



Service Above All.

Southern States Energy Board Coal Combustion Products and Rare Earth Elements

September 24, 2017

Coal Ash Opportunities In A Dynamic Market

- Regulatory Climate For CCPs
- Production & Use – Traditional Markets
- CCP/REE Trends & Market Drivers
- REE Opportunity Status
- Impacts To States & Policies

RCRA 1976 – Energy Goal & Objective

- **RCRA -42 U.S. Code § 6902 - Objectives and national policy**
- **Objective** “The objectives of this chapter are to promote the **protection of health and the environment** and to **conserve valuable material and energy resources by**” ... “**providing technical and financial assistance to State and local governments and interstate agencies** for the development of solid waste management plans (including resource recovery and resource conservation systems) which will promote improved solid waste management techniques (including more effective organizational arrangements), new and improved methods of collection, separation, and **recovery of solid waste**, and the environmentally safe disposal of non-recoverable residues;”
- “The Congress finds **with respect to materials**, that ...**millions of tons of recoverable material which could be used are needlessly buried each year**” and that “**the recovery and conservation of such materials can reduce the dependence of the United States on foreign resources and reduce the deficit in its balance of payments.**”

- EPA Issued RCRA Subtitle D Regulation – April 17, 2015
 - Focus On Disposal - Self Implementing – Citizen Suit Enforcement
 - Primary Purpose – Regulate CCR Disposal – Landfills & Ponds
 - Next Major Impact Related To Groundwater Deadlines – October 2017
 - CCR Rules Impact CCP Utilization As Resource
 - EPA Introduced New Concept & Terminology- Encapsulated
- Water Infrastructure Improvements For The Nation Act-Dec-2016
 - Places State Approved Programs As Primary CCR Enforcement
 - Gives EPA Subtitle D Enforcement If State Program Not Approved
 - EPA -“CCR State Permit Program Guidance Document-Interim Draft”- August 10, 2017
- ELG Stay Of Deadlines & Reconsideration – 4/12/17
- EOs – Regulatory Burden Reduction
 - 13777: Reform & Reduction Task Reviews
 - 13771: Regulatory Reduction – 2 For 1
 - 13783: Suspend, Revise or Rescind Domestic Energy Burden Regs
- Request For Input On Regulatory Burden Candidates – 5-15-17
 - Industry Requests For Delay Of CCR Deadlines & Modifications

- OSM Regulatory Schedule - CCR Removed – States Will Control
- CCR Law Suit Actions – Oral Argument Scheduled – 10-17-17
 - CCP Issue - Beneficial Use > 12,400 tons versus Smallest Landfill @ 80K Tons - Math Error
 - April 18, 2016 EPA Brief - Admitted Math Error But Said No Duty To Stick To 80K Ton
 - USWAG Reconsideration Petition - 5-12-17 - For All Challenged Issues
 - EPA Responded To Industry - 9-13-17 –EPA Will Reconsider Provisions Addressed By USWAG’s Petition
 - EPA Filed Request - 9-18-17 Asking For 120 Day Delay In Oral Arguments
 - EPA Will Define Which Portions Of The Rule It Will Reconsider, If Any
 - EPA Points To WIIN Act & Issues Related To State Approvals
- ACAA Pushing EPA To Restart The C2P2 Program
- EPA TSCA Reg-Neg Committee – CDR For Inorganic Byproducts
 - CCP Product Reporting When Placed In Commerce
 - Committee Consensus Not Met – Further EPA Action Subject To Resources

- August 10, 2017 – EPA Issues “CCR State Permit Program Guidance Document-Interim Draft”
- Implementation Of WIIN Act – X 2301– December 2016
 - Section 2301 – Approval of State Programs For Control Of CCR
 - State Option To Authorize For CCR Permit Program
 - State Program Must Be At Least As Protective
 - EPA Has 180 Days To Act On “Complete Application”
 - EPA May Approve In Whole Or Part Of State Program
 - Once Approved States Enforce In Lieu Of Citizens/EPA
 - State Program Review Every 12 Years
 - Approval At Regional Administrator Level w/ HQ Concurrence

CCR Status -Traditional -2015 Data



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- Cement 2016 Usage 101MTon-Up
- CCR Production-2015-117.3 M- Down
- Beneficial Use-2015, 61.1MT-52%- Up
- CCRs 3%+ Of Cost Of New Home
- 50% Of Wallboard Has CCR



ACAA Annual Survey Data-2015



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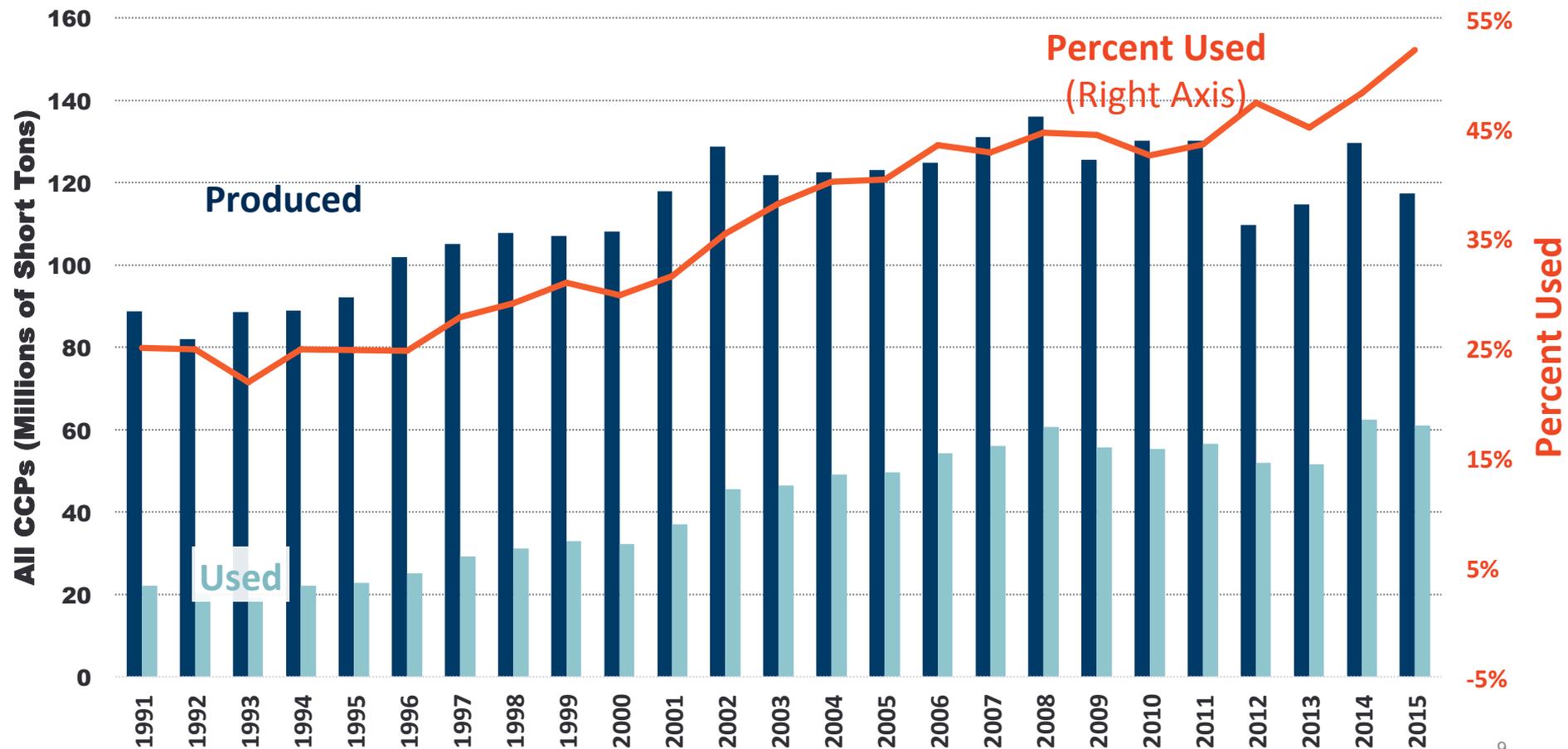
2015 Coal Combustion Product (CCP) Production & Use Survey Report

2015 CCP Categories	Fly Ash	Bottom Ash	Boiler Slag	FGD Gypsum	FGD Material Wet Scrub	FGD Material Dry Scrubbers	FGD Other	FBC Ash	CCP Production / Utilization Totals
Total CCPs Produced by Category	44,365,587	12,010,425	2,228,205	32,661,536	11,313,960	1,311,947	206,314	13,191,460	117,289,432
Total CCPs Used by Category	24,062,786	4,819,205	1,866,912	17,058,178	1,249,438	252,849	20,697	11,723,843	61,053,908
1. Concrete/Concrete	15,737,238	570,092	33,290	409,134	-	-	-	-	16,749,754
2. Blended Cement/Raw Feed for	3,629,151	1,130,802	-	1,649,934	-	-	-	-	6,409,887
3. Flowable Fill	107,263	9,106	-	-	-	-	-	-	116,369
4. Structural Fills/Embankments	1,277,356	1,561,531	305,770	1,221,865	100,940	-	-	-	4,467,462
5. Road Base/Sub-base	178,281	311,779	21	-	-	-	-	-	490,081
6. Soil Modification/Stabilization	216,483	66,253	-	8,053	-	-	-	-	290,789
7. Mineral Filler in Asphalt	52,784	-	14,176	-	-	-	11,479	-	78,440
8. Snow and Ice Control	-	527,695	77,935	-	-	-	-	-	605,630
9. Blasting Grit/Roofing Granules	-	184,712	1,400,455	173	-	-	-	-	1,585,340
10. Mining Applications	1,128,682	73,416	-	807,280	-	215,974	-	11,593,760	13,819,113
11. Gypsum Panel Products	-	28,378	-	11,322,016	973,785	-	-	-	12,324,178
12. Waste	1,138,078	242	-	-	-	-	9,218	130,083	1,277,621
13. Agriculture	2,409	1,788	-	1,392,693	174,713	-	-	-	1,571,602
14. Aggregate	-	173,472	-	-	-	-	-	-	173,472
15. Oil/Gas Field Services	181,907	-	-	-	-	36,875	-	-	218,782
16. Miscellaneous/Other	413,152	179,940	35,265	247,030	-	-	-	-	875,387
Summary Utilization to Production Rate									
CCP Categories	Fly Ash	Bottom Ash	Boiler Slag	FGD Gypsum	FGD Material Wet	FGD Material Dry Scrubbers	FGD Other	FBC Ash	CCP Production / Utilization Totals
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Category Use to Production Rate	54.24%	40.13%	83.79%	52.23%	11.04%	19.27%	10.03%	88.87%	52.05%

Historical CCP Production & Use

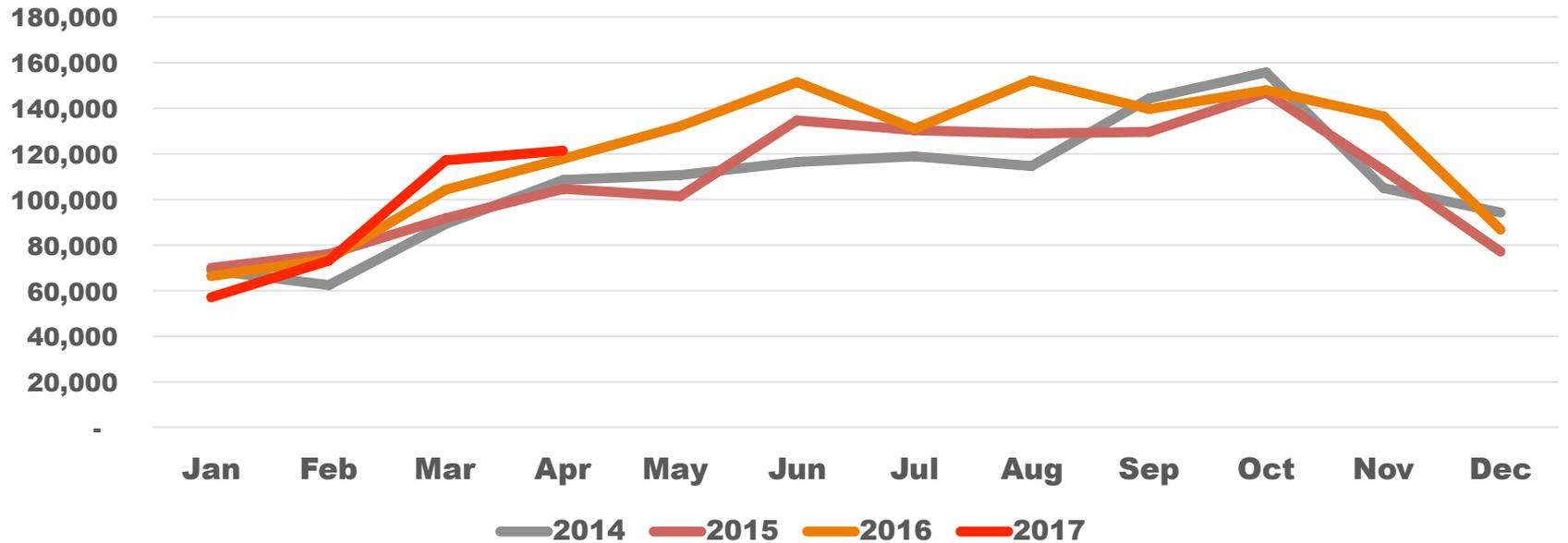


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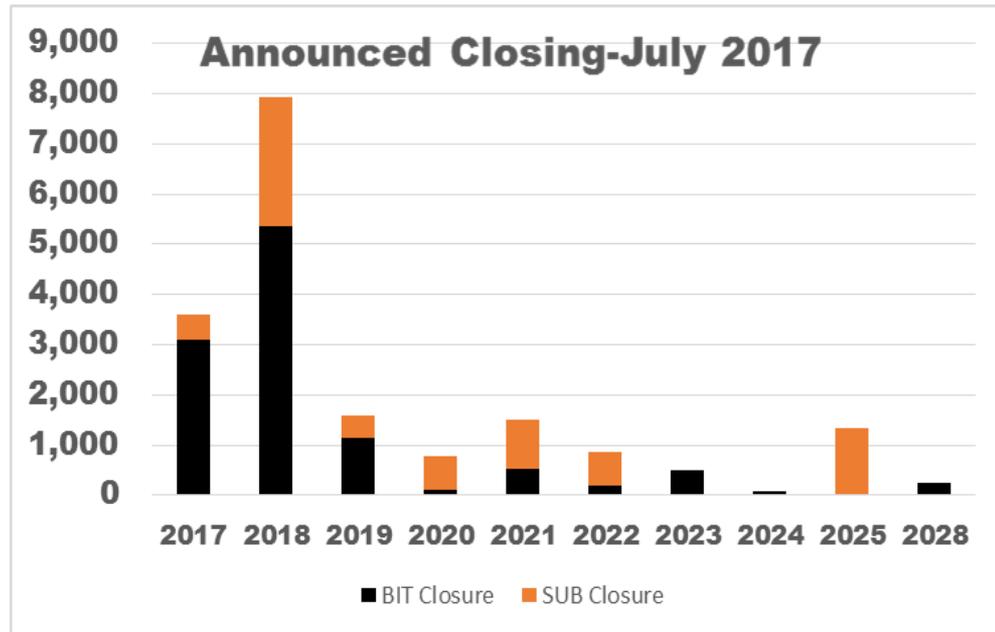
- Coal Production – Through 9-16-17
 - YTD Production – 563.7M; Up 13.2% Over 2016 Same Period
 - Exports Projected Up 21% 17 over 16
- Current EIA Electricity Fuel Projections:
 - Coal Full Year: 2017 -31% v 2016 - 30%
 - Nat Gas Full Year: 2017 - 31% v 2016 - 34%;
 - Higher Gas Prices
 - Operations Improvements
 - 2018 Projection: Nat Gas 31% & Coal 32%
- Electricity Demands – Expected Flat
 - Hurricane Impacts Regional Demand
- Construction – Strong Early – Slowing Mid-Year

Cement Usage- Short Tons



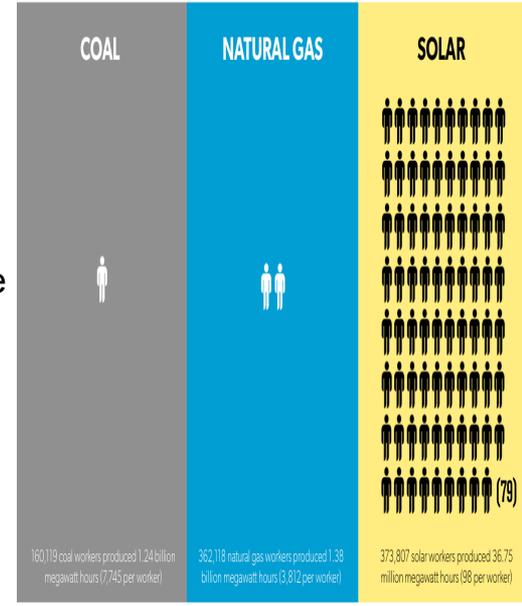
- EIA Announced Closures-July 2017- Coal Reduction 57M+ TPY; Ash Lost – 3.9M TPY Fly Ash; 1M TPY Bot Ash
- CCR Deadlines Also Drive Planned Closures – Groundwater & Location
- Potential Impacts Of ELG Stay & Potential CCR Deadline Stay

Year	Total Units	Net Summer Capacity (MW)	BIT Closure	SUB Closure
2017	17	3,602	3,091	511
2018	22	7,922	5,352	2,570
2019	9	1,584	1,128	456
2020	2	788	118	670
2021	7	1,496	519	977
2022	2	862	180	682
2023	2	490	490	0
2024	2	90	90	0
2025	2	1,350	0	1,350
2028	2	250	250	0
Totals	67	18,434	11,218	7,216



- Plant Closure & Lower Capacity Factors
 - Gas Prices Higher – Renewables Higher – Capacity Factors - Nuclear & Coal
- Energy Civil Wars
 - Protectionist Actions To Protect Jobs – NY Credit \$18+/MWH - Jobs
 - Renewables & Grid Reliability Impacts – California Eyes Western ISO - Pricing
 - Excel Separation Of ND & MN Due To Competing Energy Objectives
 - Renewable Tax Credits Vs. CO2 Reduction & Efficiency Credits – Coal States
- CCP Impacts
 - CCR Rules Drive Reclamation & Increase Usable CCPs
 - NGO Pressure For Clean Closure – Push Beneficial Use - Market Balance
 - In Certain Markets Reclamation of Ash Must Fill Voids In Certain Markets
 - Specification Fly Ash Shortage Regional Markets - Boston, CA, FL
 - Rail & Barge Movements Increase - Foreign Subsidized Shipments – Beneficiation
 - CAPX Expands
 - Bottom Ash LWA Losses Must Be Met With Manufactured LWA
 - Wallboard Plants Seek Back-up Sources – Mined Gypsum Must Fill Void
- CCP Rare Earth Elements – Future Opportunity

Workers Required to Produce the Same Amount of Electric Power (2016)



Source: US Department of Energy

REE Opportunities In Coal & Byproducts



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1 H 1.00794																	1 H 1.00794	2 He 4.002602					
3 Li 6.941	4 Be 9.012182																	5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.9984032	10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050																	13 Al 26.581538	14 Si 28.0855	15 P 30.973761	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.933200	28 Ni 58.6534	29 Cu 63.545	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.504	36 Kr 83.80						
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 196.56655	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29						
55 Cs 132.90545	56 Ba 137.327	57 La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.56655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.58038	84 Po (209)	85 At (210)	86 Rn (222)						
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)			114 (289) (287)			116 (289)	118 (293)					

**RARE
EARTH
ELEMENTS**

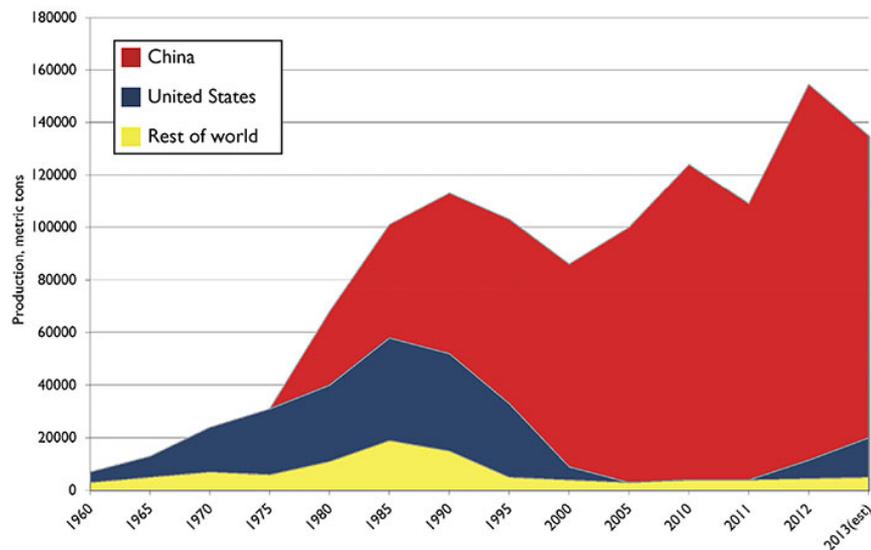
58 Ce 140.116	59 Pr 140.50765	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.92534	66 Dy 162.50	67 Ho 164.93032	68 Er 167.26	69 Tm 168.93421	70 Yb 173.04	71 Lu 174.967
90 Th 232.0381	91 Pa 231.035888	92 U 238.0289	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

REE – Opportunity Focus



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- REE Are Crucial For Advanced Materials And Key Industries-Electronics, Automotive, Energy Etc. – Impacts \$2.3 Trillion Of US Imports Finish Goods
- China Is The Saudi Arabia Of REE – 90+% Of Current Supply
- Strategic Interests Dictate That We Develop A Domestic Supply - Congress Mandate To Assess -In Strategic And Critical Materials Stockpiling Act For FY 2017
- Global Demand – 165KTPY –US-11% Of Total
- Crustal Average Concentration – 184ppm
- Coal And Related Products - >300ppm
- DOE Funded Projects
 - Assess Sources >300ppm
 - Develop Process - 300ppm to 2%
 - Assess Economic Viability
 - Assess Environmental Impacts
- Study Success
 - Met Goal 300ppm To 2%
 - **Move To Pilot Plant Demo Phase**



REE Research Advances



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- Three New DOE Projects (June 2017)
 - 3 Test & Pilot Design
 - Coal Prep Byproducts
 - Anthracite, ILB & APP
- Four DOE Funded Projects Move To Phase II (August 2017)
 - 2 Bench Scale Projects
 - Lignite & AMD
 - 2 Pilot Scale Projects
 - Fly Ash & Coal Prep Fines
 - Focus On Pilot Scale Production
- Schedule Results – 2020 Target For Pilot Plant & Economic Assessments
- Independent R & D Ongoing Of DOE

	Type of Project	Research Host	Location	Materials	Process	DOE (\$000s)
1	Bench Scale	University of Wyoming	Larimie, WY	PRB Coal Ash	CO ₂ , FeChloride under Supercritical Conditions	660
2	Bench Scale	Duke University	Durham NC	Various CCB	Solvent Extract & Membrane Filtration	720
3	Bench Scale	West VA University	Morgantown WV	NApp Coal Mine Drainage	Extraction from AMD & AMD Sludges	750
4	Bench Scale	Batelle	Columbus OH	OH Coal & Ash	Closed Loop Digestion	710
5	Bench Scale	University of North Dakota	Grand Forks, ND	ND Lignites & Refuse	Separate, Extr & Concentrate	749
6	Pilot Scale	University of KY	Lexington KY	Central App Prep Refuse	Qtr TPY Physical & Chemical Separation	1,000
7	Pilot Scale	Physical Sciences, Inc	Andover MA	Ash E KY Fire Clay & Anthracite Refuse	1-5 TPD Physical-Chemical Separation	999
8	Pilot Scale	Southern Res Institute	Birmingham AL	Cent App & E Bitum Coal	Plasma Based Testing on Ash	1,000
9	Pilot Scale	Tusaar Inc	Lafayette, CO	KY & OH Coal Ash	Extraction & Metal Sorption	984
10	Sample & Characterize	UK Research Foundation	Lexington KY	Coal & Coal By-Products	Sample & Characterize	400
11	Sample & Characterize	Resources Research	Morgantown WV	Coal & Coal By-Products	Sample & Characterize	400
12	Sample & Characterize	XLIGHT Corporation	Morristown NJ	Coal & Coal By-Products	Sample & Characterize	215
13	Sample & Characterize	Tetra Tech Inc.	Pittsburgh PA	Coal & Coal By-Products	Sample & Characterize	373
14	Sample & Characterize	Tetra Tech Inc.	Pasadena CA	Coal & Coal By-Products	Sample & Characterize	376
15	Test & Pilot Pit Design	Equinox Chemicals LLC	Albany GA	East KY Coal Prep Plant ByProducts	Lab Test & Design Pilot Plant	1,000
16	Test & Pilot Pit Design	Inventure Renewables	Tuscaloosa, AL	PA Anthracite Coal Mine Mat'l	Test & Pilot Pit Design	1,000
17	Test & Plant Design	Marshall Miller & Assoc	Bluefield WV	WV Coal Prep Plant Byproducts	Test & Pilot Plant Design	1,000
18	Bench Scale Test	UND	Grand Forks ND	ND Lignite & Related Mat'ls	Phase II	2,750
19	Bench Scale Test	WVU	Morgantown WV	WV Appalachian Coal Mine AMD	Phase II	2,750
20	Pilot Scale	Physical Sciences Inc	Andover MA	Central AP Fly Ash-Trapp KY	Phase II	6,000
21	Pilot Scale	Univ KY	Lexington KY	Coal Prep Fines-Cent APP & ILB	Phase II	6,000

- REE In CCPs –Joint Processes
 - REE Processes May Include Beneficiation For Traditional Uses
 - Initial Step Process- Fly Ash Pozzolan
 - REE Separation Process – Clean Fly Ash
- Ponds & Landfills – Large Feedstock – 1.5B-2.5B Tons
 - Access Is Key Under State CCR Rules – Closure & Post Closure
- Next Generation Power Plants Incorporate Processes
 - Capture REE Before Encapsulation Into Glass Fly Ash Matrix
 - Dual Income Streams – Energy & Materials
 - Dual Co-Product Income – Ash & REE Materials

- Coal Use Will Be Impacted By Cheap Natural Gas (Capacity Factor) & Regulatory Impacts (Closures)
 - Current Administration Reviews May Reduce Regulatory Timed Impacts
- CCP Use As A Valued Resource Continues
 - Demand Increasing As Economy Grows – Infrastructure Impacts State \$\$
 - Volumes Impacted In Certain Markets – Closings & Capacity Factor
 - Quality Impacted By Regulation-Reclamation & Beneficiation Investment
 - Supply/Demand Economics Will Raise Prices
 - Future Opportunities May Include REE Extraction & Processing
- State Energy & CCR Programs – Address Current & Future Needs
 - War Between States Strategy – Jobs Matter
 - State Control Of CCR – Prompt State CCR Program Submittal
 - Enhance Resource Recovery & New Opportunities For CCPs & REE
 - Ensure Federal & State Tax Policies & Funding For Logical Energy Decisions & Environmental Protection

QUESTIONS

**Danny L. Gray, P.E. – dgray@charah.com
EVP Government & Environmental Affairs
Charah, LLC
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