Taking the Plunge: The Re-use and Re-programming of a Coal Power Plant in Cape Breton

by

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Contents

Abstract

With coal power plants being one of the largest contributors to greenhouse gas emissions worldwide, Nova Scotia and its energy providers must address these mounting concerns by initiating the decommission of our coal power plants along with the development of strategies for future uses of these sites.

This thesis investigates the adaptive reuse of the Point Aconi Generating Station, a coal-powered energy production facility in Cape Breton. The thesis strategy is to explore the possibilities for public programming including, a pool, spa, rock climbing and bouldering, trampolining, and other form of recreation on past sites of infrastructure. Introducing new hubs of recreation and community gathering can revitalize the site for both locals and tourists, maintaining the significance of the building by keeping the industrial elements and adapting them for an entirely different function.

Acknowledgements

This thesis is the result of much support and would not have been possible on my own. There are many individuals who inspired this journey from its commencement in my undergrad to the conclusion here with this thesis.

I would like to extend my sincerest gratitude to my thesis committee. Sarah Bonnemaison, your constant advice, guidance, and support throughout this process allowed me to pursue my goals and feel confident in my ideas. With the challenging circumstances of the world at this time, I could not have asked for a better person to support and motivate me through this process. Diogo Burnay, your wild imagination inspired me to pursue this project to its full potential without the constraints of reality. Without this support, this project would have taken on a whole different approach, one that would be much less fun!

Thank you to Ron MacNeil, the plant manager at Point Aconi, for providing me with invaluable insight into the workings of the plant and documents which were extremely helpful in documenting the existing buildings.

A special thank you to my peers who have supported me through this journey from near and far, keeping my creativity alive. I would not have made it to this point without the support and insight of my peers and the Dalhousie Architecture faculty.

Finally, I would like to thank my family. Steven, Liz, and Zoe, this wouldn’t have been possible without your unparalleled love, motivation, and support.

Chapter 1: Introduction

Industrialization

The first Industrial Revolution, which began during the mid 18th century in Britain, marked a period of new technologies and innovation. These technological advancements relied heavily on the extraction and processing of fossil fuels and simultaneously prioritized the continued development of infrastructure which could provide fuel to these industrial technologies. Infrastructure such as mines, plants, and refineries was built to extract, process, and transform fuels such as coal, oil, and natural gas. This prioritization of this infrastructure, which relies so heavily on fossil fuels, has contributed to some of society's worst losses for our natural environment and its fragile balance.

> The Industrial Revolution changed the human relationship with the earth. The legacy of the industrial revolution - its disruption of the natural systems of air, water, soil, and habitat - is being addresses in the twenty-first century. Mandated by regulations, but also reflecting a change in society's values. (Kirkwood 2001, 125)

Climate Urgency

Climate Change, also known as Global Warming, is a highly relevant issue in today's society. Industrial methods have changed significantly over the years, creating more efficient extraction and processing systems. However, these changes do not always address the environmental impacts of fossil fuel extraction and processing. Within the last decade, new policies have been introduced to limit emissions. Governments must take these policies seriously and begin investing in sustainable development strategies to decommission existing fossil fuel burning emitters and replace them with renewable energy alternatives.

> Sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations. (World Commission on Environment and Development 1987, 9)

National Strategy

In 2016 the Government of Canada published the *Pan-Canadian Framework on Clean Growth and Climate Change,* to solidify goals set in the *Paris Agreement* in 2015.

> The Pan Canadian Framework on Clean Growth and Climate Change presented here is our collective plan to grow our economy while reducing emissions and building resilience to adapt to a changing climate. (Government of Canada 2016, Foreword)

The Framework was designed to reduce emissions and grow resilience to climate change within the country. A key aspect of emission reduction is the transition from fossil fuel-powered electricity towards sustainable forms of electricity production. This has prompted many provinces and territories to begin the process of phasing out coal power facilities across the country by 2030. (Government of Canada 2016, 11). The power generation industries in Alberta, Saskatchewan, New Brunswick, and Nova Scotia create significantly more greenhouse gas (GHG) emissions than the rest of the country due to the large investments and infrastructure these provinces have in coal power generation.

Provincial Strategy

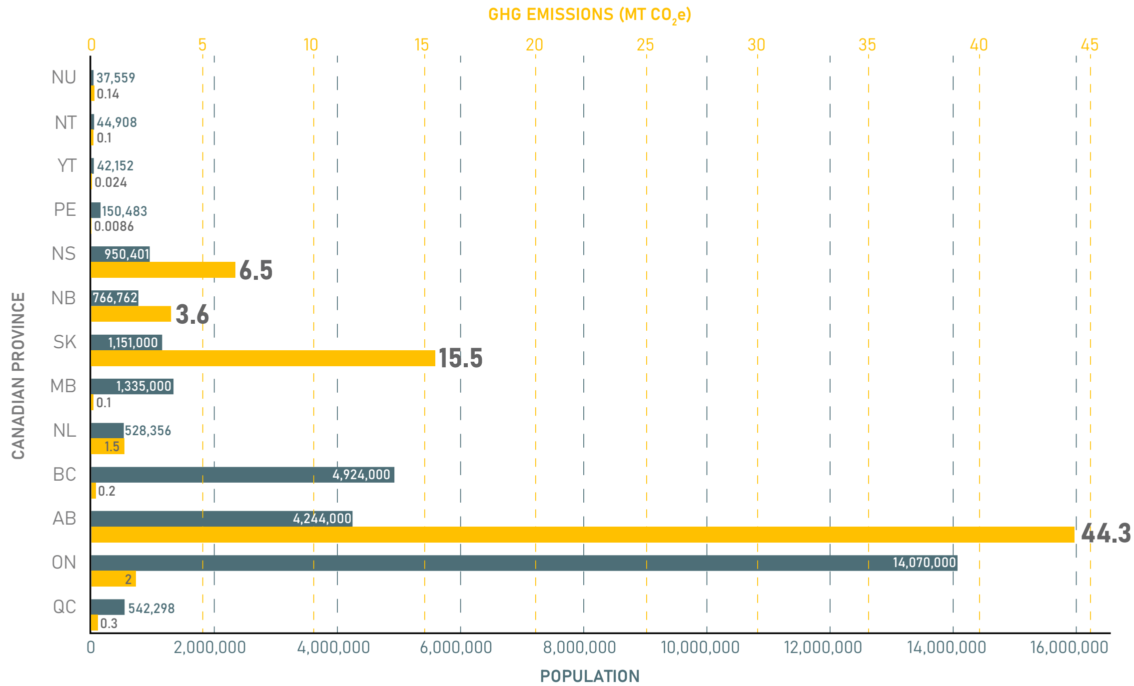
The Nova Scotian government has taken similar steps by developing programs and regulations to help reduce emissions within the Province. Clean and renewable energy is being developed to reduce the high amount of emissions produced by the electricity sector. For instance,

> Action 2 (Cleaner Energy) - Target GHG and air pollutant emissions from sources other than coal-generated electricity, by working with stakeholders to develop policies and regulations. (Nova Scotia Department of Environment. 2009a, 14)

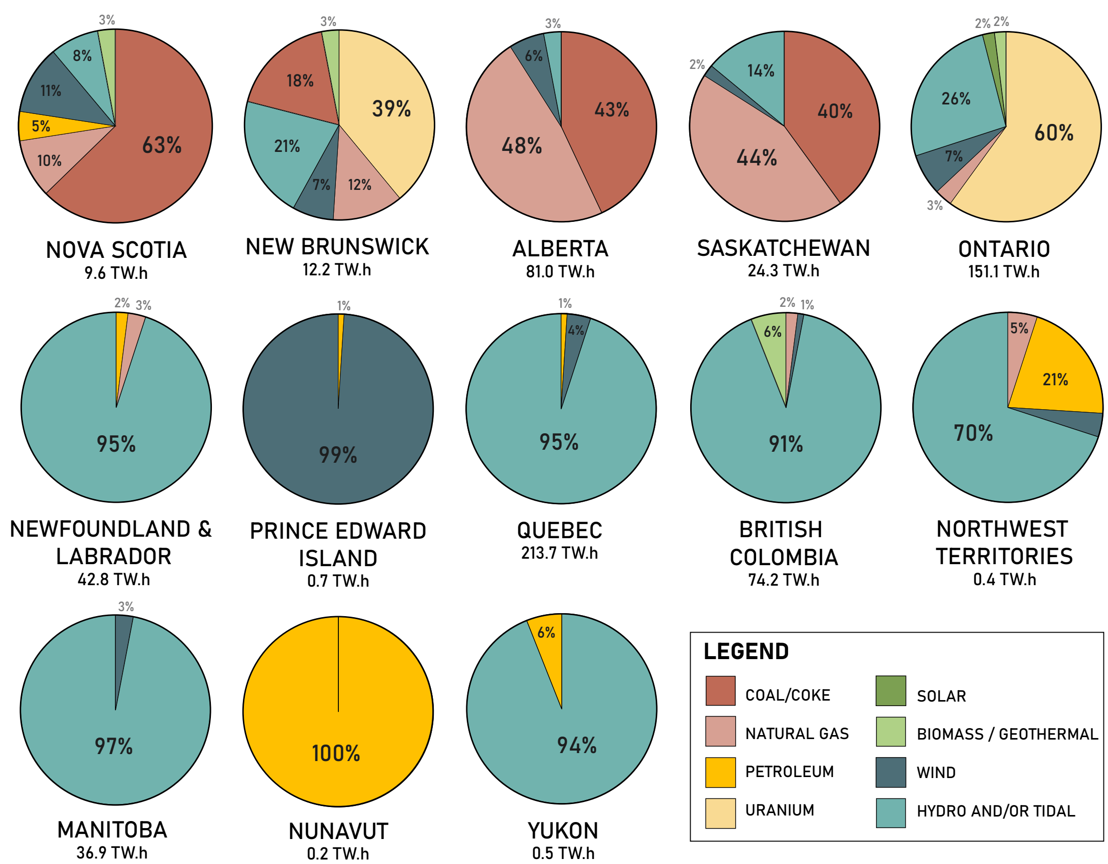
However well-intentioned, it is clear that these actions do not address the issues which exist in the coal industry and Nova Scotia remains the most coal-dependent electricity grid in Canada (Ecology Action Centre 2019). Few plans have been made by the Province for the decommissioning of existing coal-power facilities, which continue to produce the majority of the province's electricity and associated greenhouse gases. In 2018, Nova Scotia generated 63% of its energy using coal, more than any other province with coal energy in the Country,

> Nova Scotia's Liberal government has said coal will likely play a role in the province's electricity system until at least 2042, having recently won an exemption from the federal government. Nova Scotia is exempted from federal timelines to close coal-fired electricity plants, provided the province hits targets of a 25 per cent reduction in greenhouse gases by 2020 and a 55 per cent reduction by 2030. (The Canadian Press 2017)

Nova Scotia's exemption from the federally mandated phase-out demonstrates a lack of provincial commitment to making lasting changes towards sustainable development. Why should we continue to support the use of these high emitting facilities when the source of fuel is unsustainable? It is known that fossil fuels are nonrenewable resources and that new technologies and methods are required for sustainable energy production, why wait to develop these required technologies until it is too late to repair our environment?



Provincial population and GHG emissions from power generation (Canada Energy Regulator 2018).



Provincial power generation by method (Canada Energy Regulator 2018).

The End of Coal

Governments across the globe have begun the transition towards a more sustainable energy future by using renewable technologies to produce electricity. In Nova Scotia, this transition must include the decommissioning of existing fossil fuel power facilities. Nova Scotia must invest in the revitalization of such facilities to ensure the memory of past coal infrastructure while creating opportunities for new sustainable infrastructure. In the wake of the phase-out of this form of energy production, Nova Scotians could be left with landscapes and infrastructure that celebrate the memory of the place and enable a sustainable vision of the future. The redevelopment of these sites would ensure they are socially, culturally, and even economically productive well into the future. However, these industrial sites create...

> [...]opportunities for collaborative work between the scientist, engineer, planner and designer. It also provides the means to both protect and improve the natural and man made civic environment. (Kirkwood 2001, 11)

An interdisciplinary approach to reclaiming sites impacted by industrial activity, allows the existing physical site conditions and new technologies to influence the redevelopment of the site. By exploring the process of decommissioning, reprogramming, and remediation on a single industrial site, we can better understand solutions that may be used across the province on sites of fossil fuels infrastructure.

Thesis Question

How can the adaptive reuse of power plant building typologies present opportunities for diverse and vibrant public use, green energy infrastructure, and landscape remediation?

This is the Wish Image, a drawing which represents the past and the hope for the future of the coal industry and Cape Breton.

Chapter 2: Local Context

Post-Industrial Towns: Memory and Identity

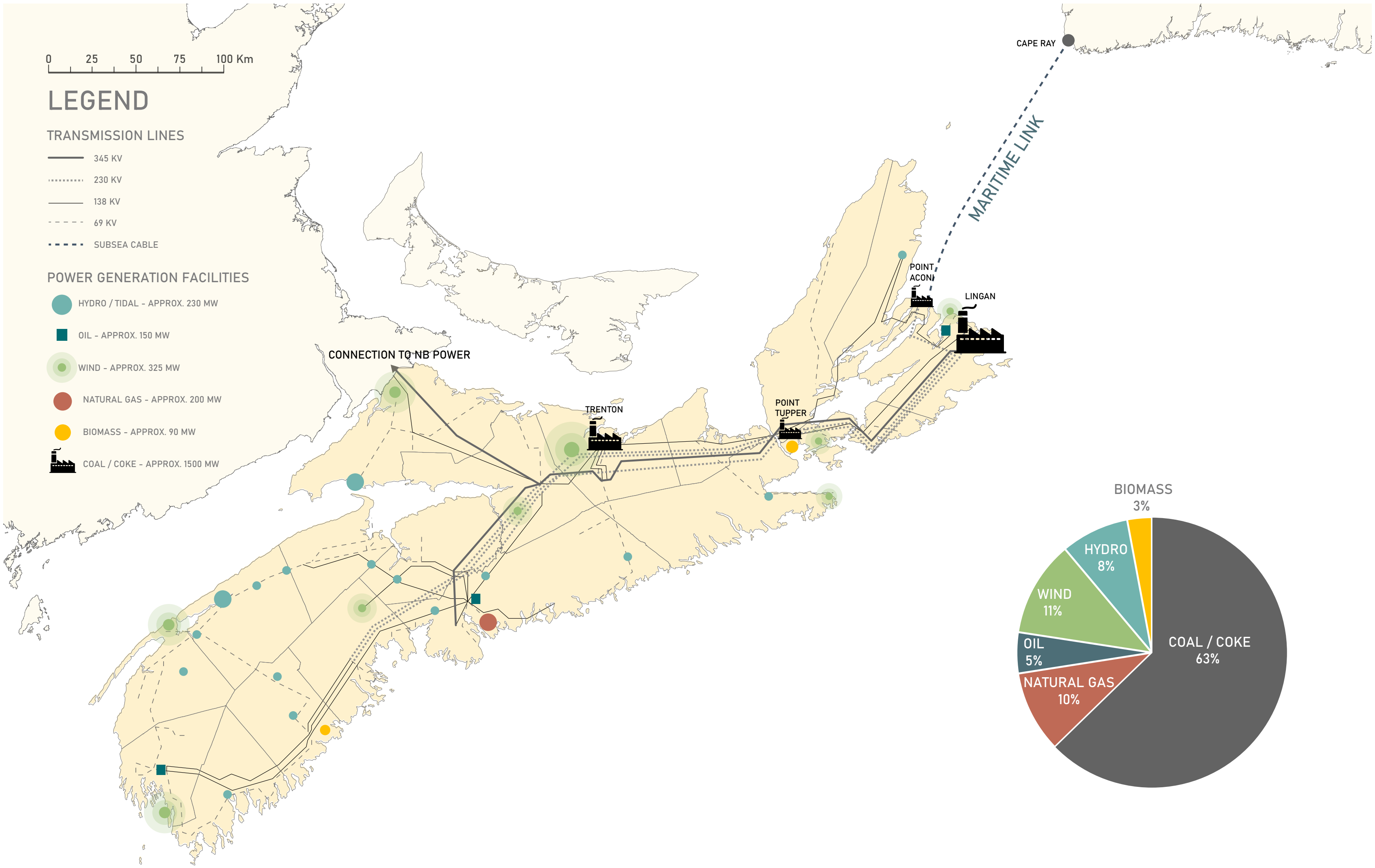
In Cape Breton coal has been mined since the early 1700th century. By 1912 the Dominion Coal Company had 16 collieries producing 3,250,000 tonnes per year, accounting for approximately 40% of Canada's total output (Miners Museum n.d.). The coal industry boomed until the mid-1960's when it began to fail due to a decreased market for coal fuel, forcing many of the mines to close. A final attempt to save the industry was made when the Prince Mine, located in the Point Aconi region, was opened in 1975 (Gregory 1978). From the early 2000s until recent years mines have sporadically opened and closed due to resource demand and environmental restrictions. With the loss of coal came a loss of identity and stability for many whose families have been employed by the industry for generations.

> It has a cultural significance that still resonates on this island — it is a key piece of our history that has an incredible lesson behind it and that story is very moving and it is timeless, It helped shape our values such as the concept of fairness in the workplace because, as we know, our culture very much reflects the struggles of the coal miners. (Jala 2019)

The memory of the coal industry is crucial to inform what comes next on these sites. This history and narrative must remain present to inform the future uses of the existing industrial sites.

Residual Coal Infrastructure

Historically coal that was mined in Cape Breton would travel by truck or train to the local power stations where energy was then distributed throughout the province. As the local mining of coal slowed due to environmental regulations, power stations began importing coal from the United States and



Map of energy production and transmission in Nova Scotia (Nova Scotia Department of Energy 2009, 15).

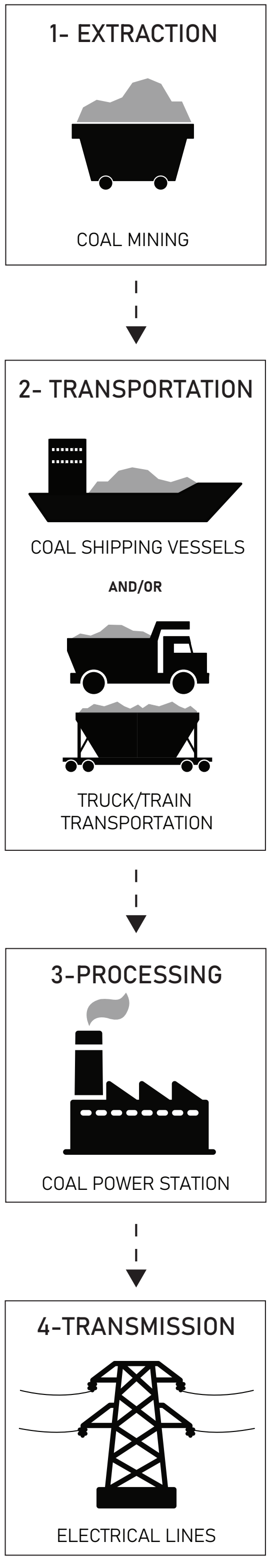


Diagram shows the flow of resources from extraction to transmission in the coal industry.

South America. Even with the environmental implications of importing, coal plants stayed open due to the province's significant investments in coal infrastructure. Many past sites of coal infrastructure in Cape Breton have only been known through stories, with little physically remaining of the immense industry. Point Tupper, Lingan, and Point Aconi Generating Stations are the three active coal power plants in Cape Breton, and Trenton Generating Station is located on the mainland in Trenton, Nova Scotia. These four power stations generate over half of the electricity of the province.

New Infrastructure

Over the last decade tidal, hydro, and wind power generation has begun to diversify the Nova Scotia energy grid. In addition, the Maritime Link is a recently completed Emera project which connects the transmission grids of the Atlantic provinces. This connection allows Nova Scotia to import hydroelectricity from Newfoundland, with the intent of reducing dependency on coal-fired power generation. Though these projects represent a significant investment in the sustainable development of power generation, they do not address the issue of continued fossil fuel consumption by power plants in Nova Scotia. New infrastructure must support the decarbonization of the province through the divestment from fossil fuel industries and re-invest resources into sustainable production methods.

Trenton Generating Station - 307MW
Opened in 1969

Point Tupper Generating Station - 154MW
Opened in 1973

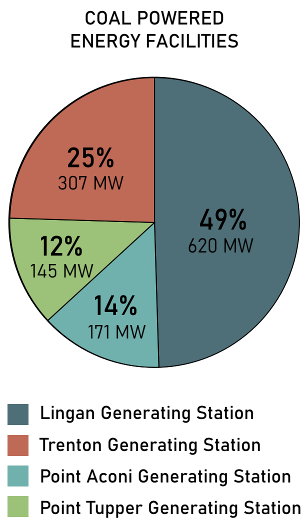
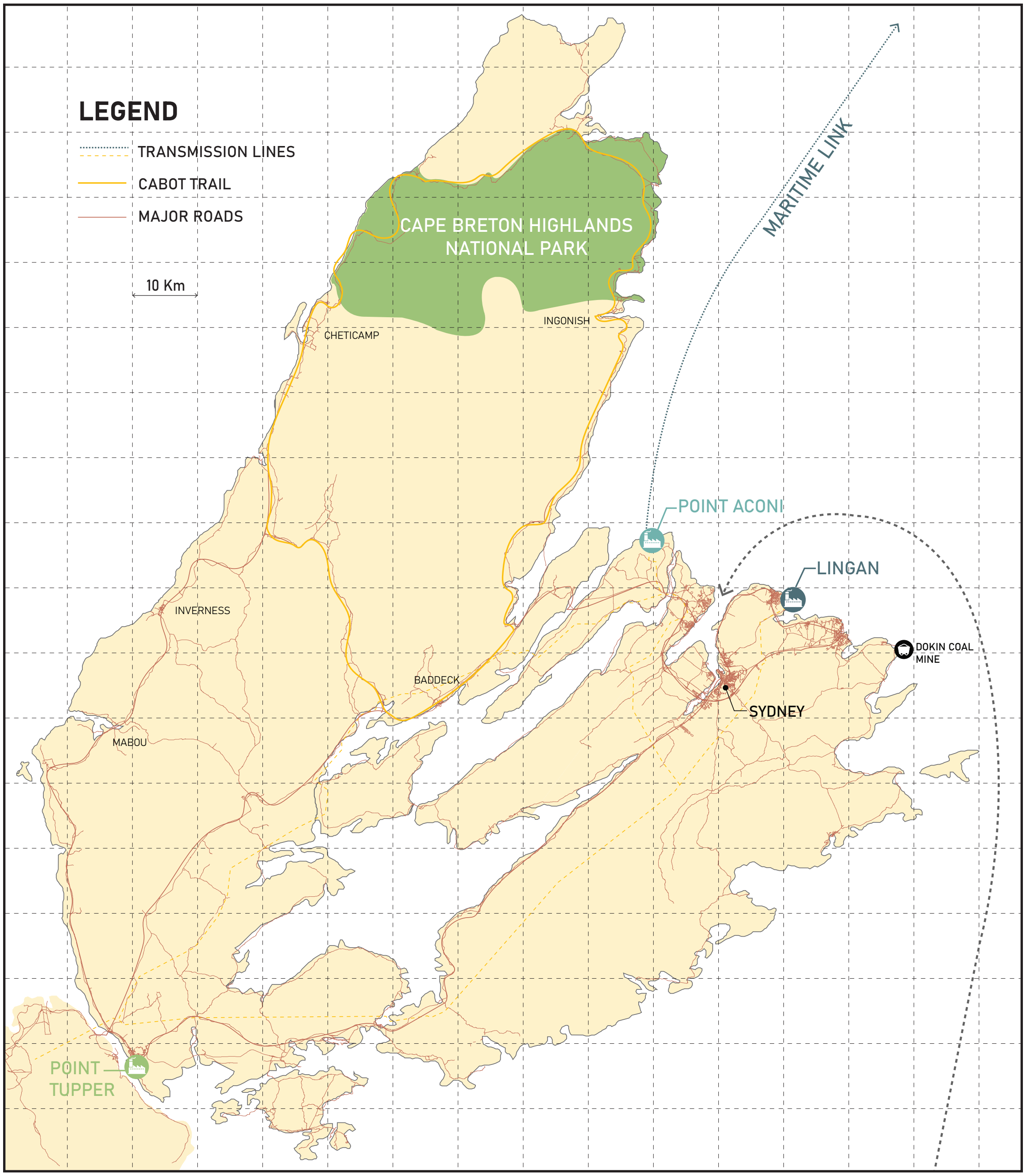


Chart shows the generation capacity of the remaining four coal power plants in Nova Scotia (Canada Energy Regulator 2018).

Lingan Generating Station - 620MW
Opened in 1979

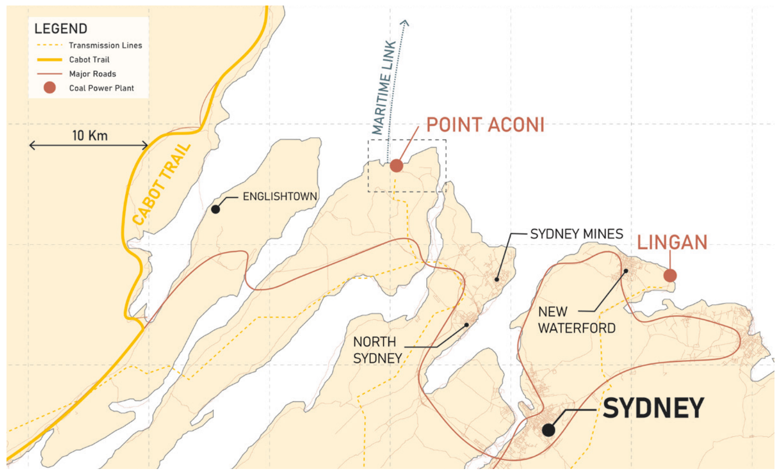
Point Aconi Generating Station - 171MW
Opened in 1994



Map shows the three existing coal power stations in Cape Breton along with the major routes. Including the site of study, Point Aconi, in light blue (roads from ESRI Canada 2019; transmission lines from Nova Scotia Department of Energy 2009, 15).

Chapter 3: Site Context

The subject of this thesis is the Point Aconi Generating Station, located approximately 40 km northwest of Sydney, the largest city on Cape Breton Island and 40 km northeast of the Cabot Trail.



Context map shows Point Aconi's relationship to Sydney and the Cabot Trail.

Historic Use

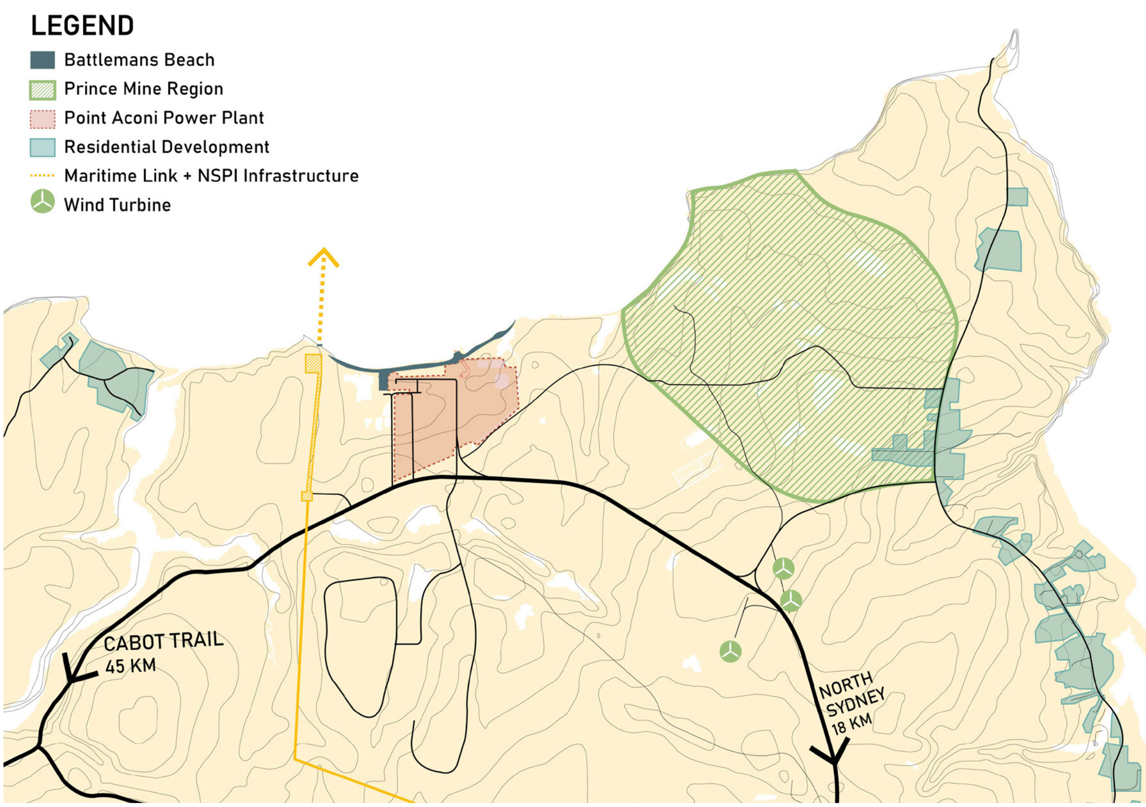
Point Aconi Generating Station opened in 1994 to take advantage of coal resources of the Prince Mine site which has been operating since 1975. In 2001, mining ceased in the Prince Mine due to increased environmental restrictions, and at this time Point Aconi began importing coal from the United States and South America (Woodbury 2016).

However, in 2006, through the manipulation of these environmental restrictions, the Prince Mine Site was redeveloped by Pioneer Coal Limited into a “Surface Coal Mine and Reclamation” project. This “reclamation” of the site came after the excessive and disruptive extraction of coal, disturbing the existing wetlands and associated ecosystems. The coal extracted was sold directly to Nova

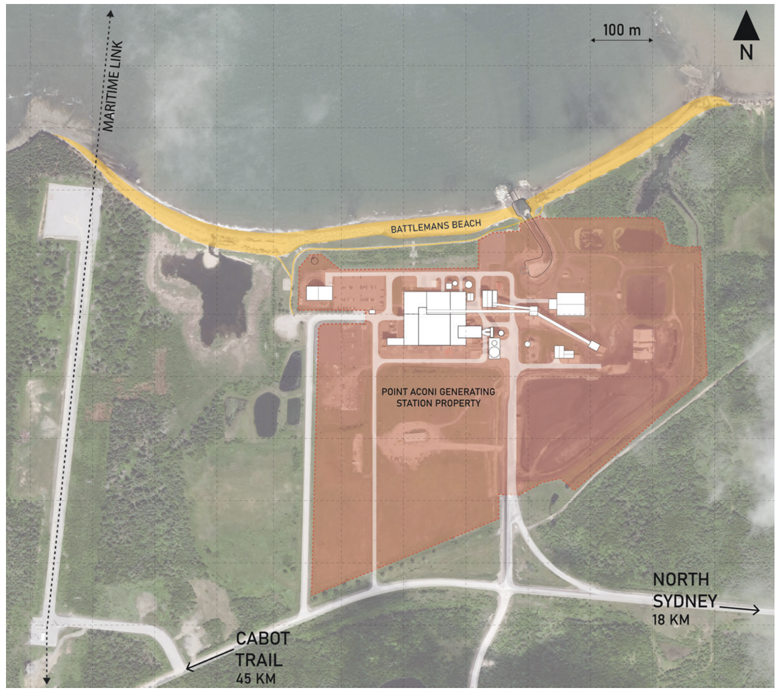
Scotia Power and sent to the Point Aconi and Trenton generating facilities. The project ended seven years later in 2013, when the extraction of approximately 1.6 million tons of coal was complete (Nova Scotia Department of Environment 2009b).

This project failed to address the known environmental issues related to coal extraction and consumption likely due to the province's reliance on fossil fuels for power generation. However, this project demonstrates partial acceptance of the fate of the industry through the reclamation of the site back to a somewhat natural state following the final extraction of resources.

Similar, but improved reclamation projects should be developed on sites of coal power generation to initiate Nova Scotia's transition towards carbon-free power generation.



Map demonstrates Point Aconi Station's proximity to past mining sites, the Maritime Link landfall site, and the few residential lots in the area.



Site plan shows the plant's relationship to the adjacent beach and Maritime Link landfall site.

Maritime Link

The Maritime Link is a recently completed Emera project which connects the transmission grids of the Atlantic provinces. It was built to transmit excess power produced by hydroelectric facilities in Newfoundland to Nova Scotia, New Brunswick, and Prince Edward Island (Maritime Link n.d.). This connection allows Nova Scotia to import hydroelectricity from Newfoundland, with the intent to reduce dependency on coal-fired power generation within the province.

Just west of Point Aconi generating station is the landfall site for the Maritime link subsea cable from Cape Ray, Newfoundland. The cable comes ashore and is transferred to above-ground transmission lines which disperse electricity into the existing Nova Scotia grid. The supporting infrastructure is made up of multiple conversion boxes where the subsea cables connect to the above-ground transmission lines. The site was likely selected due to its proximity to the existing province-wide transmission lines fed by Point Aconi and the clear connection across the Cabot Strait to Newfoundland.

Though this project represents a significant investment in the sustainable development of power generation, it does not address the issues related to continued fossil fuel consumption by power plants in Nova Scotia which continue to produce the majority of the province’s electrical power.

Battlemans Beach

Directly north of the power plant is a beautiful sandy beach called Battlemans Beach. The beach has public access from the same road that employees use to access the power plant. The beach is approximately one kilometre long and stretches past the plant to the east and west. The beach acts as a seaside connection from Point Aconi to the Maritime Link landfall site. The plant has a chain-link fence around its entire site with several access gates. Therefore, the current interaction between public and private on the site here is only through views and not physical connections. When the landfall site project was completed in 2017, the adjacent beach received some upgrades including improved beach access, picnic tables, signage, and a tower viewer looking across the Cabot Strait to Newfoundland.

Maritime Link Signage


Tower Viewer


Picnic Tables

The natural features of the beach are contrasted by the stark presence of the massive industrial activities and buildings next door. None the less the beach is still popular with locals on a hot summer day despite the unfortunate neighbour. This interaction between industry and public space represents a significant point of interest in this thesis, questioning how can we build on this existing public space?

Battlemans Beach

View of public path and beach adjacent to plant.

Enclosed public walkway allows the public to continue to the eastern part of the beach past the plant's water output into the ocean.

Image from the northeast edge of the site, looking at the plant from the public beach.

Interior view of walkway

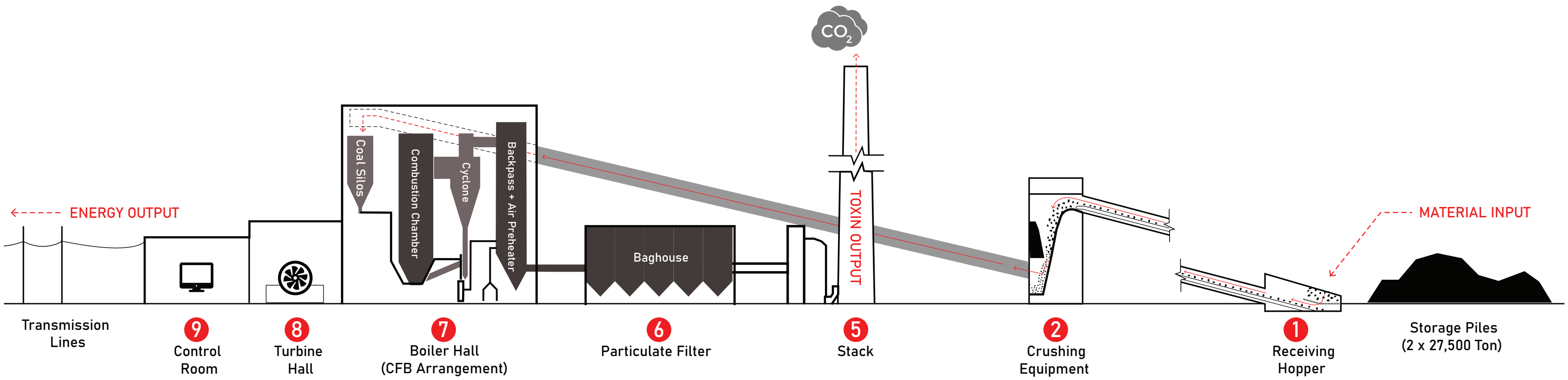
Image from the northwest edge of the site, looking at the plant and public walkway.

Power Plant

Currently, coal arrives in trucks from Sydney Coal Pier with coal that has been imported from around the world. Once the coal arrives on site it is unloaded onto storage piles, then placed in receiving hoppers, transported through crushing equipment, and up a conveyor to the boiler hall where it is heated to create steam. This steam turns a turbine generating electricity which is then transported off-site by transmission lines.

The emissions produced during the process travels through the baghouse filtration and up the stack. The plant consumes about 550,000 tons of coal annually and generates roughly 6.8% of the province's electricity ("Nova Scotia Power's Point Aconi" 2006). The consumption of coal and production of electricity at Point Aconi produces well over 1,000,000 tonnes of carbon dioxide equivalent (CO2e) annually, producing approximately 10% of the province's air pollution (Nova Scotia Department of Environment 2019).

Image showing road access to the plant.



1. Receiving Hoppper
2. Coal Pulverizer
3. Converyors
4. Limestone Pulverizer + Storage Silos
5. Stack
6. Baghouse Filtration
7. Boiler Hall
8. Turbine Hall + Seawater Condenser
9. Control Block
10. Water Treatment
11. Warehouse
12. Office Area
13. Seawater Intake Pumphouse
14. Water Filtration and Treatment
15. Equipment and Inventory Storage
16. Fly Ash Storage and Distribution

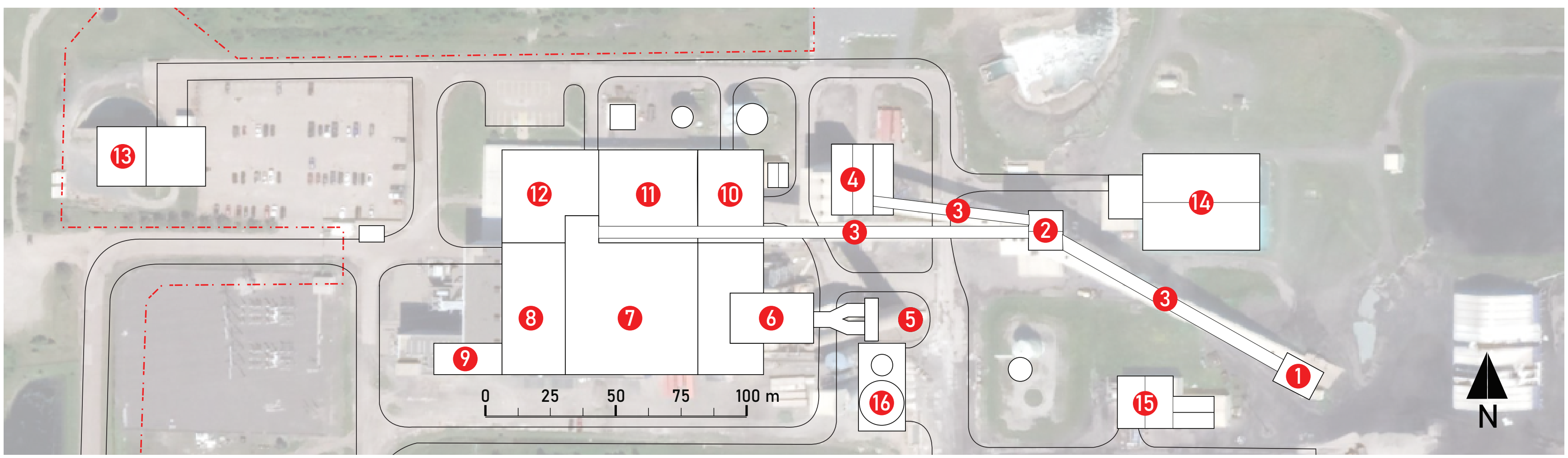


Diagram show the existing infrastructure, and the material and energy flows of the plant (Taylor 1986, 372).

Boiler Hall

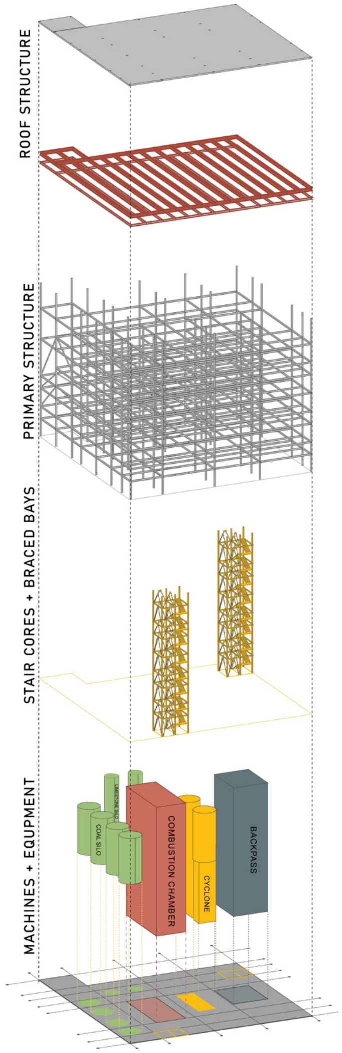
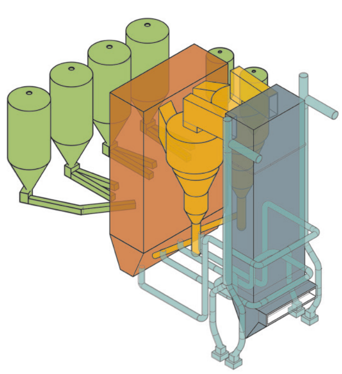


Diagram of existing (CFB) arrangement and main Boiler Hall structure.



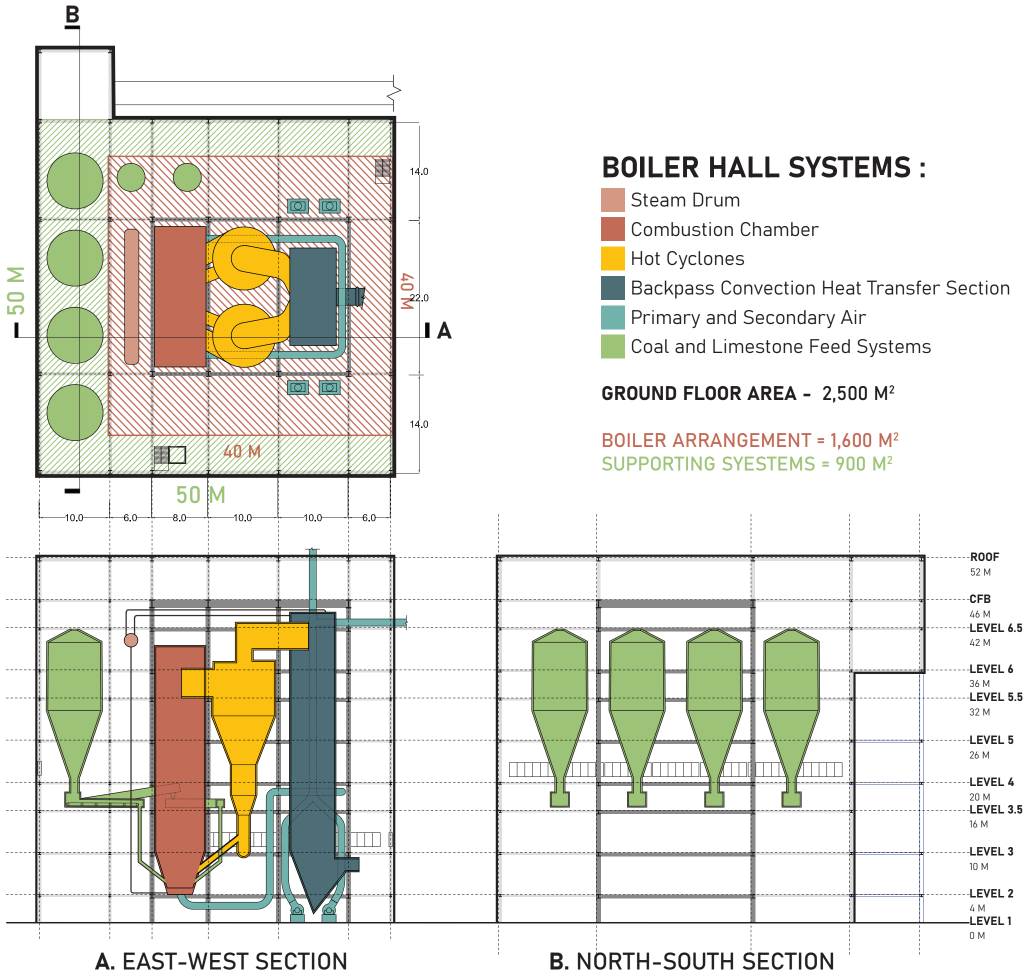
Existing CFB arrangement

As a central element of the plant, and tallest building on site, understanding the existing spatial arrangement of the boiler hall is an important step in the adaptive reuse of the plant.

The Point Aconi Generating Station uses a Circulating Fluidized Bed (CFB) Boiler to produce steam, turning the 3,600 rpm tandem-compound steam turbine and generating electricity ("Nova Scotia Power's Point Aconi" 2006).

The 150 MW CFB arrangement within the boiler hall includes a combustion chamber, a steam drum, primary and secondary air systems, coal and limestone silos, two cyclone collectors, and a back pass. The different machines within the CFB system collect and distribute water, steam, air, limestone, and coal. The machines themselves are hollow objects made from steel. The combustion chamber and backpass heat transfer sections are made of steel membrane tube walls to create air-tight enclosures. The two cyclones collectors are formed from plate steel with an internal refractory lining. Additional machinery is also made of plate steel with varying thicknesses and levels of perforation (Taylor 1986, 370). The existing steel structure surrounds the machines which are hung from the large roof structure. Metal grate catwalks sit within the primary structure, placed surrounding the perimeter of machines to provide access for monitoring and maintenance.

Collecting and interpreting this information about the existing building and mechanical elements is highly important to imagine the opportunities of the adaptive reuse of these industrial sites. These mechanical elements make unique spaces for new programs to take place.



Drawings show the existing Boiler Hall in plan and sections, demonstrating the spacing of the machines and equipment (Taylor 1986, 372; “Commissioning and Early Operating Experience Point Aconi Circulating Fluidized Bed, Cape Breton, Nova Scotia” 2015, 395).

Image from the northwest edge of the site, looking at the plant from the public beach.

Chapter 4: Program Development

A public recreation facility with multiple indoor and outdoor programs provides locals with an escape from the island's harsh weather while giving tourists a unique recreation experience along their journey.

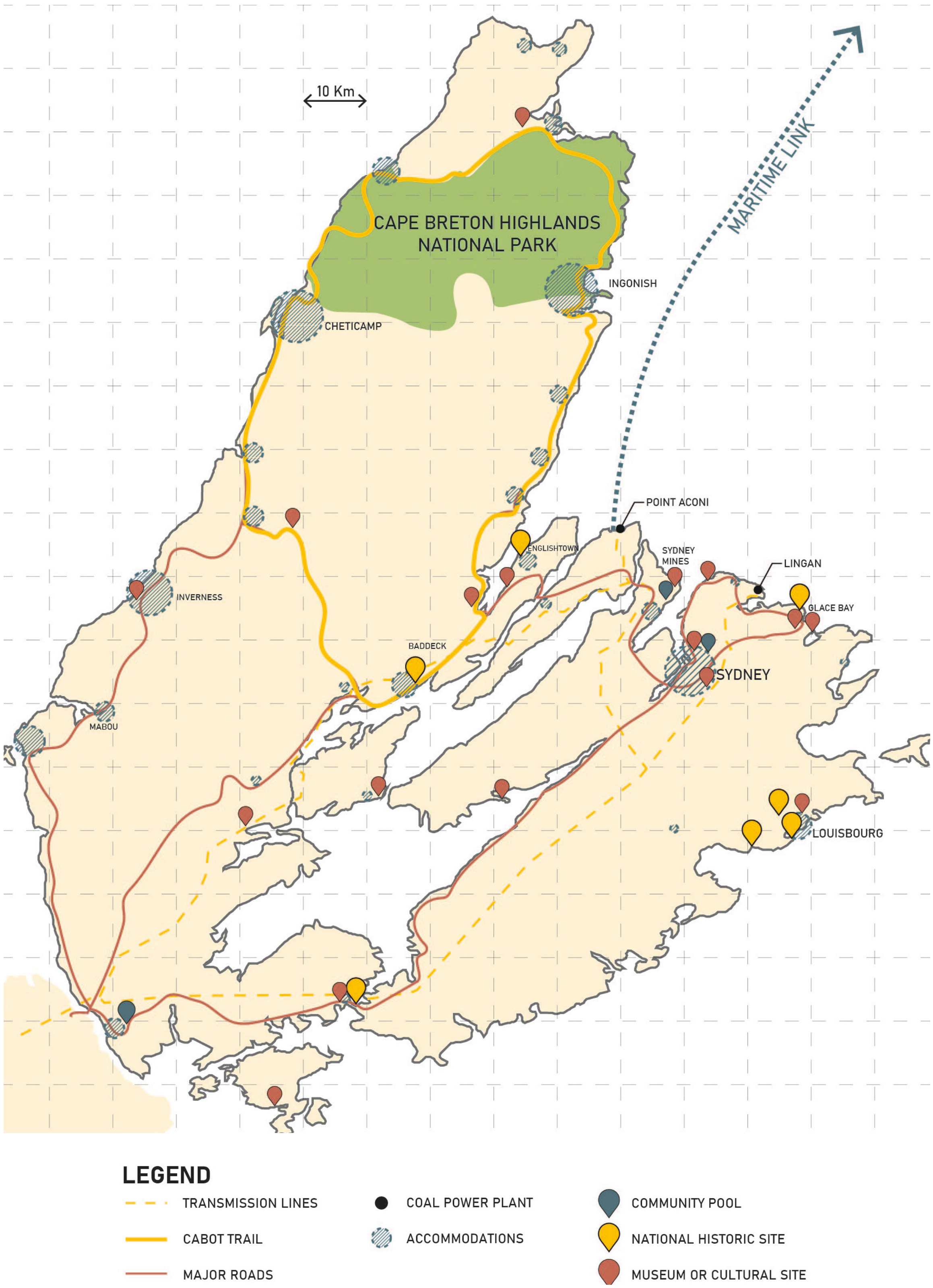
Identifying Needs

Cape Breton has a total population of approximately 134,000 (Ayers 2020). This number is drastically dwarfed by the approximately 300,000 individuals who visit Cape Breton Highlands National Park annually ("Destination Cape Breton Strategy" n.d., 7).

Many of these visitors come to enjoy the natural beauty the Cabot Trail has to offer and do not often venture beyond. Though the island claims world class camping and hiking, the residents face the stark contrast of rain and snow for many months of the year. There is little indoor or physical recreation programing present on the island for these times of inclement weather, with only a few small community pools and hockey arenas, including a YMCA in Sydney. This presents the opportunity to service locals and tourists alike with a much needed indoor public amenity.

A public indoor swimming pool with additional recreation provides an accessible amenity for residents and tourists of all ages and backgrounds. New public infrastructure, such as a pool, interacts with the current and past industrial systems on the site, and the environmental systems around it, creating a balanced system.

By comparing the height requirements of potential public recreation programs to the height of the existing machines,



Map showing existing tourist destinations, major roads, and existing community pools (roads from ESRI Canada 2019; transmission lines from Nova Scotia Department of Energy 2009, 15; destinations from Google 2021).

the scale of the space can be better understood. Challenges are present in the industrial scale of the building and the existing structure but these challenges also provide opportunities for the diversity of program through cross-programming.

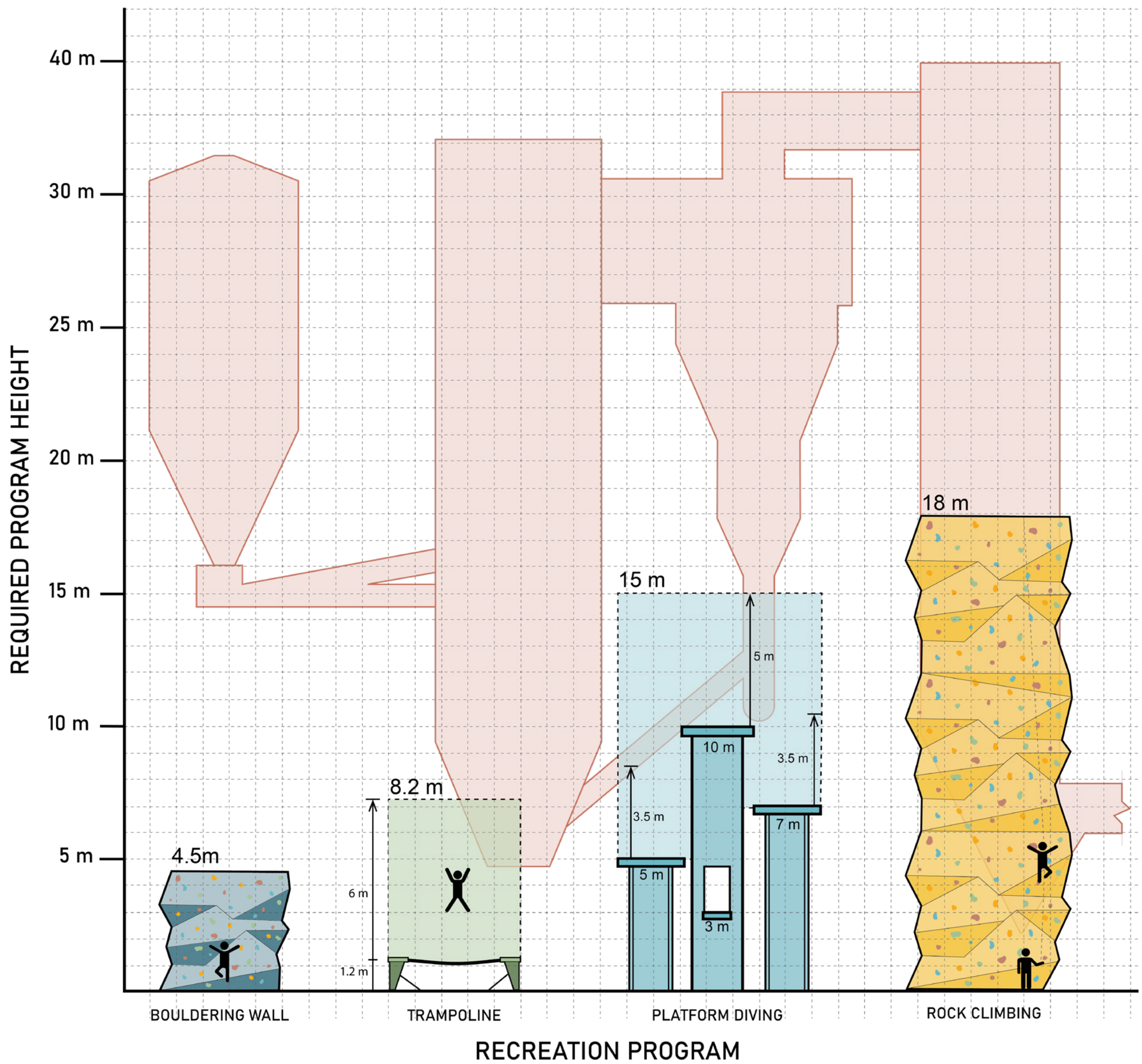


Chart demonstrates the size of the machines within the existing Boiler Hall in comparison to various recreation programs to be introduced.

Public Programming

Traditionally the public is kept away from industrial plants, mostly for security reasons. Toxic emissions, noise disturbances, and other impacts on the surroundings mean that zoning laws have kept people away from the industry. However, along with the transition towards renewable energy comes decreased toxins and hazards in the industrial processes. This provides opportunity to overlap appropriate public programs and renewable infrastructure on a single site.

The public programs chosen for this site need to work well with the existing structure and new building systems. Industrial buildings like the Point Aconi Generating Station present unique opportunities due to their large structural capabilities and immense vertical spaces. For instance, many types of indoor recreation require long-spanning spaces (as is present in the existing structure). Such recreation may include pools, sports fields/courts, large event/gathering spaces, etc. The potential public programs can be divided into four categories, Aquatics, Active Recreation, Leisure Recreation, and Community. The large scale of the existing buildings provides an ideal setting for these four categories to overlap on a single site.

Diagrams display the potential programs to be introduced on the site.

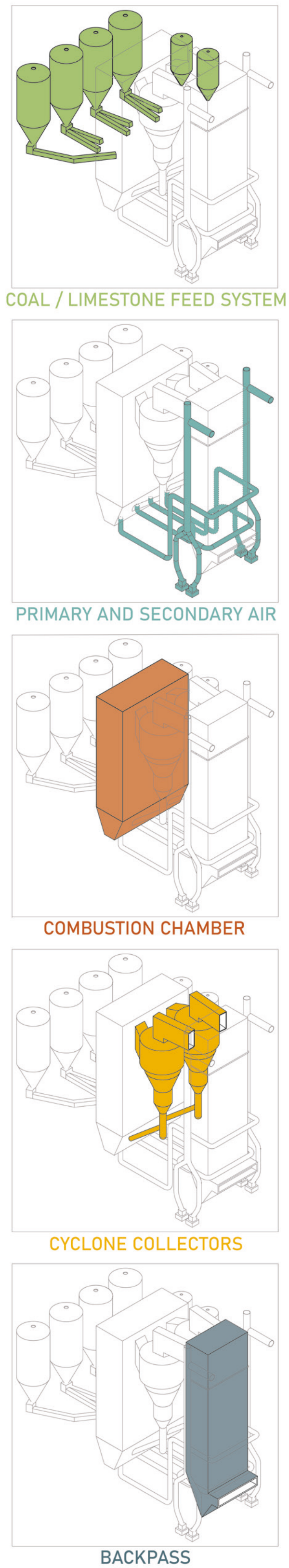


Diagram of CFB Boiler arrangement main elements

Adaptive Reuse

This project focuses on the adaptive reuse of the Point Aconi Generating Station, an industrial and cultural monument. Programmatic choices are influenced by the opportunities and restrictions presented by the existing structure and elements. These buildings are unique and lend themselves well to redevelopment for new uses (Tam & Hao 2019, 509).

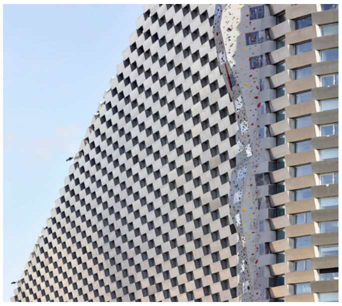
> Adaptive reuse is the process of adapting old structures, renovation of a building or site for including elements that allow particular uses to occupy a space that originally was intended for a different purpose. It is the act or process of making possible a compatible use for a property through repair, alterations and additions while preserving those portions or features which convey its historical, cultural, or architectural values. (Tam and Hao 2019, 510)

Adaptive reuse projects often consist of two main strategies, addition and subtraction, which seek to support the renewal of existing parts while creating opportunity for new programs. The existing structure and envelope can be modified to suit new programs, and elements of the boiler arrangement can be renewed and cleaned of toxins. These hollow steel elements can be cut into pieces, taken apart and re-purposed, or punched to allow for circulation and light penetration into the new space. Larger machines such as the combustion chamber or smoke stack can support programs with significant height requirements such as a rock-climbing wall. These are just a few examples of how new programs can be introduced while retaining and emphasizing the existing site and building elements.

The subtraction of structural and mechanical elements and the addition of new programmatic elements is key to the successful adaptive reuse of industrial sites while retaining the cultural significance of the site.

Chapter 5: References

CopenHill



Outdoor Climbing Wall (Hufton + Crow 2020)

Rooftop Ski Trail (Hjortshoj 2019)

CopenHill, also known as Amager Bakke is a waste-to-energy plant in Copenhagen by the Bjarke Ingels Group. CopenHill demonstrates a new approach to industry and infrastructure by incorporating urban recreation and environmental education with energy infrastructure. The urban recreation is made up of public programming including a ski slope, hiking trail, and climbing wall.

> [...]rather than an isolated architectural object, the building envelop is conceived as an opportunity for the local context while forming a destination and a reflection in the progressive vision [...]. (BIG n.d.)

This project is significant because it demonstrates how urban recreation and the energy industry can intersect to create a new form of public/social infrastructure.

Key Terms: Recreation, Public Infrastructure

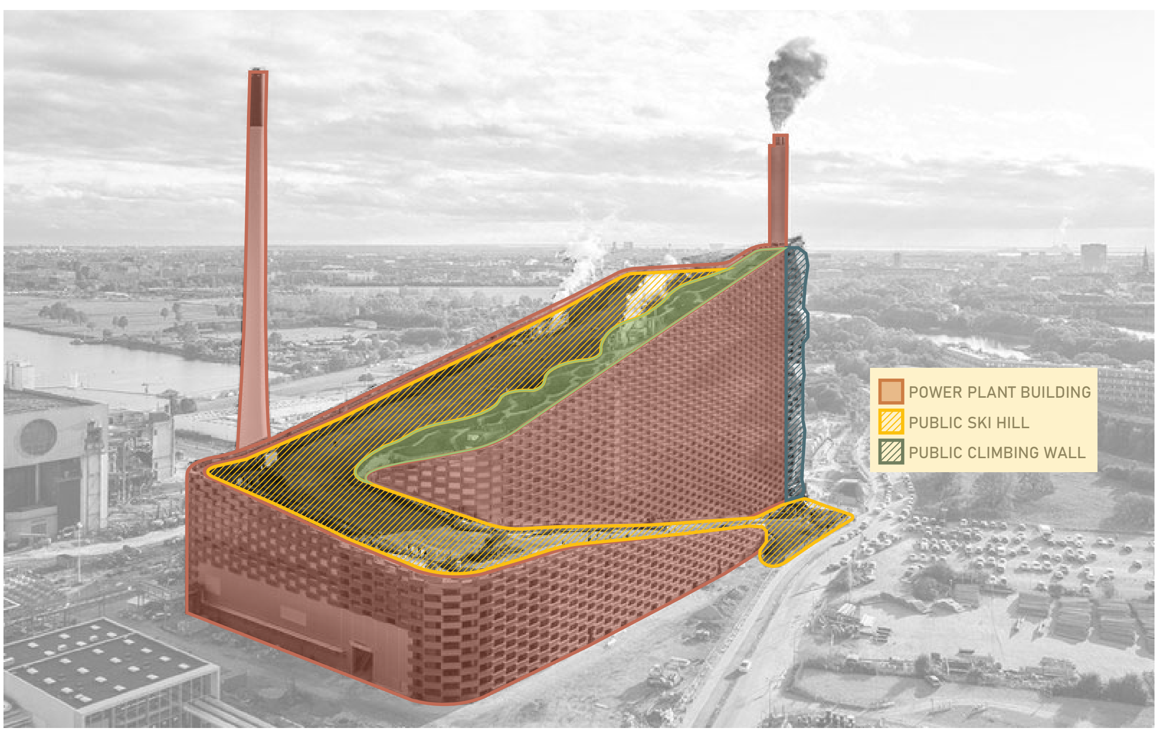
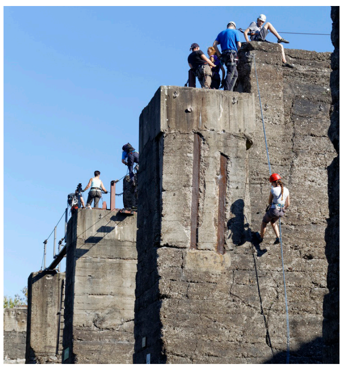


Diagram of Plant highlighting the industrial space and the public space. (BIG n.d.)

Landschaftspark

View of Blast Furnace Park during community event. (Latz 2002)

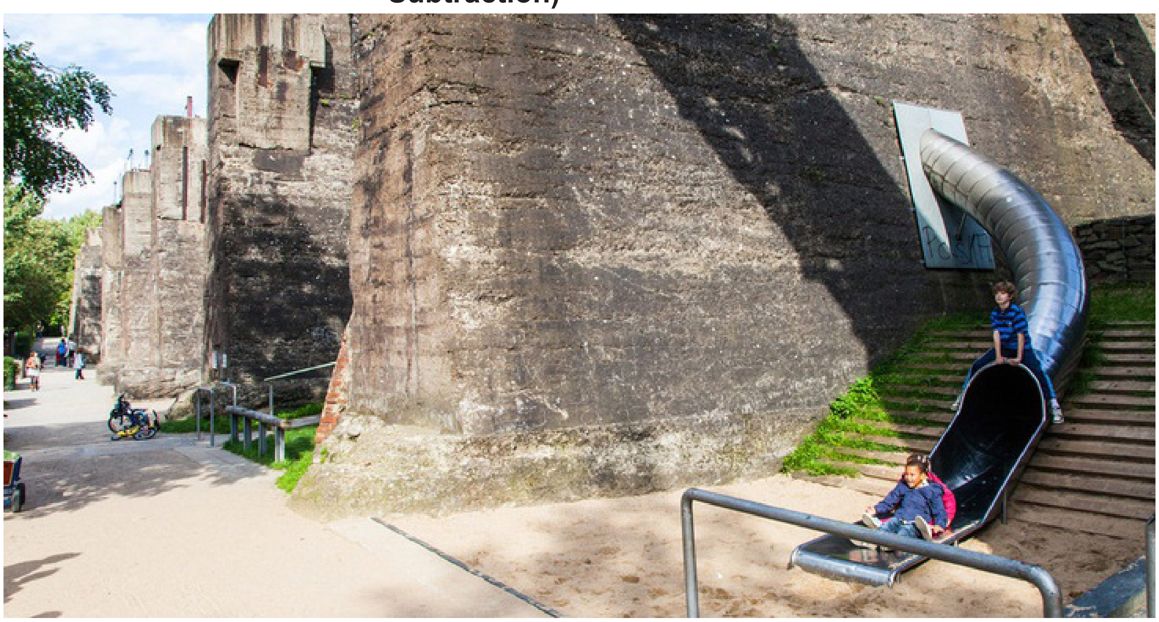


View of Play Point where structures are reused for rock climbing. (Latz 2002)

In 1990, Latz + Partner won a competition to design the future Landschaftspark in Duisburg-Nord, Germany. Landschaftspark is a project which redeveloped and re-established an abandoned coal and steel plant through remediation and new programming. The individual systems within the park operate independently and connect (visually or physically) at specific points through linking elements. These independent points include the blast furnace park, water park, sinter park, railway park, play points, and the ore bunker. The interventions at these points represent a "metamorphosis of the hard industrial structure into a public park" (Kirkwood 2001, 150). The metamorphosis or manipulation of the original industrial forms and programs creates layers on the site.

> This site is a complex matrix of buildings and landscapes, and the designers' goal was to utilize the existing fragmentate of industry as layers that are recombined through the lens of park design. (Kirkwood 2001, 136)

Methods: Remediation, Cross-Programming (Addition/ Subtraction)



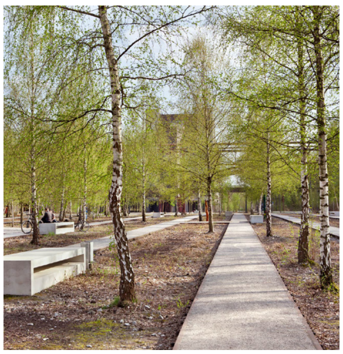
View of Play Point where existing structure has been modified into a slide. (Latz 2002)

View of the Landschaftspark demonstrates how sites which once destroyed the environment can become a part of it. (Latz 2002)

View of the Landschaftspark Ore Bunkers which was a highly toxic region of the site where soil and planting was introduced to begin remediation. (Latz 2002)

Zollverein

View of repurposed railways into public bike and walking paths. (Tack n.d.)



View of new planted pathways (Dreysse 2017)

In 2010 OMA's master plan for the redevelopment of the Zollverein coal complex in Essen, German was completed. The industrial site was re-established with public spaces through the addition of new programs and reprogramming of existing buildings.

> The allocation of new programs on the periphery allows the old buildings to maintain their grandeur and impact on the visitor. Inside the band of new program surrounding the Zeche Zollverein, new functions are placed to guide, inform and attract visitors. The programming of the new buildings and re-programming of the existing buildings contain many functions, most of which are related to art and culture. (OMA n.d.)

The Zollverein master plan incorporates layers of form and program, present and historical. New public programs on the site include the Ruhr museum, art/event centers, education spaces, and landscaped promenades and bike paths. These interventions allow new interaction with the site.

Key Terms: *Re-Programming*

Image demonstrates the beauty of remediation, as the newly planted trees take over the once barren site. (Dreysse 2017)

View of new public pool program introduced within the decommissioned machinery. (Tack n.d.)

View of the public ice rink among the decommissioned machines.(Tack n.d.)

Methods

The above analysis shows the successful implementation of methods including cross programing and transprograming, remediation, and the manipulation of form through addition and subtraction. These strategies are used to support a new form of social/public infrastructure amongst past or existing industrial infrastructure. This approach allows individuals to get closer to the machines, creating a new interaction between the users and the producers of electricity. Throughout this thesis, this new type of infrastructure is referred to as productive industrial landscapes. These productive industrial landscapes are made up of layers of the past, present, and future, as well as layers of new/old programs and forms.

Remediation

Sites of past industrial uses are often associated with soil and subsoil contamination. At Point Aconi such contamination has likely occurred in the areas of the site where coal has been stored directly on the ground, allowing chemicals and toxins to seep into the soil. Remediation is the act of correcting or recovering. In the context of industrial sites, this means correcting the damage done by industry such as soil contamination.

Remediation through planting or phytoremediation is occurring at both Landschaftspark and Zollverein. “Phytoremediation is the use of living planted material to clean environmental hazards” (Kirkwood 2001, 52). Both sites used planting to support the remediation of toxic soil, contaminated by past industry. The introduction of remediation allows portions of the site which contain toxic soil to become productive landscapes, reversing the industrial impacts on the site.

> Here phytoremediation and creative site design are united by the used of planted systems that both remediate and at the same time establish spatial and functional patterns of use. (Kirkwood 2001, 52)

Remediation strategies will be explored on the Point Aconi site in attempt to repair soil and filter stormwater.

> In addition to environmental restoration and human health protection, recovering contaminated urban brownfields can offer relevant advantages, including exploiting the existing infrastructures, preserving greenfields, producing positive social and economic effects for nearby communities—such as higher property values and reduced crime rate— and contributing to environmental, economic, and societal sustainability. (Palma et al. 2021, 1)

Remediation is a necessary step in the redevelopment of the Point Aconi site to ensure the future health of the surrounding ecosystems and communities. Remediation will be delivered through the restoration and planting up of the existing wetlands and coal storage areas with appropriate native plants.

View of diverse planting contributing to remediation of the site at Landschaftspark. (Tourism n.d.)

Crossprogramming and Transprogramming

Crossprogramming and Transprogramming are programmatic methods explored by Bernard Tschumi in his book, *Architecture and Disjunction*. Crossprogramming occurs at Landschaftspark and Zollverein through the adaptive reuse of past industrial buildings into public programs such as galleries, theatres, and recreation spaces. A new program is introduced to structure remaining from past industrial processes, giving new use to decommissioned elements.

> Crossprogramming: using a given spatial configuration for a program not intended for it, that is, using a church building for bowling. Similar to typological displacement: a town hall inside the spatial configuration of a prison or a museum inside a car park structure. (Tschumi 1996, 205)

Transprogramming occurs at CopenHill through the introduction of a public program, specifically urban recreation, with the industrial activity of a waste-to-energy plant. The programs on the site act as separate systems with little public interaction woven into industrial activity, instead the public program is simply placed above the industry.

> Transprograming: combining two programs, regardless of their incompatibilities, together with their respective spatial configurations. (Tschumi 1996, 205)

Image of Zollverein demonstrates cross-programing, the introduction of a new program on a site with a different original use. (Dreysse 2017)

Both of these methods of program are relevant for examining sites of past industry and future development to understand the opportunities and losses of weaving public and private(industrial) programs.

Addition + Subtraction

At Landschafts Park and Zollverein, sites of industrial remediation and redevelopment, the adaptive reuse strategy consists of the addition and subtraction of program and form. By manipulating existing structures and program spaces, new programs can be introduced which offer new opportunities for the site that are different from those originally intended. Subtraction occurs when elements of structure/form are removed and/or when past programmatic uses are ceased. Addition occurs where a new structure/form is introduced and/or when new programs are introduced to the site. The addition and subtraction of form and program on a site of adaptive reuse reflect a reinterpretation of existing structures and space for new uses.

Diagram shows where existing structure has been modified to create new program at Landschaftspark. (Latz 2011)

Addition

In this thesis, addition is explored as a method for programs and structural interventions. The collection of additional forms and programs supports the building's transition from private to public by creatively introducing forms and objects to reinforce the new programs.

> Applied to architectural addition, it (addition) pertains to series of related elements—stairs, walkways, ramps, corridors, steps, balconies—that are not discrete volumes in and of themselves, but added together form a unified intervention to a host structure. These series of interventions occur both on the exterior and the interior, and at different scales. (Wong 2017, 206)

Addition at multiple scales has the potential to create new relationships and renew connections that have been shifted or destroyed over time (Wong 2017, 195). This includes the site's connection with the surrounding community and environment.

> [...]addition results in more than an increase of space. An increase in size or scope equates to changes in many other aspects of the host structure; the worth of the building, its property value, its relationships within the context and its place in the continuum of time. Its revised worth is a product of the old, the new and the many implications of its adjusted identity. (Wong 2017, 190)

Therefore, addition as a method can change or add to the character of the building. By creating new forms, addition can facilitate the introduction of new programs on a site with a different purpose than originally intended.

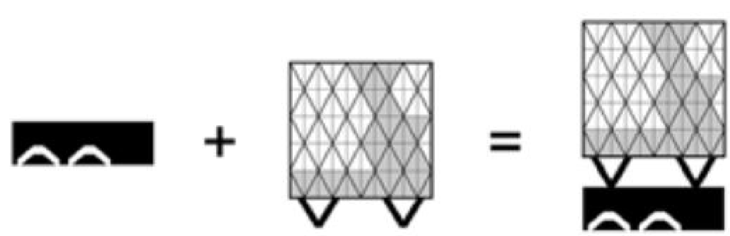


Diagram demonstrates the process of addition of new form onto old/existing form. (Wong 2017, 200)

Subtraction

In this thesis, subtraction is a significant strategy for the transformation of Point Aconi. Subtraction is an important aspect in the adaptive reuse of industrial sites as the removal of toxic or unnecessary parts is fundamental to the success of the building's new uses.

> Intentional subtraction takes place for various reasons: to make room for the new through demolition, to return a host to an original form, to appropriate the host structure for various intents, to bring an out-of-date host structure to current standards, to create double or multiple height spaces within the host. (Wong 2017, 210)

The process of subtraction removes form and program to make room for new programs and forms while changing the atmosphere of the spaces to reflect these changes. Subtractions should be thoughtful and deliberate by ensuring significant parts of the original structure still demonstrates some of the original identity of the space while creating a new identity for the future.

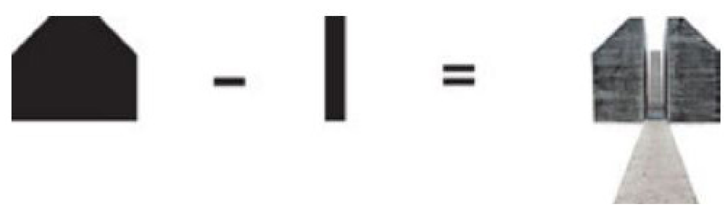


Diagram demonstrates the process of subtraction of form from old/existing form. (Wong 2017, 211)

In 1975 Gordon Matta-Clark presented a 23-minute film titled *Day's End* which explores an abandoned pier that he worked on in New York. In this film, you see an abandoned industrial space with what looks like large holes cut into the walls. These holes are subtractions made by Matta-Clark which demonstrate the significance of removing parts of old buildings, creating a new identity for the space. The modifications made in the form of subtraction by Matta-Clark challenge the use and feel of this old industrial space. Similar to the Point Aconi building, this industrial building originally had few openings and therefore lack of natural light within the building. This project demonstrates how subtraction as a method can significantly change the atmosphere of the space by allowing more light and air to penetrate the building, and by creating space for new programs to be introduced.

This technique of subtraction is applied on the site at multiple scales. Parts of buildings or entire structures are removed to reduce the footprint and allow light to enter the building. Machinery is removed or reconfigured to allow for new programs and to maximize light penetration deep into the building and program-filled spaces.

Therefore, the method of subtraction can modify the character of the space without losing the existing identity of the site. In the case of Point Aconi, it is important to make subtractions to create space for new programs, however, such subtractions must be thoughtful and ensure the identity of the site and its past is not lost.

Images of the industrial space modified by Gordon Matta-Clark for the *Day's End* project. These images demonstrate the significance of physical modifications to existing structures using subtraction. (Matta-Clark 1975)

Chapter 6: Project

Design Framework

This thesis proclaims that as infrastructure associated with the fossil fuel industry becomes obsolete and abandoned, the best course of action is for these large industrial sites to introduce public recreation programs that contrasts the original private industrial intent of the sites. By introducing public programs onto these typically private sites, the public can become aware of the intense infrastructure associated with fossil fuel consumption, and gain a better understanding of the impact non-renewable energy production has on surrounding communities and the environment.

In exploring this new relationship between public recreation and energy infrastructure, a few strategies are required to ensure the successful redevelopment of Point Aconi Generating Station. These strategies together form the framework for the exploration and modification of industrial buildings. This framework aims to begin the conversation around energy production as a safe and participatory activity in which communities can and should directly and indirectly engage. These strategies work toward the ultimate goal of sustainable adaptive reuse and include landscape remediation, sustainable energy systems, and cross-programming (addition/subtraction).

Architecture is explored as a means of reclaiming these industrial sites, often located on coastal waterfronts, for public use and enjoyment. The connective elements of the design aim to generate a link between infrastructure, nature, and public programs as a way to approach the future of infrastructure.

Site Strategy

The site strategy consists of providing active programming such as a swimming pool, spa, rock climbing/bouldering walls, trampolining area, and more that can be utilized by both locals and tourists all months of the year. At the site-wide scale, the project focuses on environmental remediation and reprogramming of green spaces and wetlands through restorative planting and water management. A raised boardwalk circulates between the two main buildings and connects the buildings to the water and allows for an accessible nature experience. Such site features are multi-seasonal, but have different uses depending on the season. For instance, in the winter months, the wetland ponds will freeze over and become outdoor hockey and skating ponds. Additionally, a landscape mound which forms a mountain bike trail and picnic area transforms into a small sled and ski hill in the winter months. The site needs to have winter and summer uses to be a destination all year round. Renewable energy production methods are introduced on the site to explore the production potential compared to the existing coal production methods.

Remediation

On the master plan, remediation planting can be seen in the southeast corner of the site where two large coal storage piles used to be. Over the years of use, chemicals and toxins from the coal have leached into the ground below these piles. Therefore this area will not contain any significant program but rather become a testing site for the remediation of the soil by re-introducing native species. The characteristic Acadian forest tree species in the area include sugar maple, yellow birch, American beech, balsam fir, and

SITE FEATURES
- Beach
- Energy Production
- Circulation
- Remediation Planting
- Natural Water Feature
- Man-Made Water Feature
- Man-Made Landscape Mound

ALL-SEASON
1. Pool Building
2. Social Building
3. Service Building
4. Boardwalk
5. Observation Tower at Maritime Link Landfall

SUMMER PROGRAMS

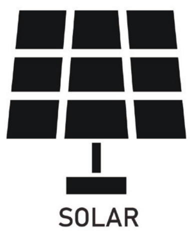
6. Kayak/SUP Rental + Launch
7. Hiking Trial
8. Wetland Paths
9. Short Mountain Bike Track
10. Outdoor Ampitheatre/Gathering

Summer master plan shows the new programs and circulation introduced on the site and their summer uses.

Winter master plan shows the new programs and circulation introduced on the site and their winter uses.

eastern hemlock, which will be planted with understory companion plants. (Parks Canada 2018)

Existing ponds are converted into constructed wetlands which act as a catchment for stormwater runoff from the site. These constructed wetlands ensure any toxins which remained on the site and have been picked up by the stormwater are filtered out before the water flows into the ocean. Bioremediation occurs in the wetlands through the use of macroalgae to filter or sequester contaminants from water that may have come in contact with contaminated soil. (Roberts et al. 2015, 26)



Energy Production

Renewable energy production is introduced on the site in the form of solar photovoltaics, and wind turbines. A ground-mounted solar array and wind turbines are located on the southern border of the site, exploring the production opportunities and restrictions of the site and providing

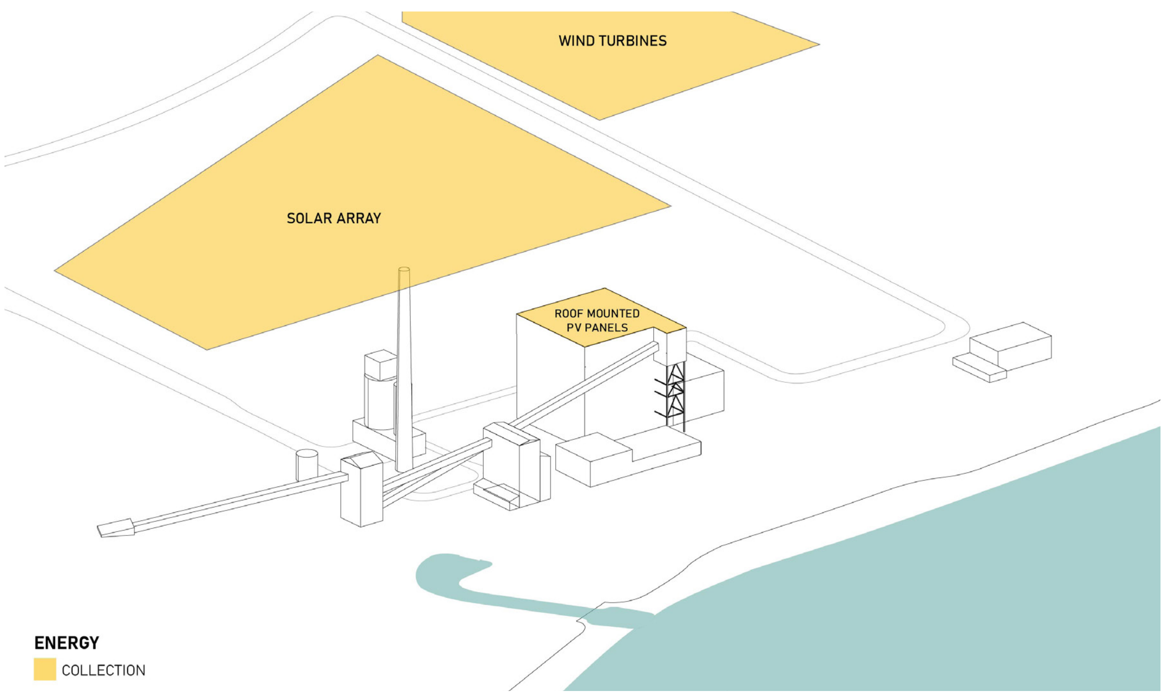
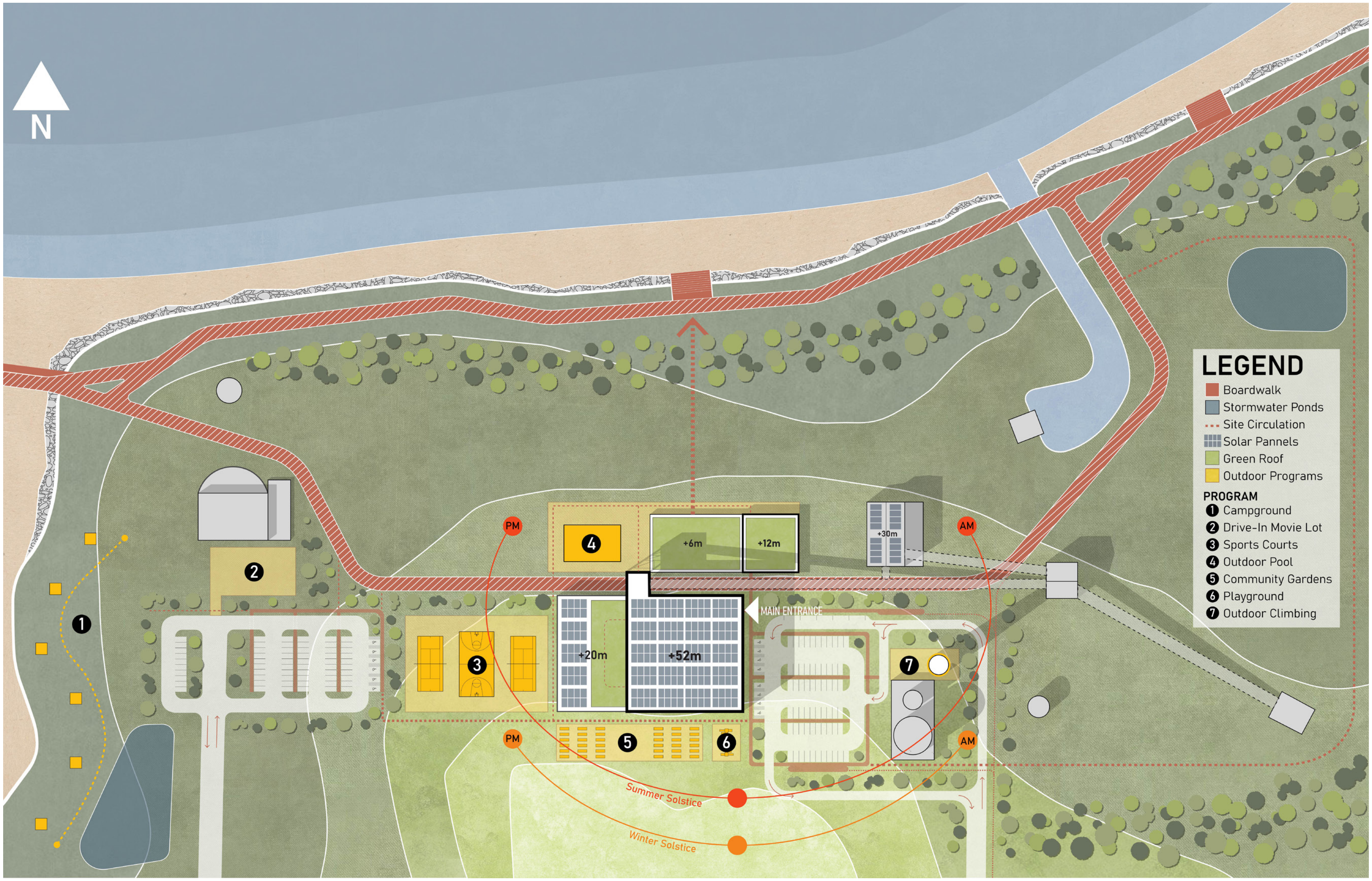


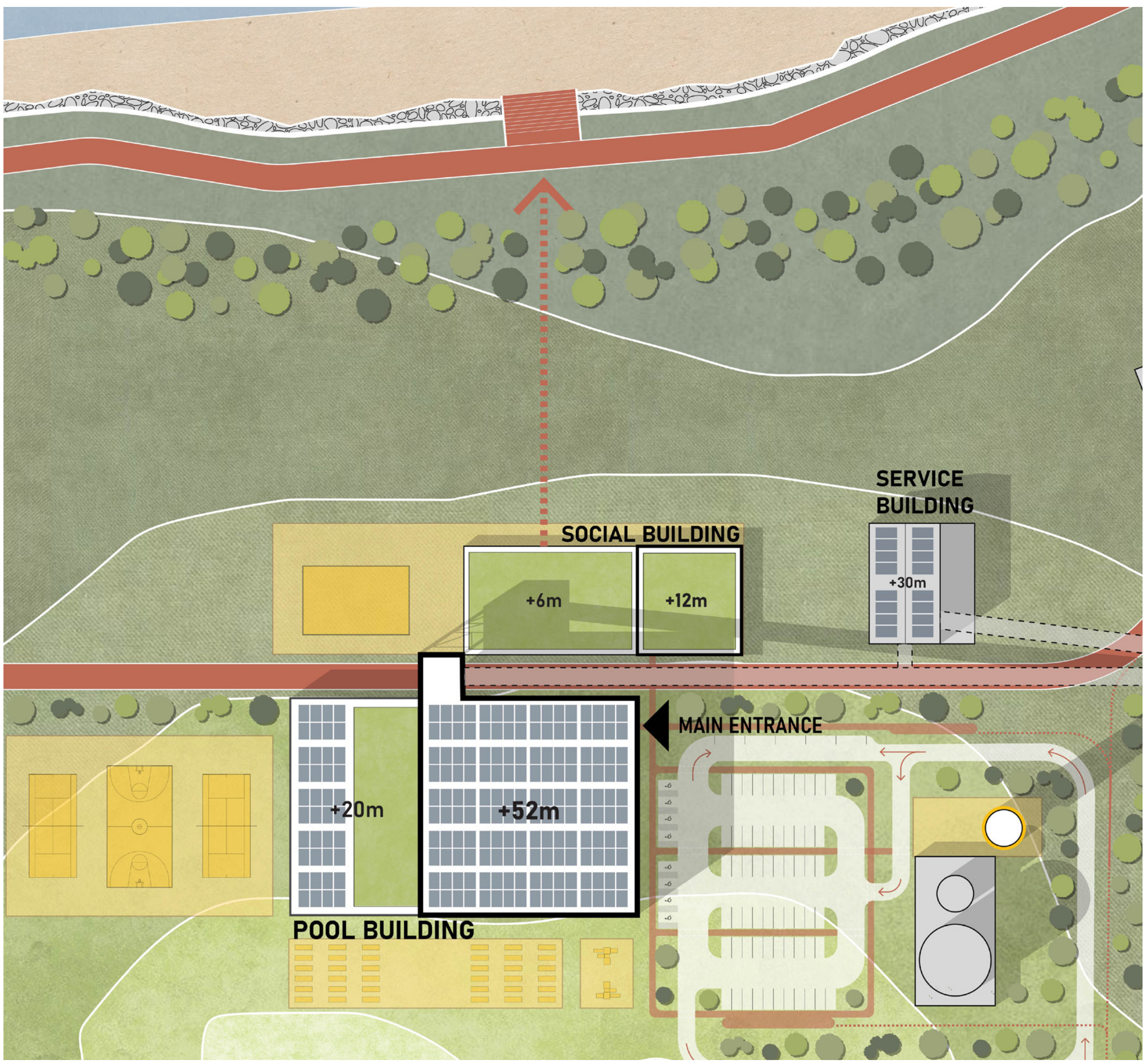
Diagram demonstrates the location of solar panels to maximize production potential .



Site Plan shows landscape features, outdoor programming, and outdoor circulation energy for the community. All of these methods are tested on a medium scale to determine which solution fits best on this site to maximize production potential.

Building Strategy

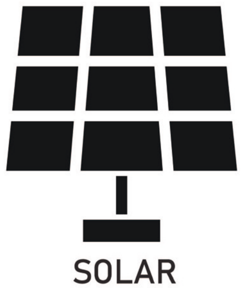
At the scale of the building, there are multiple strategies used to ensure the success of the adaptive reuse of the Point Aconi Generating Station. These strategies include the introduction of new sustainable systems (solar panels, wind turbines, and rainwater collection), and cross-programming through the subtraction of structure/form, and the addition



Plan demonstrates the organization of the buildings and connection to site circulation, including the boardwalk, beach, and road access.

of new/contrasting program. The project is divided up into three buildings, the pool building, the social building, and the service building

Systems



The introduction of new systems on the site helps to begin the site's transition away from unsustainable methods towards a more renewable site strategy. The new systems introduced on the site include rainwater collection, filtration, and distribution as well as roof-mounted solar panels to supply the building's energy and water demands. Considering the intense industrial capacity the structure was designed for, the roof structure is adequately sized for the introduction of solar panels and related equipment.

Based on the roof dimensions (50m x 50m) the area of the boiler hall roof is 2500m^2. This large roof area allows for just under 600,000 kWh to be collected using the solar panels, and approximately 4,000,000 litres of rainwater annually. The water collected is stored in existing storage

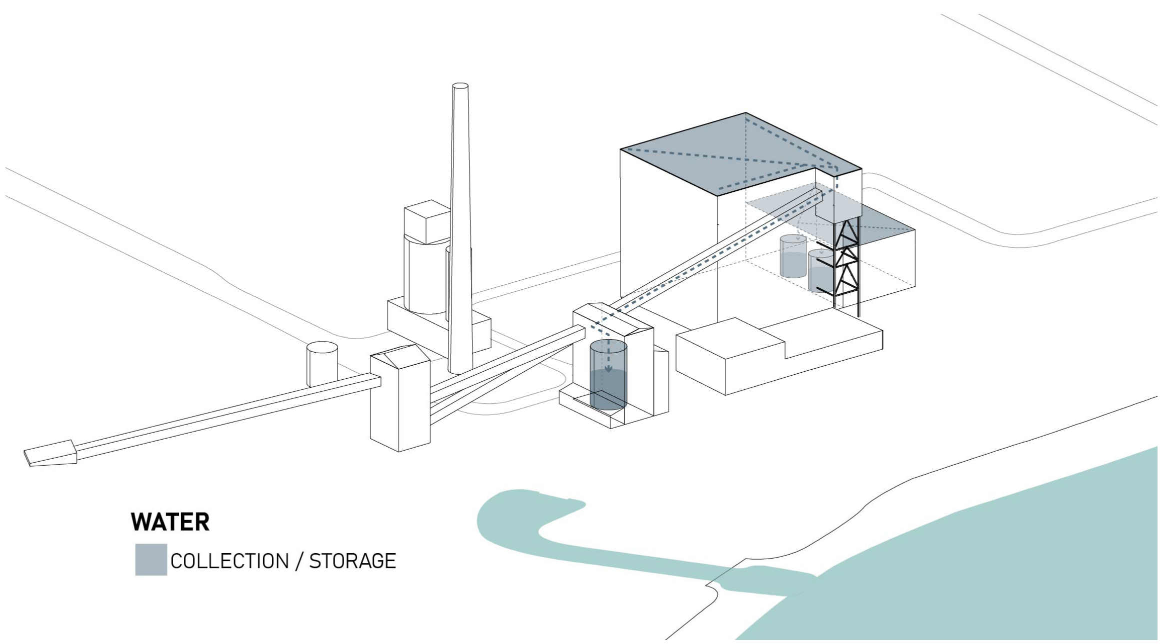
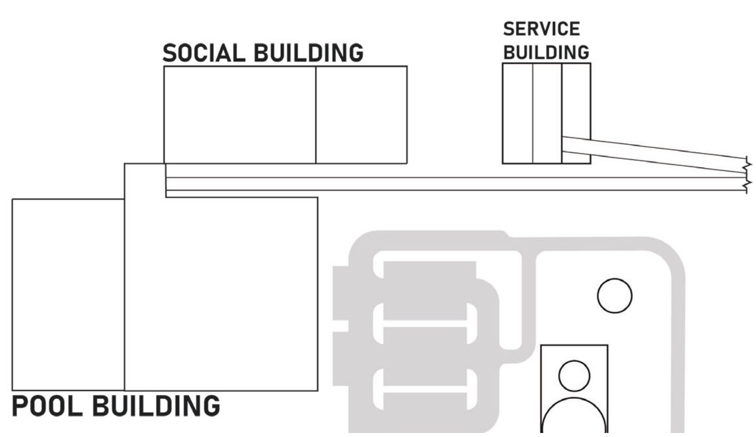


Diagram demonstrates rainwater catchment surfaces and storage areas tanks present on the site which are moved into the pool hall building. The amount of water which can be collected is more than enough to meet the needs of the buildings, and may at time exceed the storage capacity of the buildings, in this case, overflow water will flow into the constructed wetland to be absorbed back into the water table.

The Pool Building's water system is split up into two loops. One loop supplies water to the change rooms and washrooms and the other supplies the pool and spa amenities. The pool loop is a closed loop that is connected to the adjacent regeneration planters. These planters use biofiltration to filter the greywater and put clean water back into the pool. The second loop uses a more traditional filtration method to filter greywater from sinks and showers while black water from toilets is pumped to exterior wastewater biofiltration ponds and planters where water is filtered and used on-site for irrigation.

The Social Building also collects water from the main pool building roof. This water is transported via the repurposed coal conveyor, using gravity to move the water into the Service Building where it is filtered via biofiltration and stored for later use in the restaurant, cafe, and washrooms.



Key plan shows the three main buildings : the Pool Building, the Social Building, and the Service Building.

Subtraction - Demolition and Renovation

Subtraction of form is necessary at Point Aconi to create quality spaces for new programs which require optimal access to natural light and ventilation. Using the technique of subtraction, certain buildings are removed to create smooth circulation and increase day light into the main building.

The existing infrastructure which supports coal processing and energy production is fully decommissioned and cleaned of toxins. Certain mechanical elements are removed or relocated to allow for the introduction of new contrasting public programs and renewable energy production.

The first major subtraction that influenced the organization of the program was the removal of the envelope in part of the lower building which currently houses offices, and maintenance part storage. Ten meters of cladding will be removed across the length of the entire building to create a connection across the site, that follows the past flow of the coal conveyor.

The primary subtraction that will take place is on the facade of the building. Much of the existing facade will be removed and replaced with glass to maximize views and access to sunlight.

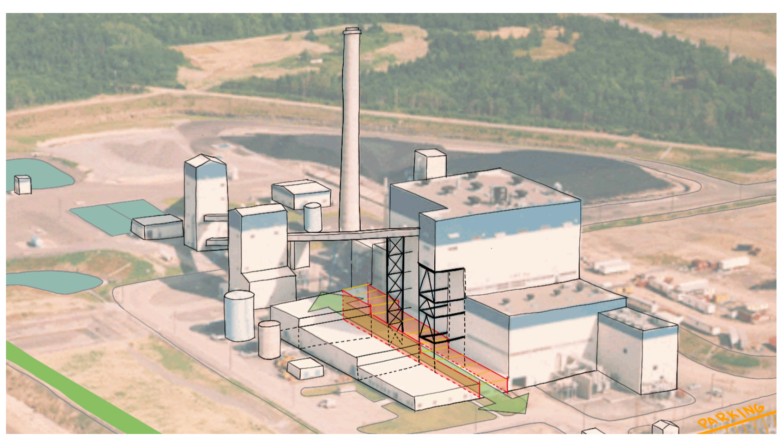
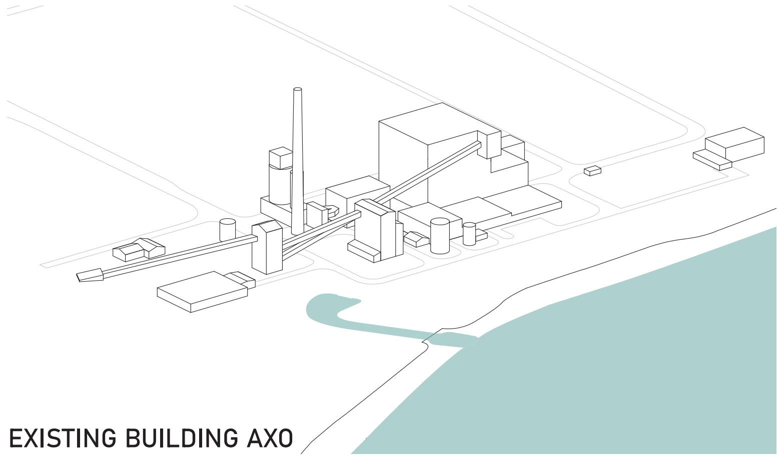
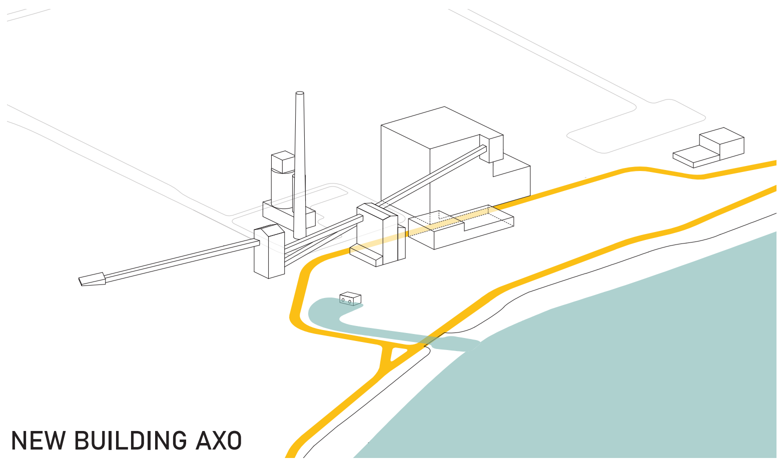


Image demonstrates the first example of subtraction on the site.





Axo diagrams demonstrate the site massing before and after intervention.

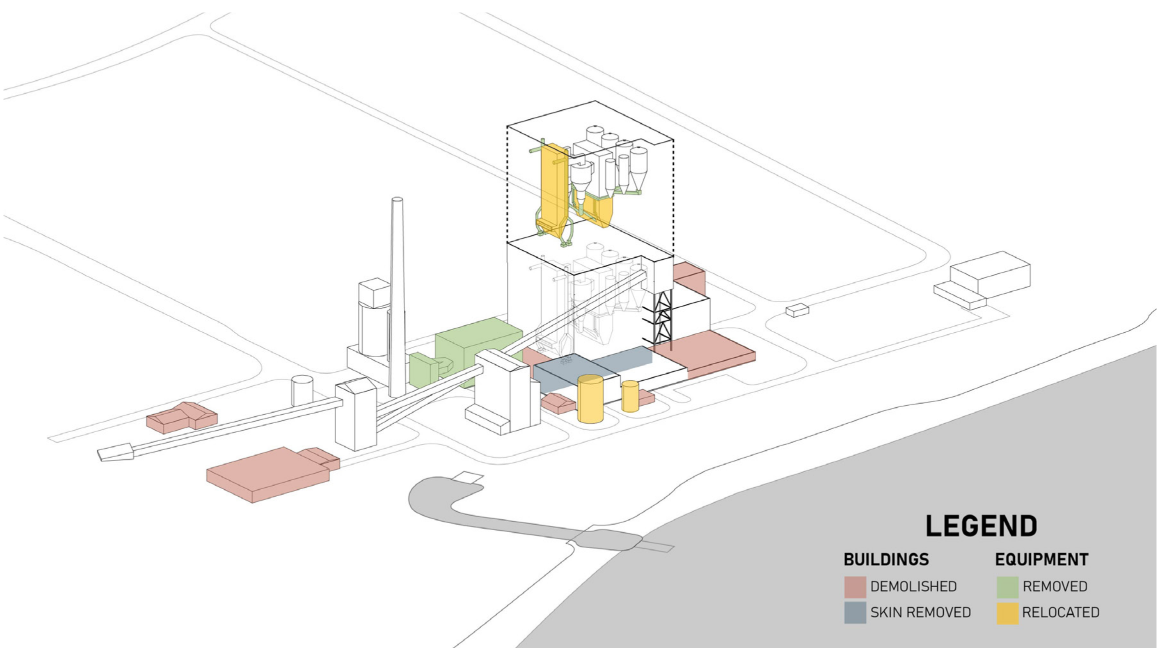


Diagram demonstrates which buildings and parts will be removed or relocated in the redevelopment of the site.

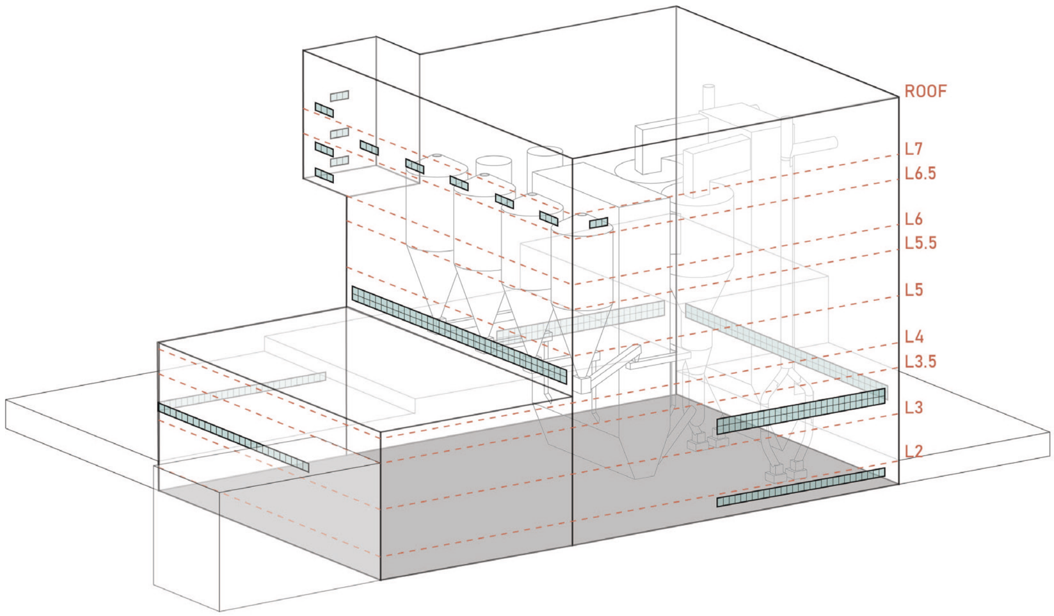
Skin and Openings

Similar to subtraction strategies as explored by Gordon Matta-Clark in the *Day's End* project, the Point Aconi project includes large subtractions of cladding to significantly change the appearance of the building while providing increased views from the new program spaces.

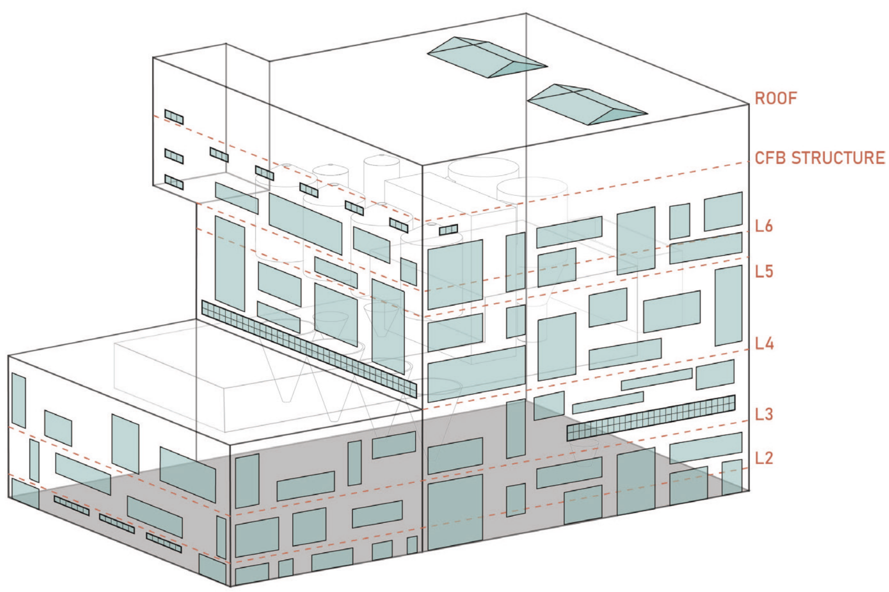
> The introduction of a new facade through the removal and replacement of the old is necessarily both subtractive and additive. An important intervention for the establishment of a different identity, it is an opportunity that requires consideration of how the new is woven into the existing. In addition to the issues of weaving into the host, the consequence offacade interventions reverberates outside the limits of the building structures into the surrounding context. The impact of facade replacement is ultimately one that is positive in moving the project forward in time. The facade replacement as an intervention is a renewal of the building skin. As a facelift, it updates a worn and outdated host building. (Wong 2017, 214-215)

As Wong argues, modification of the facade in the form of subtraction is crucial in the adaptive reuse of buildings to present a new identity for the building. By removing parts of the existing steel cladding and replacing it with a glass curtain wall, the industrial feel of the building is challenged creating more open and public spaces in which users still get a sense of the buildings past life.


The Zeitz Museum, Cape Town, South Africa before and after the adaptive reuse project. (Dobree 2016)



EXISTING SKIN AND OPENINGS



MODIFIED SKIN AND OPENINGS

Diagrams demonstrate the impact of subtraction on the facade of the building.

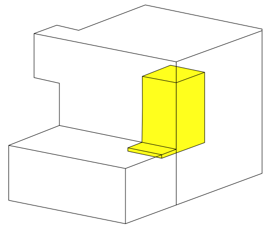
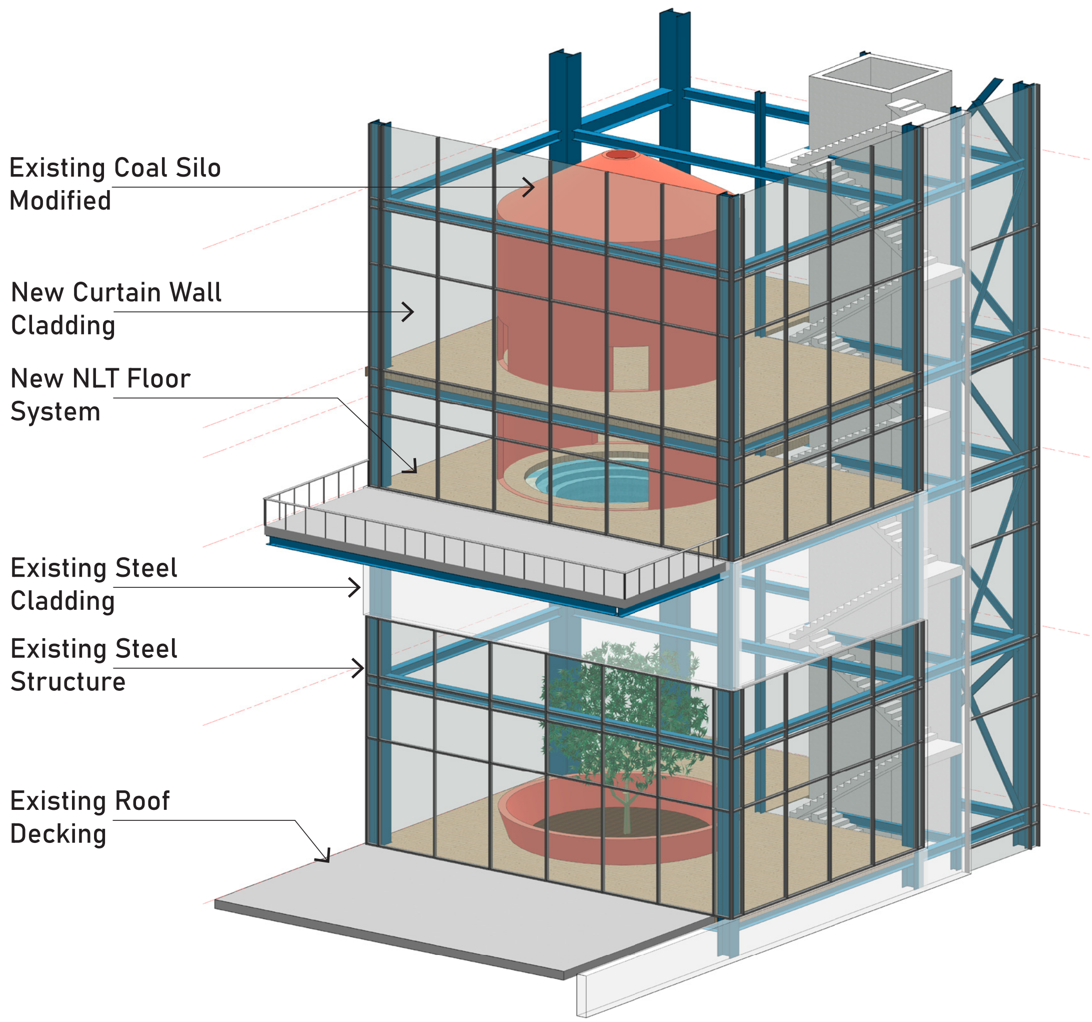


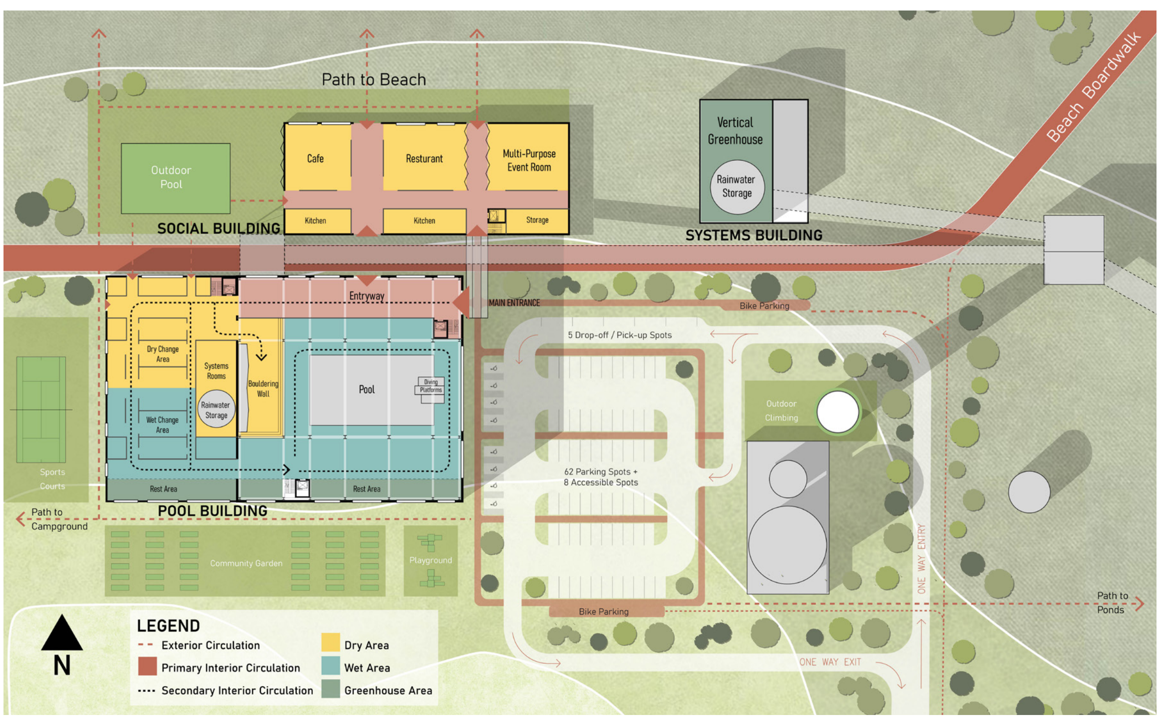
Diagram shows the location of the following section on the boiler hall building.



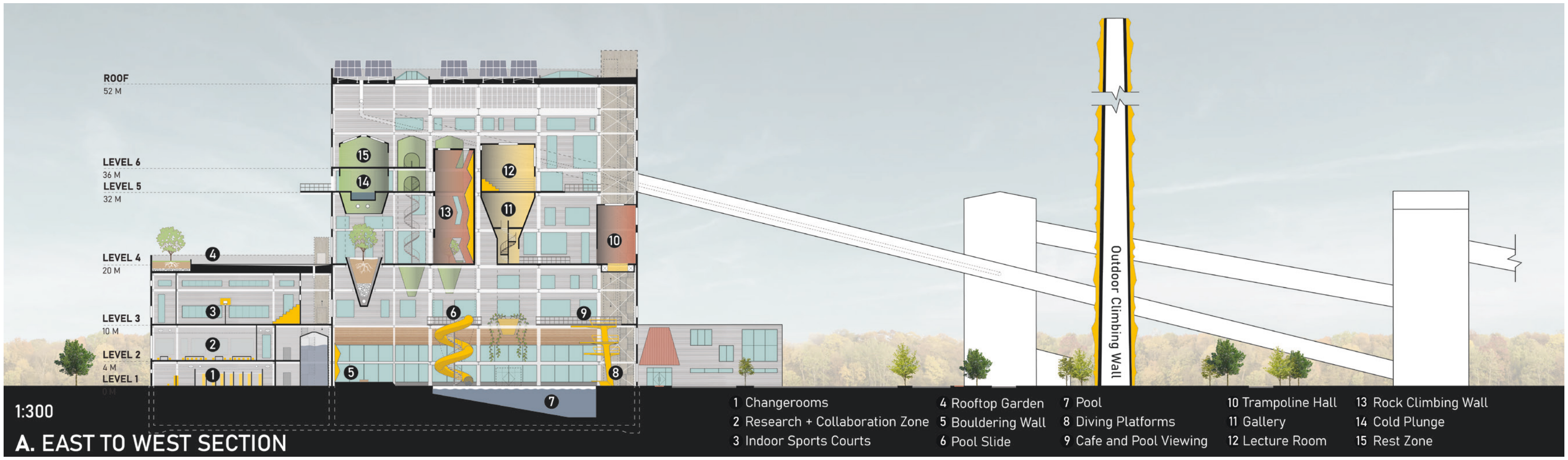
Axonometric section shows the new and the old elements including the coal silo, steeling cladding, and structure as well as the new curtain wall and NLT floor systems.

Addition - Experience

Upon arrival, visitors have direct access to the boardwalk and exterior programs as well as entrances to both the Pool and Social buildings. The entry to the buildings is marked by a covered pathway which is made of a large sculptural metal awning created from parts removed from the combustion chamber. As visitors arrive into the pool building, the entry way provides the first experience of the buildings industrial scale, with an unobstructed view to the roof fifty meters or fifteen stories above. The main floor of the Pool and Social Buildings include the swimming pool, change rooms, bouldering wall, Filtration planters, restaurant, cafeteria, and multi-purpose event space. The boardwalk which connects to the beach cuts directly though the Pool and Social Buildings to follow the past flows of coal and energy on the site and ensure a seamless and accessible connection from the plant to the beach.



Plan zooms in on first floor showing circulation and program.



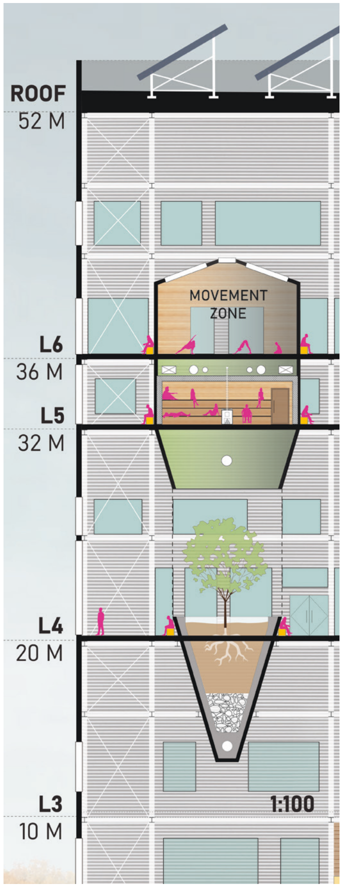
Site sections demonstrate how existing elements are reused to vertically distribute program and maximize the building's potential.

This thesis focuses efforts on the Pool Building (old boiler & turbine halls) as this is the most complex for adaptive reuse due to the amount of machines and structure within it. These complexities are also what create interesting opportunities and inspire creative applications of subtraction and addition methods. The Social and Service Building are less complex structures which are used to provide supporting programs to the Pool Building.

Pool Building

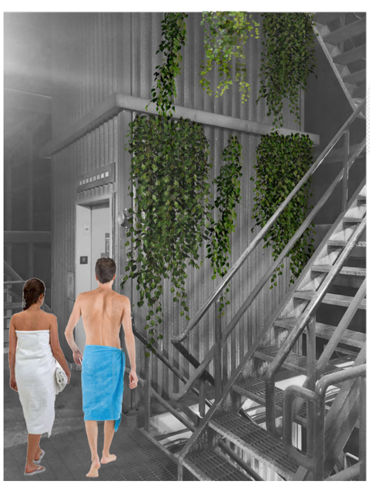
The Pool Building consists of two main buildings divided into multiple parts. The recreation area including the pool, spa, and climbing facilities are located in the east portion of the building, once called the Boiler Hall. In the Boiler Hall, program is dispersed vertically throughout the building taking advantage of the structures immense height. The western wing of Boiler Hall contains changing rooms, collaboration spaces, water/electrical system rooms, gym, and sport courts.

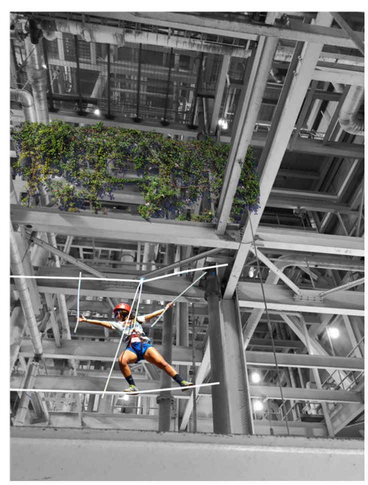
The pool area of the main building is placed in the middle of the building where the structure has the largest span. The pool and bouldering wall are accessed through the wet and dry change rooms on the western side of the building. The shorter building on the western side of the Pool Building is the existing turbine hall which houses change rooms and service rooms on the main level. Above the change rooms is a space for research and collaboration, followed by a multiuse sports courts providing additional recreation options on level three. On level three in the Boiler Hall, visitors can access a café and viewing area where they experience the full scale of the building looking to the swimming pool below and skylights above.



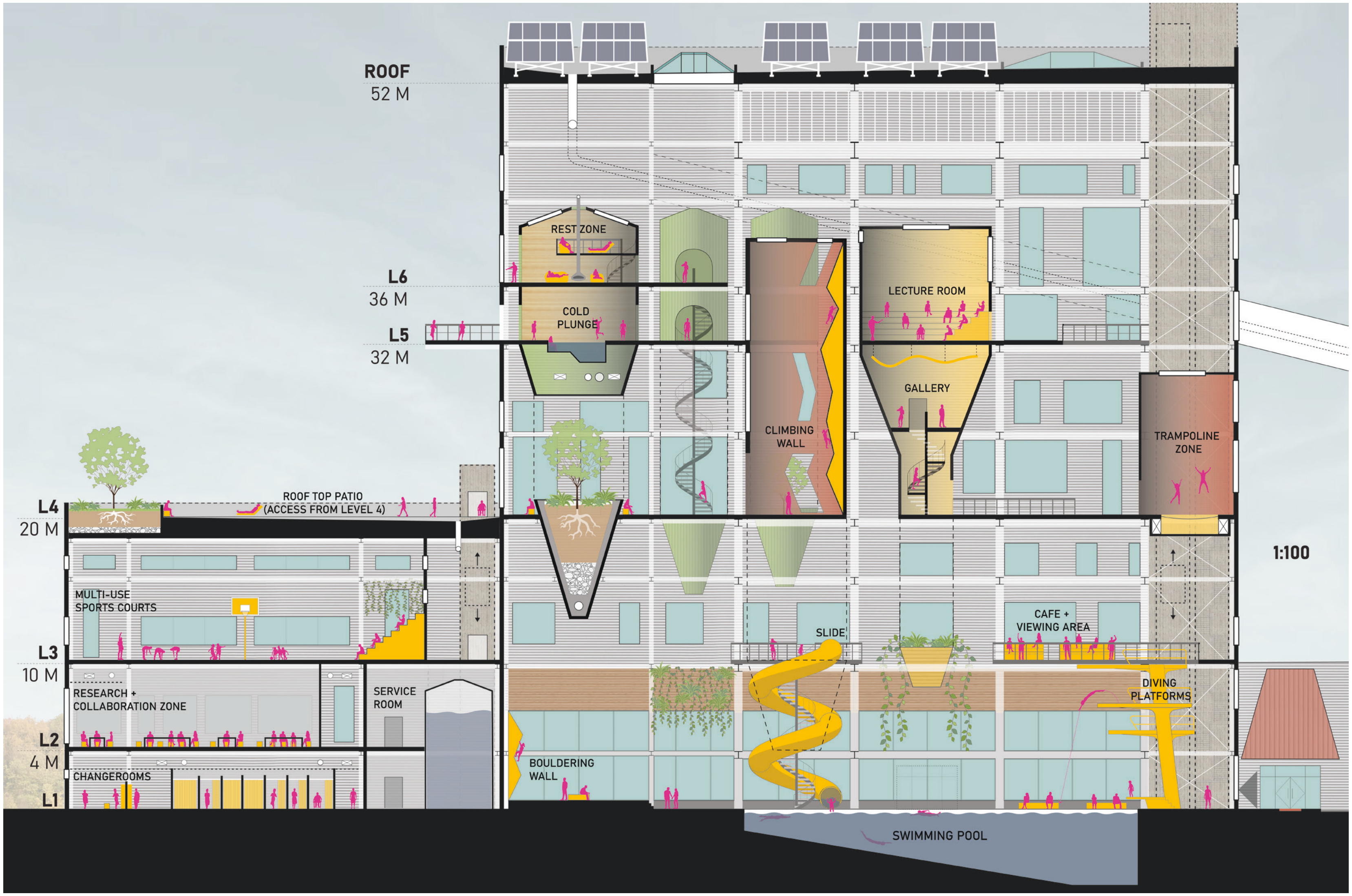
Section demonstrates how coal silos are renewed and filled with spa and rest programs.

On level four and above multiple varying programs are introduced into the existing machines to great unique gathering, recreation, and relaxation spaces. The Cyclone Collectors are converted into lecture hall and gallery spaces. Subtractions are made to create doorways to enter into these new spaces. The Combustion chamber is spilt into three parts, the largest section of the chamber stays in its original location and becomes the location for a full sized rock climbing wall approximately twenty meters tall. The middle section is moved to the east wall of the building where it now houses the trampoline program, requiring approximately ten meters of height. On the western side of the upper levels is the spa area of the program located in what remains of the coal and limestone silos. The silos are cut into two parts, the top portion on level five houses spa program including a hot tub, cold plunge, sauna, and steam room. The hot tub and cold plunge have direct access to balconies on the west wall. The lower portion of the silos which have been dropped to level four and sit within the existing structure. These cones are turned into planters adjacent to the roof top garden access.





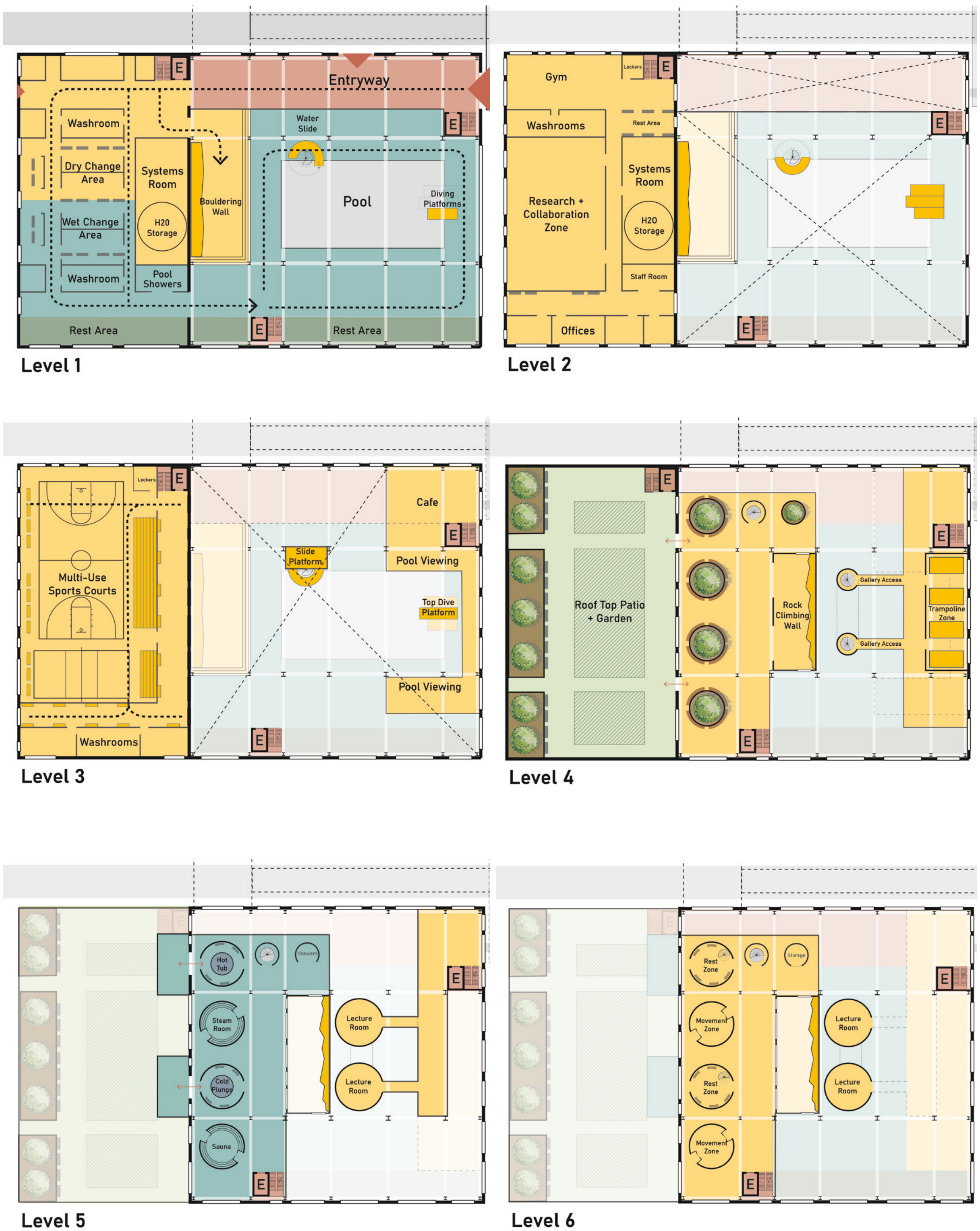
Diagrams demonstrate the contrast of public program taking place within industrial buildings.



Section through the Pool Building demonstrates how the adaptive reuse of such industrial buildings can be playful and effective.

LEGEND

Primary Interior Circulation | Dry Area | Wet Area | Greenhouse Area

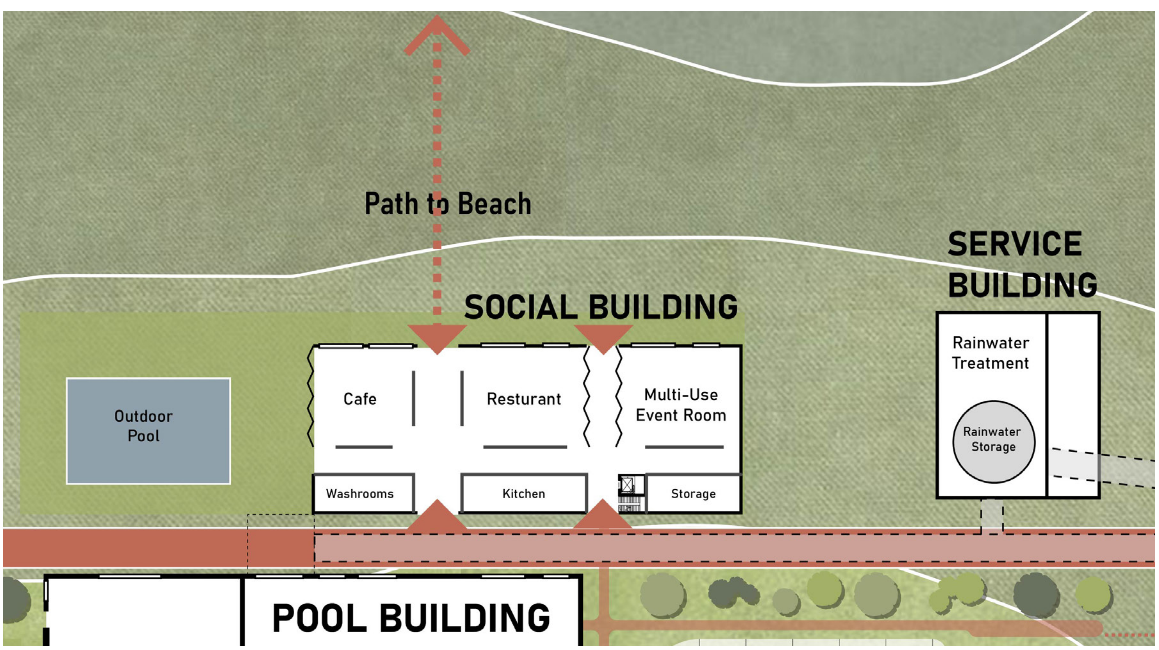


Floor Plans of the Pool Building show the diversity of wet and dry spaces throughout the building.

The overall approach for the Boiler Hall and Turbine Hall in the Pool Building was to remove as little structure and elements as possibly to retain the character of the industrial building, while introducing contrasting public program which these spaces.

Social Building and Service Building

The social building is located in what was the maintenance storage and water treatment sections of the plant were located. The water treatment equipment is moved to the east into the Service Building where rainwater storage located. The eastern side of the Social Building is approximately twelve meters(four stories) tall and divided into two stories housing event halls/ gathering space with double-height spaces with views over the field to the ocean. The western two-thirds of the Social Building is approximately six meters tall, and used as a double-height Cafe and Restaurant area. Here swimmers, climbers, and other visitors can gather for food and drinks while looking out to the view of the ocean.



Floor plan of the Social and Service Building shows how additional necessary support program is integrated into the existing buildings.

Chapter 7: Conclusion

Overall, this thesis explores the opportunities of introducing public program onto a site of past and future energy infrastructure while using the structural and mechanical complexities as opportunities for new recreation program. The project introduces public program onto what was once a very private site in hopes that such contrast provides a unique perspective to visitors, emphasizing the immense structural and spatial requirements of coal energy production.

The current site overpowers the surrounding landscape and will continue to do so, but in a way in which public can engage and the connection between the plant and nature becomes clear.

It is the responsibility of architects, urban designers, engineers, etc. to express their concern in the continued use of these coal power facilities through the development of design proposals which demonstrate the potential of these sites to push a healthier, and more socially beneficial approach to infrastructure and use of infrastructure after its decommissioned.

Through an understanding of historical context of Cape Bretons industrial past and methods gained from case studies, the proposed project demonstrates that thoughtful and creative integration of recreation spaces, within the existing power plant infrastructure, can demonstrate a powerful new connection between the contrasting public and private programs to create a more productive landscape for the community, its visitors, and the entire province.

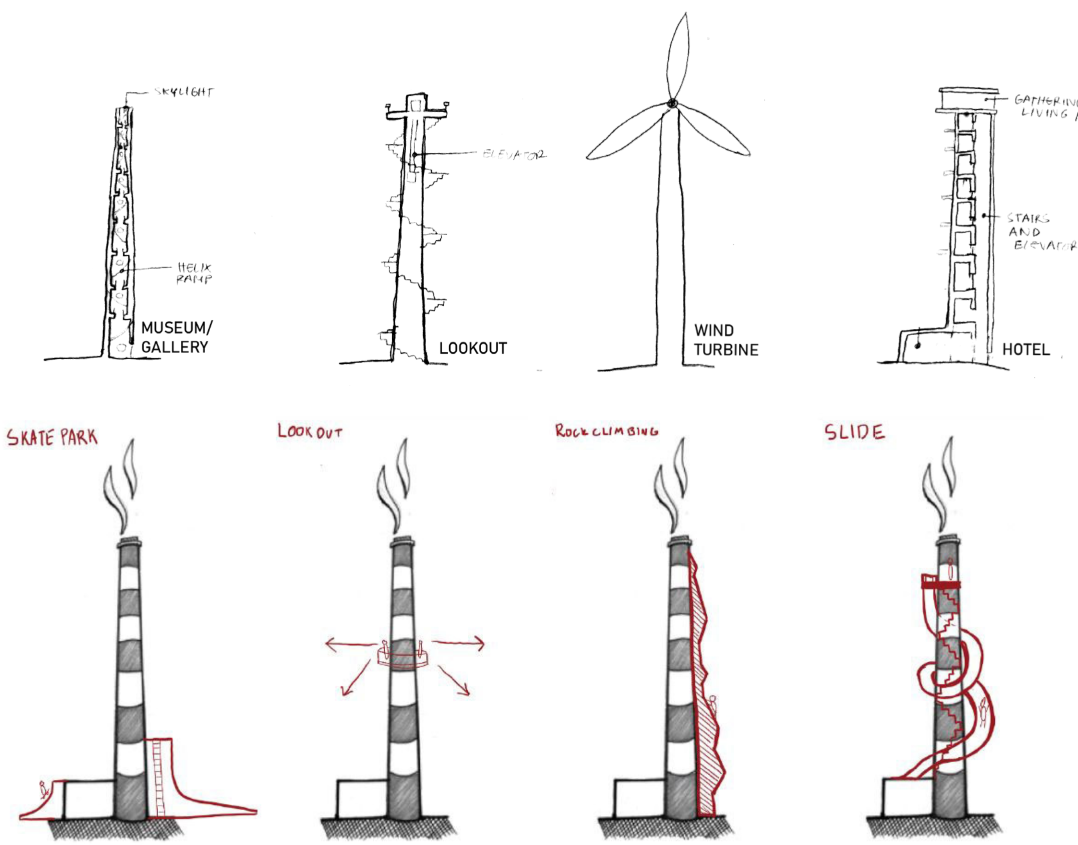
The key elements which guided the development of this project include, the remediation of the surrounding site to allow for safe public interaction, the connection across the site and through the buildings to create a cohesive landscape in which the landscape and the building become one, and the cross-programing of the building through addition and subtraction.

Specifically, this thesis aim to demonstrate how the adaptive reuse of power plant building typologies present opportunities for diverse and vibrant public use, green energy infrastructure and landscape remediation to encourage the decommissioning of the plants to begin the transition away from carbon based energy production and towards a greener future.

Appendix: B1/M5 Charette

In a charette exercise, masters students created an exercise to be performed by junior students which may inform next steps in their thesis programs. My exercise began investigations into how industrial parts of the power plant can be repurposed.

This exercise was to use both addition and subtraction method to, design possible approaches to the adaptive reuse of the existing smoke stack. Possible interventions may explore public, private/commercial, or industrial uses of the stack.



Top row of drawings done by Andrea Santoyo and Myranda Talbot demonstrate how the junior students interpreted the task and brainstormed adaptive reuse opportunities of the smoke stack. The bottom row of drawings are done by myself and represent my interpretation the variety of public recreation programs which could be introduced to the stack.

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