CINERGY COAL ALLOCATION

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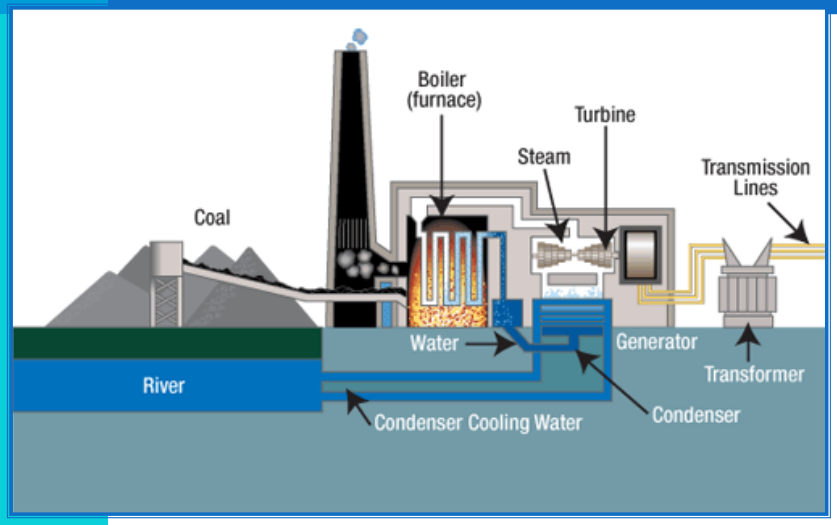
INTRODUCTION

- Cinergy Corporation
- Initial Scenario
- Problem
- Analysis
- Managerial Implications

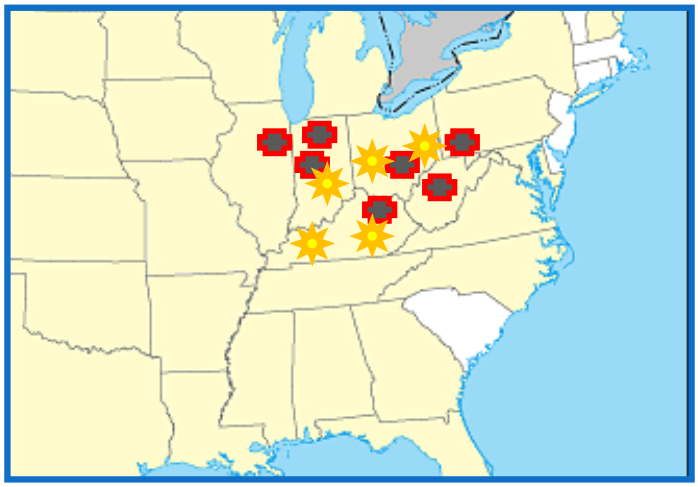
CINERGY COAL-BURNING GENERATING PLANTS



GENERATING UNITS & MINES

GENERATING UNITS

MINES



FACTORS TO BE CONSIDERED

$67 M

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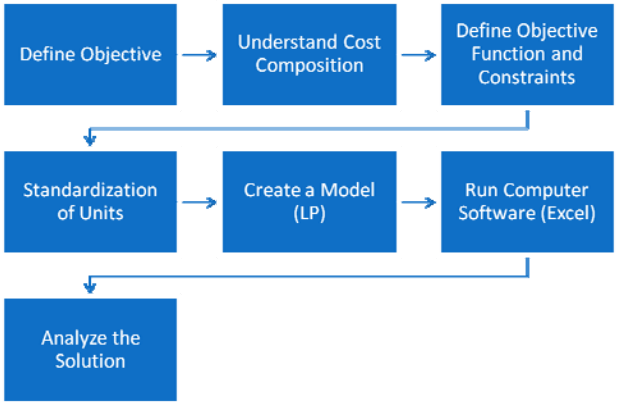
BTU / lb

+

- Fixed Contracts & Variable Contracts (min & max)
- Cost Variables
  - Price/ton
  - BTUs/lb
  - Add-On Cost (processing cost dependent upon moisture content, ash content, sulfur content, and grindability)
  - Transportation Costs
  - Plant Efficiency (Heat Rate)

SOLVING THE PROBLEM

MAP OF PROCESS



ORIGINAL OBJECTIVE FUNCTION

Minimize: $C = \sum_{i=1}^{n} \sum_{j=1}^{n} C_{ij} X_{ij}$

Total Cost $/ton: Purchase + Transportation + Processing

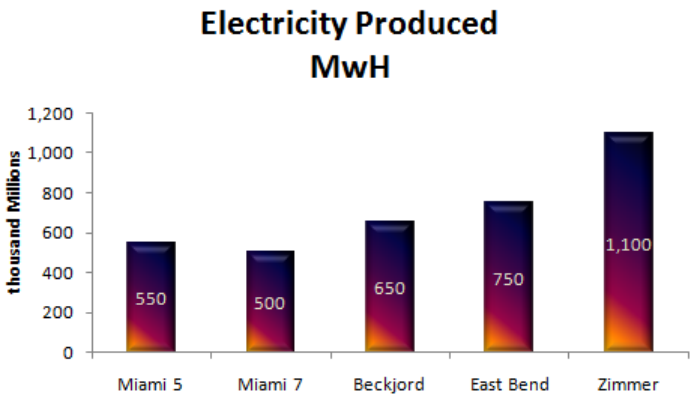
	Miami 5	Miami 7	Beckjord	East Bend	Zimmer
RAG	37.00	37.00	36.75	32.00	32.75
Peabody	39.75	39.75	40.50	35.75	36.50
American	38.00	38.00	39.75	34.00	33.75
Consol	45.25	45.25	45.85	42.25	41.85
Cyprus	50.00	50.00	49.75	45.00	45.75
Addingtor	38.25	38.25	39.00	37.25	37.00
Waterloo	46.00	46.00	45.60	42.00	43.60

BTU BASED OBJECTIVE FUNCTION

Total Cost $/million BTUs					
	Miami 5	Miami 7	Beckjord	East Bend	Zimmer
RAG	1.42	1.42	1.41	1.23	1.26
Peabody	1.49	1.49	1.52	1.34	1.37
American	1.51	1.51	1.58	1.35	1.34
Consol	1.85	1.85	1.87	1.72	1.71
Cyprus	2.08	2.08	2.07	1.88	1.91
Addingtor	1.59	1.59	1.63	1.55	1.54
Waterloo	2.04	2.04	2.02	1.86	1.93

$$C_{\$/BTU} = \frac{C_{\$/Ton}}{BTU/Ton}$$

ELECTRICITY PRODUCED BY EACH PLANT



ELECTRICITY PRODUCTION CONSTRAINTS

		Electricity Requirement (MwH)		Millions BTUs
Miami 5	>=	550,000	→	5,775,000
Miami 7	>=	500,000	→	5,100,000
Beckjord	>=	650,000	→	6,565,000
East Bend	>=	750,000	→	7,500,000
Zimmer	>=	1,100,000	→	11,000,000

$$Electricity\,\mathrm{Pr}oduction = \sum_{i}^{n}\sum_{j}^{n} e_{ij} X_{ij}$$

$$Electricity\,\mathrm{Pr}oduction_{BTU} = Electricity\,\mathrm{Pr}oduction_{KwH}\left(BTU/_{KwH}\right)$$

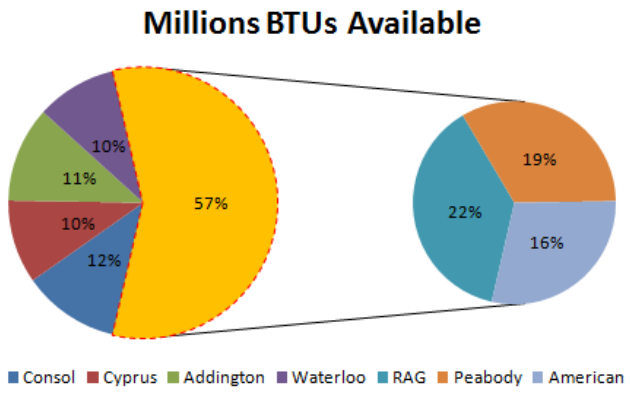
COAL AVAILABILITY CONSTRAINTS

		Ton's of Coal Available		Millions BTUs Available
RAG	=	350,000	→	9,100,000
Peabody	=	300,000	→	7,980,000
American	=	275,000	→	6,930,000
Consol	<=	200,000	→	4,900,000
Cyprus	<=	175,000	→	4,200,000
Addingtor	<=	200,000	→	4,800,000
Waterloo	<=	180,000	→	4,068,000

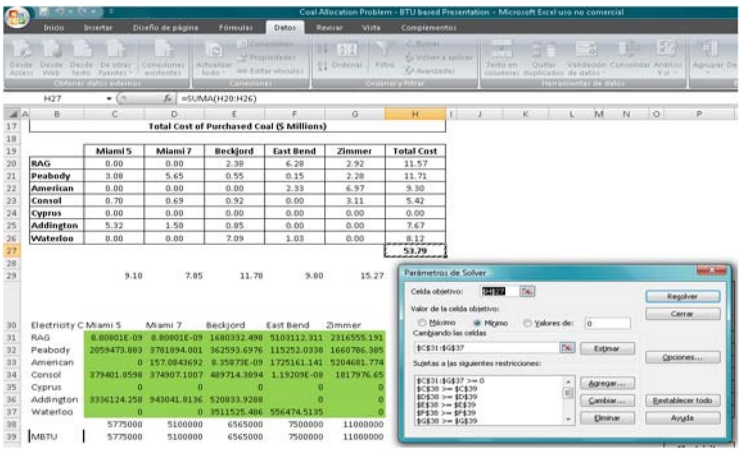
$$FixedContr\,act = \sum_{i=1}^{n}\sum_{j=1}^{n} X_{ij} \qquad VariableCo\,ntract <= \sum_{i=1}^{n}\sum_{j=1}^{n} X_{ij}$$

$$AvailableCoal_{BTU} = Tons\left(BTU/_{Ton}\right)$$

MANDATORY CONTRACTS VS VARIABLE CONTRACTS



EXCEL SOLVER



Total Cost of Purchased Coal ($ Millions)

	Miami 5	Miami 7	Beckjord	East Bend	Zimmer	Total Cost
RAG	0.00	0.00	2.38	6.28	2.92	11.57
Peabody	3.08	5.65	0.55	0.15	2.28	11.71
American	0.00	0.00	0.00	2.33	6.97	9.30
Consol	0.70	0.69	0.92	0.00	3.11	5.42
Cyprus	0.00	0.00	0.00	0.00	0.00	0.00
Addington	5.32	1.50	0.05	0.00	0.00	7.67
Waterloo	0.00	0.00	7.09	1.03	0.00	8.12
						53.79
	9.10	7.85	11.78	9.80	15.27	

Electricity C	Miami 5	Miami 7	Beckjord	East Bend	Zimmer
RAG	8.80801E-09	8.80801E-09	1680332.498	5103112.311	2316555.191
Peabody	2059473.883	3781894.001	362593.6976	115252.0338	1660786.385
American	0	157.0843692	8.35873E-09	1725161.141	5204681.774
Consol	379401.8598	374907.1007	489714.3094	1.19209E-08	1817976.65
Cyprus	0	0	0	0	0
Addington	3336124.258	943041.8136	520833.9288	0	0
Waterloo	0	0	3511525.486	556474.5135	0
	5775000	5100000	6565000	7500000	11000000
MBTU	5775000	5100000	6565000	7500000	11000000

OPTIMAL COST

Total Cost of Purchased Coal ($ Millions)						
	Miami 5	Miami 7	Beckjord	East Bend	Zimmer	Total Cost
RAG	0.00	0.00	2.38	6.28	2.92	11.57
Peabody	3.08	5.65	0.55	0.15	2.28	11.71
American	0.00	0.00	0.00	2.33	6.97	9.30
Consol	0.70	0.69	0.92	0.00	3.11	5.42
Cyprus	0.00	0.00	0.00	0.00	0.00	0.00
Addington	5.32	1.50	0.85	0.00	0.00	7.67
Waterloo	0.00	0.00	7.09	1.03	0.00	8.12
						53.79

OPTIMAL AMOUNT OF COAL PURCHASED

Total Purchased Coal (Thousand Tons)						
	Miami 5	Miami 7	Beckjord	East Bend	Zimmer	Total Purchased
RAG	0.00	0.00	64.63	196.27	89.10	350.00
Peabody	77.42	142.18	13.63	4.33	62.44	300.00
American	0.00	0.01	0.00	68.46	206.53	275.00
Consol	15.49	15.30	19.99	0.00	74.20	124.98
Cyprus	0.00	0.00	0.00	0.00	0.00	0.00
Addington	139.01	39.29	21.70	0.00	0.00	200.00
Waterloo	0.00	0.00	155.38	24.62	0.00	180.00
						1429.98

MANAGERIAL IMPLICATIONS

BASE SCENARIO

Total Cost of Purchased Coal ($ Millions)

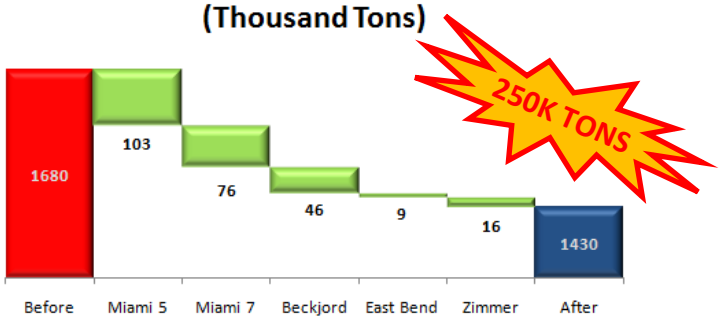
	Miami 5	Miami 7	Beckjord	East Bend	Zimmer	Total Cost
RAG	8.21	2.45	2.28	0.00	0.00	12.93
Peabody	0.64	2.30	2.84	2.25	3.39	11.42
American	0.13	2.09	3.46	2.02	2.37	10.07
Consol	0.00	1.54	2.10	2.37	2.68	8.69
Cyprus	3.57	1.45	1.19	0.43	1.87	8.52
Addingtor	0.00	0.00	0.43	3.31	3.70	7.44
Waterloo	1.01	1.41	0.98	1.10	3.48	7.98
						67.06

Total Purchased Coal (Thousand Tons)

	Miami 5	Miami 7	Beckjord	East Bend	Zimmer	Total Purchased
RAG	221.78	66.26	61.96	0.00	0.00	350.00
Peabody	16.22	57.74	70.05	62.98	93.00	300.00
American	3.41	55.00	87.00	59.37	70.21	275.00
Consol	0.01	33.99	45.90	55.99	64.10	200.00
Cyprus	71.46	29.03	23.99	9.61	40.92	175.00
Addington	0.00	0.00	10.94	88.96	100.10	200.00
Waterloo	21.89	30.66	21.57	26.15	79.72	180.00
						1680.00

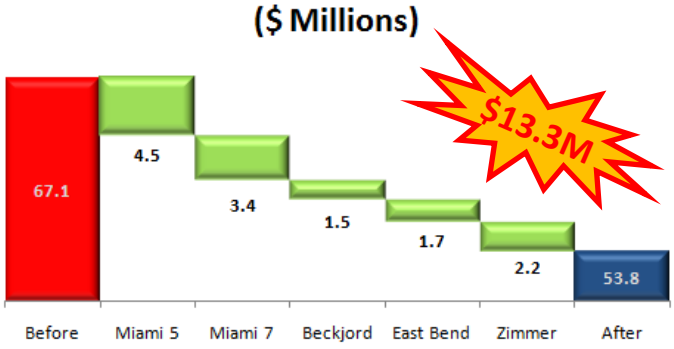
IMPROVEMENTS

REDUCTION IN COAL PURCHASED
(Thousand Tons)



IMPROVEMENTS

REDUCTION IN COST
($ Millions)



THANK YOU – GRACIAS –
SPASIBO – 謝謝