

From Coal to Gold: Proving the Case for Reconversion of Coal Plants in the United States

SIPA Spring 2024 Capstone Project

Students:

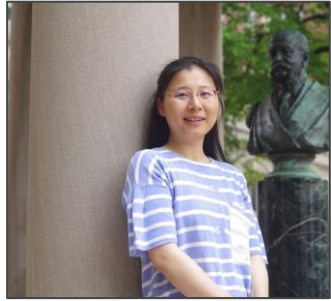
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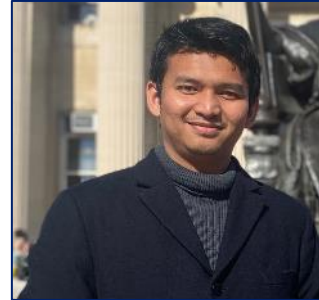


Meet the Team of students from Columbia SIPA



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We believe in a sustainable growth paradigm for the world, balancing economical, ecological and societal challenges

Roland Berger's vision and purpose

Our vision

Every great business is driven by an idea – ours is to secure sustainable growth, instead of focusing on short-term financial interest only at the cost of others and our environment

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There is a lack of equilibrium that we must rebalance – our ambition is to consult organizations, businesses and entrepreneurs to reimagine their reality and shift the world towards a new sustainable paradigm

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We are diverse and authentic personalities, committed, courageous and unafraid of pushing boundaries – as a management consultancy we believe we have a role to play and commit to net zero emissions



The study examines the viability of transitioning US coal plants to alternative uses by assessing their impact on grid stability, electricity rates, jobs, taxes, and emissions

Scope of the project

1

Quantitative Analysis

Utilize the Fort Martin Power Plant in West Virginia as a use case to develop a **quantitative model to evaluate various redevelopment options** (from conversion to gas, to solar, industrial, or other redevelopment forms). To the extent possible based on publicly available data, evaluate quantitatively the costs and benefits for different stakeholders across the impact areas

2

Qualitative Analysis

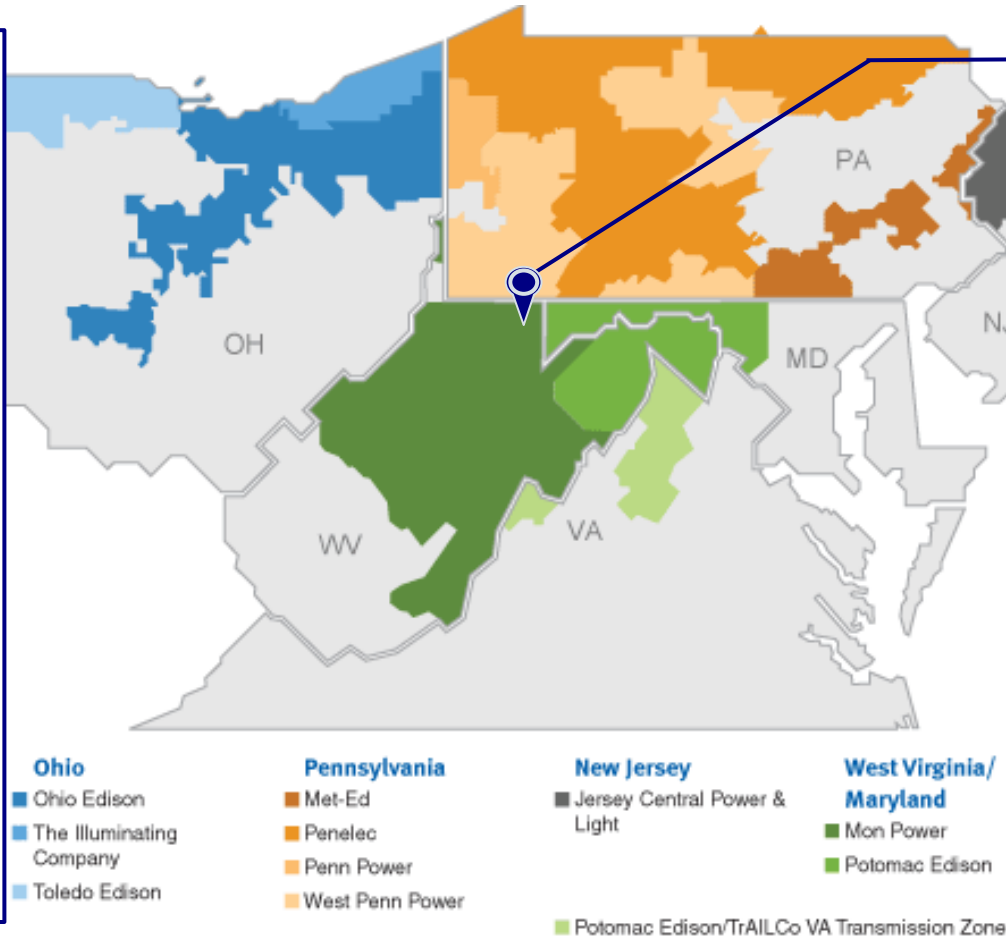
Conduct a high-level analysis of selected coal plants in the U.S. to develop a **qualitative framework** that can be used to identify the viable options for redevelopment of each plant

First Energy is a utility company that operates across OH, PA, and WV, headquarter in Akron, Ohio. Fort Martin is a 1,098 MW powerplant located in the Mon Power service territory

FirstEnergy Business Overview and Fort Martin Power Plant

About First Energy

- FirstEnergy is an electric utility comp.
- **Headquarter: Akron, OH**
- Includes one of the largest investor-owned electric systems, including **24,000 miles of transmission lines** and a regulated generating fleet of **3,500+ megawatts**








About Fort Martin (“FM”)



- Location: **Monongalia County, West Virginia**
Nameplate capacity: **1,098 MW, CF ~51% (2023)**
Owner: Mon Power (First Energy subsidiary)
- The plant **sources more than 2.8 million tons of coal annually from West Virginia, Pennsylvania, and Illinois**
 - Employs approximately **180 people**
 - Pays approximately **\$3.4 m annually in property taxes**
 - FM emits **4.5 million tons of CO2 in 2023**

The decommissioning plan requires a multifaceted analysis that considers the impact of 5 dimensions on three key types of stakeholders

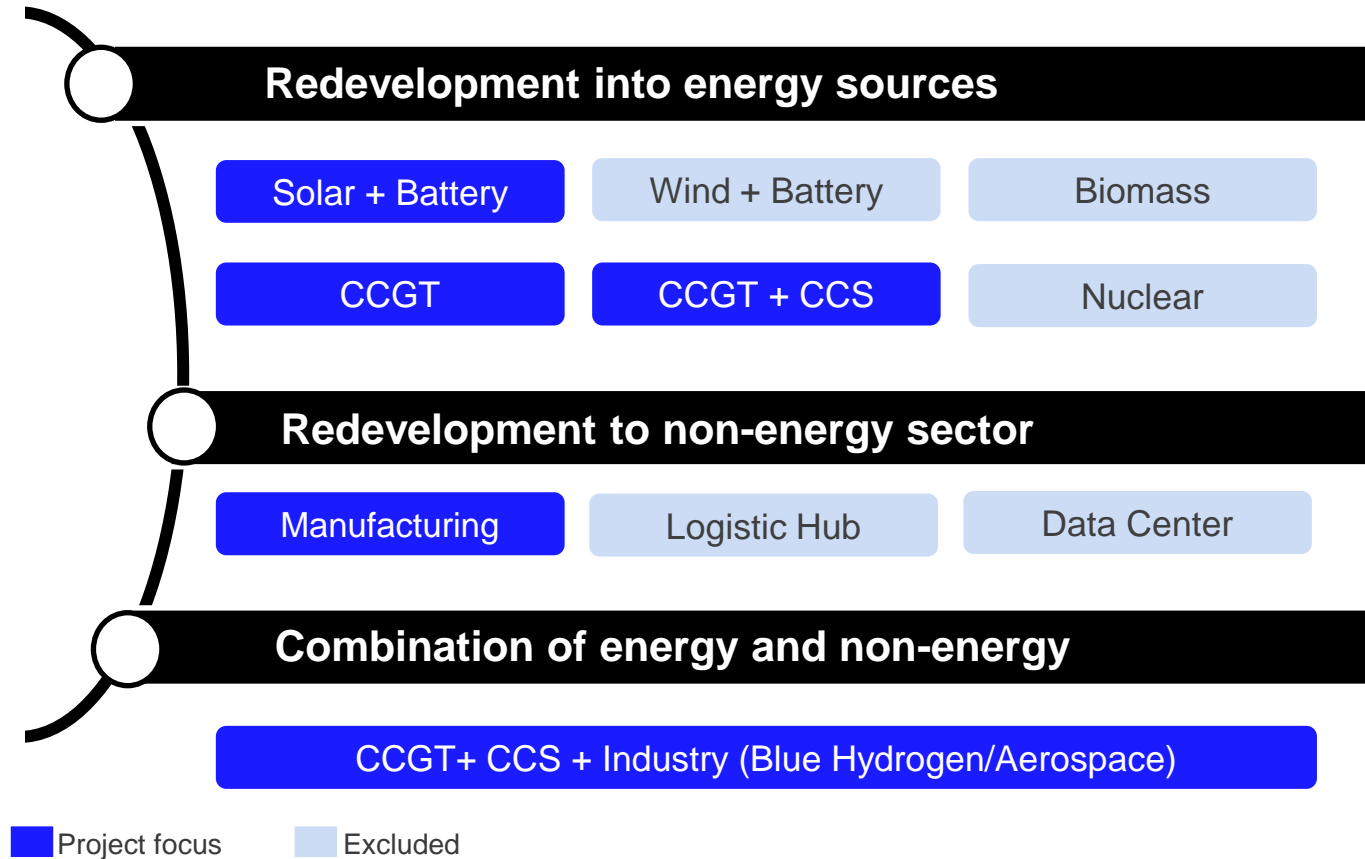
Framework of analysis – different dimension and illustrative impact on key stakeholder groups

	 Resource Adequacy	 Electricity Price	 Job Market	 Tax	 Emissions
	<p>Analysis of the energy supply and demand within the impacted market to maintain grid reliability and prevent shortages</p>	<p>Analysis of decommissioning and redevelopment costs. Projected changes in electricity rates</p>	<p>Estimated job losses due to plant retirement and potential job creation from redevelopment</p>	<p>Impact on state tax revenues (i.e. property tax of the plant and the surrounding properties)</p>	<p>Projected reductions in GHG emissions and their social cost in the short term and long term</p>
Utility	<ul style="list-style-type: none"> (+) Reinforce grid's stability by aligning the site with current needs (+) Firm renewables 	<ul style="list-style-type: none"> (+) Add Capex to the company's balance sheet (-) Risk of IRP not being approved 	<ul style="list-style-type: none"> (+) Upskill workforce (-) Skills and headcounts unaligned with needs 	<ul style="list-style-type: none"> (+) Use of tax credits (e.g. IRA) to improve profitability 	<ul style="list-style-type: none"> (+) Meet corporate sustainability goals
Community	<ul style="list-style-type: none"> (+) Improve grid reliability, reduced risks of blackouts 	<ul style="list-style-type: none"> (+) Lower cost of electricity (-) Reduce baseload, bringing potentially higher rates at peak 	<ul style="list-style-type: none"> (+) New job opportunities (-) Risks of layoffs for workers with skillsets that are no longer needed 	<ul style="list-style-type: none"> (+) Use of added tax revenues to finance local services 	<ul style="list-style-type: none"> (+) Cleaner air (+) Cleaner water (+) Health benefits (+) Increased land value
Government	<ul style="list-style-type: none"> (+) Decrease in blackouts incidences 	<ul style="list-style-type: none"> (+) Lower rate reduce the need of subsidies (-) High or fluctuating rates might require policies to protect vulnerable payers 	<ul style="list-style-type: none"> (+) Opportunity for upskilling programs (-) Risk of industrial reconversion (coal) 	<ul style="list-style-type: none"> (+) Potentially higher property tax revenues 	<ul style="list-style-type: none"> (+) Meet local sustainability goals

(+) Opportunity; (-) Risk

The redevelopment options considered include transitioning to alternative energy sources, diversifying into non-energy sectors, and pursuing a combination of both approaches

Overview of considered redevelopment options



Feasibility Study: A qualitative analysis is conducted to explore repurposing options for energy activities in West Virginia.

Key Variables: The primary factors, permit & construction time and energy resource availability, lead to excluding wind, nuclear, and biomass from further analysis.

Industry Trends: Considering market trends and local industry strengths, viable options for West Virginia include sectors like blue and green hydrogen, aerospace, and the food processing industry.

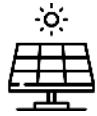
Innovative Revenue Strategy: To capitalize on revenue opportunities from selling surplus land at Fort Martin, the proposed innovative solutions are:

CCGT (Combined Cycle Gas Turbine) + CCS (Carbon Capture and Storage) + Blue Hydrogen.

CCGT + CCS + Aerospace.

Solar + Storage, standalone CCGT, and CCGT + CCS are more likely to be further assessed as the redevelopment options for Fort Martin

Redevelopment Options (Energy Sources)



Energy Sources	Solar + Storage	CCGT (Standalone)	CCGT + CCS	Wind	Nuclear	Biomass
Availability of the existing land size						
Regulatory support						
Availability of Energy Source						
Others (requirement for new infrastructures, feedstock, etc.)						








Support redevelopment options



Undermine redevelopment options

The three options considered come with their trade offs with respect to the different dimensions of the framework

Analysis of identified options through the framework

	 Resource Adequacy	 Electricity Price	 Job Market	 Tax	 Emissions
CCGT (standalone)	<p>Not expected to cause a resource adequacy issue within the FM grid</p>	<p>Expected to lower the cost of electricity</p>	<p>Drop in employment compared to coal – from both direct and indirect impact. The powerplant can be co-sited with an industrial development</p>	<p>Equivalent tax revenues from the site – potentially more revenues if the powerplant is co-sited with an industrial development</p>	<p>Available land for green spaces, but reduction of only ~40% of the emission from the site</p>
CCGT + CCS	<p>Not expected to cause a resource adequacy issue within the FM grid</p>	<p>Unsure impact on electricity prices due to the variability in CCS costs. Tax credits can be leveraged for CCS to reduce costs</p>	<p>CCS can add indirect jobs, despite a drop in permanent employment. The powerplant can be co-sited with an industrial development</p>	<p>Equivalent tax revenues from the site – potentially more revenues if the powerplant is co-sited with an industrial development</p>	<p>Available land for green spaces. Significant reduction of the emissions from the site</p>
Solar PV + BESS	<p>Not expected to cause a resource adequacy issue within the FM grid</p>	<p>High capex but competitive price due to the tax credits</p>	<p>Significant drop in employment that must be compensated with co-sited industrial developments</p>	<p>Potential increase in site property tax – potential increase as well of nearby land value due to pollution reduction</p>	<p>Significant reduction of the emissions from the site but potential usage of a larger share of the site to produce energy (less green spaces)</p>

Various industrial redevelopments could also be considered on the site, including aerospace manufacturing and hydrogen production – which can create additional jobs and tax revenues

Redevelopment Options (Non - Energy Sources)

Manufacturing options

	Aerospace Manufacturing	Food Processing	Blue Hydrogen	Services	Information
Water Requirement	●	●	●	○	●
Electricity Requirement	●	●	●	◐	●
Location Consideration	●	◑	●	◑	◐
Infrastructure Readiness	●	●	●	◐	○
Government Support	●	●	●	◐	◐
Market Potential	●	●	●	◑	◐

● Support redevelopment options ○ Undermine redevelopment options



This analysis explores the likelihood of a new owner being interested in purchasing the existing land.

Based on the analysis, even though, The Fort Martin Area offers potential for industrial expansion, yet the choices that can be explored in the immediate future remain limited. If the new business requires a large amount of water and electricity, this location will be preferable to the buyer.

This analysis framework can be applied to other coal-plant sites considering similar transformations

Examples of other sites (high-level qualitative study only)

	Bowen	Coal Creek	Four Corners Steam Elec Station
Selected Redevelopment Options	<ul style="list-style-type: none"> • Solar • CCGT • CCGT + CCS • Manufacturing • Services • Information • Humanitarian 	<ul style="list-style-type: none"> • Biomass • CCGT • CCGT + CCS • Raw materials • Manufacturing • Information 	<ul style="list-style-type: none"> • Solar • CCGT • CCGT + CCS • Biomass • Raw materials • Manufacturing • Services • Humanitarian
Key rationales	<ul style="list-style-type: none"> • Good incentives for renewable, particularly solar. • Decent solar resources, on the flip side under-threshold resources wind resources. • Located very close to natural gas trunk, highly possible for CCGT. • Proximity with residential areas, making a push-back nuclear plausible. • 1-hour away from Atlanta and with easy access to transport infrastructure, making manufacturing options feasible. 	<ul style="list-style-type: none"> • North Dakota has the potential to supply over 500,000 tons biomass feedstock annually. • In terms of site suitability, policy support, and market suitability, almost all the power options are feasible to be built, including nuclear where North Dakota is planning to develop the plant. • For services and humanitarian, it is not preferable, particularly because of the coal creek location that is far away from the city center and near other plants. 	<ul style="list-style-type: none"> • The site has decent amount of solar but under-threshold wind resources. • Currently, there is no operating nuclear reactors in New Mexico and there is still no enabling policy. • There are gas transmission pipelines near the site. • New Mexico is 28% forested and wood from these forests are the local renewable fuel source (such as biomass).

Overall recommendations & next steps

Recommendations

1. The Transformation and Evaluation Framework (TREF), with the five assessment categories, can be applied to assess the most suitable redevelopment options for a coal plant in the U.S.
2. The framework can be used by decision-makers and policymakers considering the holistic view of the categories which includes the geographical location, availability of supporting policies or regulations, market dynamics, local context, and available workforce.

Next Steps >>>

1. Internally test and refine the framework with a diverse range of coal plants, incorporating more variations in location, nameplate capacity, capacity factor, age, year of decommissioning, socio-economic conditions of the county/state, and the political tensions in the region – working with the site owners to use actual data and obtain the full picture.
2. Conduct user-compatibility tests with prospective users, such as government agencies and utility companies, and gather feedback for enhancement.



Thank you

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