Project Update: Energy Recovery Optimization Across Mine Sites

Objective

Created a GAMS optimization model that determines (for each mine site) the preferred energy recovery system (scenario) to maximize total recoverable energy / $ profit, subject to:

- Tailings heat potential
- Energy conversion efficiency
- Water-use limits
- Economic factors (CAPEX, OPEX)

Work 1: Base GAMS Model

I initially created a conceptual GAMS model with three sites and two scenarios:

Sets

- i → mine sites (site1, site2, site3)
- s → scenarios (s1, s2)
- t → time periods (t1*t20)

Parameters

- Tailings temperature (T(i,s))
- Efficiency (E(s))
- Water usage and limit (Water Use(i,s), Water Limit(i))
- Price of electricity (Price(t))

Decision Variables

- X(i,s) → Binary: 1 if scenario s selected for site i
- P(i,s,t) → Power generated
- Revenue(i,s,t) → Revenue per site, scenario, time
- Energy_total, Revenue_total → Summed objectives

Objective
Maximize total energy recovered:

$$\text{Maximize } Energy\_total = \sum_{i,s,t} P(i,s,t)$$

Key Constraints

- **Power output:** $\boldsymbol{P(i,s,t) = T(i,s) * E(s) * X(i,s)}$
- **Only one scenario per site**
- **Water-use limit:** $\sum_s \quad \boldsymbol{WaterUse(i,s) * X(i,s) \leq WaterLimit(i)}$
- **Revenue tracking:** $\boldsymbol{Revenue(i,s,t) = P(i,s,t) * Price(t)}$

UPDATED WORK: MRDS Data Integration

I'm replacing the dummy data with real-world mine site information using the USGS Mineral Resources Data System (MRDS).

Idea:

1. **The MRDS data I used** *(MRDS.csv)*.
2. **Filtered relevant sites**:
    - States: Western U.S. (CO, NV, UT, AZ)
    - type of deposit: tailings, past producers, or stockpiles
    - Commodities: gold, copper, uranium, silver, etc.
3. **Created a GAMS formatted parameter table** (mrds_top100.csv) for the top 100 filtered sites, including *heroic assumptions* for missing data.

NEXT: Data Table for GAMS

Each site record in mrds_top100.csv contains:

Parameter	**Description**	**Assumed / Derived**
site	Site name (from MRDS)	MRDS
state, commodity, latitude, longitude	Metadata	MRDS
Heat	Tailings temperatures (°C)	Random 80–120
Efficiency	Conversion efficiency	0.08–0.12
WaterUse	Water needs	80–150 m^3
WaterLimit	Max allowable water use	100–120 m^3
CAPEX_USD	Capital cost	$10–30M
OPEX_USD per/year	Operating cost	$1–2.5M
SystemSize	Installed capacity	3–5 MW

Final GAMS Model (MRDS-driven)

I built the final integrated GAMS model energy_recovery_mrds.gms (not finished):

- Reads parameters from mrds_top100.gdx
- Uses MRDS sites as the set i

- Maximizes total energy recovered (Energy_total)
- Includes:
    - Water-use constraint
    - Scenario exclusivity
    - Optional capacity limit (based on system size)
    - Full revenue structure for later economic optimization

Up to this point, I generated the data with the USGS MRDS. I filtered it to the top 100 mine sites from Colorado, Nevada, Utah, and Arizona. Focusing on tailings and producers that could become candidates for energy recovery. I'll switch them to past producers if it doesn't work. Selected sites have been put together in an Excel sheet, which I've attached as proof of progress. Once the model is readied with code, these sites will be employed to simulate and assess various energy recovery scenarios.