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THE NEW INDUSTRIAL REVOLUTION: FINDING LIFE FOR THE BUILDINGS LEFT BEHIND

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Abstract. From large generating facilities to modest neighbourhood substations, public power structures are an exercise in dichotomy. Captivating yet mysterious, designed with both powerful function and beauty in mind. Quietly playing a role in the development of cities and supporting the activities of home worldwide, the magic of heritage power plants, pumping houses and substations is often hidden behind metal gates and pressed brick facades punctuated with oversized steel windows and carved decorative ornamentations.

Efforts to achieve global goals of carbon-neutrality paired with advancements in infrastructure, utility distribution and alternative energies now forces the reconsideration of many unique historic resources.

Brimming with astounding potential, power generation facilities present unique challenges that can be deterrents to redevelopment. Adaptive reuse celebrates the contributions of those who designed, constructed and operated the architectural and engineering marvels that powered the world while deterring exceptional building materials from languishing in landfills.

As an increasing number of sites are decommissioned how can they be positioned to power new experiences for generations to come? What redevelopment tools are available to incentivize the adaptive reuse of industrial heritage, specifically public utility architecture? How do government-led approaches to adaptive reuse differ?

Keywords: Power plant, adaptive reuse, rehabilitation, heritage, industrial, decommissioning.

1. Introduction

Worldwide goals to achieve carbon-neutrality and promote sustainable energy production are driving advancements in the generation and distribution of power. Past reliance on non-renewable and polluting energies are being replaced by wind, solar and biofuels. Concurrently, heritage power facilities are reaching a predictable end of life and face replacement by cleaner and more efficient technologies. As the energy sector repositions, the futures of many historic power and utility buildings are called into question.

The Industrial Revolution ushered in a new era of production and growth. Reliable delivery of power became a paramount necessity for manufacturing centres and burgeoning municipalities. Power plants, substations, gasworks, and waterworks housed massive mechanical operations but also received sophisticated architectural treatments. Like public institutions of the period such as post offices, libraries and schools, the design of power buildings emphasized function and proportion without abandoning aesthetic enhancements. For decommissioned heritage power buildings, adaptive reuse of these unique sites is the only alternative to demolition and relegation to landfills teeming with construction waste. Distinctive architectural design, high grade materials and robust community affinity are all arguments for retaining and reusing historic generating facilities.

The primary challenges to adaptive reuse of utility architecture are overcoming perceived obsolescence and financing. While funding is an inherent issue in historic building rehabilitations, the building scale and potential site contamination of power plants can be daunting adversaries to embracing preservation and reuse. Government agencies must support project success by administering financial incentives while fostering partnerships created to activate sites. Each are essential to promoting adaptive reuse of legacy power generation and service buildings that have reached end of service.

2. Public Utility Architecture: Why Adaptive Reuse?

2.1. The Municipal Plant: Civic Duty and Beauty

Rapid expansion of manufacturing and population required cities around the world to provide massive amounts of power demanded by such unprecedented growth. Engineering advancements enabled the manipulation of impressive amounts of water, gas, and heat to generate substantial outputs while intricate systems were installed to deliver power directly to the consumer. No longer reserved for only the largest cities or the elite, soon lamp-lit streets, electric streetcars, and new home comforts became the norm. The expansion of public utilities as a civic amenity resulted in the construction of captivating buildings dedicated to powering the populace.

World expositions, fairs and architectural design contests fostered an exchange of ideas and competitive atmosphere amongst nations and states and the resulting influence on architectural design included power structures. In the United States, the 1876 Centennial Celebration in Philadelphia sparked a period of growth and a new commitment to following established principles of design when planning cities and buildings. The Chicago Exposition in 1893 further cemented this philosophy and became a launch point for the City Beautiful movement, American architect Daniel Burnham's response to the dirty and chaotic urban areas resulting from rapid industrial growth. Burnham advocated that beautification and order of public buildings and spaces were necessary for a functioning city and resulted in a positive behavioural impact upon the masses [1]. European approaches to architecture had long emphasized aesthetics for civic projects. The Paris Exposition of 1900 paid special attention to public power innovations, with a Palace to Electricity featuring state of the art technology as well as the competitive construction of two artfully designed chimney stacks. The French entry to the design competition was a masterpiece, with large shield representing industry and decorative brick patterns terminating in impressively stepped caps and relief of half rosettes, showing "what France could do in the way of making art out of a brick pile" [2]. In Germany, the design of utility buildings "were given architectural expression which does not belie their true nature" while still expressing an "appearance of quaintness and charm" [3]. Inspired by expositions and planning movements that encouraged enhancement of public buildings and spaces, municipalities commissioned architects with portfolios of museums, libraries, and universities to partner with engineers on the design of new power facilities. Styles such as Beaux-Arts, Neoclassical, Renaissance Revival and later Art Deco and Moderne, were used to elevate plants from modest undertaking to canvas for architectural expression. Despite being unnecessary for the facility's primary functions, the classical treatment and adornment of municipal power buildings was embraced. The orderliness of activities occurring inside the plant was replicated in the classical balance and proportion applied to exterior elevations, punctuated by rows of oversize steel windows to maximize daylight and ventilation. The deliberate application of decorative elements transformed utilitarian plants and substations into captivating works of art. Architects designed new facilities with decorative tile, ornamental brickwork and attractive lighting. Decorative embellishments occasionally played directly on the building function, with the integration of lightning bolts or patterns mimicking waves or the ombre effect of a chemical reaction. Doorways were formalized with pediments and sculptural ornamentation and prominently featured the municipal crest or year of construction. Publicly accessible spaces were handsomely trimmed in marble and stone and provided the same interior appointments one would expect visiting a post office or city hall. Ample exterior lighting assured that even the night-time onlooker would be awed by the plant's magnificence.

Large-scale energy generation and distribution required that power plants, substations, gasworks, and waterworks be constructed in nearly every town and state. As cities grew in population and prominence, pressure increased to construct more noteworthy structures and the application of classical techniques to public buildings enjoyed a resurgence. These facilities played a vital role in supporting metropolitan development, manufacturing, and activities of daily life. Municipalities regarded their ability to provide reliable power as a source of civic pride and a way to attract new businesses and residents. Privately-held utility companies considered power plants to be testaments of corporate success, necessary to build legitimacy and attract new investors. Both regarded new facilities as investments worthy of careful planning and consideration, including architectural treatments. In 1916 James N. Hatch, a consulting engineer to power plant construction in the United States advocated to the Western Society of Engineers that artistic touches to a power plant should not be overlooked, as the stability and success of any enterprise is judged consciously or unconsciously by the appearance of its physical property [4]. Power plants and substations were provided the same architectural considerations as other prominent municipal institutions. With nearly every opening of a new power facility, the plant was proclaimed as "world's largest" in some capacity. The design, engineering and construction of new power plants became its own competition amongst towns and utility companies. Records for highest output, gallons pumped, or new technologies were routinely eclipsed as more facilities were completed and competed for such illustrious distinctions. Grand openings were celebrated with ribbon cuttings and lauded with newspaper articles detailing every aspect of the design. Equipment suppliers placed advertisements featuring crisp images of brand-new turbines, boilers and engines and noting the impressive performance capacities of machinery. Municipalities and private utility companies alike commemorated new additions with postcards and ephemera that artistically depicted the facility and its surroundings. Power plants symbolised achievement and signalled a strong future.

By refusing to underestimate the importance of architectural design when planning hydroelectric plants or electric substations, decision-makers achieved mechanically superior yet beautiful facilities. Generation plants and distribution substations received a uniform architectural treatment favoured by the company or were influenced by the existing architectural styles of the area. California's Pacific Gas and Electric Company (PG&E) placed great emphasis on the design and engineering of its facilities, recognizing that power stations could be objects of beauty without diminishing the brute forces concealed inside. This approach resulted in a series of substations with stunning stone ornamentation that appear plucked from Paris or Rome but were instead tucked into San Francisco neighbourhoods. Other PG&E facilities throughout California are Spanish Renaissance, with red-tiled roofs and stucco plaster exterior walls, to compliment the prevalent use of that style throughout the region [5, 6]. Existing architecture and popular materials routinely influenced design choices at new facilities, especially for distribution substations sited in neighbourhoods or prominent districts. In 1925 plans for a new municipal Rapid Sand Filtration Plant in Washington D.C. were required to pass examination by the Fine Arts Commission of the National Capitol due to the water filtration facility's prominent setting along a busy highway near the federal seat of government. After multiple rounds of scrutinization, the team selected a style for the complex that complemented the existing buildings in the District [7]. Michigan's Detroit Edison Company's substations took stylistic direction from current residential building stock in the neighbourhood, using reclaimed timbers to elevate the design of its Tudor Revival stations.

The emphasis on architectural treatment and materials juxtaposed with massive power and force is an exercise in dichotomy and the primary reason historic power facilities are deserving of preservation and reuse.

2.2. Material Assets: Leverage not Landfill

World leaders are committed to reducing waste and pollutants to promote sustainability and combat climate change. The European Union is proposing carbon-neutrality by 2050, supplemented with a fast-approaching goal to drastically reduce emissions by 2030 [8]. The United States aims to cut its greenhouse gas pollution by 2030 [9]. To facilitate these goals, large coal and gas-fired energy generation plants must either convert to cleaner processes or face decommissioning. At the same time, advancements in energy generation and distribution call into question the futures of aging municipal utility facilities, once postcard-worthy beacons of pride. In the absence of a plan that includes preservation, the site either proceeds directly to demolition or languishes in vacancy. Removing legacy power plants from service does not end their negative environmental impact if demolition and disposal is the only path forward.

Demolition undertakings produce an enormous amount of construction waste and risk the release of harmful substances into the environment. While some building materials such as asphalt, concrete and certain metals provide an economic incentive to recover and recycle, others will persist in landfills. A 2018 study by the United States Environmental Protection Agency (EPA) estimated that the United States generates 600 million tons of construction and demolition debris with demolition activities responsible for more than ninety percent. Of this total, the majority of waste was relegated to landfills [10]. In the European Union, construction and demolition debris is the largest single waste stream, responsible for 374 million tons in 2016 [11]. Diverting construction waste to secondary recycling markets to lessen the environmental impact of demolition remains an industry priority but barriers remain to a uniform embrace of recycled construction materials. At legacy power plants, demolitions are weeks-long undertakings, often involving controlled explosives and transporting waste to specialised landfills. Encapsulated hazardous materials are disturbed and disbursed into the air, ground and water. The massive amounts of building materials used to construct power generation and distribution facilities, including reinforced concrete, steel, and millions of bricks better serve the environment as a repurposed building rather than conveyed to landfills. Adaptive reuse is an inherently sustainable solution for heritage utility buildings that are removed from service and deters valuable materials from contributing to an already overwhelming burden of construction waste.

3. Overcoming Challenges to Reuse

3.1. Opportunity not Obstacle

Classification as industrial site need not be a death knell for the preservation and adaptive reuse of power and utility buildings. Adaptive reuse must be presented early as a viable redevelopment option so that stakeholders understand the opportunities embodied in these unique locations and financial tools to assist with rehabilitation. Assessing project feasibility, assembling financial incentives and marshalling local support are critical steps to position adaptive reuse projects for success. Leveraging community affinity is exceedingly valuable when assembling support for saving heritage assets, particularly with utility owners and political representatives. Strong citizen attachment to a utility facility can be a differentiating factor in the decision by community leaders and private developers to repurpose or demolish the asset. Owners seeking to reactivate decommissioned utility facilities without transfer of ownership may enter into public-private partnerships or create long-term leases with non-profit organizations. These agreements can remove maintenance and operational burdens, often costly even for a decommissioned site, while enabling adaptive reuse to move forward. In Seattle, Washington a collaboration to preserve the 1906 Georgetown Steam Plant exemplifies the potential of such municipally driven partnerships. Decommissioned in 1977, the generating facility is owned by Seattle City Light, the municipal electric provider. It was named a National Historic Landmark in 1984, the highest distinction for a historic site bestowed by the National Park Service. After extended dormancy, the complex reopened in 2014 to great fanfare for guided tours and art-based installations. Sustained public interest in the site led Seattle City Light to seek a partner to maintain and operate the shuttered steam plant. After a proposal process, the newly formed non-profit Georgetown Steam Plant Community Development Authority assumed fundraising, rehabilitation and maintenance responsibilities while continuing the public access and artistic spirit synonymous with the site. The group entered a twenty-five-year lease with plans to reinvigorate the steam plant as a historic, scientific, artistic, and cultural resource [12]. Strategic partnerships can catalyse rehabilitation and reuse while removing obligations from local governments or utility providers who are unable to devote necessary resources to preserve historic facilities or undertake ambitious development projects.

Perceived challenges to the rehabilitation of power plants must instead be embraced during adaptive reuse undertakings. The embodied industrial grit and grime is a valuable commodity which distinguishes energy generation buildings from other architectural heritage. Rather than removal, character-defining features and exceptional architectural elements should be preserved and showcased during reuse. Multi-story ceiling heights create dramatic vertically oriented spaces and equipment such as turbines and boilers can remain in situ as visual links to the building's history. Exposed catwalks, overhead rigging and pully systems create interesting visual features once cleaned and secured. Large complexes that offer multiple buildings and auxiliary structures can be activated with a multitude of complementary uses. Facilities sited along water should embrace this amenity in rehabilitation plans. The features which differentiate power buildings from other historic resources must not be viewed as deterrents but rather as fascinating elements worthy of a sustainable second act.

3.2. Empowering Reuse

Heritage building rehabilitation can be financially daunting and the cost to repurpose power structures fluctuates widely depending on exiting conditions and end use. To deter demolition, it is essential for government agencies to provide financial tools to offset the remediation and rehabilitation of historic power facilities. These initiatives can transform preservation projects from insurmountable to viable economic development undertakings. For maximum impact, stakeholders must be effectively informed and prepared to take advantage of such programs.

In the United States, government programs play a large role in encouraging the redevelopment of historic resources. Sites of significance designated in the National Register of Historic Places can receive a twenty percent tax credit for eligible building rehabilitation expenditures. Undertakings utilizing the credit must follow the *Secretary of the Interior Standards for Rehabilitation* to ensure character-defining features are retained during the project and provide for the modernization of mechanical and plumbing systems as well as accessibility and seismic performance. As of 2022 thirty-nine states administer individual historic tax credit programs that can be twinned with the federal incentive to increase the return. Grants supporting adaptive reuse undertakings are also deployed at government and institutional levels but are largely reliant on budget allocations and highly competitive [13].

Addressing potential site contamination is important to determining next steps during the adaptive reuse of public utility buildings. As different historical uses created varying degrees of environmental pollution, in some cases the facility may not present stakeholders with as significant of a burden an initially anticipated. For projects where sites are polluted, there are remediation techniques to clean contamination, but they are costly endeavours. To encourage reclamation of polluted industrial sites the U.S. government offers multiple incentive programs to assess, clean and sustainably reuse contaminated properties, also called brownfields. Multiple programs and federal tax incentives are administered by the Environmental Protection Agency to underwrite the elimination of contaminants and revitalization of eligible locations [14]. It is common for adaptive reuse projects at industrial sites such as power plants to utilize both the historic tax credit and brownfield programs to counteract the costs of rehabilitation. Despite existing initiatives there remains a disconnect between decommissioned property owners recognizing adaptive reuse as an attainable alternative to demolition. Government agencies must do more to incentivize the reuse of legacy power plant facilities, dissuade the knee-jerk reaction to demolish and encourage thorough site remediation.

4. Conclusion

Global commitments to carbon-neutrality and advancing energy technologies are relegating heritage power facilities to decommissioned status with demolitions occurring at unprecedented rates. These sites are massively undervalued in site planning and the perceived obsolescence of discharged power buildings must instead be viewed as an exceptional development opportunity. Character-defining elements that received thoughtful consideration by architects and engineers during design must receive similar contemplation by stakeholders determining the fates of decommissioned facilities. To combat the existing disconnect between disposition planning and adaptive reuse, owners and stakeholders must be empowered to envision the site outside its industrial functions and be informed of best practices and financial incentives that support adaptive reuse undertakings.

Government support for the adaptive reuse of heritage power facilities is a critical component to project success. Financial programs that incentivize remediation and rehabilitation are vital and affirm a commitment to environmental stewardship and preserving industrial heritage but must be buoyed with additional funds. Proponents must advocate for the expansion of incentive programs with additional monies specifically directed toward the redevelopment of legacy power plants which present enchanting adaptive reuse potentials but often present with daunting remediation realities. Changes to eligibility requirements and construction timelines for federal rehabilitation incentives may be necessary to encourage the phased reactivation of large complexes. Collaborations between public and private sector stakeholders are critical to developing sustainable new uses for historic utility buildings. Global affinity for power heritage and the inherent community attachment to power generating facilities is often overlooked, underestimated, and can make a significant impact during redevelopment conversations. As we boldly commit to sustainable energy generation and building practices, we must resist the pervasive belief that heritage power plants, gasworks and substations are obsolete and beyond any capable service. With the proper fuel and partnerships, these majestic monuments to power can continue serving generations to come.

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