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Viable and feasible decarbonization; Tent Mountain Coal Mine re-purposing for the clean energy economy

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Introduction

In 1983, open cut coal mining operations were suspended at the Tent Mountain Coal Mine, located in Alberta, Canada in an area called Crowsnest Pass.

Montem Resources (“Montem”), an Australian mining company, purchased the asset in 2016. They conducted several drilling campaigns and undertook environmental monitoring with the intent to restart operations. In 2020, Montem completed a Definitive Feasibility Study, which indicated a mine life of more than 14 years.

The location of the Tent Mountain mine and the layout of existing historical operations is provided in Figure 1 below.

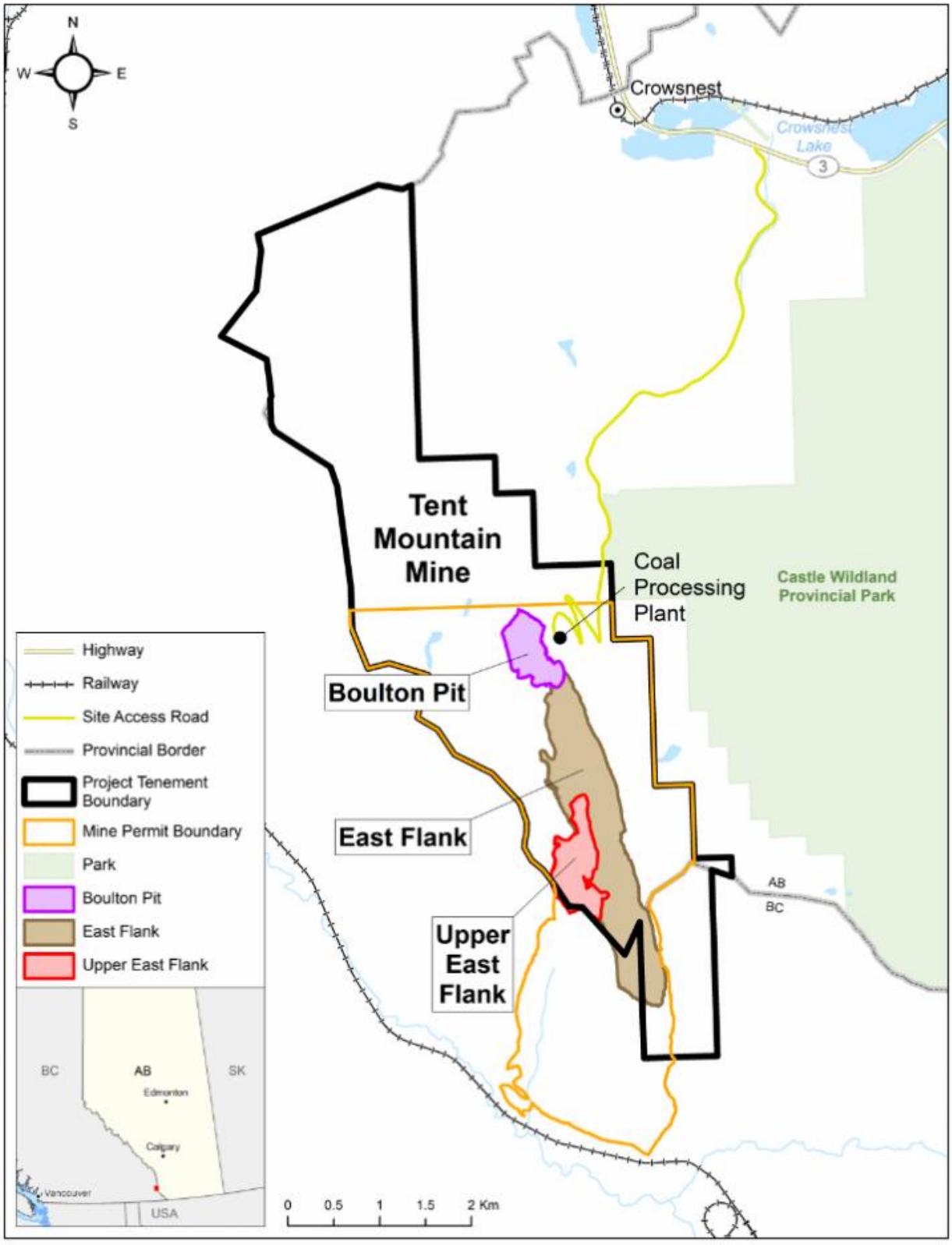

Figure 1 ***Location and layout of the Tent Mountain mine site, near Crowsnest Pass, Alberta, Canada (courtesy of Montem***

Challenge

Despite Montem moving the mining restart forward within the Provincial framework at the time, the proposed mining project was ordered to undergo a Federal impact assessment before it could operate. (Canada, 2021)

The Federal review process can take many years, with some projects taking over five years and with no guarantee of success. As a result, Montem sought to study alternatives for the Tent Mountain asset that they owned.

The challenge for Montem was to find a way to deliver a sustainable and socially accepted project with strong economic value that could attract investment and utilize the unique features of the Tent Mountain site and location. The transformation project would need to be both financially viable and technically feasible.

Method

To commence an opportunity identification process, Montem engaged multiple professional services firms to look at their unique issue and work collaboratively to identify a technically and financially viable solution.

There are three main ways in which Montem looked to identify the opportunity and move the opportunity forward with the greatest chance of success. These were:

1. Utilize a diverse set of skill sets and knowledge to look at the issue in different ways;
2. Undertake a logical project assessment process; and
3. Establish a steering committee of key advisors to move the project forwards.

GHD was consulted initially to look at enhancing an early PHES (Pumped Hydro Energy Storage) concept and preliminary financial returns if it were to be deployed in isolation. This exercise included looking broadly at renewable energy and alternative or clean fuel (including hydrogen) opportunities that might be possible and driving the opportunity identification process in a collaborative fashion. GHD then took the main role of developing the clean hydrogen portion of the project.

Other firms were tasked with further detailing the PHES scope and return on investment, risks and opportunities, feasibility, and defining the PHES project development, whilst others were engaged on matters of regulatory and permitting requirements, grid interconnectedness, and the important Indigenous aspects of a clean energy project in this location.

Through the bringing together of different groups and initial divergent or “free” thinking, the conceptualization is an example of what is possible when multiple, diverse skill sets, and thinking is brought together to solve a compelling challenge.

The steps that resulted in the transformation opportunity were:

1. Framing the issue and brainstorming “free thinking” options.
2. Value chain interrogation and opportunity definition, including alternatives.
3. Initial market sounding, commercial development and exploratory discussions with prioritized end-users.
4. Initial high-level financial viability assessment through financial analysis and benchmarking.
5. Understanding risks and constraints, and interconnectedness of the project elements.
6. Additional technical and business case studies. Including water balance and testing, geotechnical investigation, siting for the hydrogen facility and water constraint understanding.
7. Understanding the key levers for value, including Indigenous participation, clean fuels standard credits, scaling timeframes, key consortia participants, captive end-market users and propensity to pay.
8. Development roadmap with approaches to de-risk the project at various points.

The transformation scheme was deemed by Montem to be both viable and feasible, Montem formed a steering committee led by the previous Chair of the Alberta Electric System Operator (“AESO”), which included subject matter experts from across each of the project elements. This has ensured that the project was aligned across elements and moved forward in an efficient manner.

Result

The resulting conversion project is named the Tent Mountain Renewable Energy Complex ("TM-REX") and includes a 320MW / 4,800 MWh pumped hydro energy storage facility (PHES), a 100MW green hydrogen production electrolyzer, and a 100MW wind farm off-site (originally considered on-site). (Montem, 2021) (CBC, 2021)

The PHES utilizes an existing legacy open mining pit called the "Upper Reservoir" shown in Figure 2 below, which shows the general layout and elements of the PHES. This Upper Reservoir is presently filled with water and collects rain and snow melt throughout the year. A Lower Reservoir, approximately 300m below, would be constructed with a dam structure and existing natural terrain. A powerhouse and surface penstock would complete the required infrastructure, pump water from the Lower to Upper Reservoir when power prices were low and sell power when prices were high.

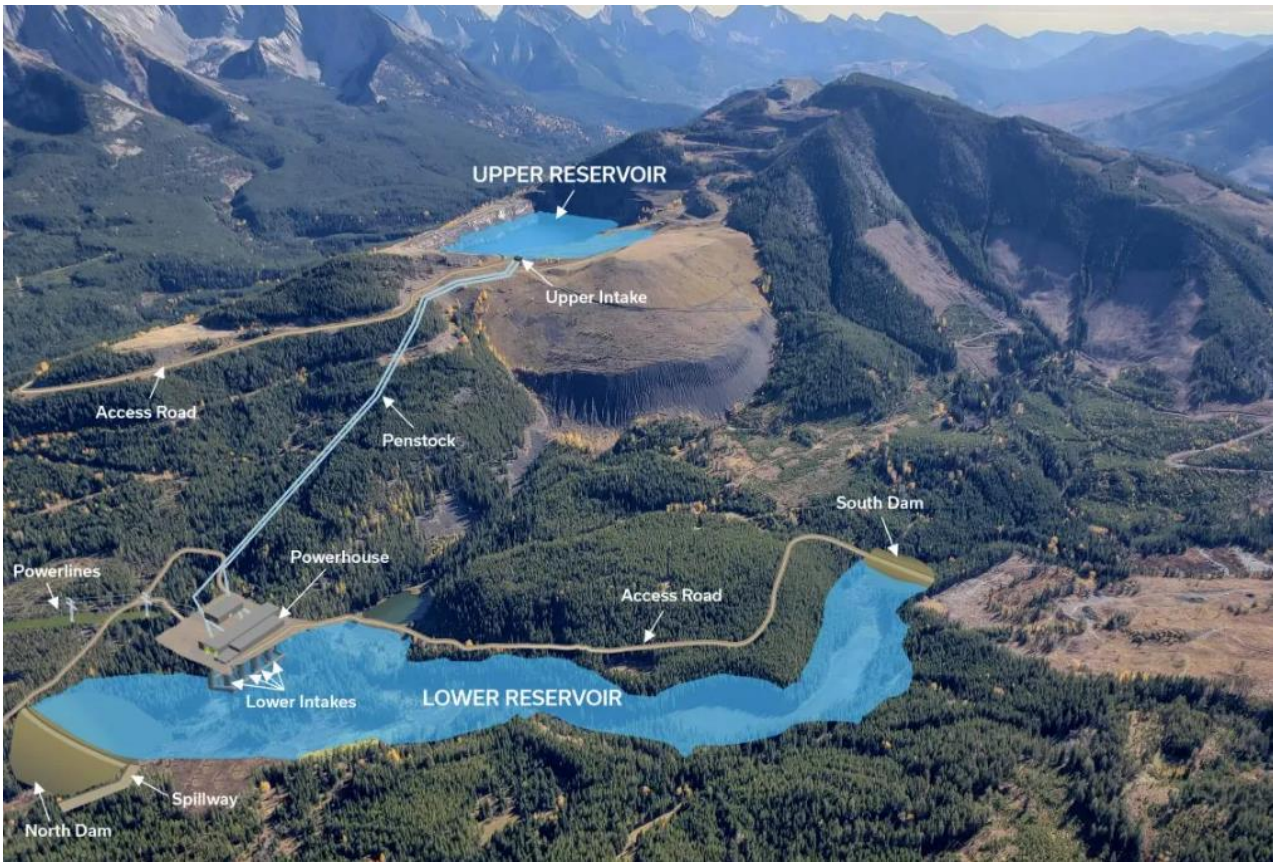

Figure 2 Overlay rendering of the PHES configuration at Tent Mountain (courtesy of Montem)

Wind power would be the renewable energy supply for both the PHES and the hydrogen electrolyzer. The offsite wind farm is proposed to be developed by the Piikani Nations, an Indigenous group in the region.

"Green" hydrogen is a very low CO2 intensity fuel when it is created using renewable energy. The other feedstock required is potable water, for which there are several sustainable options in the area. Electrolyzers work by splitting water into hydrogen gas and oxygen gas. The hydrogen is then stored at pressure and transported to an end user. For this project, there were a few opportunities identified; the most promising of which are mining haul trucks at other operations and hydrogen locomotives (both which would directly substitute diesel as a fuel) and natural gas blending opportunities.

The full-scale, 100MW hydrogen production facility will produce around 14,000 tonnes per annum of hydrogen. This would be enough to displace approx. 50 million litres of diesel from large highway trucks, or the equivalent of approximately 200,000 tonnes of CO2 emissions each year.

The TM-REX development displays several key attributes as described in Table 1 below.

Table 1 Attributes of the Tent Mountain Renewable Energy Complex

Attribute	Description
Utilizes leading edge renewable technology	Using wind farms and water based electrolyzers, as a business change enabler to produce zero-emission fuel and power. The 100MW electrolyzer if in operation today would be the largest green hydrogen facility globally
Has a very high societal and environmental impact	In new, green jobs creation in the region, and through reducing transport emissions significantly and pivoting from coal mining to renewable fuels
Involves Indigenous communities completely	Through partnerships for wind farm development and broader participation and joint ownership opportunities
Creates a new business for Montem, and a viable use for this idle asset	To pivot from coal mining to green power, energy storage and fuels as part of their corporate portfolio. Further, there is a new and differentiated opportunity for investors to partake in a unique opportunity
Clean fuel supply of hydrogen as a substitute for diesel	Providing green hydrogen production in this region is the first of its kind and has the potential to aid decarbonization of multiple industries such as heavy haul transport and other regional coal mining operations
Providing grid stabilizing energy storage	Pumped hydro energy storage firms the grid and allows additional renewable energy projects to be added
A first of its kind in North America	Incorporating renewables with pumped hydro and green hydrogen production has not been undertaken in North America
Commercial potential is broad and large	Both for hydrogen sales and off-takers and for the pumped-hydropower system to the grid
Will be an iconic green energy legacy project	Supporting the energy transition well into the future of low carbon energy

As of March 2023, feasibility studies and in-depth business cases have been undertaken, and the project has recently been agreed to undertake joint-venture development with a major utility in Alberta, TransAlta. (TransAlta, 2023)

Summary

The TM-REX is a novel approach to re-imagining and then physically re-purposing an idle coal mine. It takes advantage of natural topography and previously disturbed areas, market, and political support for both green hydrogen and a grid stabilizing energy storage system.

The TM-REX development is one that achieves many objectives across Indigenous, social, political, environmental, and energy transition elements. Importantly, it is both financially viable and technically feasible decarbonization.

It is a compelling transformation that is an example of what is possible when multiple, diverse skills and thinking are brought together to solve a complex challenge of transforming a legacy mine.

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