

COAL MINE CLOSURE STANDARDS

Raymond C. Pilcher, President

Raven Ridge Resources, Incorporated

Chair UNECE GoE on CMM and Just Transition

WORLD BANK GROUP

ENERGY AND EXTRACTIVES GLOBAL PRACTICE



Three Pillars Underpin Successful Transitions

- **Institutional Governance**
 - Policies and legal framework are critical to a just transition and may need adjustments/ amendments to provide adequate coverage as mines close and transition proceeds
- **People and Communities**
 - This is the core consideration and actions that impact the coal mining communities must have broad stakeholder input and interaction—something that has not always been central to the process in coal mining regions
- **Repurposing Land and Assets**
 - Critical to redevelopment is providing restored land and ensuring best use that is environmentally sound and most equitable for stakeholders
 - Establishes post mining potential for re-investment and healthy growth

Why it is important to strengthen existing legal and regulatory requirements for coal mine closure?

- In many jurisdictions, existing mine closure regulations were designed to avoid environmental and safety hazards but may not have considered future uses of land
- Regulations governing environmental consequences of mining, closure, and restoration have changed over the years as experience and understanding has become more global in scope, but not in all jurisdictions
- Planning for closure should begin as the mine is opened to avoid future problems caused by poor decisions during mine life
- Mine closure should be engineered to protect aquifers, and control gas emissions and effluents,
- Surety bonds or other financial facilities may be inadequate for closure and restoration—knowing the costs of closure is critical for future planning
- Processes for irrevocable closure are important to protect against unofficial mining and allow for repurposing

Three phases of closure—planning and good practices are key to achieving a just and equitable transition

Pre-closure

Planning operations should start as early as possible involving mine operator, governing authorities and local stakeholders

- Early and well-informed risk-based choices in the early planning stages of mine closure
- Preparation of a well-considered and comprehensive plan
- Selecting possible options for repurposing mine lands
- Make choices that ensure that the value of the mined land and remaining non-coal resources are utilized to their fullest potential

Closure

Reclaiming and restoring mine lands, initiated to reduce/eliminate geotechnical and environmental risks and hazards such as mine water and fugitive gases

- Preservation of remaining assets and natural resources, archived mine plans, maps, and data
- Identifying, monitoring and addressing residual risks during closure enables optimal and sustainable use of former mine lands and assets
- Managing risks and developing mitigation strategies which are based on sound technical approaches
- Engage and involve governing bodies and affected stakeholders

Regional transition

Implementing projects with higher value in former mine lands using remaining physical infrastructure and natural resources

- Remediation and future land use with well organized government innervation
- Well informed decisions based on factually addressed legacies and opportunities, employing Land Repurposing Methodology (LRM)
- Strategic impact assessment, pre-licensing, Special purpose entities (SPEs)

The aim of coal mine closure planning



Coal mine closure planning should begin early in the mining life cycle — mining practices employed during mining should be chosen with an eye toward inevitable closure



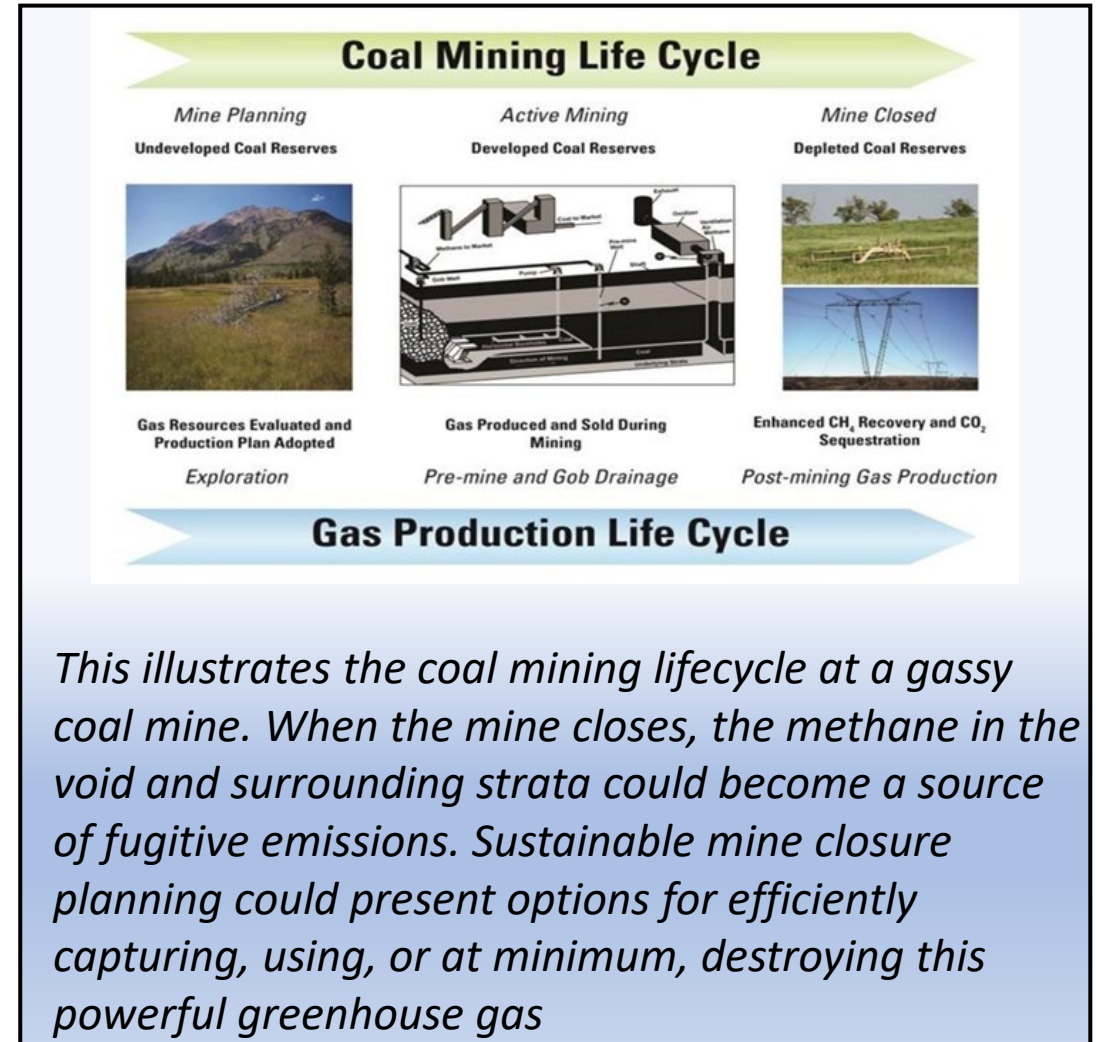
Planning should be directed at mitigating the impact of risks and charting a path to a sustainable post-closure future



Unaddressed risks increases costs of closure, reduces value of remaining natural resources, and increases potential for unintended local and global environmental consequences



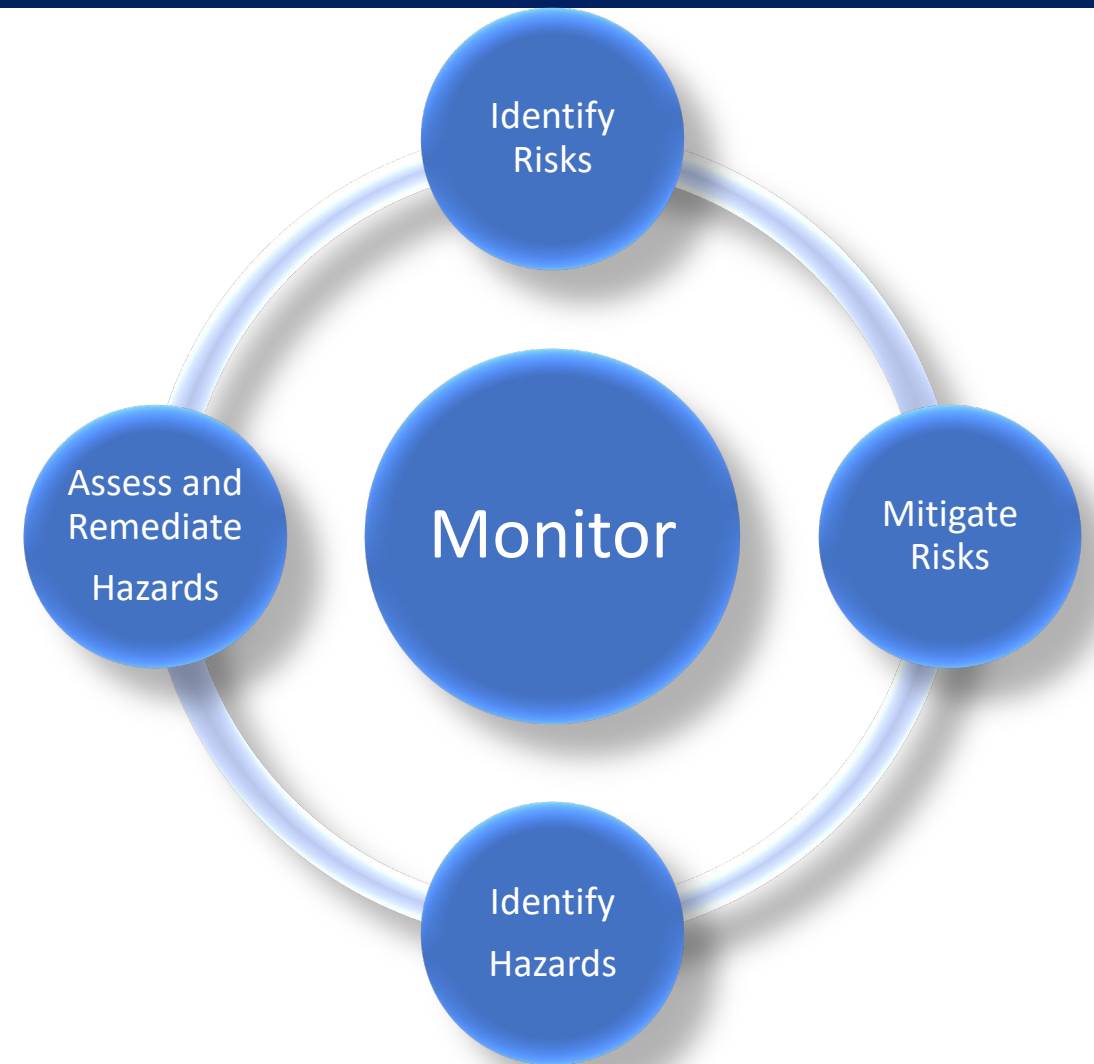
Well planned closure envisages a sustainable future and the highest use of remaining assets and natural resources after the mine closes



This illustrates the coal mining lifecycle at a gassy coal mine. When the mine closes, the methane in the void and surrounding strata could become a source of fugitive emissions. Sustainable mine closure planning could present options for efficiently capturing, using, or at minimum, destroying this powerful greenhouse gas

Coal mine closure and a post-closure sustainable future centers on risk-based planning

- Risk management is essential for planning mine closure and future resource utilization to ensure stable land and a safe environment for land repurposing.
- Key actions are:
 - identifying potential and existing hazards
 - assessing the risks to community and future land use options
 - adopting a plan of action to mitigate risks and remediate hazards
- Mitigation of risks and remediation of hazards may be costly, but the value of repurposed land and a healthy future depend on early decisions based on good-practices during the coal mine life cycle.



Sustainable coal mine closures require strong technical procedures

Four overarching principles are paramount when planning and implementing mine closure

- Public safety—protection of the surrounding community
- Land stability— prevention of soil erosion and mitigating problems caused by subsidence
- Mitigation of chemical impacts— safeguarding against surface and subsurface pollutants
- Environmental reclamation, emissions control, and post-closure land use—revitalizing mined land while controlling methane emissions and mine water excursion

In most jurisdictions, these principles are the foundation for legal and regulatory frameworks that govern mining activities on the surface and subsurface. They may need updating and better enforcement procedures

		OPERATIONAL DOMAINS		
		Surface	Subsurface	Legal and Regulatory
OVERARCHING PRINCIPLES	1.) Public Safety	x		x
	2.) Land Stability	x	x	
	3.) Mitigation of Chemical Impacts	x	x	x
	4.) Environmental, Reclamation, Emissions Control, and Post-Closure Land Use	x	x	x

Probability-based risk assessment is employed to preserve asset value and protect communities

	Insignificant	Minor	Moderate	High	Major
Improbable 0%-20%	0.19	0.38	0.57	1.14	1.71
Unlikely 20%-40%	0.42	0.84	1.26	1.68	2.10
Possible 40%-60%	0.50	1.00	1.50	2.00	2.50
Likely 60%-80%	0.58	1.16	1.74	2.32	2.90
Most Likely 80%-100%	0.81	1.62	2.43	3.24	4.05

SEVERITY OF ECONOMIC DAMAGE →

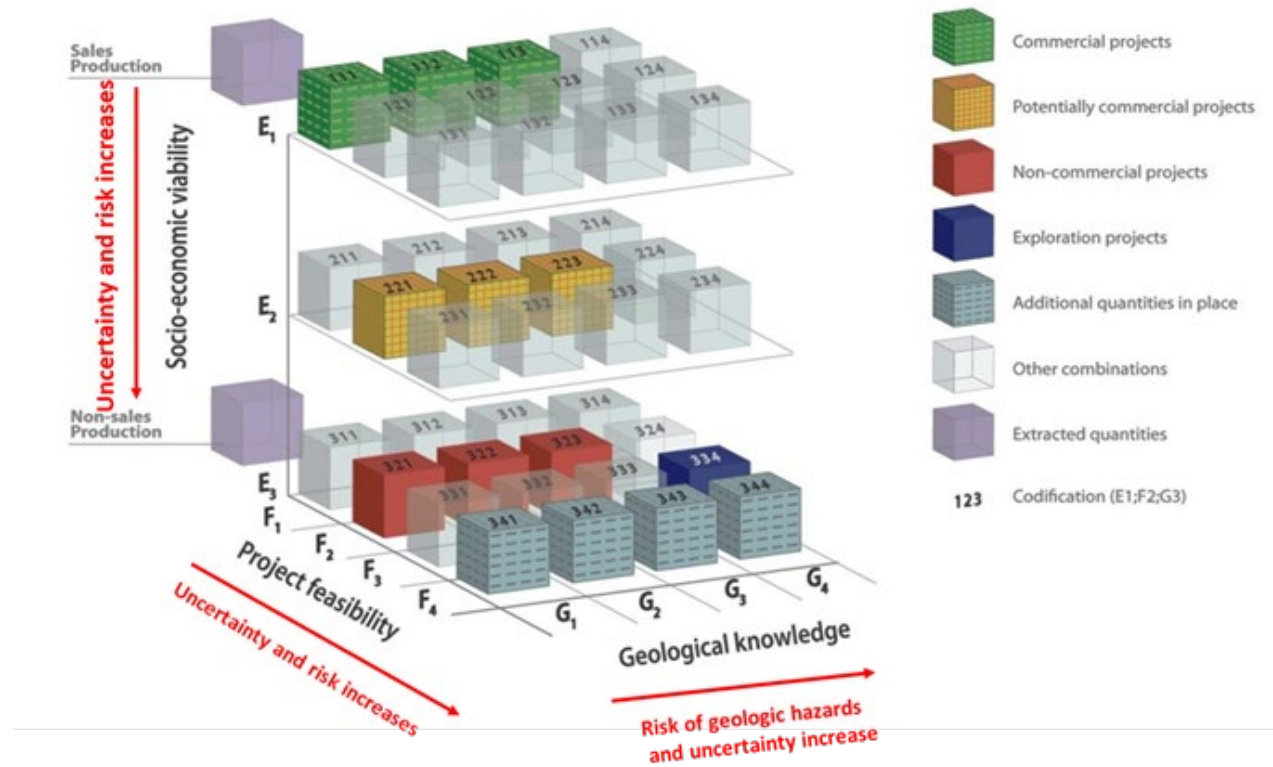
↑ INCREASING LIKELIHOOD OF OCCURRENCE

Matrix mapping the likelihood of a risk occurring versus the range in severity of its potential impact. Mine management performing the assessment will use their professional judgement to determine the likelihood of occurrence and the severity of impact.

- The World Bank has adopted an approach to mine closure that is risk-based and centered on good practices
- It is a systematic approach employing a probability-based risk assessment that may be used to predict the likely outcome of taking (or not taking) certain steps to mitigate potential loss of value to land and other natural resources
- The impact of risks to mine-related asset and natural resources should be considered when planning the closure of the mine.
- Planning should start early in the life of the mine and should be reviewed periodically

Natural resources remain after coal mine closure-they must be managed

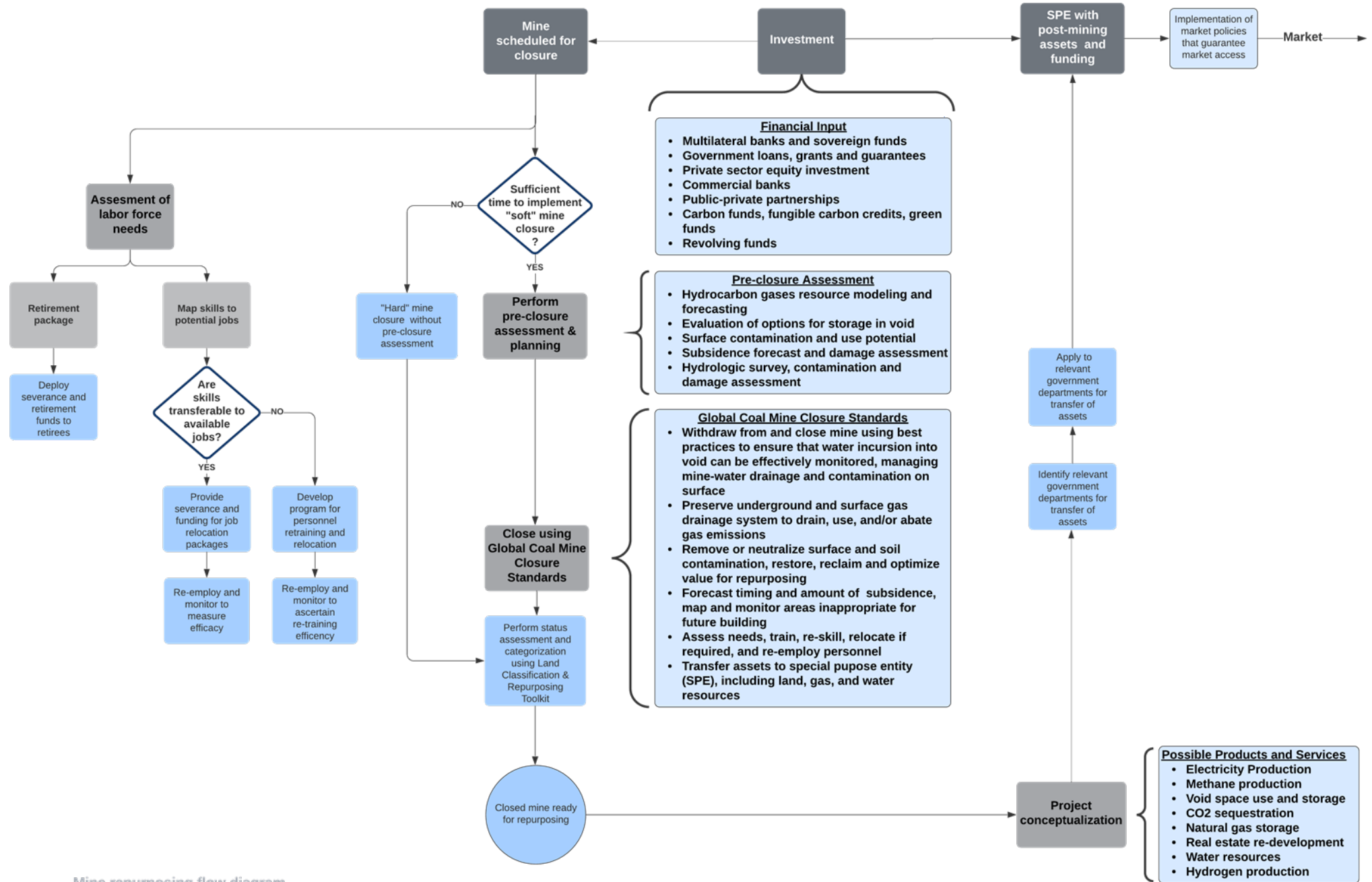
- Valuable non-coal natural resources will remain after coal mines are closed
- They may be valued, or pose a threat to the environment —but managing these resources is crucial to repurposing mined land
- The United Nations Framework Classification is a key part of a system that can be employed to manage resources and develop appropriate strategies for their future use
- Understanding the potential use of non-coal resources, such as gas, water and other valuable materials is an important consideration when planning closure and repurposing mined-land in a way that supports the local community and region undergoing transition



Planning for sustainable closure requires identification of risks and mitigants

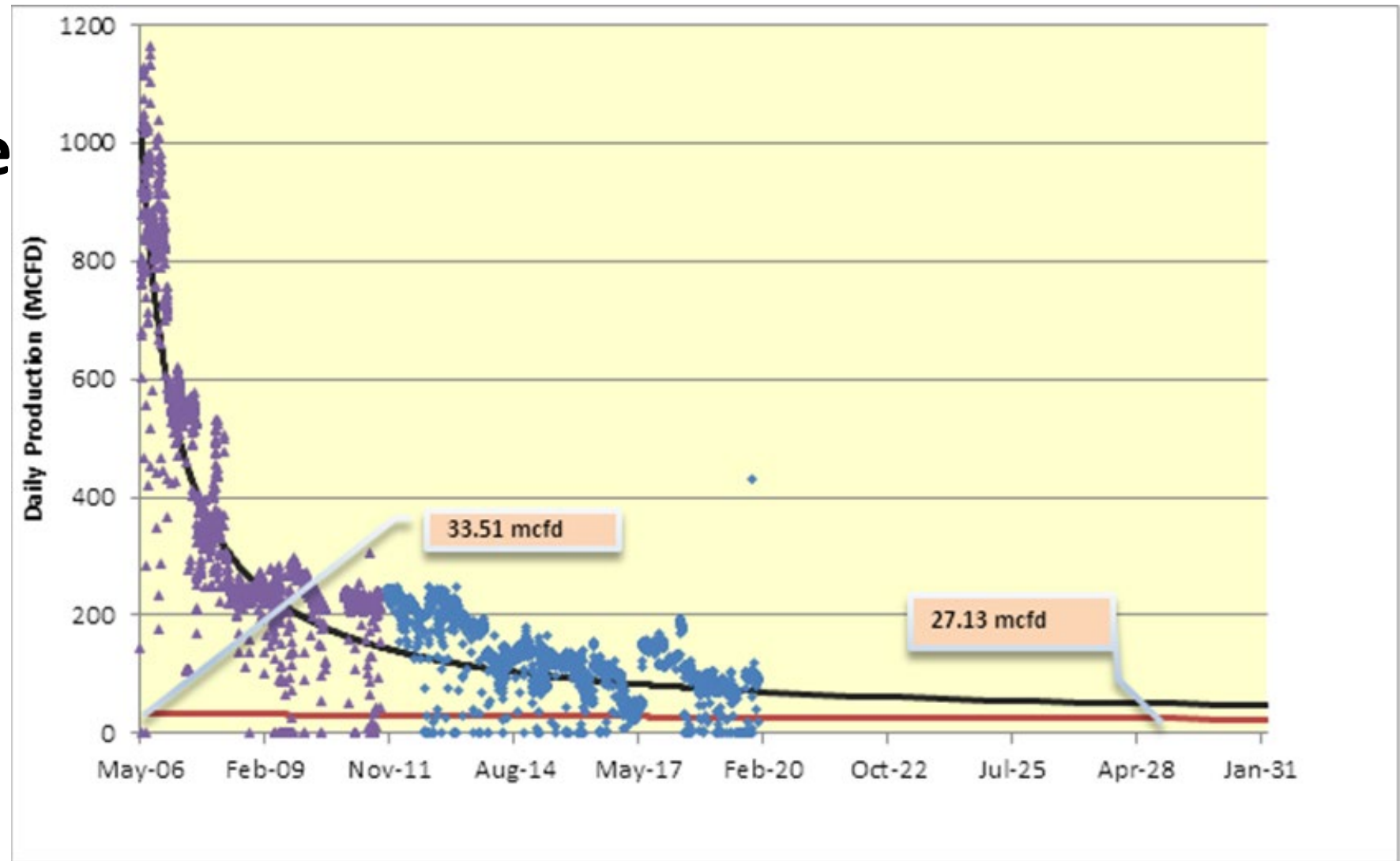
	Overarching Principles	Asset or resource at risk	Intrinsic value	Risks and potential negative impacts	Actions that will reduce risks
Surface Domain		<i>Natural ground, surface features, and landforms</i>	Ecological preservation	Irreversible alteration or destruction	Pre-mine planning and judicious placement and management of mine wastes
		<i>Useable land surface</i>	Agriculture and real estate	Contamination of topsoil, destruction of wildlife habitat	Land use planning coordinated with mine planning and periodic monitoring
		<i>Workforce and local community</i>	Human resources and community strength	Social and economic disruptions	Human resource mapping and progressive retraining during mine life. Train, up-skill, re-skill and relocate.
		<i>Neighboring industrial community</i>	Industrial ecosystem centered on natural resources and workforce	Mine closure and relocation of workforce causing economic loss	Careful planning and business community engagement. Development and implementation of long-term strategies and economic support
		<i>Surface water resources</i>	Water supply for community and agriculture	Chemical contamination, disruption or depletion of supply	Plan to prevent and avoid unnecessary impact on surface water sources. Monitor, mitigate, and report
Subsurface Domain		<i>Subsurface water resources (groundwater)</i>	Water supply for local community, commercial and industrial uses	Subsidence and strata relaxation disturb, depletes or destroys groundwater reserves	Diligent mine planning and use of water monitoring wells drilled into key aquifers. Water supply clean-up.
		<i>Mine void storage</i>	Storage of valuable resources, CO ₂ or wastes	Filled with disused equipment, fire, collapse, and water flood	Plan and retain in-mine pipes to drain and monitor and control gas and water, or stored gases or wastes.
		<i>Coal-associated hydrocarbons</i>	Low-cost and relatively clean fuel for uses	Leakage, migration, loss, and accidents	Capture, use or abate. If sealed must monitor regularly.
Legal, Regulatory, and Financial Domain		<i>Subsurface mineral rights</i>	Subsurface mineral, oil and gas rights	Lack of clear ownership will thwart development	Clarify legal rights and streamline transfer of mineral title after mine operations cease
		<i>Subsurface water rights</i>	Rights to groundwater for all uses	Rights are valuable and may be contested preventing use	Clarify legal rights and streamline transfer of mineral title after mine operations cease
		<i>Subsurface rights to the mine void</i>	Rights required for storage or extraction of gas and water	Unclear laws deter use and may prevent extraction of resources	Clarify legal rights and streamline transfer of mineral title after mine operations cease
		<i>Access to Markets</i>	Access to energy and commodity markets	Complex regulations may block easy access and impede sales	Access to energy markets should be ensured by appropriate legislation and regulation.
		<i>Access to Finance</i>	Funding is needed for commercial projects	Funding and insurance often difficult or impossible to obtain for coal mine projects	Special finance is needed for mine land repurposing, water clean-up, methane capture and use, and mine void utilization.

- Risks are present in each of the domains within which a coal mine operates: the surface, subsurface and the legal, regulatory and financial.
- Mining professionals should determine the likelihood that the intrinsic value of an asset or natural resource will be diminished if actions are not taken
- Mine plans should be developed with considerations for inevitable closure
- Mine closure should be planned using risk assessment to determine the potential diminishment of value for assets and resources that are key to reclamation and repurposing

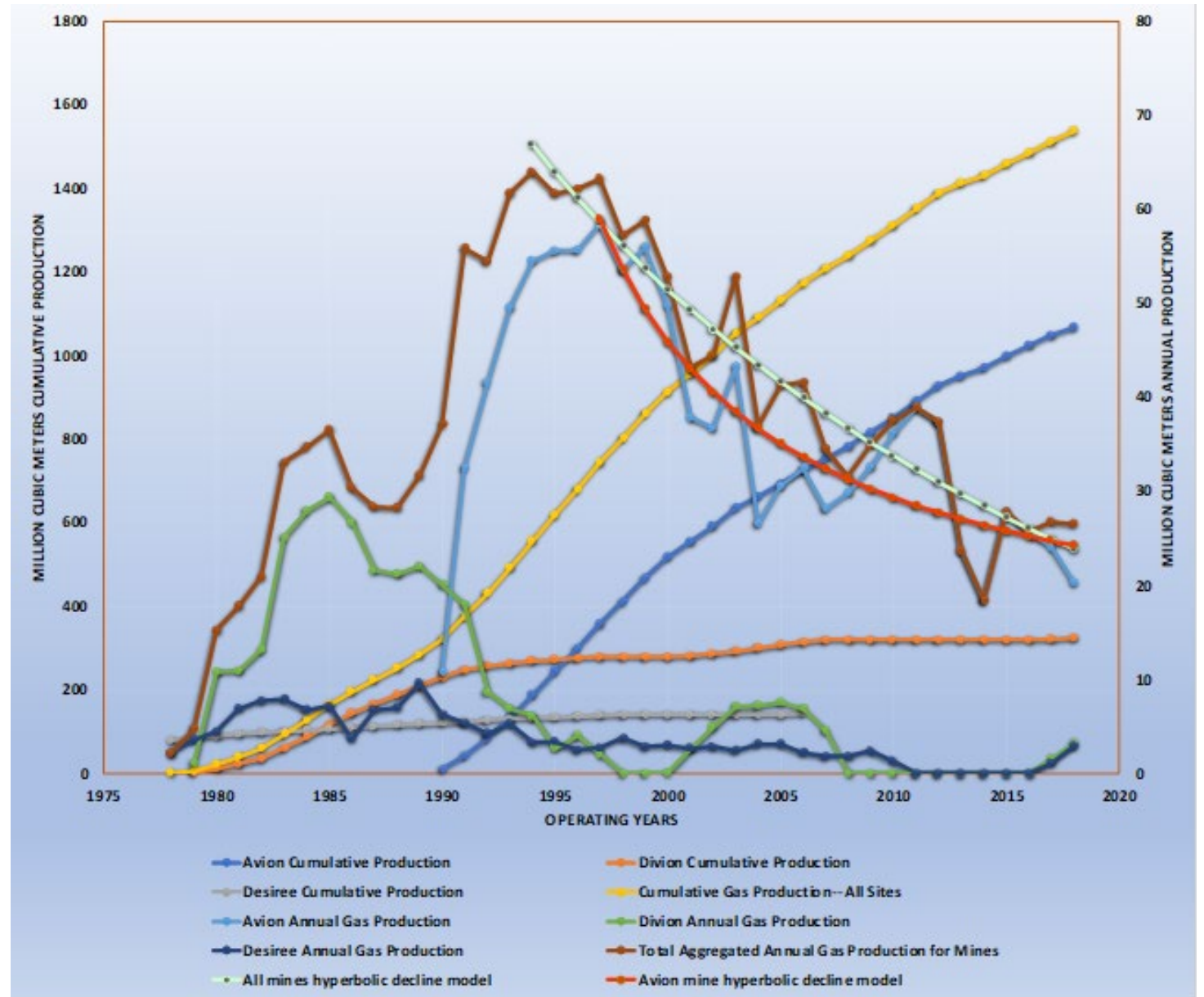


Mine repurposing flow diagram

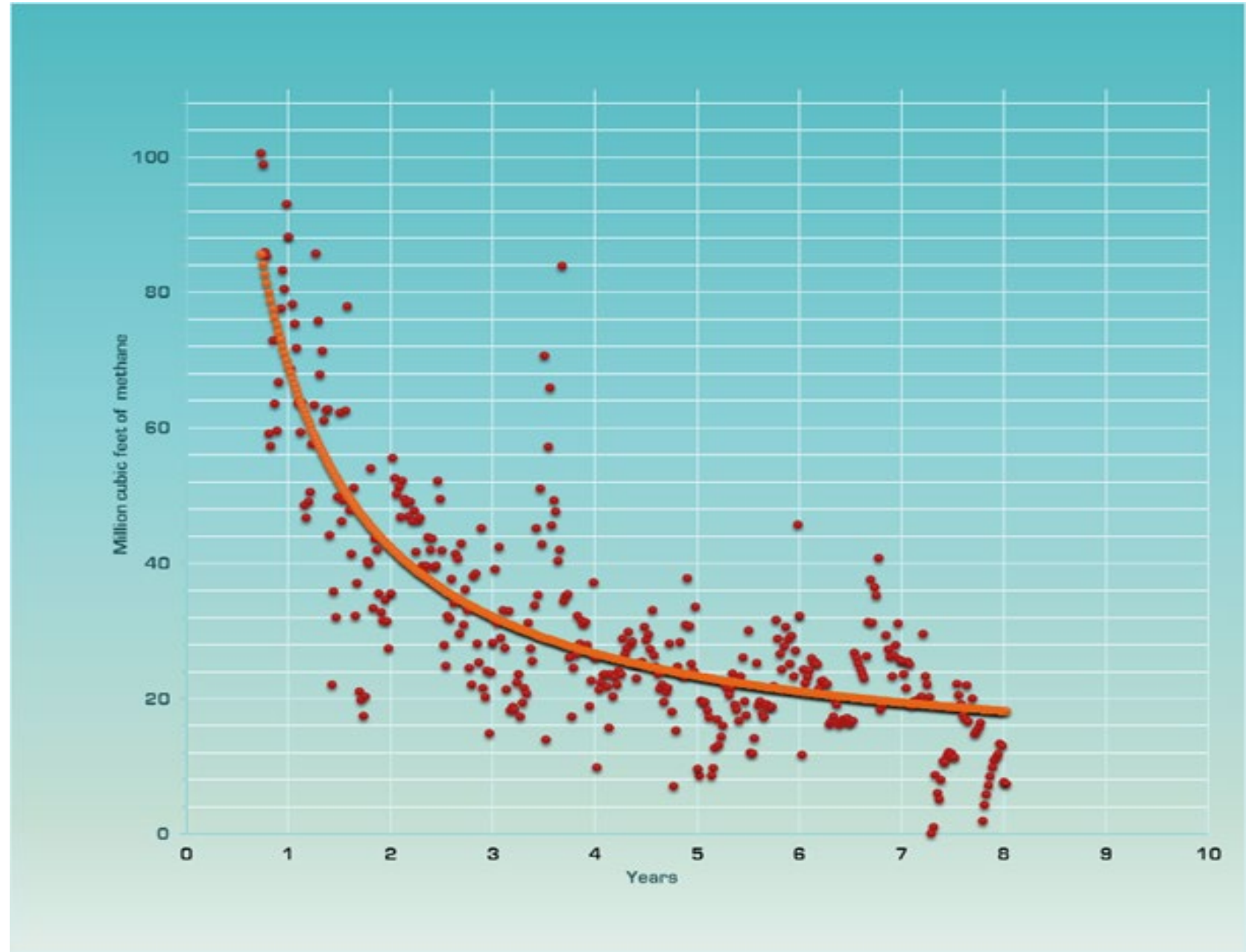
Plot of methane production at an abandoned mine complex in Illinois USA



Plot of methane production at an abandoned mine complex in France operated by Francaise de l'Energie



Plot of methane emissions at an active mine in Western Colorado, USA operated by Arch Coal





THANK YOU

FOR MORE INFORMATION PLEASE CONTACT:

Ray Pilcher | pilcher@ravenridge.com

or

Michal Drabik | michal.drabik@un.org

