

Life Cycle Results from the Existing Power LCI&C Retrofit Study

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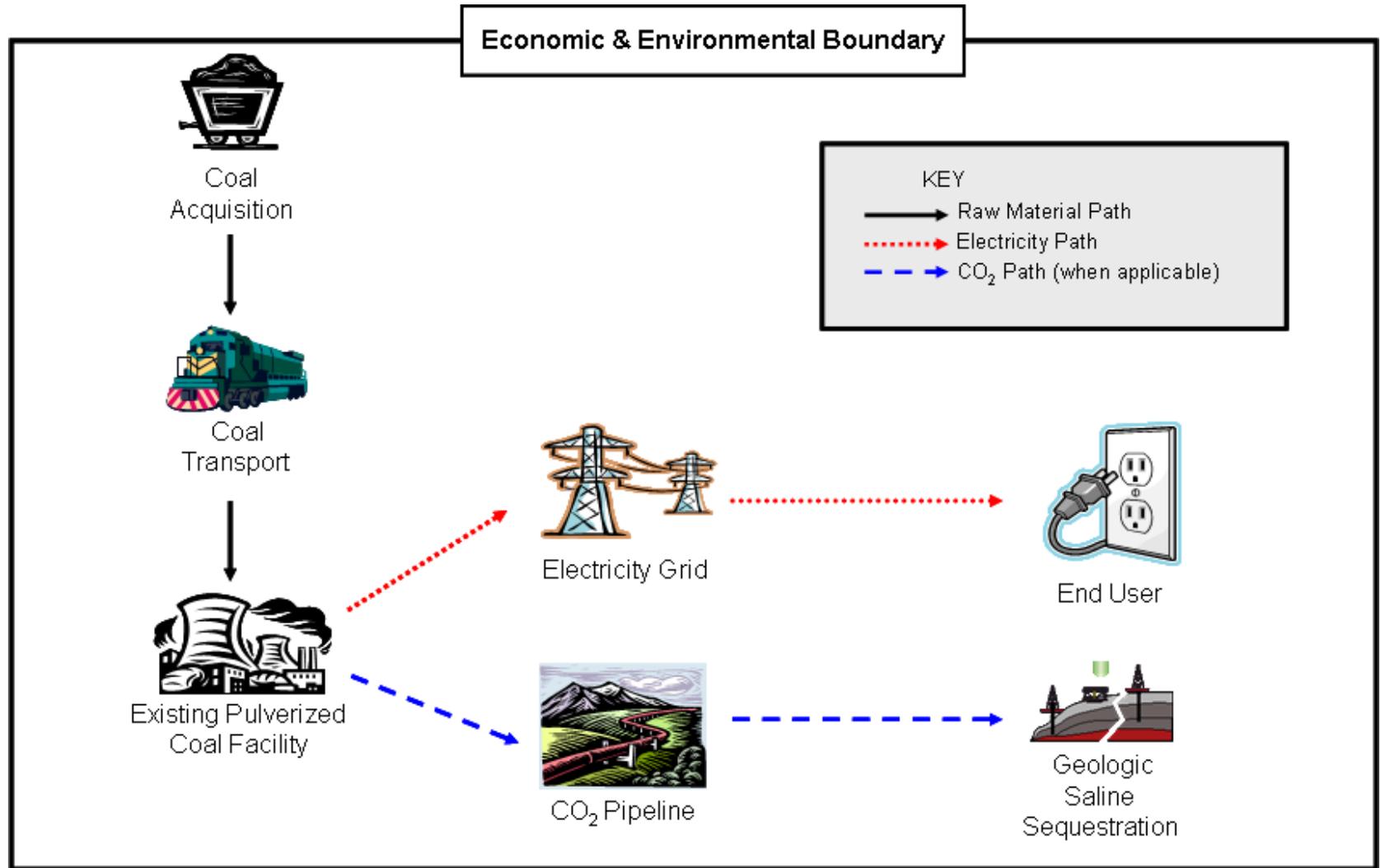
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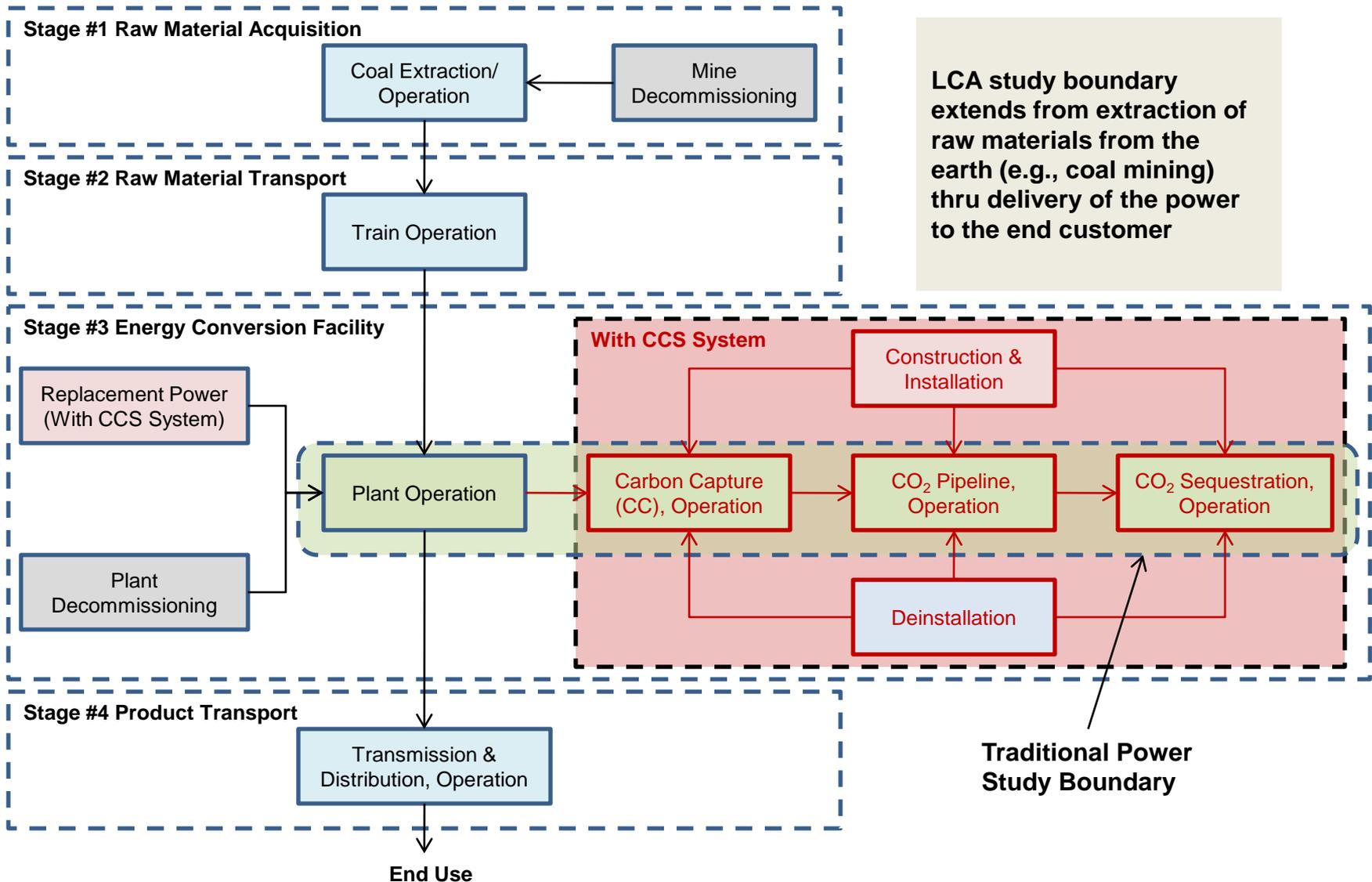
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Conceptual Study Boundary



LCA's Expanded Boundary for EXPC



Study Scenarios

	wo-CCS	w- CCS	w-CCS & No Replacement Power (NRP)
Net Power Output (MW)	434	434	303
Electric Conversion Facility (MW)	434	303	303
Replacement Power (MW)	0	131	0
Emissions Normalizing Basis (MW)	434	434	303
Information Source	EX PC LCI&C	EX PC LCI&C	Estimated from EX PC LCI&C

Replacement Power Basis

- **Based on power purchased from the applicable SERC Region**
- **Cost Calculated based on the SERC Region Whole State Average Retail Price**
 - 7.59 cents/kWh
- **Emissions data for the Replacement Power based on SERC grid 2007 operating data for US Power Plants (EPA, 2008)**
- **Emissions data normalized to the specific scenario net power output**
 - Allows addition of same basis values

Key Modeling Assumptions

	Ex. PC
Study Boundary Assumptions	
Temporal Bounday (Years)	30
Cost Boundary	Overnight
LC Stage #1: Raw Material Acquisition	
Extraction Location	Southern Illinois
Feedstock	Ill. #6 Coal
Extraction Method	Underground
C&O Costs	In Delivery Price
LC Stage #2: Raw Material Transport	
One-way transport Distance (Miles)	200
Rail Spur Length (Miles)	Pre-Existing
Main Rail/Pipeline Length (Miles)	Pre-Existing
Unit Train/LNG Infrastructure C&O Costs	In Delivery Price

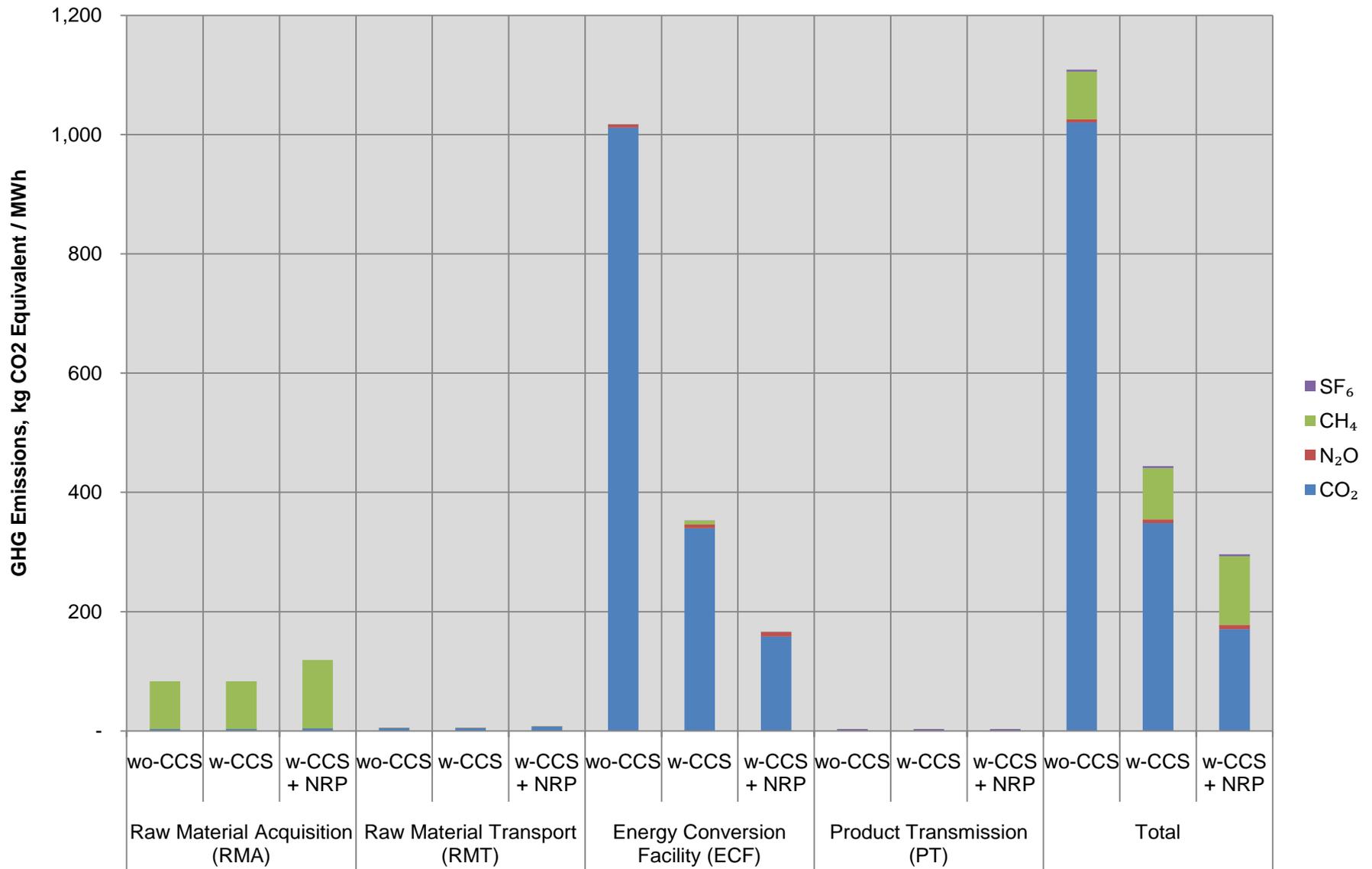
Key Modeling Assumptions (Cont.)

	Ex. PC
LC Stage #3: Energy Conversion Facility	
Location	Southern Illinois
Net Output (MW)	434
Net Output w/CCS (MW)	303
Trunk line Constructed Length (Miles)	Pre-Existing
Capacity Factor	85%
CCS CO ₂ Capture Percentage	90%
CO ₂ Pipeline Pressure (psia)	2215
CO ₂ Pipeline Length (Miles)	100
CO ₂ Loss Rate	1% / 100 yrs
LC Stage #4: Product Transport	
Transmission Line Loss	7%
Transmission Grid Construction	Pre-Existing

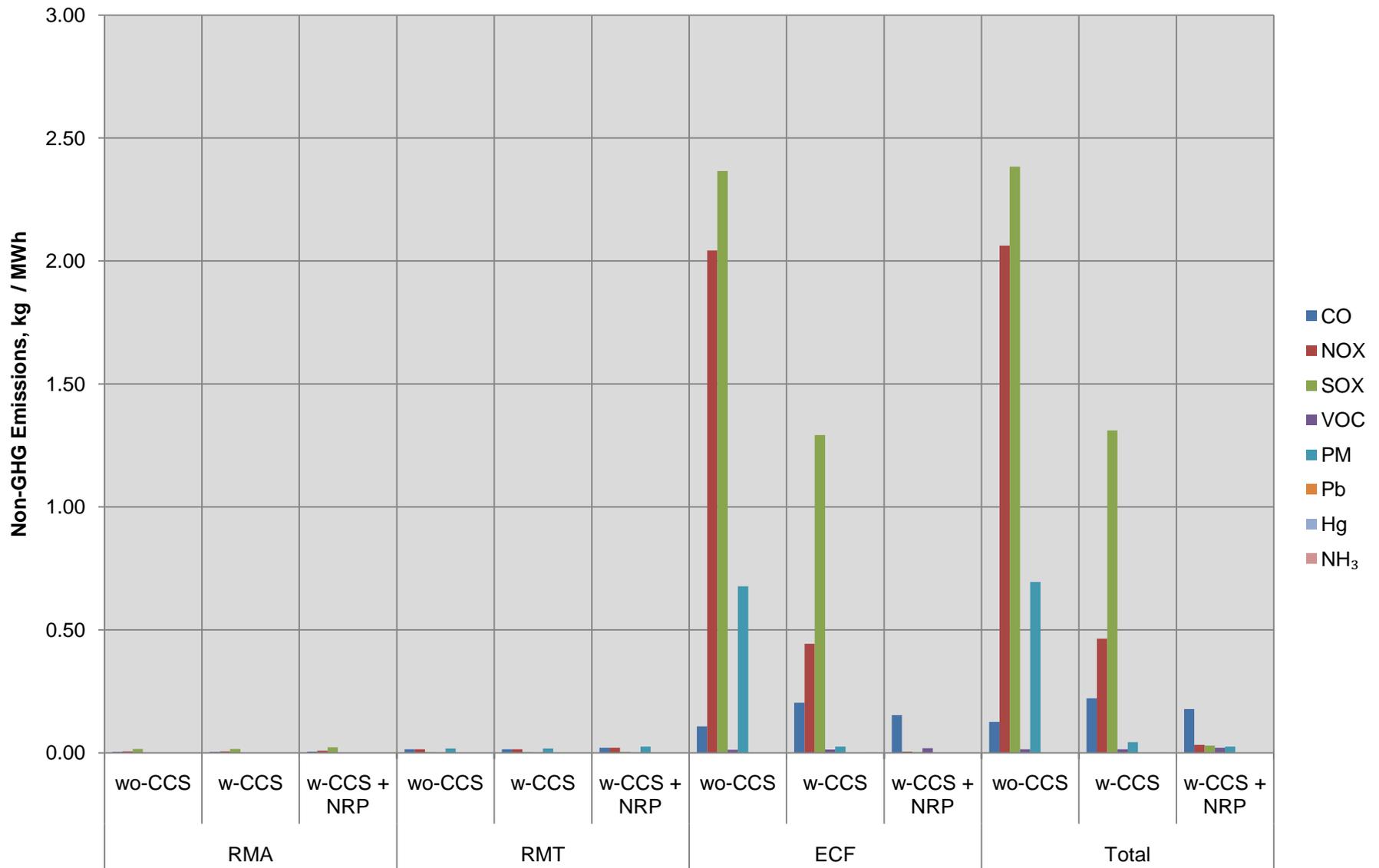
Life Cycle Cost Parameters

Property	Value	Units
Reference Year Dollars	December 2006/January 2007	Year
Assumed Start-Up Year	2010	Year
Real After-Tax Discount Rate	10.0	Percent
After-Tax Nominal Discount Rate	12.09	Percent
Assumed Study Period	30	Years
MACRS Depreciation Schedule Length	Variable	Years
Inflation Rate	1.87	Percent
State Taxes	6.0	Percent
Federal Taxes	34.0	Percent
Total Tax Rate	38.0	Percent
Fixed Charge Rate Calculation Factors		
After-Tax Real Capital Recovery Factor	0.106	--
Real Present Value of Depreciation	0.487	--
Real Fixed Charge Rate	0.139	--
Sum of PV Factors (Used in Calculating O&M Levelized Values)	9.427	--
Start Up Year (2010) Feedstock & Utility Prices	\$2006 Dollars	Units
Natural Gas	6.76	\$/MMBtu
Coal	1.51	\$/MMBtu
Process Water	0.00049 (0.0019)	\$/L (\$/gal)

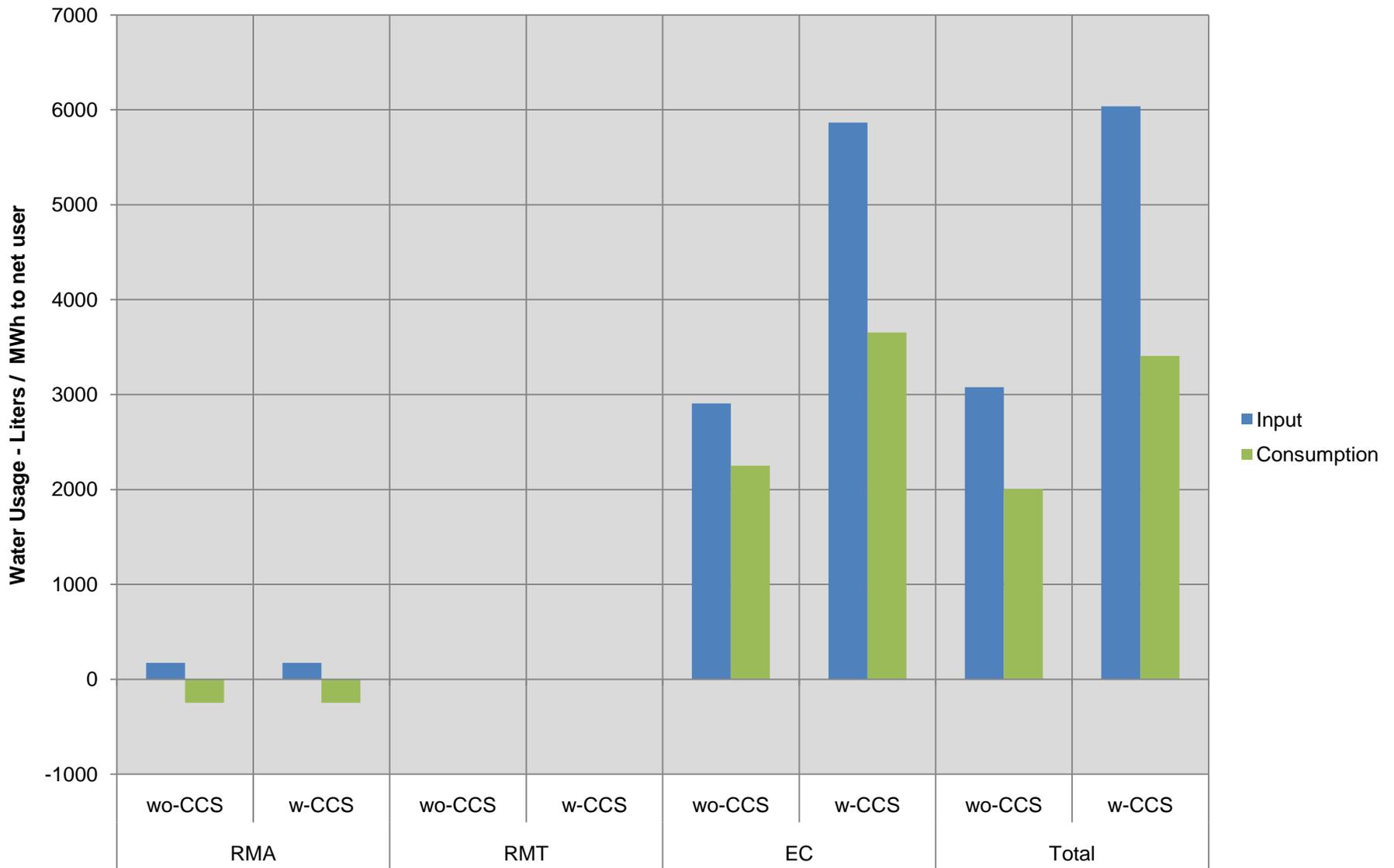
GHG Emissions



Non-GHG Air Emissions



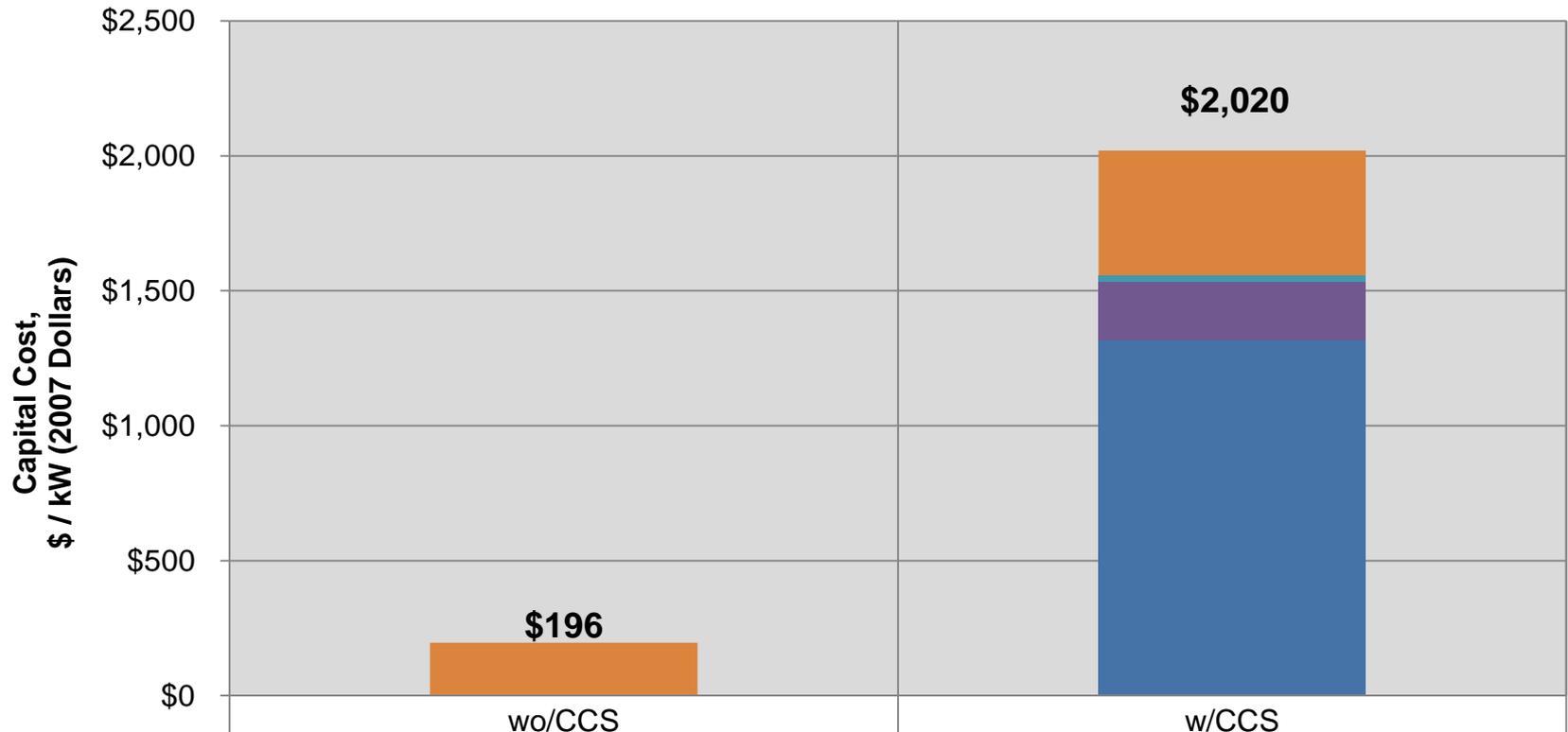
Water Usage



LCA Inventory Results Recap

Emission Type	Species	RMA		RMT		ECF		PT		TOTAL	
		wo-CCS	w-CCS	wo-CCS	w-CCS	wo-CCS	w-CCS	wo-CCS	w-CCS	wo-CCS	w-CCS
GHG (kg CO ₂ e / MWh)	CO ₂	3.15	3.15	5.19	5.19	1011.83	340.02	0.00	0.00	1020.17	348.37
	N ₂ O	0.01	0.01	0.04	0.04	5.13	6.03	0.00	0.00	5.18	6.08
	CH ₄	79.83	79.83	0.19	0.19	0.30	6.48	0.00	0.00	80.32	86.50
	SF ₆	0.00	0.00	0.00	0.00	0.01	0.00	3.19	3.19	3.20	3.20
	Total	83.00	83.00	5.42	5.42	1017.26	352.54	3.19	3.19	1108.87	444.15
Non-GHG (kg / MWh)	CO	3.1E-03	3.1E-03	1.4E-02	1.4E-02	1.1E-01	2.0E-01			1.3E-01	2.2E-01
	NOX	5.9E-03	5.9E-03	1.4E-02	1.4E-02	2.0E+00	4.4E-01			2.1E+00	4.6E-01
	SOX	1.6E-02	1.6E-02	2.7E-03	2.7E-03	2.4E+00	1.3E+00			2.4E+00	1.3E+00
	VOC	1.0E-04	1.0E-04	1.3E-03	1.3E-03	1.3E-02	1.3E-02			1.4E-02	1.4E-02
	PM	5.5E-04	5.5E-04	1.7E-02	1.7E-02	6.8E-01	2.5E-02			7.0E-01	4.3E-02
	Pb	1.4E-07	1.4E-07	3.0E-08	3.0E-08	6.3E-06	1.9E-05			6.5E-06	1.9E-05
	HG	3.9E-08	3.9E-08	2.9E-09	2.9E-09	5.2E-05	5.5E-05			5.2E-05	5.5E-05
	NH ₃	2.8E-05	2.8E-05	1.9E-04	1.9E-04	2.2E-04	1.3E-03			4.3E-04	1.5E-03
Water Usage (Liter / MWh)	Input	172.9	172.9	0.4	0.4	2905.4	5864.6			3078.6	6037.9
	Consumption	-247.4	-247.4	0.1	0.1	2250.5	3653.9			2003.3	3406.6

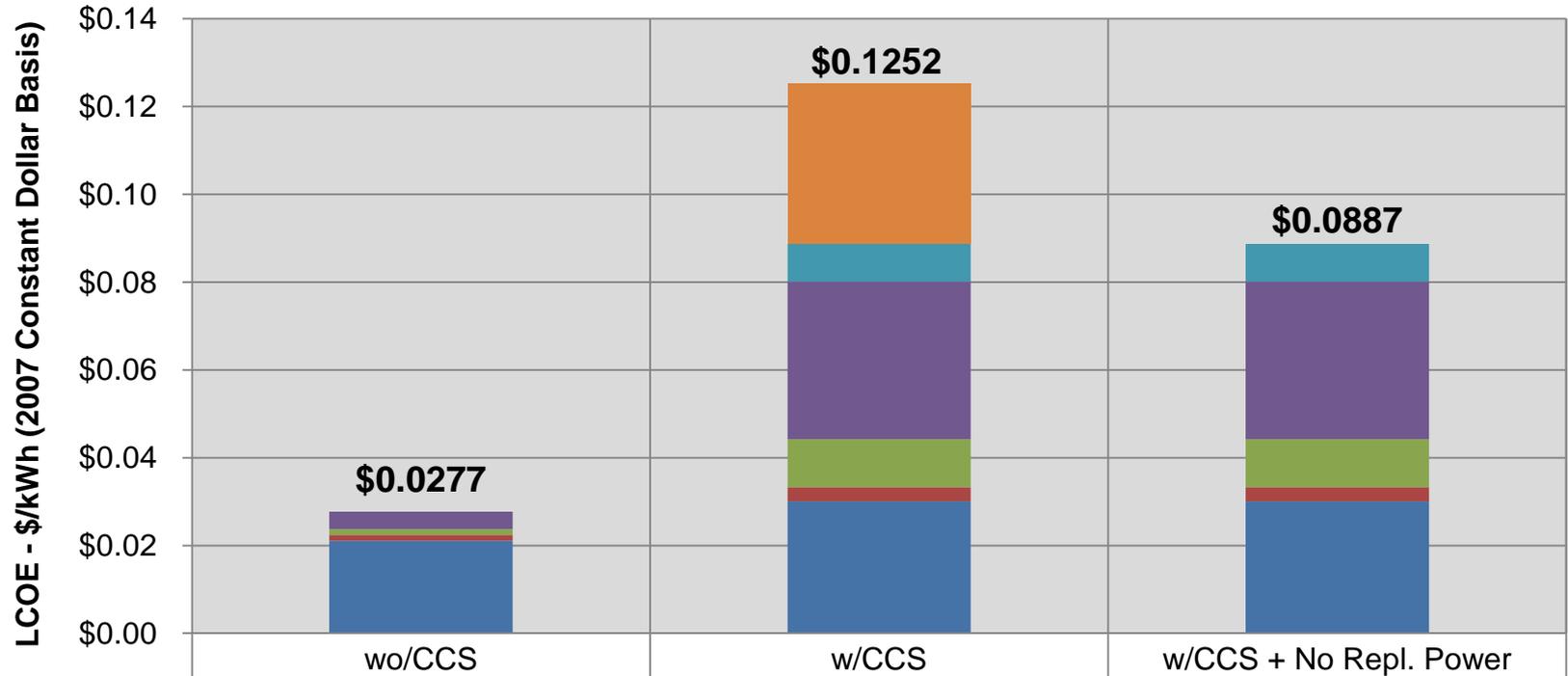
Capital Costs



	wo/CCS	w/CCS
Decommissioning	\$196	\$463
Sequestration Site	\$0	\$20
CO ₂ Pipeline	\$0	\$216
Switchyard	\$0	\$0
Trunkline	\$0	\$0
Capital + Initial Costs	\$0	\$1,320
Total Plant Cost	\$196	\$2,020

LCOE

2007 \$'s



	wo/CCS	w/CCS	w/CCS + No Repl. Power
Replacement Power		\$0.0365	
CO ₂ TS&M Costs		\$0.0086	\$0.0086
Capital Costs	\$0.0040	\$0.0359	\$0.0359
Variable O&M	\$0.0013	\$0.0109	\$0.0109
Labor Costs	\$0.0013	\$0.0032	\$0.0032
Utility Costs	\$0.0211	\$0.0301	\$0.0301
Total	\$0.0277	\$0.1252	\$0.0887

Key Findings

- **GHG Emissions**

- Coal-bed methane – 96% of RMA GHG Emissions
- CO₂
 - 96% of RMT GHG Emissions
 - 99% of ECF GHG Emissions
- Replacement Power
 - Increases GHG Emissions by 50%
 - Large impact on GHG

- **Non-GHG Emissions**

- SOX
 - Dominant ECF and Total LC non-GHG Emission
- RMA & RMT – Minimal Emissions compared to ECF
- NOX and PM
 - Drop drastically without Replacement Power
- Replacement Power
 - Brings a large component of SOX, NOX, and PM to the Emissions totals
 - Large impact on non-GHG

Key Findings

- **Water Usage**

- RMA - net production at mine
 - Due to stormwater and mine runoff
- RMT- Minimal usage
- ECF - Primary user
 - 94% to 97% of Total Input
- The Total water Input is incrementally larger than the ECF usage
- Total Consumption is lower than ECF consumption
 - Due to the offset seen from the RMA stage

Key Findings

- **Capital Costs**

- wo-CCS – Accounted for with existing plant
- w-CCS
 - Capital equipment costs – 65% of CC
 - Decommissioning – Increase slightly
- w-CCS & NRP – Same as w-CCS (no CC for RP)

- **LCOE**

- wo-CCS
 - Utility costs are the prime driver – 76% of LCOE
- w-CCS
 - Capital – 29% of total, 40% without RP
 - Utility – 24% of total, 34% without RP
 - Replacement power – 29% of total

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