

# 2022 PROP CONFERENCE

## Air Quality Benefits of Mine Land Reclamation Performed by the Coal Refuse Reclamation to Energy Industry

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# WHAT IS ARIPPA?

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- Appalachian Region Independent Power Producers Association
- ARIPPA is a non-profit trade association representing the coal refuse reclamation to energy industry in Pennsylvania, Virginia, and West Virginia.
- Comprised of facilities that utilize circulating fluidized bed (CFB) boiler technology to convert coal refuse into highly alkaline “beneficial use ash” utilized in mine land reclamation.
- This process uses coal refuse as a primary fuel to generate electricity which is sold through the PJM wholesale energy market to provide private funding for mine land reclamation.
- An industry which helps the state turn environmental challenges into economic opportunities.

# WHAT IS COAL REFUSE

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- Remnants of centuries-old coal mining, conducted before the advent of modern environmental protection laws
- Also known as culm, gob, tailings, boney, silt, among other names, coal refuse consists of low-quality coal mixed with rock, shale, slate and other inert material

# POLLUTION CAUSED BY COAL REFUSE

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- Under the SMCRA, landowners and companies responsible for abandoning coal refuse piles are no longer liable for remediating them.
- This left the cost of remediating this environmental problem to the state and federal government, currently estimated at more than \$5 billion in PA alone.

# POLLUTION CAUSED BY COAL REFUSE

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More than eyesores – coal refuse piles are prone to subsidence, acid seepage and leachate production, and present public health and safety hazards.

Pennsylvania has over 5,500 miles of streams degraded by acid mine drainage (AMD).

# POLLUTION CAUSED BY COAL REFUSE

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- Coal refuse piles have negative consequences on air quality for surrounding communities.
- Coal dust from piles can be swept up by the wind and deposited elsewhere, creating adverse effects for downwind residents.
- Unattended coal refuse piles can be ignited, releasing uncontrolled toxic air emissions into the atmosphere.

# COAL REFUSE TO ENERGY INDUSTRY

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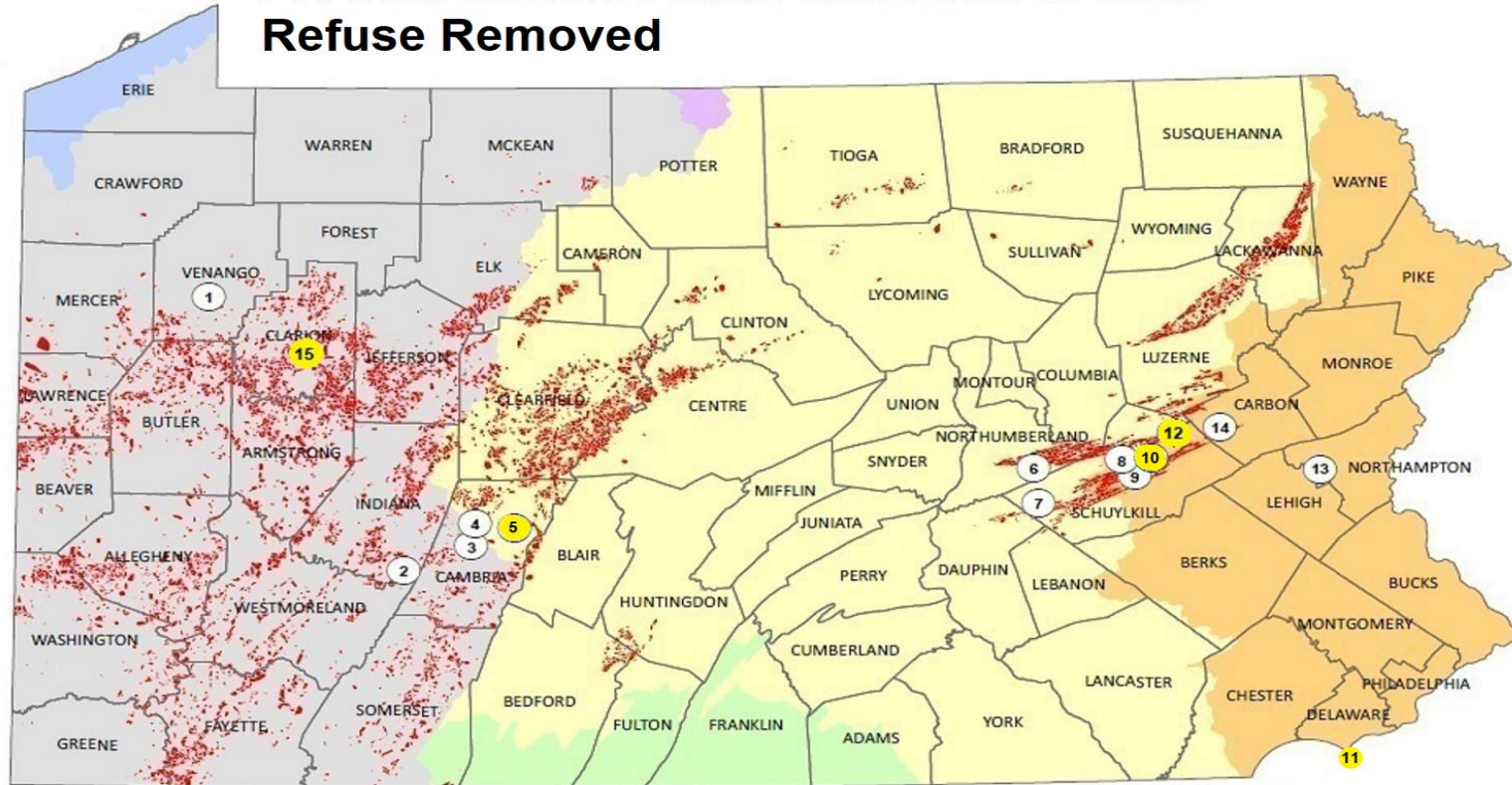
State	Plant	Net Operating Capacity (MW)	Fuel Type
Montana	Rosebud Colstrip Energy	39	Bituminous
Pennsylvania	Cambria Cogen (Closed in 2019)	87	Bituminous
Pennsylvania	Colver Green Energy	111	Bituminous
Pennsylvania	Ebensburg Power Company	50	Bituminous
Pennsylvania	Gilberton Power Company	80	Anthracite
Pennsylvania	Kimberly Clark Chester Operations (Converted to natural gas in 2019)	67	Anthracite
Pennsylvania	Mt. Carmel Cogen	43	Anthracite
Pennsylvania	Northampton Generating Company	112	Anthracite
Pennsylvania	Northeastern Power Company (Closed in 2018)	52	Anthracite
Pennsylvania	Panther Creek Power Operating	80	Anthracite
Pennsylvania	Rausch Creek Generation	33	Anthracite
Pennsylvania	Schuylkill Energy Resources	80	Anthracite
Pennsylvania	Scrubgrass Generating	83	Bituminous
Pennsylvania	Seward Generation	521	Bituminous
Pennsylvania	Wheelabrator Frackville Energy Company (Closed in 2020)	42	Anthracite
Utah	Sunnyside Cogeneration Associates	60	Bituminous
Virginia	Virginia City Hybrid Energy Center	610	Bituminous
West Virginia	American Bituminous Power Partners	80	Bituminous
West Virginia	Morgantown Energy Associates (Converted to natural gas in 2019)	50	Bituminous

**Sources:**

ARIPPA Survey (2018)  
Permit Technical Review Document, Montana DEQ (2014)  
SCA #2 CCR Certified Dust Control Plan, Sunnyside Cogeneration Facility (2015)



# PA Coal Refuse Plants and Tons of Coal Refuse Removed



1. Scrubgrass Generating - 83 MW; 15,012 tons
2. Seward Generation - 525 MW; 2,106,108 tons
3. Ebensburg Power Company - 60 MW; 360,893 tons
4. Colver Power Project - 110 MW; 428,762 tons
5. Cambria Cogen Company - 87 MW; N/A [2019]
6. Mt. Carmel Cogen - 43 MW; 98,104 tons
7. Rausch Creek Generation - 33 MW; 362,830 tons
8. Schuylkill Energy Resources - 80 MW; 1,357,501 tons

9. Gilberton Power Company - 80 MW; 745,488 tons
10. Wheelabrator Frackville Energy Company - 42 MW; 81,686 tons [2020]
11. Kimberly Clark Chester Plant - 67 MW; N/A [2019]
12. Northeastern Power Company - 52 MW; N/A [2018]
13. Northampton Generating Company - 112 MW; 7,791 tons
14. Panther Creek Energy - 80 MW; 64,329 tons
15. Piney Creek LP - 32 MW; N/A [2013]

\*MW = Net capacity; Tons of coal refuse removed in 2020

## Watersheds

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|---|---|
|  Ohio                              |  Genesee           |
|  Delaware                          |  Potomac           |
|  Erie                              |  Susquehanna       |
|  Abandoned Mine Land Problem Areas |  Closed            |
|   |  Announced Closure |

# COAL REFUSE PILE RECLAMATION

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Properly reclaimed coal refuse sites can and have returned the land to productive uses including wildlife habitat, recreational opportunities and even commercial development.

# SOURCES OF AIR POLLUTION FROM COAL REFUSE PILES

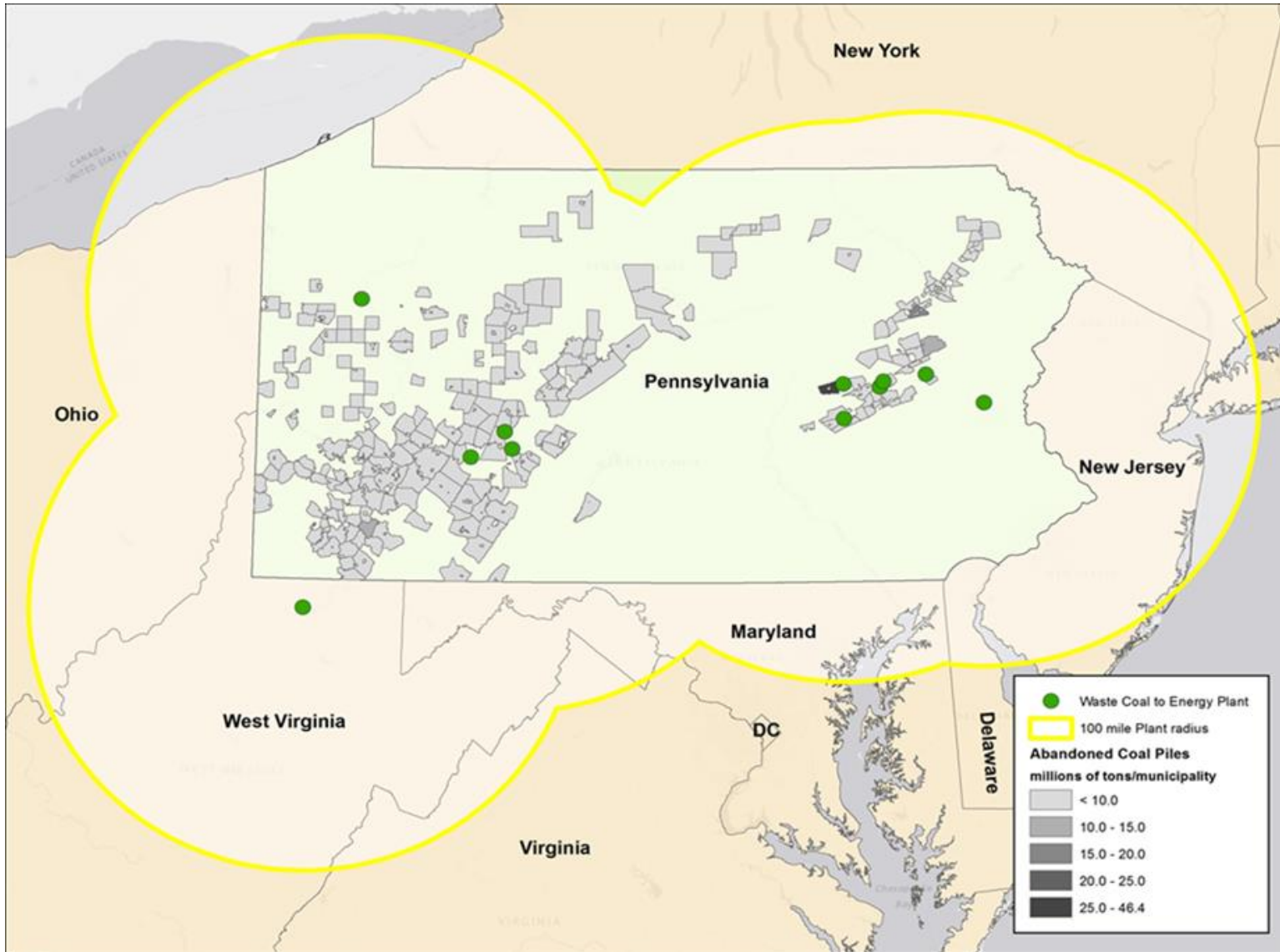
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- Weathering
- Spontaneous Combustion
- Open Burning



**Simpson Refuse Fire January 9, 2014 – PADEP BAMR**

# EXTENT OF ABANDONED COAL REFUSE PILES IN PA



Identified Waste Coal Piles (from State Inventories)	Area (Acres)	Volume (Cubic Yards)	Abandoned (Tons)
Average PA Waste Coal Pile	8.61	199,112	161,280
Total Identified PA Waste Coal Piles	12,809	272,982,161	221,111,554

# WEATHERING

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- Many older refuse piles are high in coal fragments. Often, such piles were constructed in loose, unconsolidated configurations that allow oxygen to interact easily with the refuse.
- During low temperature oxidation (weathering), carbon atoms which give the coal its heating value as a hydrocarbon fuel oxidize to the greenhouse gas CO<sub>2</sub>, which will continue to be emitted (along with fuel-bound air pollutants and fine particulates) for perhaps hundreds of years, until there is no carbon left to be oxidized.
- Also noteworthy is that as coal refuse weathers and the surface layers oxidize, they also become more friable and continue to generate windblown fugitive dust (PM<sub>10</sub>).
- Worse than this, however, is that slow oxidation becomes a runaway chemical reaction that generates heat, causing the phenomenon known as spontaneous combustion.

# SPONTANEOUS COMBUSTION

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- Spontaneous combustion occurs first within the interior of coal refuse piles themselves. This is because formerly crushed waste coal (such as tailings and rejects) contains voids (interstices) between the discrete broken coal fragments which contain air, and secondly because temperatures rise in the interior of the piles since the interior layers are not subject to radiational or rainwater cooling as at the surface.
- Thus, heat from the oxidation process results in increasing internal temperatures, resulting in partial (incomplete) combustion as evidenced by smoke being emitted from the pile.
- The occurrence of this internal combustion within coal refuse piles is often not outwardly visible, but as this slow combustion of the burnable material occurs within the pile it may produce a reddish-brown slate called “red dog”.



# SPONTANEOUS COMBUSTION

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- For any hydrocarbon fuel to be theoretically completely combusted to  $\text{CO}_2$  and water vapor ( $\text{H}_2\text{O}$ ) requires the ability to control the ideal, or stoichiometric, air-to-fuel ratio and high combustion temperatures to be continuously maintained.
- Insufficient, off-stoichiometric air-to-fuel ratios and/or smoldering at low temperatures cause incomplete combustion of fuel.
- This means when there is insufficient oxygen, any fossil fuel will be only partially combusted, emitting intermediate products of incomplete combustion.
- The combustion of coal refuse lacking the stoichiometric amount of air to complete combustion releases different, more polluting, and more dangerous emissions and greenhouse gas intermediates such as methane and nitrous oxide, uncontrolled mercury, odorous and poisonous hydrogen sulfide ( $\text{H}_2\text{S}$ ), carbon monoxide ( $\text{CO}$ ), and others directly to the local environment as ground-level area sources of air pollutants.

# OPEN BURNING

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- Runaway temperatures within a now smoldering pile will ultimately erupt into open flame, however still at an air to fuel ratio that is far from ideal.
- This type of higher temperature, but still oxygen starved combustion, not only releases the greenhouse gases CO<sub>2</sub> and methane, but other air pollutant emissions such as mercury, oxides of nitrogen, carbon monoxide and sulfur compounds.
- It is clear that abandoned coal refuse piles are a very significant source of CO<sub>2</sub>e, hazardous air pollutants and Clean Air Act regulated criteria air pollutants only due to their very existence.





**Estimated Air Emissions from Existing Coal Refuse Piles in Northern Appalachia due to Weathering plus Spontaneous Combustion**

Pollutant	Annual Emissions (tons)		
	Coal Refuse Weathering In-situ; tpy	Coal Refuse Smoldering or Burning In-situ; tpy	Total Estimated Air Emissions, Weathering plus Smoldering or burning in-situ; tpy
NO <sub>x</sub>		86	86
CO		278,662	278,662
PM <sub>10</sub>		1,293	1,293
SO <sub>2</sub>		95,084	95,084
CO <sub>2</sub>	204,168	3,391,053	3,595,221
CH <sub>4</sub>	45,504	2,086,802	2,132,306
N <sub>2</sub> O			
H <sub>2</sub> S		1,752	1,752
Hg		1.1	1.1
CO <sub>2</sub> e	1,341,768	55,561,101	56,902,869

# PERMANENT COAL REFUSE REMEDIATION

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- Absent permanent remediation, the thousands of legacy coal refuse piles littering Appalachia represent virtually “forever emitters” of greenhouse gases, windblown fugitive particulate fines, hazardous air pollutants and Clean Air Act regulated air pollutants, as they have been for over 100 years since being originally discarded.
- Societal goals such as net zero greenhouse gas emissions by 2050 will be frustrated by this manmade source of nearly continuous “forever” emissions of greenhouse gases unless abandoned coal refuse piles are also permanently remediated by then.
- When a ton of coal refuse is forever neutralized via useful energy recovery, it can never again emit air pollutants or greenhouse gases, let alone contribute to acidification of soil and water resources.
- In considering the air emissions profile of these unmitigated coal refuse piles, it is therefore meaningful to contrast them with the coal refuse reclamation-to-energy industry.

# NET AIR BENEFITS OF COAL REFUSE RECLAMATION TO ENERGY INDUSTRY

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- Coal refuse reclamation to energy facilities operate very responsibly, are aggressively regulated, and operate in continuous compliance with all applicable state and federal air quality regulations and standards. Emissions from coal refuse piles are not.
- While some air pollutants and greenhouse gases are emitted at once during controlled combustion in a CFB boiler, coal refuse reclamation to energy plants are very efficient in terms of converting nearly 100% of the hydrocarbon component of coal refuse to CO<sub>2</sub>. When they do so, they remove the ability of that amount of coal refuse to emit any carbon, or methane, ever again.
- Based upon comparing the same amount of coal refuse combusted in coal refuse reclamation to energy facilities instead being allowed to burn in piles across the region, it is estimated each ton of coal refuse consumed by the industry produces a net greenhouse gas reduction of 18 tons of CO<sub>2</sub>e in the first year and up to 192 tons of CO<sub>2</sub>e over a 10-year coal refuse emissions lifecycle.

# MISCHARACTERIZING THE COAL REFUSE RECLAMATION TO ENERGY INDUSTRY

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- There has been a groundswell of public sentiment that coal combustion should be phased out of use in favor of renewables that do not emit CO<sub>2</sub>. Lost in translation is the unique environmental role, including net reductions in air pollutants and greenhouse gas emissions, provided by the coal refuse reclamation-to-energy industry.
- What distinguishes these plants from traditional coal power plants is the role they play in environmental remediation.
- Coal that is mined to produce power in coal-fired plants has been effectively sequestering carbon beneath the earth for millions of years. Coal refuse piles, however, have already been mined and are now an abandoned environmental legacy pollutant, free to continue emitting greenhouse gases and other harmful air emissions without any further human intervention over hundreds of years.

# ALTERNATIVES TO PERMANENT COAL REFUSE PILE REMEDIATION

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- US EPA studies of potential alternatives to prevent spontaneous combustion of coal refuse piles suggest that every pile would need to be permanently sealed from the air and that an inert gas such as nitrogen would need to be continuously pumped in to preclude the possibility of future spontaneous combustion.
- One alternative suggestion was to plant abandoned coal refuse piles with “green” shallow root system plants such as beach grass. A field of beach grass growing on top of a coal refuse pile could not materially affect the ability of the pile to spontaneously combust and vent air emissions from deep within.
- Planting abandoned coal refuse piles may reduce impacts from rainwater runoff entering surface water but could not eliminate the presence of oxygen or the hazard of spontaneous combustion beneath the shallow roots.
- Planting and maintaining shallow root system plantings over thousands of acres of abandoned coal refuse is not self-funding nor economically sustainable.

# CONCLUSION

- ❖ The coal refuse reclamation-to-energy industry is historically the most effective and prolific actor in the remediation of coal refuse piles across Pennsylvania.
- ❖ The estimated annual air emissions from doing nothing about these piles suggests that they represent an impediment to achieving net zero greenhouse gas emissions in the state, region, US and globally.
- ❖ A comparison of the air emissions from not remediating existing legacy coal refuse piles shows that this industry is providing very significant net air quality and CO<sub>2</sub>e benefits to the environment.
- ❖ Unfortunately, lack of understanding that these facilities operate to address legacy environmental damage has become confused with the environmental movement to shutter utility-scale coal-fired generating plants that purposely extract more coal for the sole purpose of generating electricity.
- ❖ Absent the coal refuse reclamation to energy industry, these legacy waste coal piles would remain essentially abandoned to the environment and will frustrate regional air quality and climate change goals for multiple additional generations as they continue to emit products of incomplete combustion, particulate matter, CO<sub>2</sub>, and most importantly the potent greenhouse gas methane.
- ❖ The impactful net greenhouse gas benefit to the environment resulting in substantial reductions in CO<sub>2</sub>e more than justifies maintaining this important, environmentally-friendly industry.

# QUESTIONS & CONTACT INFO

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