B34 =B34 =B41+B43 =SUM(B38:B39)	=C29 =C21-C30 0 =C32-C34 =C36*\$B\$13 =C36*\$B\$12 =C36*\$B\$12 =C36*C39 =C34 =C34 =C41+C43 =SUM(C38:C39)	=D29 =D21-D30 =(B28)/7 =D36-58\$13 =D36*58\$12 =D36*58\$12 =D36-D38-D39 =D34 =D41+D43 =SUM(D38:D39)	=E29 =E21-E30 =D34 =E32-E34 =E36*\$B\$13 =E36*\$B\$12 =E36*\$B\$12 =E34 =E34 =E41+E43 =SUM(E38:E39)	=F29 =F21-F30 =E34 =F32-F34 =F36*\$8\$13 =F36*\$8\$12 =F36*\$8\$12 =F34 =F34 =F34 =F41+F43	=G29 =G21-G30 =F34 =G32-G34 =G36*58\$13 =G36*58\$12 =G36-G38-G39 =G34 =G41+G43 =SUM(G38:G39)	=H29 =H21-H30 =G34 =H36*\$B\$13 =H36*\$B\$12 =H36*\$B\$12 =H36+H38-H39 =H34 =H41+H43 =SUM(H38:H39)	=129 =121-130 =H34 =132-134 =136*\$B\$13 =136*\$B\$12 =136+3B\$12 =136+	= J29 = J21-J30 = J34 = J32-J34 = J36*\$B\$13 = J36*\$B\$12 = J36-\$38-J39 = J34 = J41+J43 = SUM(J38:J39)	=K29 =K21-K30 0 =K32-K34 =K36*\$8\$13 =K36*\$8\$12 =K36*\$8\$12 =K34 =K34 =K41+K43 =SUM(K38:K39)	=L29 =L21-L30 0 =L32-L34 =L36*\$B\$13 =L36*\$B\$12 =L36+\$B\$12 =L34 =L41+L43 =SUM(L38:L39)	=M29 =M21-M30 0 =M32-M34 =M36*\$8\$13 =M36*\$8\$12 =M36*\$8\$12 =M36*M38-M39 =M34 =SUM(M38:M39)	=N29 =N21-N30 0 =N32-N34 =N36*\$B\$13 =N36*\$B\$12 =N36*\$B\$12 =N36-N38-N39 =N34 =N41+N43 =SUM(N38:N39)	=029 =021-030 0 =032-034 =036*\$B\$13 =036*\$B\$12 =036*038-039 =034 =041+043 =SUM(038:039)
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation EARNINGS BEFORE TAXES - State Taxes - Federal Taxes NET INCOME + Depreciation AFTER TAX NET CASH FLOW	=B21-B30 0 =B32-B34 =B36*5.5% =B36*35% =B36*35% =B36-B38-B39 =B34 =B34 =B41+B43 =SUM(B38:B39)	=C29 =C21-C30 0 =C32-C34 =C36*\$B\$13 =C36*\$B\$12 =C36*\$B\$12 =C36*C39 =C34 =C34 =C41+C43 =SUM(C38:C39)	=D29 =D21-D30 =(B28)/7 =D32-D34 =D36*\$B\$13 =D36*\$B\$13 =D36*\$B\$12 =D36-D38-D39 =D34 =D41+D43	=E29 =E21-E30 =D34 =E32-E34 =E36*\$B\$13 =E36*\$B\$12 =E36 - \$38-E39 =E34 =E41+E43	=F29 =F21-F30 =E34 =F32-F34 =F36*\$8\$13 =F36*\$8\$12 =F36*\$8\$12 =F34 =F34 =F34 =F41+F43	=G29 =G21-G30 =F34 =G32-G34 =G36*58\$13 =G36*58\$12 =G36-G38-G39 =G34 =G41+G43 =SUM(G38:G39)	=H29 =H21-H30 =G34 =H32-H34 =H36*\$B\$13 =H36*\$B\$13 =H36*\$B\$12 =H36+H38-H39 =H34 =H41+H43	=129 =121-130 =H34 =132-134 =136*\$B\$13 =136*\$B\$12 =136*3B\$12 =136+138-139 =134 =134 =141+143	= J29 = J21-J30 = J32-J34 = J32-J34 = J36'\$B\$13 = J36'\$B\$12 = J36-J38-J39 = J34 = J34	=K29 =K21-K30 0 =K32-K34 =K36*\$8\$13 =K36*\$8\$12 =K36*\$8\$12 =K34 =K34 =K41+K43 =SUM(K38:K39)	=L29 =L21-L30 0 =L32-L34 =L36*\$B\$13 =L36*\$B\$12 =L36+\$B\$12 =L34 =L41+L43 =SUM(L38:L39)	=M29 =M21-M30 0 =M32-M34 =M36*\$8\$13 =M36*\$8\$12 =M36*\$8\$12 =M36*M38-M39 =M34 =SUM(M38:M39)	=N29 =N21-N30 0 =N32-N34 =N36*\$B\$13 =N36*\$B\$12 =N36*\$B\$12 =N36-N38-N39 =N34 =N41+N43 =SUM(N38:N39)	=029 =021-030 0 =032-034 =036*\$B\$13 =036*\$B\$13 =036*\$B\$12 =036-038-039 =034 =041+043
TOTAL EXPENSES (TAX BASIS) GROSS MARGIN FROM OPERATION (EBITDA) - Depreciation EARNINGS BEFORE TAXES - State Taxes - Federal Taxes NET INCOME + Depreciation AFTER TAX NET CASH FLOW + Taxes PRE-TAX CASH FLOW	=B21-B30 0 =B32-B34 =B36*5.5% =B36*35% =B36*35% =B36 *35% =B34 =B34 =B41+B43 =SUM(B38:B39) =-1*(B28)	=C29 =C21-C30 0 =C32-C34 =C36*\$B\$13 =C36*\$B\$12 =C36*\$B\$12 =C36*C39 =C34 =C41+C43 =SUM(C38:C39) =C45+C47	=D29 =D21-D30 =(B28)/7 =D36*58\$13 =D36*58\$12 =D36*58\$12 =D36-D38-D39 =D34 =D41+D43 =SUM(D38:D39)	=E29 =E21-E30 =D34 =E32-E34 =E36*\$B\$13 =E36*\$B\$12 =E36*\$B\$12 =E34 =E34 =E41+E43 =SUM(E38:E39)	=F29 =F21-F30 =E34 =F32-F34 =F36*\$8\$13 =F36*\$8\$12 =F36*\$8\$12 =F34 =F34 =F34 =F41+F43	=G29 =G21-G30 =F34 =G32-G34 =G36*58\$13 =G36*58\$12 =G36-G38-G39 =G34 =G41+G43 =SUM(G38:G39)	=H29 =H21-H30 =G34 =H36*\$B\$13 =H36*\$B\$12 =H36*\$B\$12 =H36+H38-H39 =H34 =H41+H43 =SUM(H38:H39)	=129 =121-130 =H34 =132-134 =136*\$B\$13 =136*\$B\$12 =136+3B\$12 =136+	= J29 = J21-J30 = J34 = J32-J34 = J36*\$B\$13 = J36*\$B\$12 = J36-\$38-J39 = J34 = J41+J43 = SUM(J38:J39)	=K29 =K21-K30 0 =K32-K34 =K36*\$8\$13 =K36*\$8\$12 =K36*\$8\$12 =K34 =K34 =K41+K43 =SUM(K38:K39)	=L29 =L21-L30 0 =L32-L34 =L36*\$B\$13 =L36*\$B\$12 =L36+\$B\$12 =L34 =L41+L43 =SUM(L38:L39)	=M29 =M21-M30 0 =M32-M34 =M36*\$8\$13 =M36*\$8\$12 =M36*\$8\$12 =M36*M38-M39 =M34 =SUM(M38:M39)	=N29 =N21-N30 0 =N32-N34 =N36*\$B\$13 =N36*\$B\$12 =N36*\$B\$12 =N36-N38-N39 =N34 =N41+N43 =SUM(N38:N39)	=029 =021-030 0 =032-034 =036*\$B\$13 =036*\$B\$12 =036*\$B\$12 =036-038-039 =034 =041+043 =SUM(038:039)
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Issues with Darren's NPV analysis:

- Note the treatment of depreciation correctly affects taxes
- <u>Nominal</u>, real, or inconsistent analysis?
- No defense of the discount rate
- Inflation assumptions probably OK, but all at 2%?
- Where are the risks? (upfront costs...) Did he treat them appropriately? (ignored them)
- Did he use <u>optimistic</u>, pessimistic, or middle-of the road figures? (E.g., depreciation, installation,...) What should he have done? (middle)
- Given that the cash flows are savings in energy costs, should the discount rate be higher, lower, or the same as the firms' overall cost of capital? (Arguably higher, positive beta)
- Which are the most important assumptions? (experiment)
- Mistake in computing NPV: Forgot initial cost
- Mistake in computing IRR (ROA): Used the wrong cash flows
- Mistake in computing payback: Didn't use after-tax cash flows

"Even if your fancy NPV analysis is correct..." How to deal with various forms of opposition?

- If it is such a good idea, why aren't our smart competitors doing it?
- Adding complexity ALWAYS adds risk, and your savings (EBITDA) can only amount to 2% of revenue – lost in the noise!
- We are only given a limited amount to invest, and we always focus on increasing capacity; that's how we grow the business!
- Our bonuses depend on production, and this project will involve downtime. We might not be able to recover from it!
- Policies related to distributed generation (like the kill switch requirement, ability to sell excess power) and others are still in flux – let's wait until the dust settles.
- Is there a positive spin that Darren can put on this project to sell it despite these objections? What kinds of thinking do they reflect?
- What public policy changes would help this project most?

15.031J / 14.43J / 21A.341J / 11.161J Energy Decisions, Markets, and Policies Spring 2012

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