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# CHP in Mining Applications

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# Typical Mining Project Business and Operational Objectives

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- Business Objectives
  - Ore excavation
  - Ore processing (on-site or remote)
  - Product transportation via roadways and/or railroads
- Operational Objectives
  - Safety
  - Regulatory and environmental compliance
  - Reliability
  - Power and thermal energy production

# Majority of Mines are Located at Remote Sites

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- Utility services: preference for Self Reliance
  - Electricity
  - Fuel
  - Water
  - Waste water
- Consolidate utilities:
  - Safety: Separation of utility teams from mining and process areas
  - Operational efficiencies
  - Synergies with technologies

# Two Types of Mines

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## Electrical and Thermal Energy Requirements

- Tunnel
  - Shaft ventilation and cooling
  - Life safety
  - Shaft dewatering
  - Ore extraction
  - Delivering ore to surface: elevators / conveyors
  - Ore processing
  - Water / wastewater treatment
- Open Pit
  - Pit dewatering
  - Delivering ore via conveyors or trucks
  - Ore processing
  - Water / wastewater treatment



# Project Development: Why CHP?

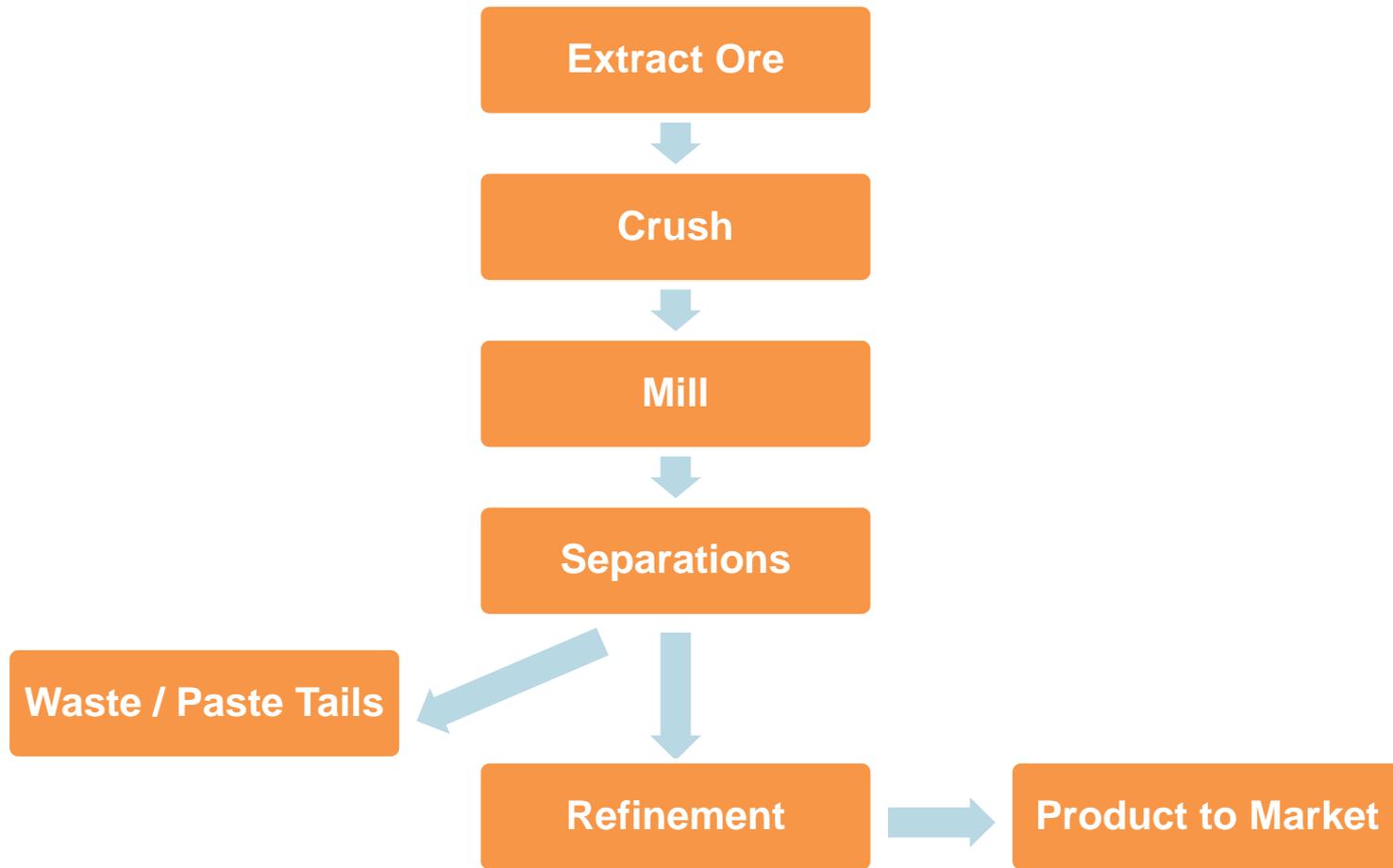
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- **Necessity:**
  - Remote location
  - Unavailable / Inadequate grid power capacity
  - Poor grid power quality
- **Economics Driven by Commodities Market Conditions:**
  - Self Generation vs. Purchase Power from Grid
  - Need for low cost power and thermal energy

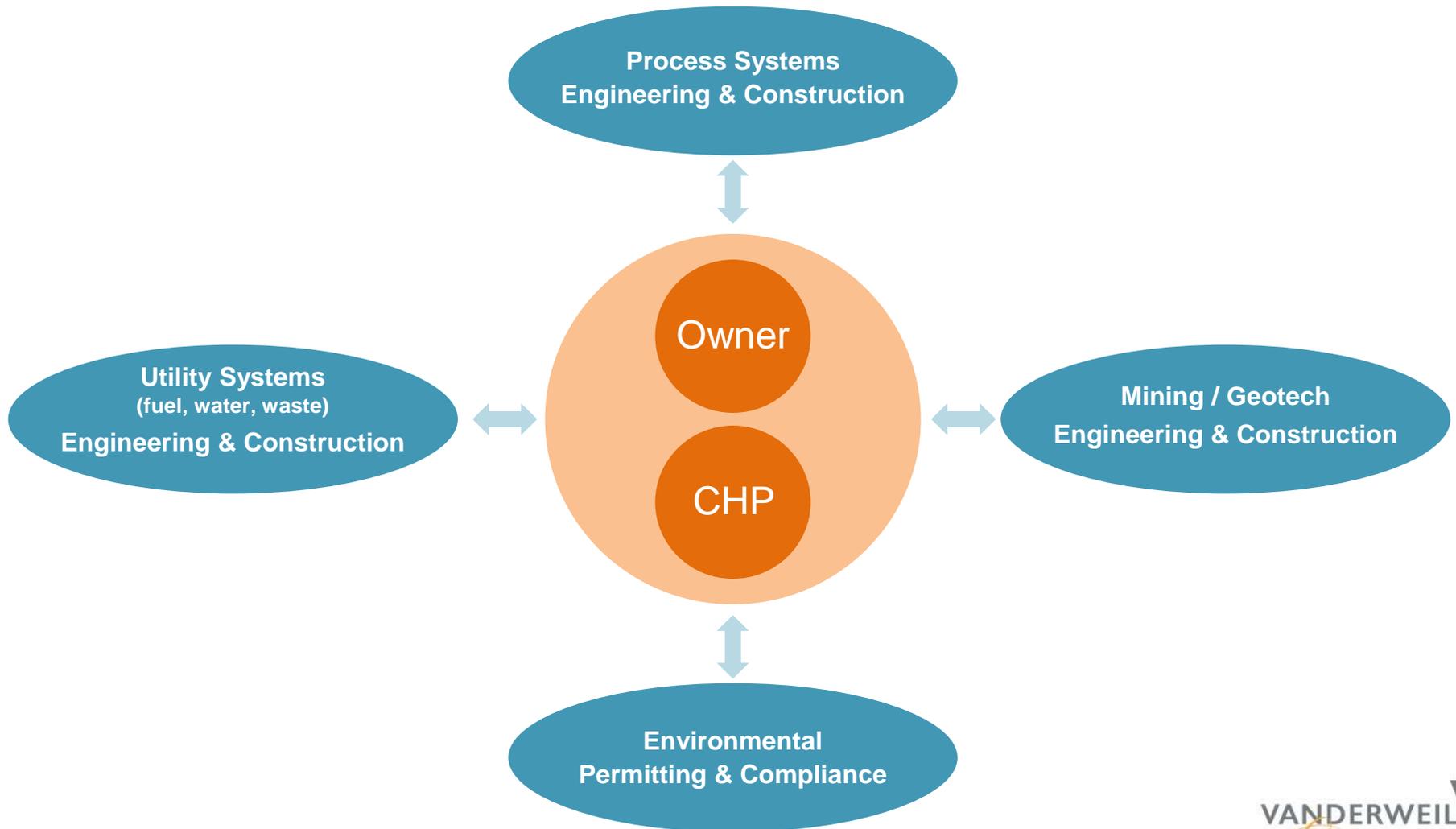
# Typical Mining Process Steps

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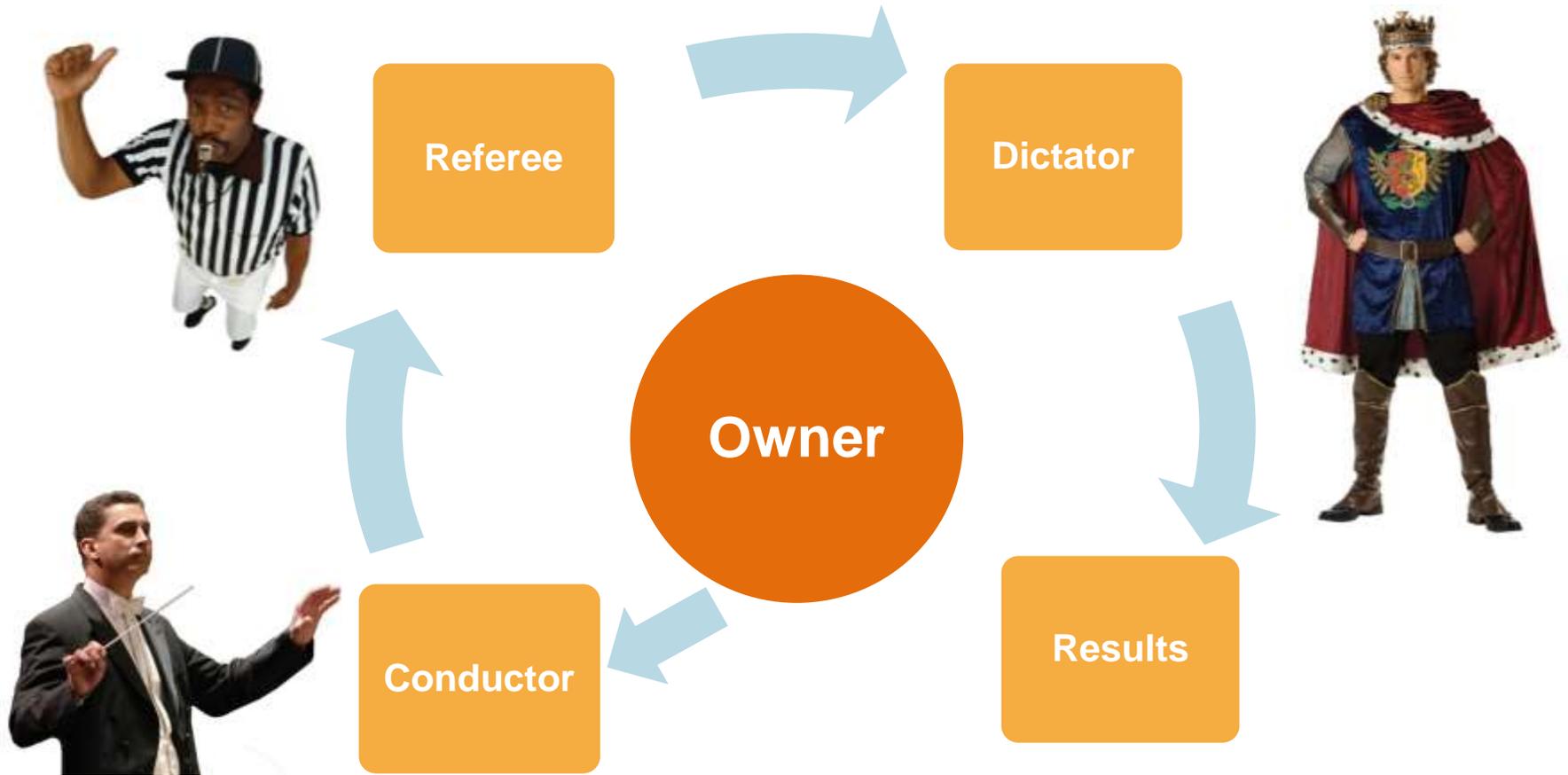


# Typical Project Team Interaction

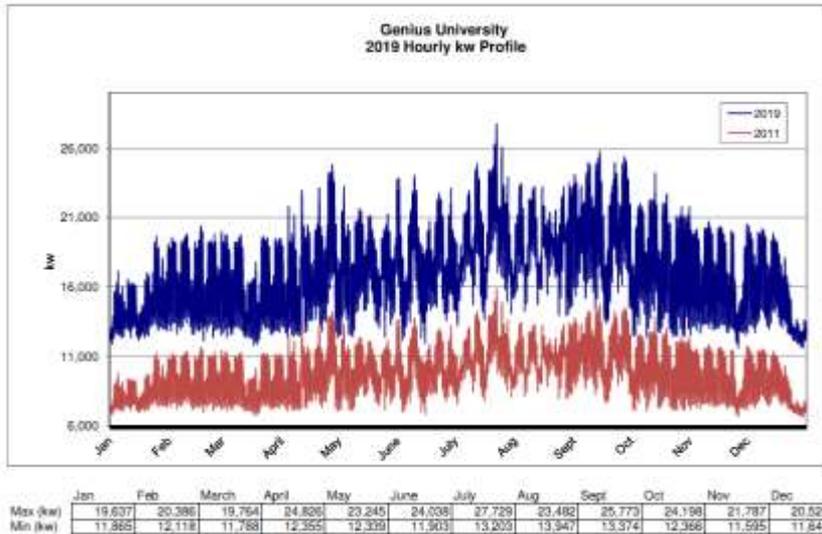
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# Project Team: Owner Roles



# Concerns, Load Development



- Over estimate loads:
  - Unnecessary front-end cost
  - Turn-down
  - Air permit
  - Operational inefficiencies
- Under estimate loads:
  - Operational shortfalls
  - High CapEx for incremental capacity addition
- Starting of large motors
  - Intervals
  - Durations
- Phasing of initial mine / process start-up

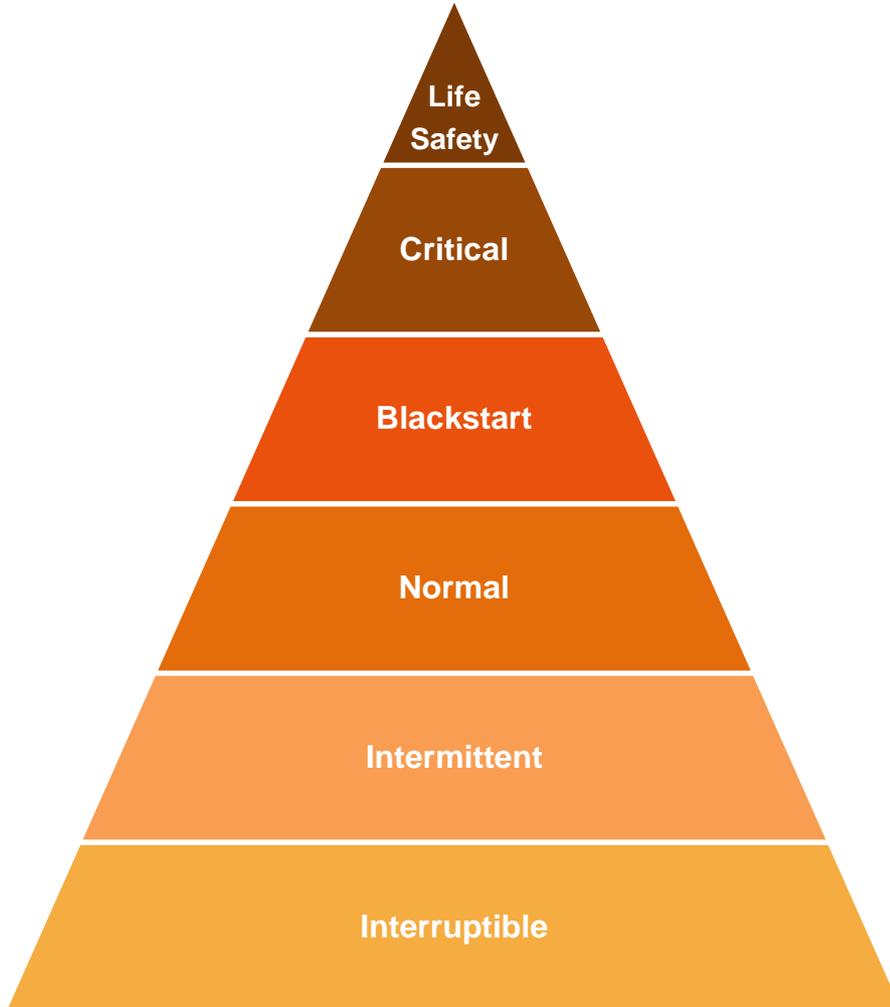
# Dynamics in Developing Load Estimate

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- Ground up approach
- Little / no historical data
- Connected load vs. diversified
- Hidden safety factor(s)
- Skid mounted equipment: adds layer of uncertainty to loads

# Define Electrical and Thermal Loads

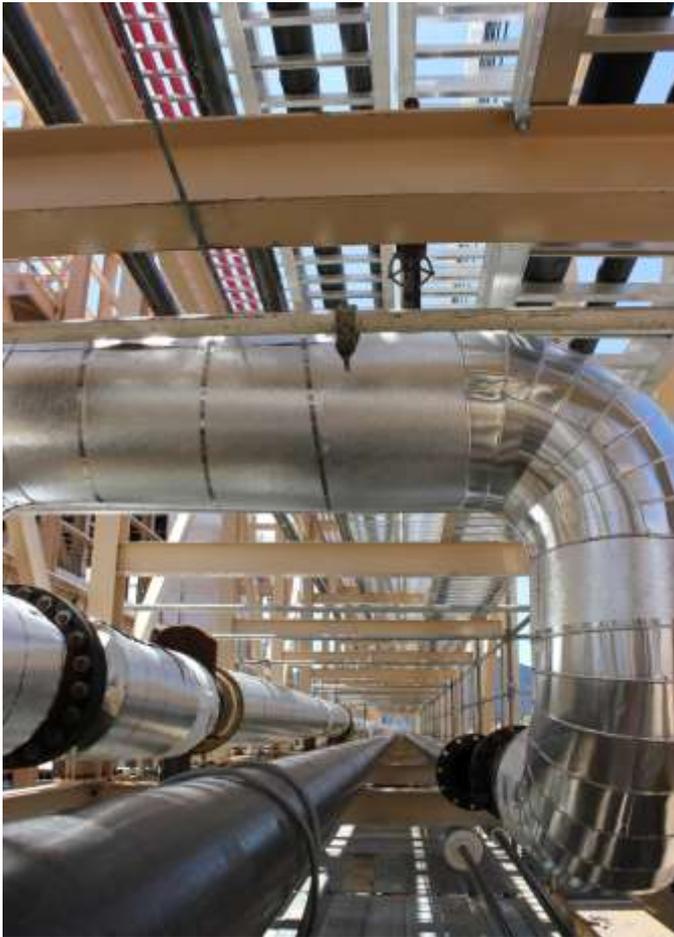
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- Iterative / educational process
- Operational flexibility
  - Curtail non-process loads during peak
  - Schedule batch process loads
  - Match thermal & electrical loads with alternate means of driving equipment or process
- Load Types

# Generation Technology

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- Reliable and Serviceable
  - Redundancy (N+1, N+2)
  - Shut downs / Upsets
- Rapid start-up
- Extremes in site conditions
  - Elevation
  - Temperatures
- Starting largest loads
- Critical generation equipment

# Permitting / Regulatory Compliance

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- **Federal, State and Local Land Use Permit Facilities**
  - Mining and process require land-use permits and appropriate zoning compliance
- **Air Permit**
  - Typically regulated by the local State DEP
  - Mining and process operations may add emissions to overall site
  - Major source vs. minor source
  - Attainment vs. non-attainment zones
  - Emission credits
- **MSHA: Federal Government oversight agency for all aspects of the mining, including the CHP**
- **Local Authorities**
  - Building and Fire Departments
- **Remote fuel source / grid connection rights of way**

# Distribution

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- Rough terrain dictates method
  - Rack
  - Utilidor / Tunnel
  - Shallow Trench
  - Buried
  - Surface
- Separate Services
  - Power
  - Signal
  - Thermal and water utilities
  - Process

# Fuel

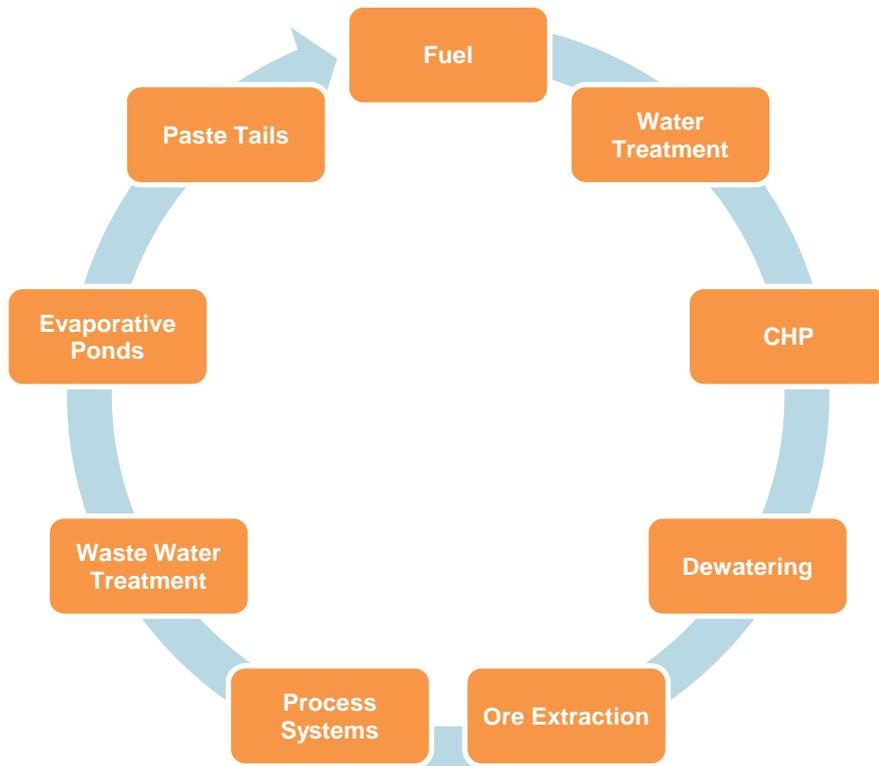
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- Natural Gas
- Alternate Fuel Sources
  - Remote locations
  - Short-term / small systems / back-up source

# Commissioning

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- Interaction between loads and utilities
- Utilize portable or stand-by generators, storage tanks, load banks, and steam venting
- Incorporate provisions into air permit

# Conclusion

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Remote location creates challenges, however, economics and independent spirit of miners can develop opportunities for CHP systems at mine sites.



# Questions & Answers

Thank you.

