EPRI

Coal Repowering

a White Paper Series

Repurposing Coal-Fired Power Plants to Anchor Net-Zero Industrial Clusters

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Abstract

In response to mounting pressure to retire coal-fueled generating assets, U.S. utilities have announced thousands of megawatts of coal plant retirements to take effect over the next 15 years [1]. Until recently, newly-constructed natural gas-fired units typically replaced decommissioned coal plants.

One potential role for a repurposed coal plant site is to act as the anchor of a net-zero industrial cluster (NZIC). An NZIC is a group or hub of industrial facilities and energy producers that collaborate to collectively achieve net-zero carbon emissions. The flexibility of options for coal plant site reuse makes an NZIC a potentially beneficial opportunity for the power producer, NZIC participants, and the local community and region.

This paper provides a high-level overview of how a coal-fired power plant slated for decommissioning can form the core and anchor of an NZIC. The paper summarizes the potential for NZICs in North America, NZIC benefits, and possible ways that a repurposed coal plant site can act as an NZIC anchor. It also describes an example NZIC that involves coal plant site repurposing to illustrate this arrangement, its capabilities, and its benefits. In addition, the paper discusses the key considerations of repurposing a coal plant to anchor an NZIC, including the importance of NZIC partner collaboration, regional goals and infrastructure, and community engagement and the local workforce. Decarbonization goals and policies are enabling advancement and application of new technologies that enable and require new and different types of collaboration between public and private sectors. However, establishing partnerships across industries that have not traditionally collaborated can be challenging. The relatively recent rise in corporate sustainability and decarbonization commitments—combined with supportive policy and incentives for new technologies—opens doors for collaboration discussions that may not have been possible even five years ago. Nevertheless, differences in corporate culture across various industries and power producers remain, and regulatory and community engagement pathways need to be defined or refined. NZICs are most successfully formed with strong public/private partnerships and where one or a few core stakeholders—with strong, ambitious corporate sustainability goals—lead the formation process.

Contents

Introduction

This section describes the motivation and benefits of coal plant repurposing, lists coal plant repurposing options, provides an overview of net-zero industrial clusters (NZICs), and describes the organization of this paper.

Motivation and Benefits of Coal Plant Repurposing

As economic, regulatory, and carbon-reduction goals evolve, the viability and desirability of operating coal-fueled generating assets continue to decline. Since 2000, at least 90 gigawatts (GW) of older, smaller, and less-efficient U.S. coal units have been retired in response to environmental and economic changes [1]. Global goals for managing climate change have put intense policy pressure on the coal fleet while driving significant financial change, including an increasing difficulty in financing coal-related projects [2]. Pressures to retire and decommission the remaining coal fleet continue to mount as power generators worldwide transition to low-carbon or carbon-free energy sources.

In the United States, utilities have announced thousands of megawatts (MW) of coal plant retirements, with anticipated closure dates within the next 15 years [1]. This round of plant retirements presents new challenges. The average name-plate capacity for this group of retiring coal plants is roughly 420 MW, compared to an average of 152 MW for those retired in the past 15 years. Globally, including the United States, expected coal retirements over the next 15 years amount to nearly 290 GW [3]. Further, the World Economic Forum (the Forum) has noted that international coal plant retirements, preferably combined with conversion to cleaner energy, must be accelerated to meet International Panel on Climate Change (IPCC) goals by 2050 [4].

The plants slated for retirement now are more complex than the older plants, due to the presence of equipment such as air emission controls. Regulatory changes have resulted in more public scrutiny on the closure process, which is a challenge that adds cost and risk to the decommissioning process for larger plants.

Utilities have typically addressed replacement of decommissioned baseload generation by constructing natural gas-fired units at existing facilities. However, the transition to low-carbon generation suggests this type of baseload replacement may no longer be the most feasible or desirable option in many regions. Rather, companies need to assess the coal-fired facilities to identify the assets, limitations, and options for developing new clean energy generation and storage as the existing fleet is retired.

Following are potential benefits of repurposing an existing coal plant site (see Figure 1):

- Operating coal plant sites have existing buildings, substations, and equipment that can be reused, depending on the selected repurposing option.
- Operating coal plant sites have existing transmission infrastructure and interconnection permits that could service the repurposed application.
- Many such sites have access to well-developed transportation infrastructure via road, rail, and waterways, as well as existing utility connections for buildings.
- The existing environmental permits for a coal facility may be modifiable for application to the new facility, possibly forestalling lengthy permitting processes that require multiple periods of public input.

- Larger facilities that already have a land use permit and certificate of occupancy, as well as buffer property to provide a visual and physical barrier from nearby neighbors, provide siting advantages that may allow the system to be constructed and commissioned more quickly than siting a new plant at a new location.
- Many current sites offer the advantage of access to a large daily water withdrawal and water discharge allowance, along with infrastructure for intake, discharge, and treatment. In the United States, these features are under more scrutiny. Modifying existing water withdrawal and discharge permits, rather than undergoing the permitting process at a new site, offers reputational and permitting advantages for the repurposed site.
- These coal plant sites also have a skilled and committed local workforce, which provides an opportunity to transition these important human resources for any site repurposing option.
- Communities in which a coal plant and neighboring industries are located are likely to be amenable to industrial reuse.
- Reusing the site maintains the tax base for the city/county.

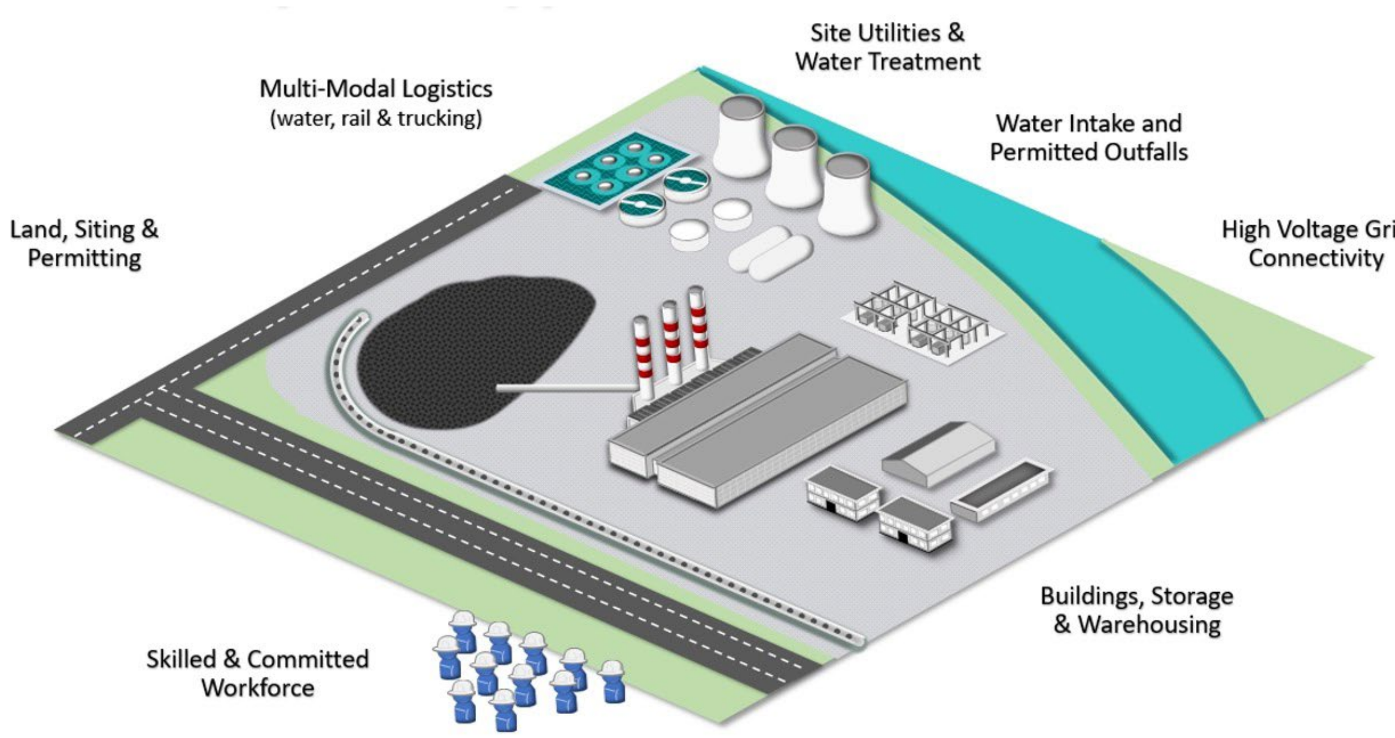

Figure 1. Coal plant sites facing closure can have significant retained value

Repowering Options for the Coal Plant Site

Utilities can develop long-term plans to support their corporate objectives for transitioning to low-carbon or carbon-free generation by developing a corporate strategy to thoroughly examine the assets, liabilities, obligations, and limitations of coal-powered facilities slated for decommissioning. Currently-available options include repowering or repurposing the site to a(n):

- Hydrogen and hydrogen derivatives production plant
  - This plant could use electrolysis—potentially powered by on-site renewables—to produce hydrogen and hydrogen derivatives for higher-value shipment off-site for various industrial, transportation, and power-production needs [5]
  - Another potential arrangement is hydrogen production from natural gas paired with carbon capture and storage (CCS).
- Battery energy storage facility that stores energy from the grid, when electricity prices are low or renewable energy production exceeds demand, and discharges power to the grid when demand is high [6]
- Photovoltaic (PV) power generation facility that directly converts sunlight to electricity [7]
- Bulk energy storage facility (most likely, thermal energy storage) that would store energy from the grid (when electricity prices are low) and discharge power to the grid when demand is high, while also leveraging existing turbomachinery [8]
- Concentrating solar power (CSP) facility that would create energy from solar thermal heat, potentially using the existing steam power island at the site to create power
- Natural gas-fueled (and potentially hydrogen-fueled) simple-cycle or combined-cycle power plant [9]
- Advanced nuclear generating station [10]
- Wind energy facility
- Hybrid plant using two or more low-carbon or carbon-free technologies, such as wind and solar, or solar and hydrogen

EPRI white papers on several of the above options describe key considerations for each technology. The papers cover air quality impacts, potential reuse of site infrastructure, the grid interconnection process, capacity factor considerations (if applicable), transportation access and utilities during construction and operation, physical site characteristics including land use and closed coal combustion residual (CCR) management, potential reuse of site structures and equipment, water availability and quality, permitting and contracts, and references for additional information.

In addition to producing these papers, EPRI is exploring low- or zero-carbon repowering options for coal plants through a screening-level evaluation of the available infrastructure, permits, site characteristics, equipment, and water access typical of coal-fired generation that may be beneficial for repowering and repurposing applications. A series of published documents provides information on primary siting and redevelopment criteria for PV, CSP, bulk energy storage, hydrogen production, and low-carbon fuels to support decarbonization efforts.

Incorporating the Repowered Plant into a Net-Zero Industrial Cluster

In another alternative, a repurposed coal plant site can act as the anchor of an NZIC. An NZIC is a group or hub of industrial facilities and energy producers that collaborate to collectively achieve net-zero carbon emissions.

As companies commit to net-zero carbon emissions, many are recognizing that the traditional approach of each company purchasing resources and creating waste for disposal may not be the most cost-effective strategy. These leading enterprises are discovering that meeting these commitments requires collaboration with co-located (or more distant) facilities in an industrial symbiosis network (see Figure 2). To this end, a growing number of companies have announced plans to forge regional, multi-entity partnerships, jointly invest in asset and infrastructure development, and coordinate strategy and operations. NZICs can help companies reach their net-zero goals through shared decarbonization infrastructure (e.g., hydrogen or CCS pipelines), clean energy supply, and systemic efficiency and circularity.

Industry profiles vary from cluster to cluster, but NZIC structure is based on regionally-adjacent enterprises, with supportive or overlapping resources, waste, raw materials, and/or product streams. Each NZIC facilitates pooling of risk and natural, financial, and human resources, while enabling participants to benefit from increased collective operating scale, diversity, and flexibility. This approach enables the cluster to accelerate decarbonization, promote economic and workforce development, and support regional revitalization through the attraction of new businesses.

EPRI (and Accenture) are collaborating in the World Economic Forum's "Transitioning Industrial Clusters towards Net Zero" initiative, which seeks to create a global movement to accelerate the transition of industrial clusters towards net-zero emissions by 2050 [11].

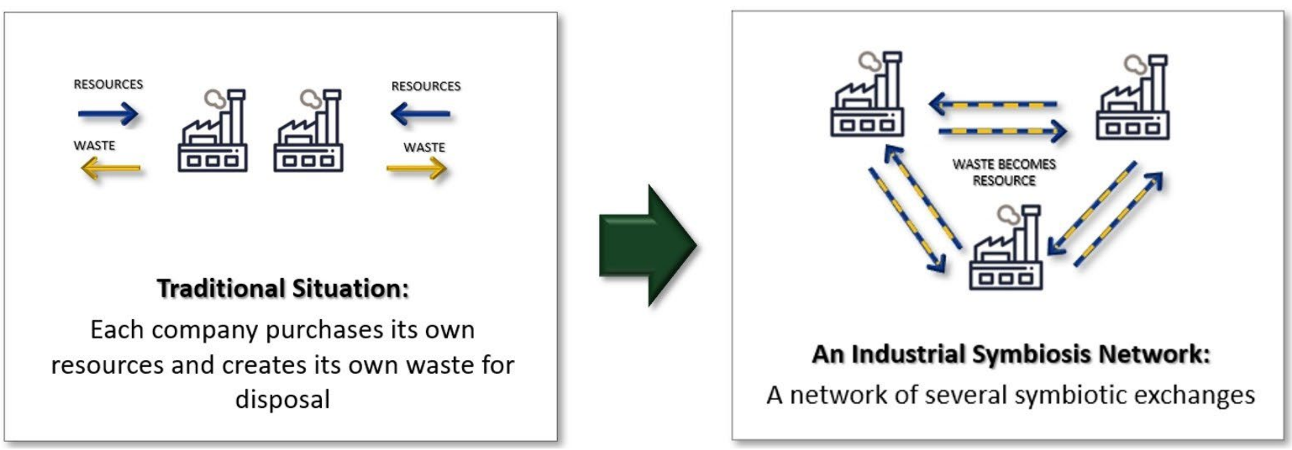

Figure 2. Shifting from a traditional manufacturing approach to a more sustainable and decarbonized network of several symbiotic exchanges

Organization of this Paper

The remainder of this paper provides a high-level overview of how a coal-fired power plant slated for decommissioning can form the core of an NZIC. The paper covers the following (see Figure 3):

- Summarizes the potential for NZICs in North America, and NZIC benefits
- Describes how the flexibility of options for coal plant site reuse makes an NZIC a potentially beneficial opportunity for the power producer, NZIC participants, and the local community and region
- Summarizes five possible ways that a repurposed coal plant site can act as an NZIC anchor
- Describes an example NZIC that involves coal plant site repurposing to illustrate this arrangement, its capabilities, and its benefits
- Describes how collaboration facilitates coal plant site reuse projects as part of an NZIC
- Summarizes regional goals and infrastructure considerations for repurposing a coal plant site to an NZIC
- Describes community engagement and the role of the local workforce in NZIC projects, and illustrates this engagement in an NZIC project that includes coal plant site repurposing
- Summarizes a key challenge of forming beneficial NZICs (including those anchored by a repurposed coal plant): enabling collaboration across diverse corporate cultures

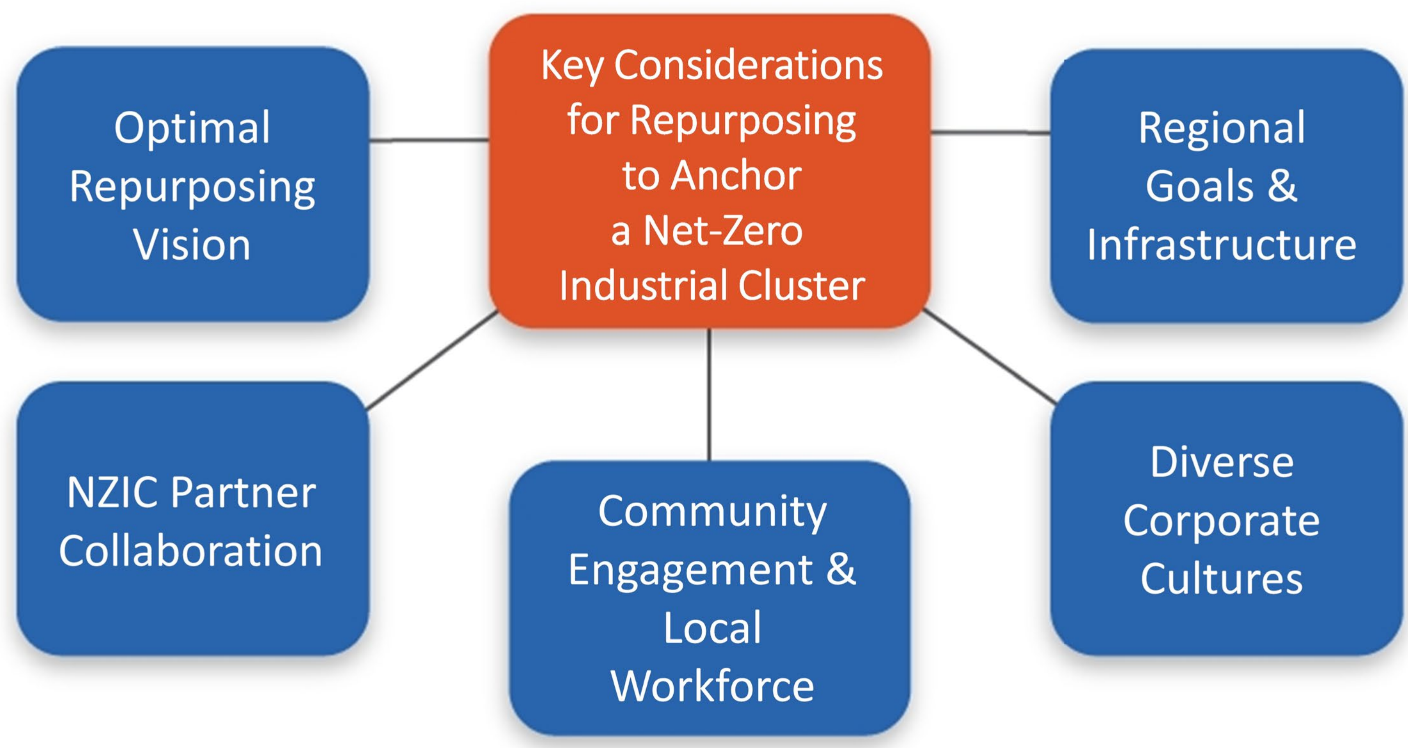

Figure 3. Key issues when evaluating coal plant site repurposing to anchor an NZI

NZICs: The Potential and Benefits

This section describes the NZIC potential in North America and lists the potential benefits of NZICs.

NZIC Potential in North America

In North America, many coal plants slated for decommissioning are located within corridors of high economic activity and development. This is illustrated in Figure 4 by the layering of coal plant locations on a county-level U.S. heat map of gross domestic product. This co-location, or clustering of coal plants and economic or industrial corridors, is borne from the inseparable connection between energy availability and economic development. These coal power plants powered decades-long economic development for these regions. Looking to the future, these regions—with their well-developed and diverse economies—can provide potential future opportunities to repurpose, reimagine, and redevelop these legacy assets.

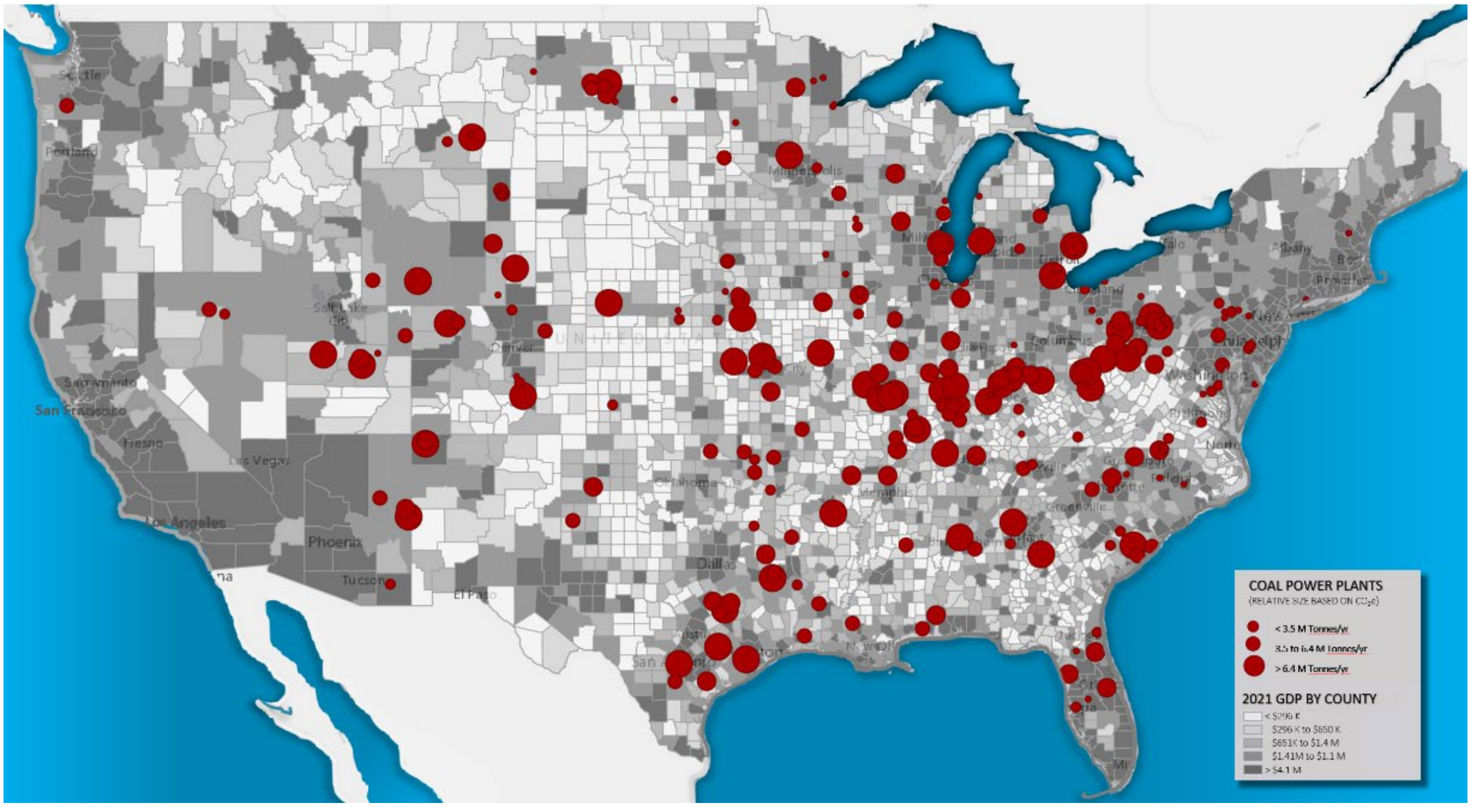

Figure 4. The superposition of coal plant sites (red dots) on corridors of high economic activity (gray shading based on county-level GDP) shows the potential to repurpose these sites for new business endeavors, including NZICs. Source: EPRI

Figure 5 superimposes major natural gas pipelines on these sites. Together these illustrate the current co-location of existing energy infrastructure and industrial facilities.

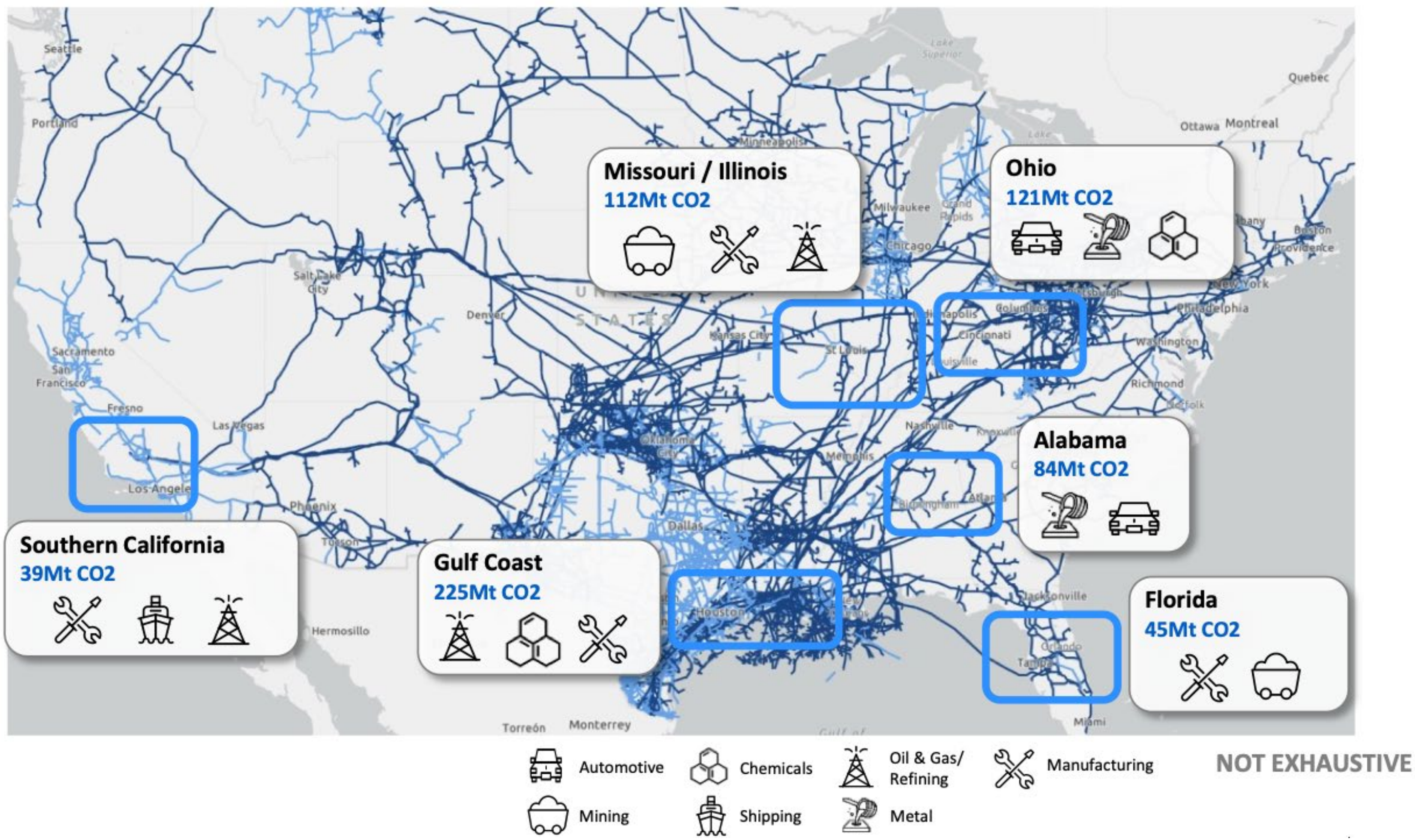

Figure 5. Superposition of major natural gas pipelines on centers of industrial activity shows the potential to leverage this energy infrastructure in NZICs [12]

Potential Benefits of NZICs

NZIC projects are now being planned and implemented around the world, with a broad array of potential benefits to participants. NZIC projects transcend sustainability and net-zero goals, providing a means to address other high-priority goals:

- Improving cost competitiveness, return on investment, and total cost of asset ownership by sharing the cost of infrastructure and collectively addressing risk and regulatory considerations
- Enhancing energy productivity and system efficiency by reducing the cost of energy and water, as well as the cost of facility disruptions due to degraded power quality
- Maintaining high reliability and enhancing resilience of operations for power producers to better serve industrial customers and for industrial companies to reduce time to market. Organizing and operating the NZIC as a system rather than a disaggregated group enables:
  - Demand aggregation, which can help stabilize power demand, enable higher capacity utilization so that plants run at the best efficiency/reliability point more often, and provides greater optionality for load balancing and shedding when needed
  - Resource pooling among cluster stakeholders, which allows collective cluster-wide prioritization and allocation of resources during service disruptions
  - Potential for systemic monitoring and operation of energy utilization across the system to improve detection and response of operational disruptions
- Enabling cost-effective environmental compliance (including air and water quality) beyond decarbonization goals through shared infrastructure and treatment systems
- Increasing flexibility of power producer operations in the face of shifting power system needs
- Creating a positive local economic impact
- Improving the safety and health of workers and the community through improved air quality

NZICs may provide advantages in the complex area of permitting. Organized, well-aligned clusters may be able to inform and collaborate on ways to address permitting needs and accelerate the permitting process for new technologies by operating as a large coalition with well-developed strategies, rather than by operating as multiple operators seeking individual permits. Aggregation may also offer advantages to the public and environment via combined operating permits (e.g., maximum allowed emissions across the cluster may be less than the sum of maximum emissions for each point source). Smaller entities may gain access to these advantages as a cluster member that they may not have been able to realize individually. Aggregation may also facilitate a broader strategy on the reuse of existing infrastructure (e.g., natural gas pipelines), which may simplify permitting pathways. In the plant decommissioning context, for example, existing water use and discharge permits, as well as existing T&D infrastructure and other permits, may provide avenues for reduced permitting risks.

Figure 6 illustrates an NZIC's potential pathways and technology options.

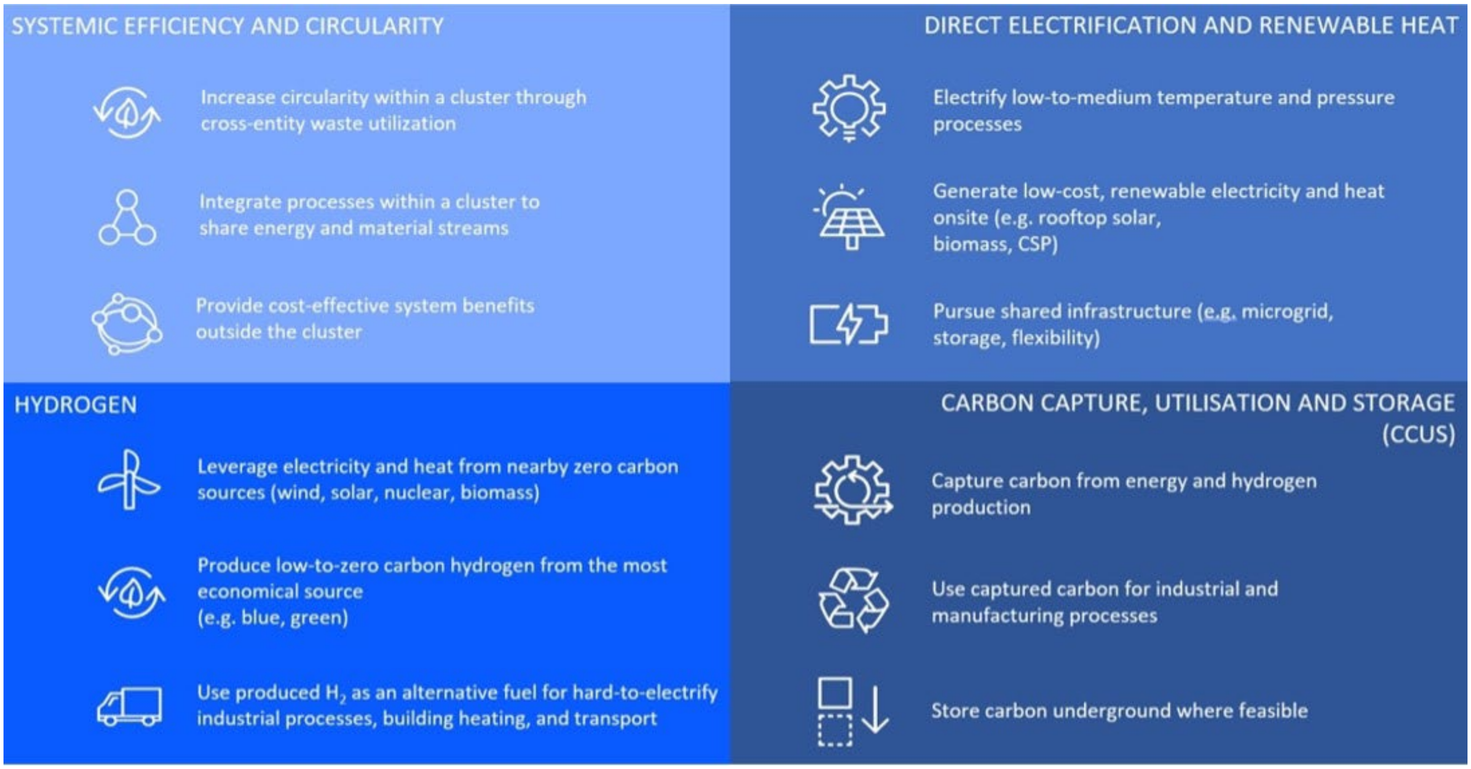

Figure 6. NZIC potential pathways and technology options. (Note: Green hydrogen is produced using electricity from renewable energy sources in an electrolysis process. Blue hydrogen is produced primarily from natural gas in a steam reforming process, and incorporates CCS.) Source: WEF Initiative [13]

Coal Plant Site Repurposing: Flexibility for an NZIC

This section describes five options for repurposing a coal plant site as an NZIC anchor and illustrates one of these options with a project that is now underway.

Repurposing Options Relevant to NZICs

The flexibility of options for coal plant site reuse makes an NZIC a potentially beneficial opportunity for the power producer, NZIC participants, and the local community and region. One reason is that the needs of this broader stakeholder group can drive the optimal choice of site repurposing option. Consider the following possibilities:

- **Hydrogen Hub.** The coal plant site can be repurposed to produce hydrogen, which can support the hydrogen needs of local industrial and transportation sectors, be blended with natural gas in existing local pipelines for local and regional use, and when electricity is scarce during high demand periods, be used as a fuel for local power generation.
- **CCUS Hub.** The coal plant site can be repurposed to form the anchor of a carbon capture, utilization, and storage (CCUS) hub. For example, if the plant is repowered to a natural gas-fired combined-cycle plant (with the capability for increasing hydrogen co-firing over time), carbon can be captured from this plant, and carbon can be stored underground where feasible.

- **Clean Energy Hub.** The coal plant site can be repurposed for a combination of renewable energy production (e.g., solar, wind, nuclear, and/or biomass) and energy storage. In this case, the plant delivers affordable, clean power and electricity storage capability (to mitigate high-cost power periods) to local industrial processes, and can be part of a resilient and high-reliability microgrid with local industrial customers.
- **Hybrid Hub.** The coal plant site can be repurposed to a combination of two or more low-carbon or carbon-free technologies (e.g., solar PV and hydrogen production) to synergistically operate with nearby industrial processes.
- **Combined Heat and Power (District Heating) Hub.** A natural gas-fired combined cycle plant can provide waste heat to industrial customers, which may also produce waste heat in their processes. Such waste heat, for example, could be used to power a hydrogen electrolysis facility.
- **Other potential arrangements** include a transport hub, direct air capture hub, net-zero industrial park, manufacturing and materials hub, and a hub focused on circularity (e.g., chemicals).

Anchoring such a hub requires careful advance planning. Coordination would typically begin at least five years prior to the scheduled decommissioning date of the coal facility, or commercial operation date of the new generating technology if it will be built prior to decommissioning the coal site. For coal site repurposing, this time constraint differentiates the NZIC option from options described in companion EPRI papers, some of which can be realized in shorter timeframes (e.g., solar PV).

NZIC Example: Coal Plant Repurposing to Anchor a Hydrogen Valley

The industrial and energy producer synergism in an NZIC is best illustrated with an example NZIC project. After 35 years of operation, Energias de Portugal (EDP) ceased operation of its 1256-MW Sines coal power plant—the largest power station in the country—in January 2021. The decision to cease operation was part of EDP's decarbonization strategy for early closure of plants on the Iberian Peninsula. The decision is also aligned with the Portuguese government's decarbonization goals, through the National Energy and Climate Plan (PNEC 2030), and with European targets for carbon neutrality. A five-year process of decommissioning and dismantlement is now underway.

As part of the GreenH$_2$Atlantic project, EDP now plans to repurpose this coal plant in a first-of-its-kind 100-MW green hydrogen production plant (an alkaline electrolyzer with an artificial intelligence-enhanced operating system) and a green ammonia pilot project. To promote hydrogen awareness, the project will also include a collaborative laboratory [14,15,16].

The GreenH$_2$Atlantic Project is a consortium of 13 European companies and research partners, including a Galp refinery, Bondalti Chemicals, and others (see Figure 7). The project will include a Sines-centered hydrogen valley that aims to deliver green hydrogen at €2.87/kg levelized cost of hydrogen (LCOH) to a local refinery and for pipeline blending with natural gas. One of three projects that the European Union selected (and awarded a €30 million grant as part of the Horizon 2020 Green Deal Call), GreenH$_2$Atlantic aims to reduce greenhouse gas emissions by 80 kilotons (kt) CO_{2e}/year[1] and create an estimated 1147 direct and 2744 indirect jobs [17,18].

This example illustrates how a repurposed coal plant can act as the anchor of an NZIC that is a key component of the decarbonization strategies of a utility, industrial enterprises, and a nation.

[1] CO_{2e} describes the combined impact of various greenhouse gases, expressed in terms of the equivalent amount of carbon dioxide (CO_2) that would yield an equivalent amount of global warming.

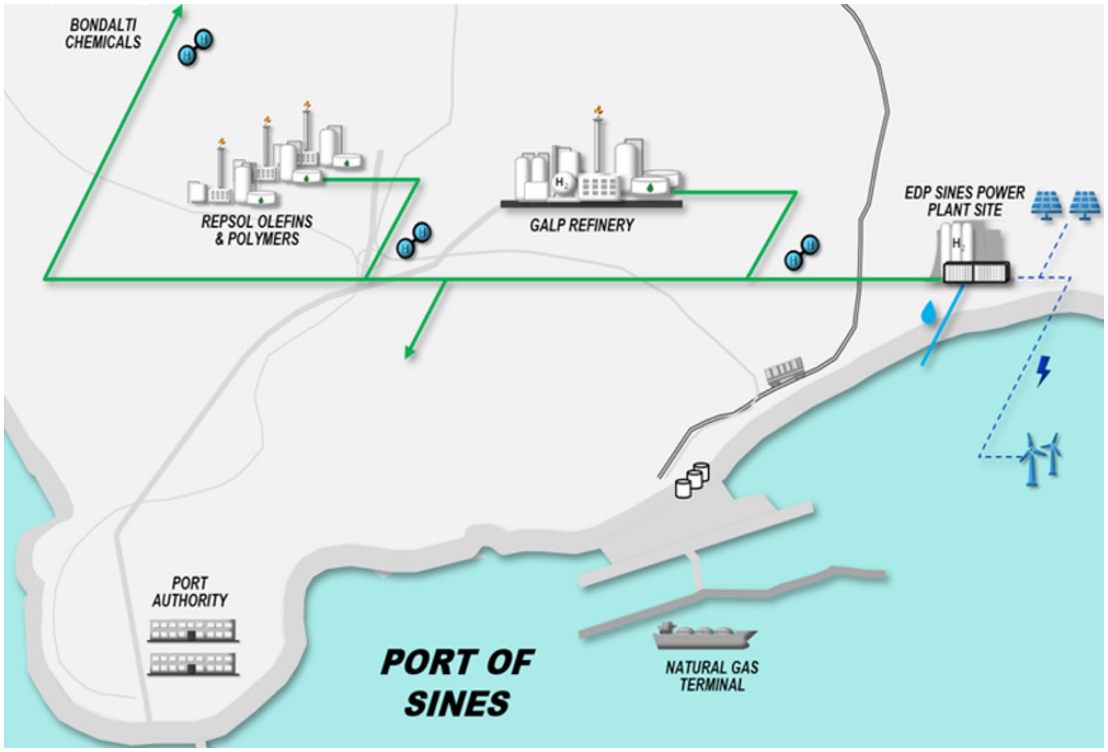

Figure 7. The GreenH$_2$Atlantic planned hydrogen valley anchored by a repurposed decommissioned coal plant in Sines, Portugal. Source: EPRI

Key Considerations

This section describes key considerations when repurposing a coal plant site to anchor an NZIC. These include the following:

- Collaboration to facilitate the NZIC
- Consideration of regional goals and infrastructure
- Community engagement and the local workforce
- Financing and policy enablers and barriers
- The corporate culture challenge

Collaboration Facilitates NZICs

As explained in the Forum's January 2023 document on NZICs, "collaboration is the new leadership" [13]. The foreword to that document explains the importance of collaboration in the NZIC initiative to explore the most challenging technical, environmental, and social justice questions of the energy transition. It also emphasizes the importance of bringing stakeholder stories into public view to help accelerate industrial decarbonization.

Active collaboration among cluster partners is necessary to successfully implement an NZIC. Within the cluster, greater integration drives greater value, and as the integration of physical systems and work processes increases, so must communication and collaboration among cluster partners. Collaboration can include:

- Sharing infrastructure
- Forming cross-cluster work teams
- Establishing processes and a cadence for reporting, communicating, and meeting at a cluster-wide level
- Developing integrated procedures
- Creating cluster-wide dashboards for real-time monitoring and decision-making [19]

Considering Regional Goals and Infrastructure

This collaboration extends to the local community—and even the broader region—in which the cluster is located. Hence, coal site repurposing in the context of an NZIC requires broad assessment and vision. The coal plant owner is uniquely positioned to lead this vision and collaboration due to its existing community relationships and, in the case of integrated utilities, due to its role as the electricity provider of large industrial companies.

Maximizing the benefits of synergism across NZIC participants requires consideration of the following participant and regional goals and infrastructure:

- The clean energy, sustainability, and net-zero goals, policy, timelines, and commitment of individual enterprises, the local power producer (and distributed power producers), local communities, the region, and (when applicable) the nation
- Decarbonization objectives of regional industry, expansion and growth plans of local industrial enterprises, existing community economic development plans, and utility integrated resource plans
- The existing, planned, and needed future energy resource mix of the power producer, local communities, the region, and (when applicable) the nation
- The existing, planned, and needed energy infrastructure, including electric transmission and distribution capacity, natural gas pipeline proximity and capacity, potential compatibility of this pipeline infrastructure with hydrogen, and availability of a CO_2 pipeline
- The existing fresh water and wastewater infrastructure, including ownership of water rights
- The existing transportation infrastructure, including railroad and waterway facilities
- The knowledge, skills, and abilities of the local and regional workforce

Many NZICs planned or under construction around the world consist of co-located facilities, while some NZICs are planned for operation across significant distances. For example, the H_2Houston Hub in the United States plans a clean-hydrogen ecosystem that could spread across the entire state of Texas [20].

Community Engagement and the Local Workforce

The members of each local community bring their own set of pre-conceived notions, biases, and concerns about any major change where they live and work, which are often based on historical activities in the community. Understanding and responding to these sentiments is as important as the technical aspects of the project, as they may present opportunities to advance equity and environmental justice in the region.

One important aspect of community engagement relates to the workforce that operated and supported the decommissioning coal plant. Community members are likely to be quite concerned with the impact of the coal plant decommissioning on their jobs and livelihood. One way to address these concerns—and simultaneously engage with the community—is to communicate in a positive way about the skills that the coal plant workforce, as well as the extended workforce in the community, bring to the NZIC project. Community members usually offer diverse skillsets, experience, and knowledge that apply to construction, operation, and maintenance of the repurposed energy facility and the coordinated NZIC planning and operation. NZIC projects require skills in a wide range of disciplines, including water and wastewater management, industrial permitting, environmental management, construction, hydrogen-based processes, pipeline operation, rail transportation, materials handling and recycling, and others. Personnel of NZIC project participants, as well as non-participants in local businesses and industrial facilities, typically offer "accidental" knowledge—relevant expertise in many of these subject areas not known prior to conducting extended community engagement efforts.

When expertise and knowledge does not exist in local personnel, retraining or upskilling of former coal plant workers in needed fields is a complementary approach to meeting workforce needs. The Forum and others refer to this as a "just and managed transition." The Forum calls for a "holistic approach to engage all stakeholders, especially those disenfranchised by technological revolutions in the twentieth century" [13].

As part of the GreenH$_2$Atlantic project, for example, EDP is mitigating the impact of coal plant site repurposing on its workers and supplier workforce via a just transition program called "Futuro Ativo Sines." In this program, all of EDP's workers will benefit from individualized plans that include internal mobility, upskilling and reskilling, or retirement. EDP conducted this effort in collaboration with two Portuguese universities and created a local office for social action by partnering with local municipal and state employment and training services. This allows the program to more fully engage with the local community, beyond just the plant workers [16].

Financing and Policy Enablers and Barriers

A key early stage priority in NZIC planning is to understand the regional landscape in terms of policy and financial support. Are federal, state, or regional funds available to support the development of decarbonization infrastructure in the region? How will these funds be matched with private funds for sustainable deployment and operations? Understanding the policy landscape is critical to the viability of decarbonization deployment strategies for NZICs. For example, a renewable energy pathway may be more favored in some regions, while other pathways such as an emphasis on CCS may have an advantage at the state level. If the NZIC proposes implementation of new technologies, project participants may need to inform policy gaps to ensure smooth deployment. A recent World Economic Forum report provides more information on key challenges to deploying NZICs, including case study examples [13].

NZIC Challenge: Corporate Culture

However, establishing partnerships across industries that have not traditionally collaborated can be challenging. The relatively recent rise in corporate sustainability and decarbonization commitments—combined with supportive policy and incentives for new technologies—opens doors for collaboration discussions that may not have been possible even five years ago. Nevertheless, differences in corporate culture across various industries and power producers remain, and regulatory and community engagement pathways need to be defined or refined. NZICs are most successfully formed with strong public/private partnerships and where one or a few core stakeholders—with strong, ambitious corporate sustainability goals—lead the formation process.

For example, a power producer planning to repurpose a coal plant site and a co-located energy-intensive industrial facility can form an effective core partnership, which can then reach out to additional potential cluster participants. Extending this partnership then becomes a "matchmaking" process that considers energy supply and demand, effluent streams and their capability for reuse (valorization), water and wastewater synergisms, carbon production and utilization opportunities, and more.

Support within organizations for a project of the complexity and needed vision of an NZIC usually originates at the executive level, which has responsibility for meeting stated corporate sustainability and net-zero goals, for example, rather than the industrial plant operation or management level, which has responsibility for plant performance. This top-down, high-level sponsorship and leadership typically then spreads within the organization to attain top-to-bottom support and internal collaboration.

Conclusion

This paper is part of an EPRI white paper series on considerations for repowering a decommissioning coal plant with an alternative technology. These alternatives may support low- or zero-carbon power generation, alternative fuel production, or energy storage technology. This paper describes a central role for the decommissioning coal plant as the anchor of a multi-partner industrial cluster that aims to achieve net-zero decarbonization. NZICs offer unique opportunities to:

- Retain the plant workforce and provide long-term economic benefits to the region
- Repurpose plant grid, natural gas pipeline, and water infrastructure to support decarbonization deployment needs
- Use land to create new clean industrial parks
- Improve engagement and collaboration with the local community
- Improve the safety and health of workers and the community through improved air quality
- Advance equity and environmental justice in the region

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