

MINE-Mobility: Copper Valley’s Accessible, Dependable, and Affordable (ADA) Transit System for Senior Citizens

Overview

Copper Valley (2132 population: 132,000) is located along the Continental Divide in the mile-high Silver Bow Valley of southwest Montana. Until 2100, Copper Valley was known as Butte, which was established in the 1860’s as a copper mining camp west of Rampart Mountain (Figure 1). The city includes ‘butte-a-ful’ Lake Berkeley and has a semi-arid climate with short summers and cold winters.

In 1900, Butte was the largest city between Chicago and San Francisco. A profitable mining-based economy gave the 100,000-resident boomtown the nickname ‘The Richest Hill on Earth.’ The 1950’s brought safer open-pit mining and created what would become the mile-wide, 1,700-foot deep Berkeley Pit. By 1982, mining became unprofitable, and the mine closed. Jobs and people left. The population plummeted to 30,000. By 2017, the pit was filled with toxic runoff. It was the country’s largest EPA Super Fund site and contained a 40-billion gallon acidic solution of heavy metals like copper (25,000 tons), zinc (100,000 tons), and iron (150,000 tons).

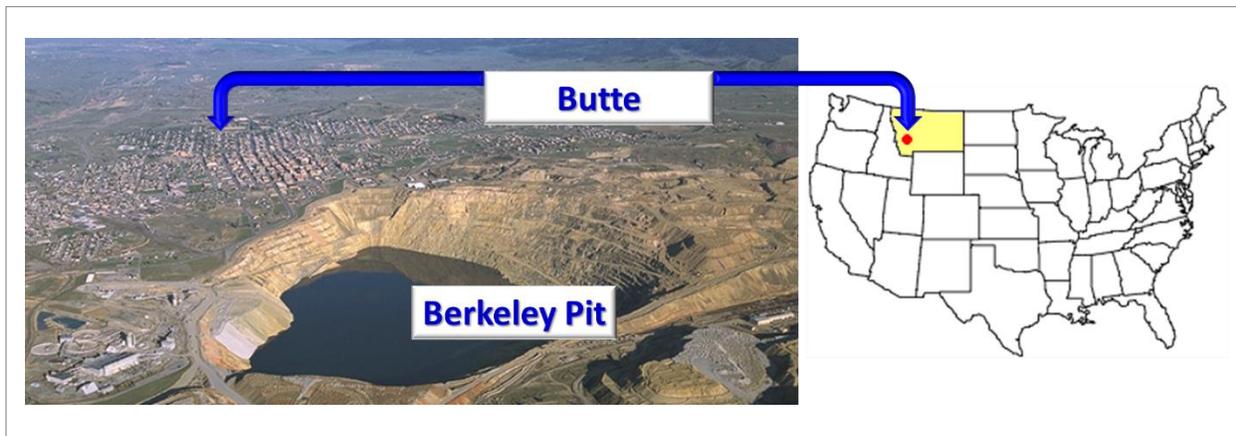


Figure 1: Butte, Montana and the Berkeley Pit (2017)

Innovations

Butte’s turnaround can be traced to R2-Remediation (Figure 2), an innovation to clean the Berkeley Pit developed in 2100 by Montana Tech’s environmental engineers. Friendly bacteria, such as *Brachybacterium-Mn32A* harvested in blackwater algae digesters, along with cornhusk-based biopolymer nanoparticles, remove heavy metals through adsorption. Purification is then maintained by graphene filtration and aeration systems. R2-Remediation is marketed to communities in need of contaminated site bioremediation and provides a major revenue stream.

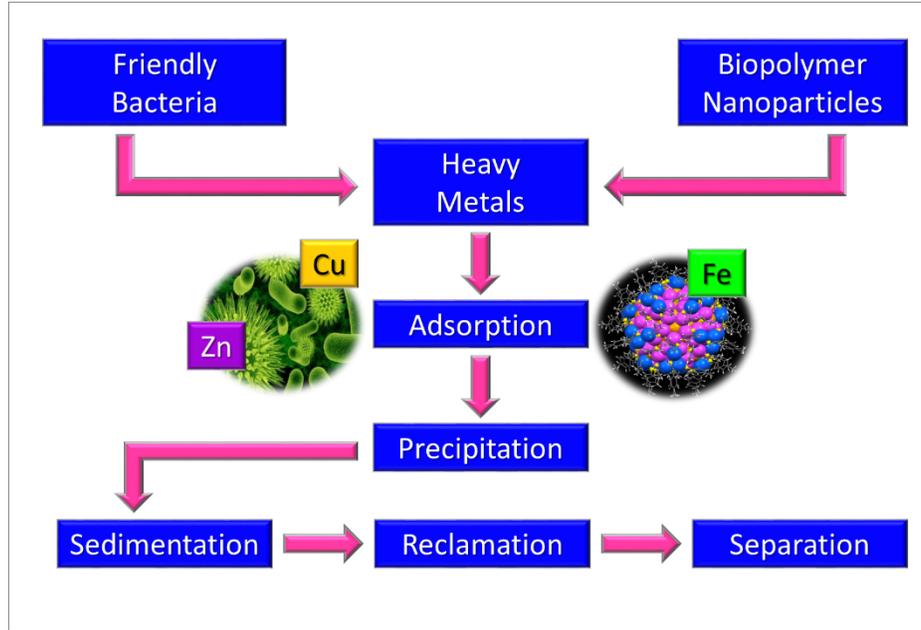


Figure 2: R2-Remediation

Additional innovations include off-the-grid utilities that incorporate active-membrane exterior surfaces that capture sunlight for interior lighting, condense humidity for water, and filter air. Hyperbaric interiors at two-times ambient pressure increase oxygen levels, promoting improved health and well-being. The city’s unique bioluminescent architecture glows after dark and was inspired by the pink and blue Bastnasite mineral discovered during remediation. Neodymium harvested from Bastnasite is used for propulsion in Copper Valley’s MagLev transit system.

Infrastructure

Housing options to suit all ages and income levels, including multigenerational duplexes, are available. The restored historic district offers low-density accommodations. Medium-density cliff-side condos provide sweeping Lake Berkeley views, while high-density high-rises offer panoramic views of the Butte Highlands.

Excess power is harvested from multiple renewable sources, including bladeless, air-multiplier wind turbines and biomimetic, high-surface area solar cells. Energy is stored in graphene supercapacitor batteries and sold as revenue. Algae digesters convert blackwater waste into energy-rich hydrogen, and non-recyclable, non-compostable trash is ionized through plasma gasification waste-to-energy systems.

Copper Valley boasts a universally-accessible transit system based on AmphiPod personal vehicles, along with elevated copper tube public transit and subterranean cargo tunnels (Figure 3). AmphiPods travel on energy-harvesting roadways and connect with public transit at depots. Vertical-parking capability also provides direct access to buildings, eliminating the need for space-wasting parking lots.

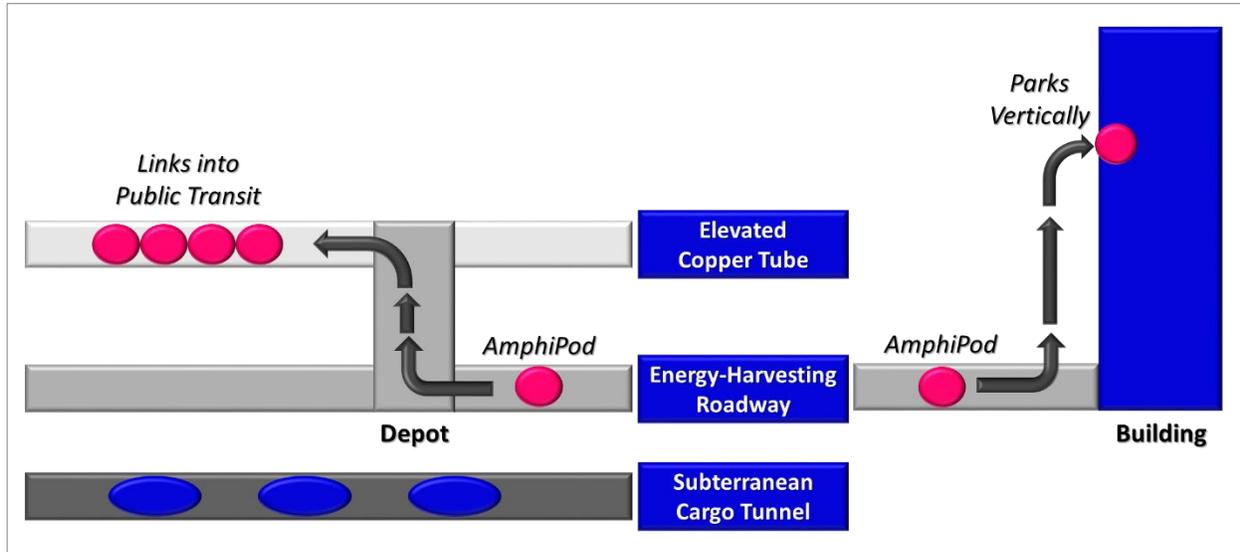


Figure 3: Transportation System

City Services

Communication is based on MEC-Lace (Medical, Education, and Communication) devices. Voice-activated, holographic capability allows students to attend class virtually. Anaconda Community College offers topnotch elder-care certifications. Unparalleled elder services are also available throughout the city, including intergenerational living at Montana Tech. In return for reduced-rate lodging, students provide companionship to seniors while learning from their wisdom and life experiences.

MEC-Laces are real-time healthcare interfaces with medical personnel. In addition, they track vital signs and provide dermal medication delivery. Strain-energy harvesting piezo-nanobeads in footwear powers MEC-Laces, encouraging residents to stay active at Copper Valley's 31 parks. AmphiBot fire-resistant rescue vehicles protect residents and emergency personnel and can travel on Lake Berkeley, climb buildings, or hover above traffic.

Age-Related Problems

Major infrastructure change requirements for the disabled and elderly resulted from the Americans with Disabilities Act (ADA) of 1990. The act mandated that accommodations be made for all regarding transportation and public places. Despite this, many age-related problems still existed in 2017. For instance, seniors often lacked access to:

- dependable public transit,
- barrier-free buildings and public places,
- affordable healthcare and medications,
- nutritious food, and
- affordable senior housing options.

Furthermore, needing to be needed through meaningful relationships and activities often brought isolation and depression.

Butte’s Problem

In addition to economic and environmental problems, Butte lacked a dependable public transit system for seniors. The Butte Bus offered fixed-route service during the week, limited Saturday service, and no service on Sundays or holidays. Two cab companies offered door-to-door service, but were expensive for everyday use. This made it difficult for seniors who couldn’t drive to get around independently.

Lack of public transit impacted a number of quality-of-life factors, including ability to visit with family and friends, shop for groceries, or attend doctor’s appointments. Mobility was directly tied to health and well-being, and lack of dependable transit negatively impacted independence. In fact, lack of mobility often determined whether seniors could age with dignity at home or have to move to elder-care facilities.

Solutions

Using the Engineering Design Process, Butte’s engineers designed two innovative, senior-friendly solutions to Butte’s transit problem: MINE-Mobility (Figure 4) and the MEC-Lace.

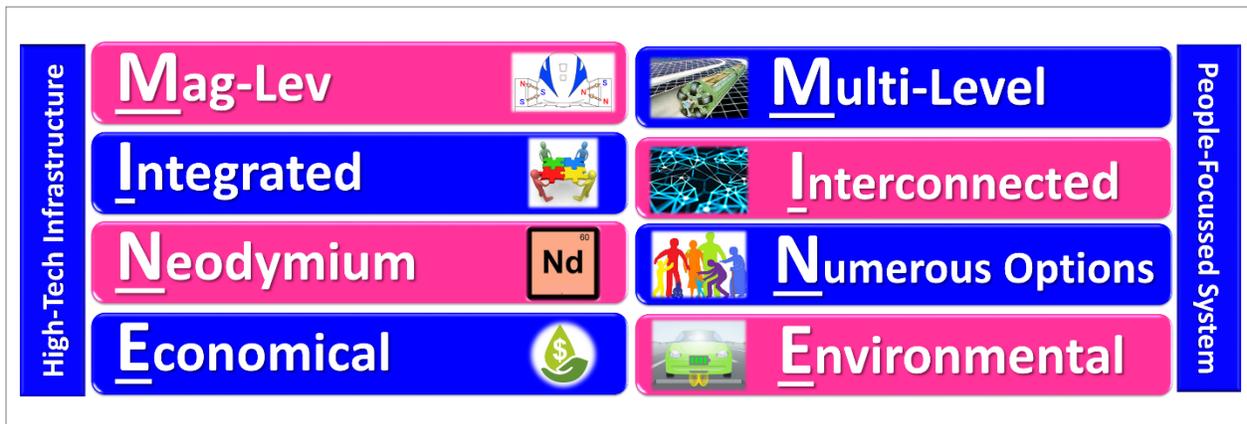


Figure 4: MINE-Mobility

Civil engineers developed MINE-Mobility’s high-tech infrastructure to be Mag-Lev, Integrated, Neodymium-Powered, and Economical. Industrial engineers designed MINE-Mobility’s people-focused, Multi-Level, Interconnected systems to have Numerous Options, and be Environmental. The MEC-Lace device integrates directly with MINE-Mobility. Since the self-learning MEC-Lace tracks each resident’s needs, seniors can communicate directly with MINE-Mobility to access numerous transit options.

For instance, AmphiPod personal vehicles can be self-driving or operate autonomously on both land and water. Solar, thermal, and piezoelectric roadways harvest energy and transfer it to AmphiPods through continuous induction charging, making them economical to operate and environmentally friendly. AmphiPods glide up the sides of buildings, allowing seniors to enter

without having to take stairs. Access is easy-in/easy-out, and living space is expanded, since AmphiPods act as a mini balconies! MINE-Mobility interconnects all zones, and AmphiPods link directly into the neodymium-powered MagLev elevated public transit system at citywide depots.

Impact on Seniors

Due to MINE-Mobility and the MEC-Lace, seniors have access to safe, secure, readily-available transit options. Quality of life and happiness have improved. Getting around the city is now possible for those who cannot drive.

Seniors are able socialize with friends and visit family. They have access to medical and emergency personnel through the MEC-Lace's real-time interface. Older residents no longer chose to become snowbirds in the winter or relocate after they retire. MINE-Mobility's HyperLoop extension even offers seniors daytrips to nearby Yellowstone and Glacier National Parks! MINE-Mobility and the MEC-Lace have restored independence to seniors, who are as active and involved as they desire!

Technologies Involved

MINE-Mobility and MEC-Lace communicators included both existing and new technologies. Existing technologies such as Mag-Lev and neodymium magnets were refined to become more efficient. New and futuristic technologies included R2-Remediation, energy-harvesting pavement and footwear, as well as continuous-charging roadways. The MEC-Lace's holographic, real-time communication interface with police, fire, and medical personnel, as well as dermal medication delivery, was based on emerging technologies imagined into the future.

Risks and Tradeoffs

Change comes with risks and tradeoffs, so engineers considered countermeasures and contingencies. To address risk of MEC-Lace malfunction, triple-redundant controls and closed-loop feedback were developed to insure uptime. Montana's winters bring risk of icy roadways and walkways. Walkability was ensured, however, through embedded thermal filaments from remediated copper to keep surfaces snow and ice free.

Cost to implement MINE-Mobility was tremendous. One tradeoff was to fund implementation over time using a revenue stream from renewable energy and the R2-Remediation technology. Modular scalability principles were also used to control infrastructure growth, which limited areas exposed to construction. Finally, patience was required, since the transformation took time.

Benefits

Despite risks and tradeoffs, the benefits of implementing MINE-Mobility and the MEC-Lace solutions were many. All residents now have an accessible, dependable, and affordable transit system for the ages. MEC-Lace's piezo-bead, self-charging capability encourages a healthier lifestyle.

The single industry causing Butte's decline has been replaced with diverse industries in Copper Valley. Employment opportunities exist in renewable energy, engineering, education, and senior care, to name a few. Finally, residents can now enjoy an improved environment, enhanced public health, improved property values, and lower taxes due to a strong tax base.

Engineers

City planners, architects, and engineers were instrumental in Butte's turnaround. Montana Tech's environmental engineers developed R2-Remediation for Berkeley Pit clean-up. Environmental engineers focus on protecting people and the environment through waste and pollution reduction.

After remediation, an engineering team of civil and industrial engineers developed the MINE-Mobility and MEC-Lace solutions to address lack of dependable public transit options for seniors. Civil engineers concentrated on high-tech infrastructure in developing system designs and implementing them on time and under budget. Industrial engineers focused on people-friendly solutions to create an efficient communication system that interfaces with the transit system.

Today, Copper Valley is again a boomtown due to solutions developed by great engineers!

Word Count:

Does not include title, references:

Text: 1,448 words

4 Graphics: $3+14+18+14 = 49$ words

Total: $1,448 + 49 + 1,497$ words

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