

NSF Engine: Sustainable Mining Innovation and Lifestyle Enhancement Regional Innovation Engine (SMILE Engine)

Abstract

Demand for minerals is at unprecedented levels, due to global energy transitions, population growth, and increasing wealth. Healthy communities and responsible mining techniques are crucial to U.S. geopolitical and defense strategies as the urgency for domestic mineral supply intensifies. The mining industry plays a key role in meeting this demand; however, it also accounts for 11% of total global energy use¹. While mining companies have set net zero goals, they struggle to meet targets as production increases. The industry also faces challenges in talent acquisition and the integration of advanced technologies.

In this Engine, mine electrification, AI, and automation technologies are pivotal for use-inspired research, fostering investments and intentional management that create a flywheel effect, driving workforce development and establishing innovation communities that endure beyond mining.

The Sustainable Mining Innovation and Lifestyle Enhancement Regional Innovation Engine (SMILE Engine) will transform these challenges into opportunities by tapping these communities as innovation testbeds. Many mining communities are unique in that they are small microcosms unto themselves, and represent unique ecosystems with dedicated schools, medical care, recreational facilities, and transportation – these represent an opportunity for innovation, sustainability and economic development - well beyond the obvious outcomes of mining jobs and direct support of mining operations. SMILE Engine will systematically leverage major planned investments in the mining sector within specific underserved communities in Southern Arizona to create generative multi-sector economic development that can be scaled regionally and nationally. This focus on use-inspired research will lead to technology development, deployment, and demonstration at scales achievable only within the unique mining ecosystem.

The Future of Mining with Transferable Workforce & Economic Benefits

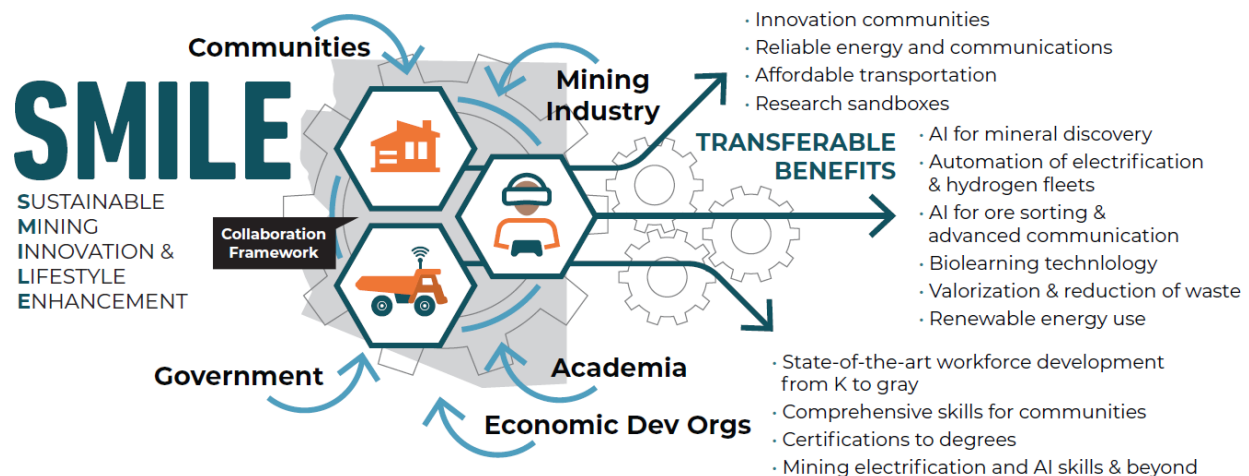


Figure 1. SMILE Engine Vision.

Technology Innovation Areas include, but are not limited to:

- Alternative Power and Automation for Mining Fleets
- AI and sensing applications in ore sorting and comminution
- Leaching (including bio-leaching)
- Renewable Energy Utilization
- Waste Valorization, Management, and Reuse

¹ Igogo, T., Lowder, T., Engel-Cox, J., Newman, A., Awuah-Offei, K., *Integrating Clean Energy in Mining Operations: Opportunities, Challenges, and Enabling Approaches*, Technical Report NREL/TP-6A50-76156. 2020. p. 54. <https://www.nrel.gov/docs/fy20osti/76156.pdf>