Maximizing the Value of Abandoned Mine Methane at Abandoned Mines in the United States

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Abandoned Mine Methane (AMM) Development

- Similar to conventional underground coal mine methane (CMM) projects
- A few differences worth noting:
  - No active mine ventilation; therefore fewer complexities
  - “Medium-quality” gas (30-80% CH4 concentrations); more consistent concentrations, less variation
  - AMM project infrastructure smaller-scale than CMM
  - AMM gas ownership may be unclear
  - Gas flows decline over time
  - Mining company involvement optional

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Technical Barriers

- Uncertainty in methane resource
- Geological conditions
- Water flooding
- Compartmentalization
- Adequate piping and seals upon closure
- Suction pressure
- Remote locations with limited access

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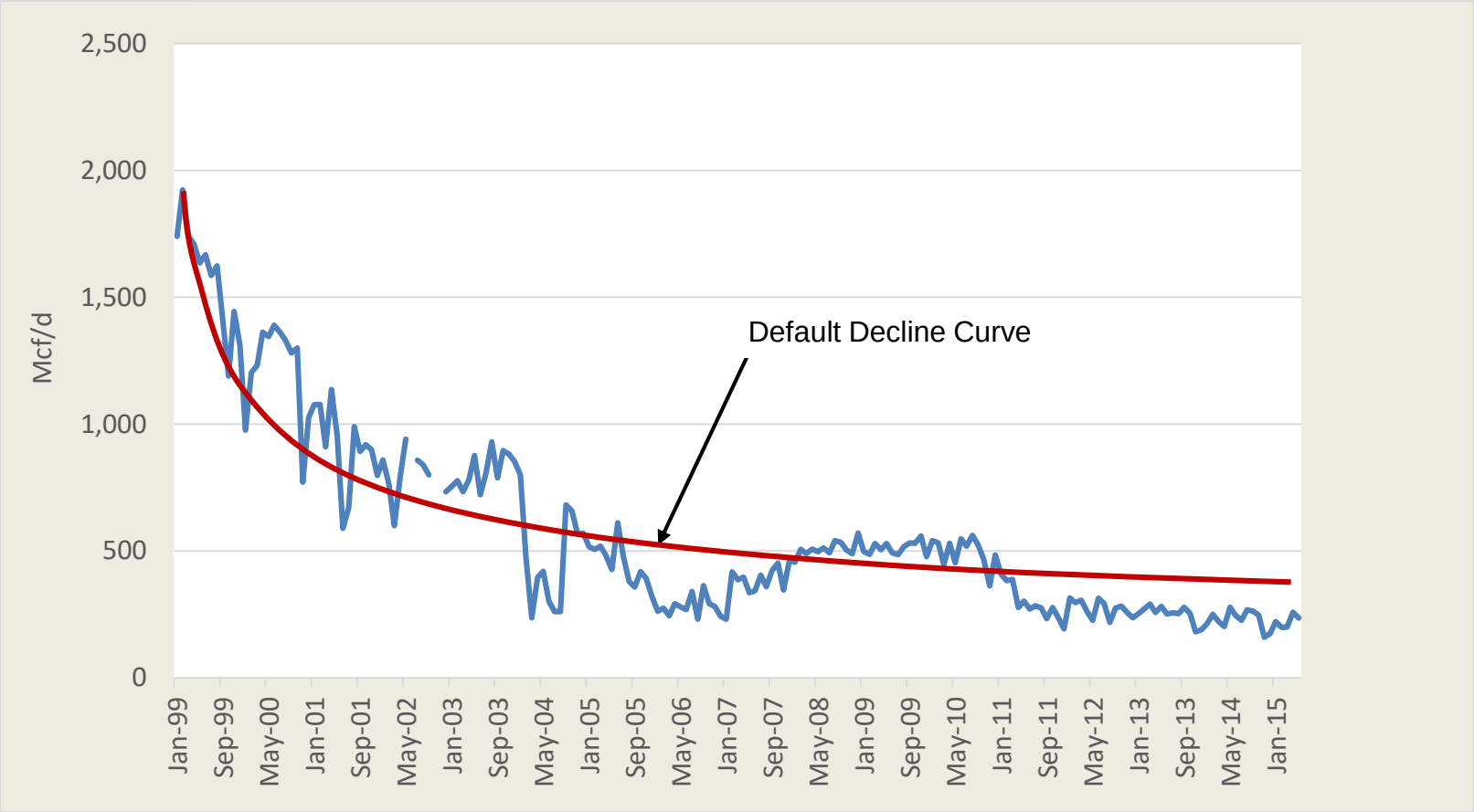
Actual AMM Production vs. Decline Curve Model Forecast



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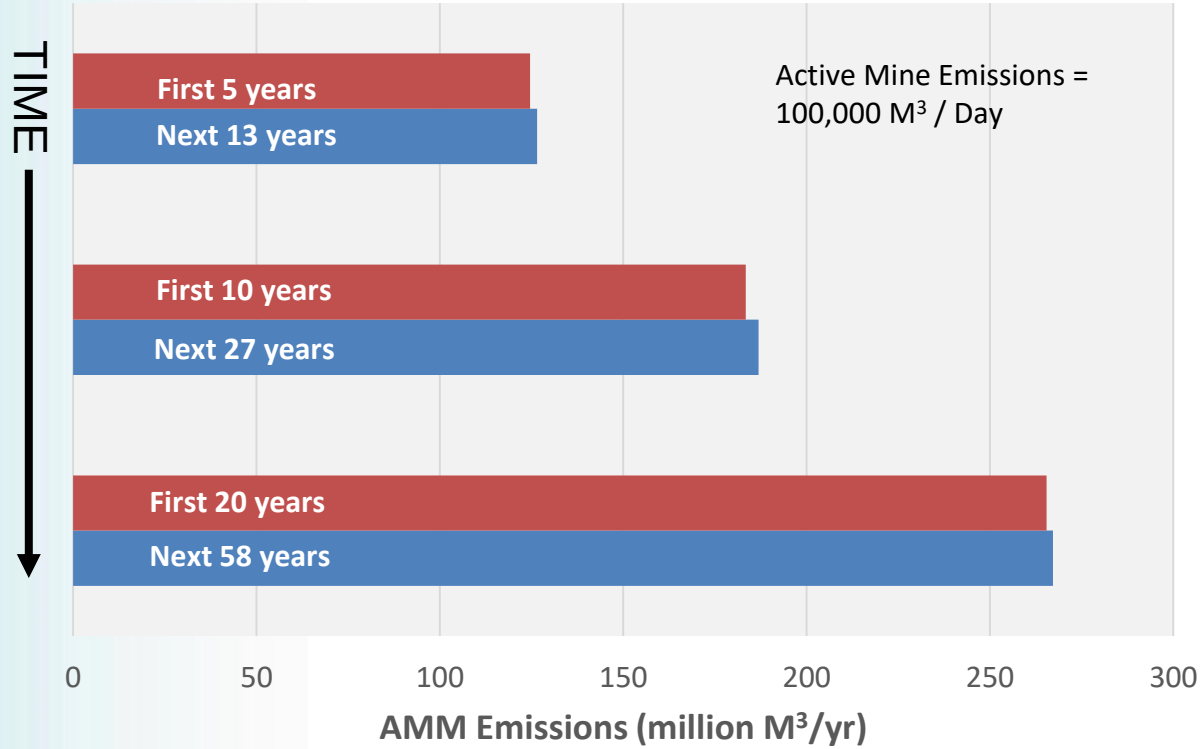
Methane Emissions After Coal Mine Closure

AMM Recovery - Sooner is Better!

- AMM Emissions Forecast Using Decline Curve Estimate



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Preparing Underground Workings at Active Mines

Certain actions can lead to increased methane recovery and use after the mine closes:

- Installing gas piping underground
- Accessing sealed mining districts
- Using the mine roadways as conduit for methane flow
- Verify integrity of surface seals to prevent atmospheric air intrusion
- Use of drones and IR technology to identify methane leaks

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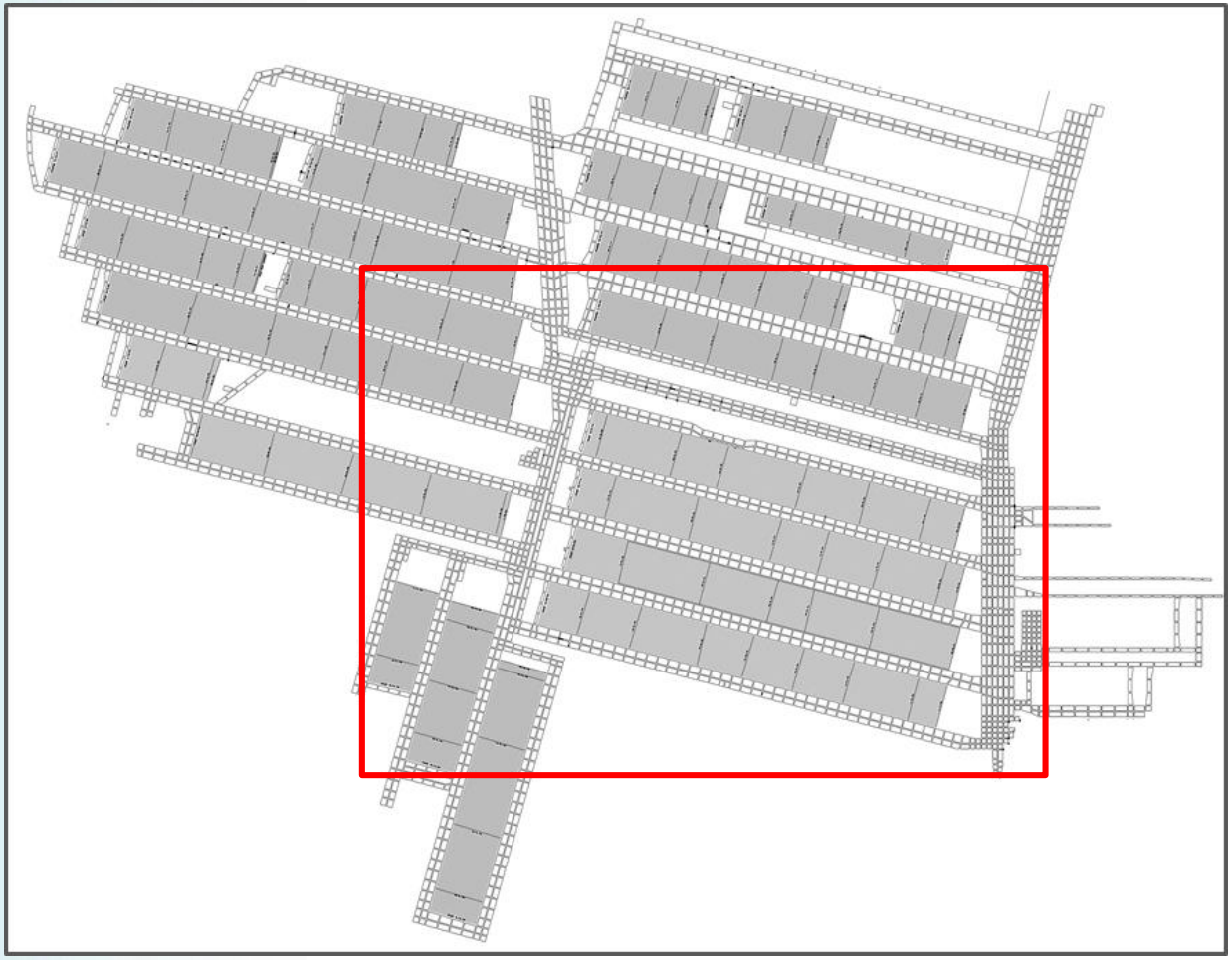
Installing Underground Pipes to Access Sealed Areas



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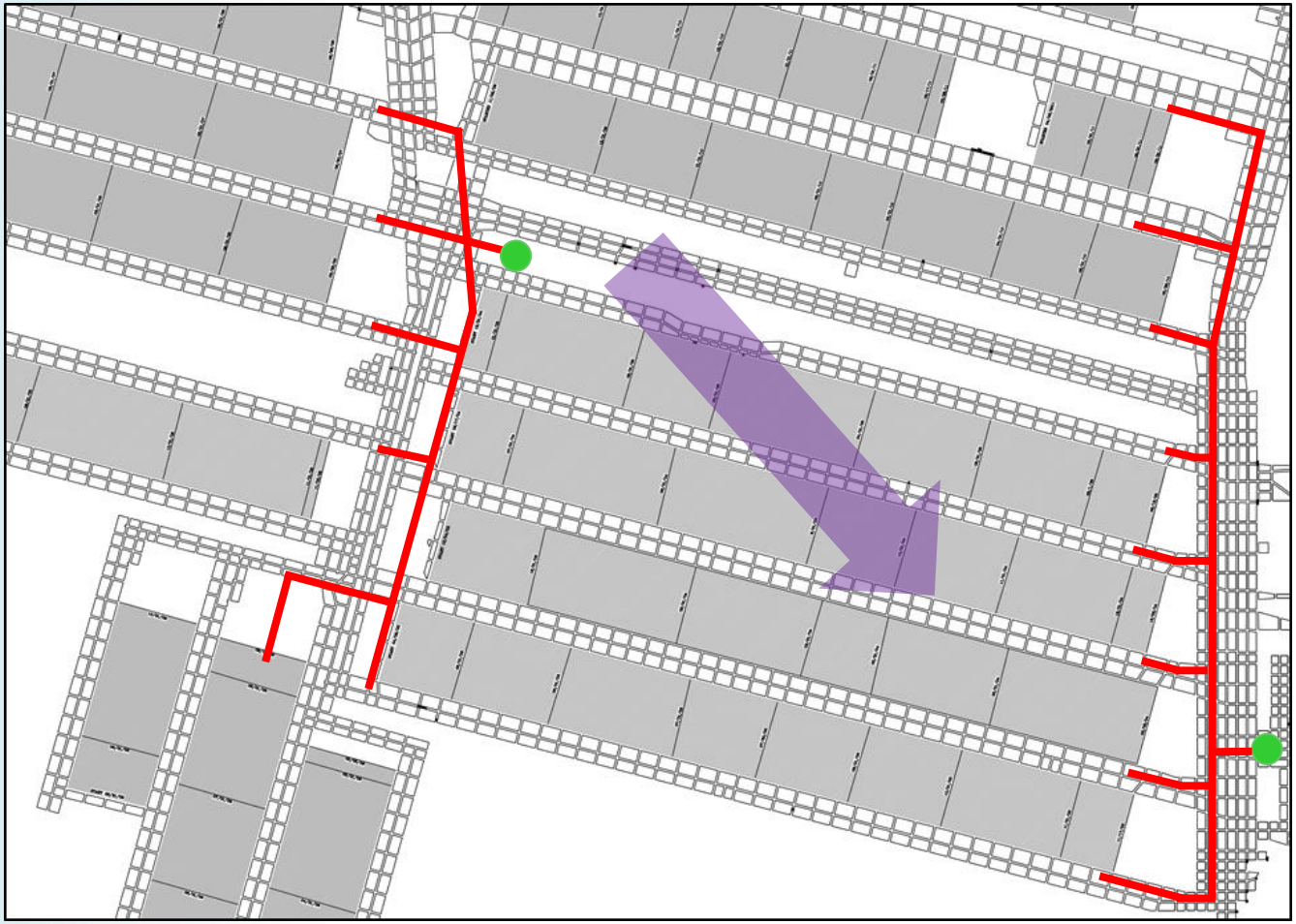
Installing Underground Pipes to Access Sealed Areas



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Underground Pipes Fuel a 3 MW AMM Electric Power Project

- Colorado, USA
- Recovers AMM from 5 mines total
- Enclosed flare accompanies power plant

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Accessing Sealed Areas Using Mine Roadways

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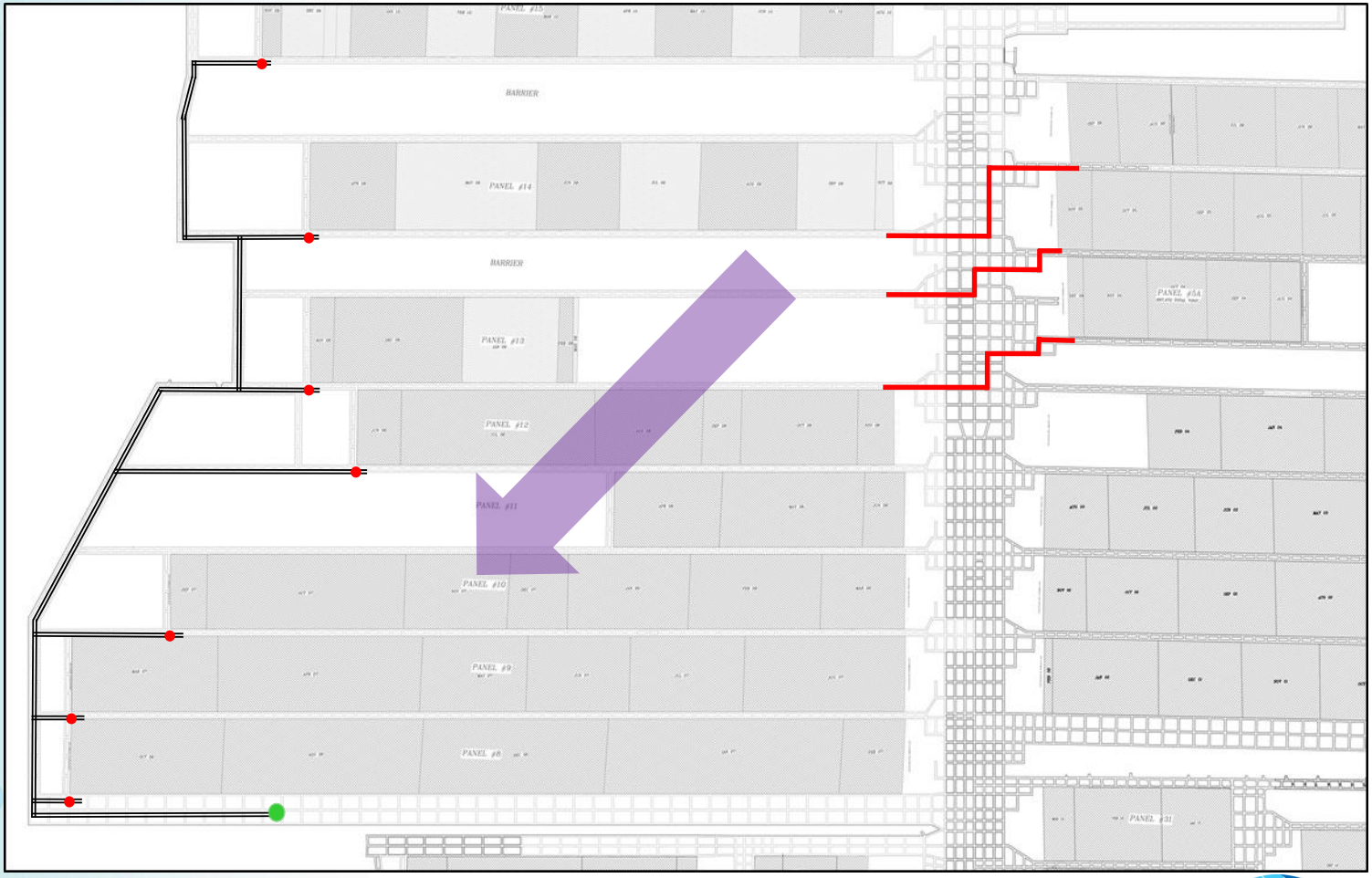
Accessing Sealed Areas Using Mine Roadways



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AMM Enclosed Flare Deployed at the Existing Gob Well Site

- Utah, USA
- 72 MMbtu/hr flare system

Remote location requires weatherization of equipment and on-site power generation

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Evaluating AMM Resources

- Pressure Testing
  - Estimate the void volume
  - Continuously monitor the borehole static P and barometric P
- Flow Testing
  - Continuously monitor gas flow rate, CH4 content and inlet P
  - Shut-in well, let pressure stabilize
  - Compare actual P to expected P from void model

Photo courtesy of Perennial Energy

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Aggregating Abandoned Mines Can Increase Project Viability

- Total AMM Projects in U.S. –
  - 19 AMM projects at 45 mines
  - 7 of 19 projects with multiple mines
- Aggregated Projects Include –
  - 3 AMM projects group 3-5 mines into a single project
  - 1 AMM project aggregates methane from 14 mines
  - 3 AMM projects are combined with existing CMM projects

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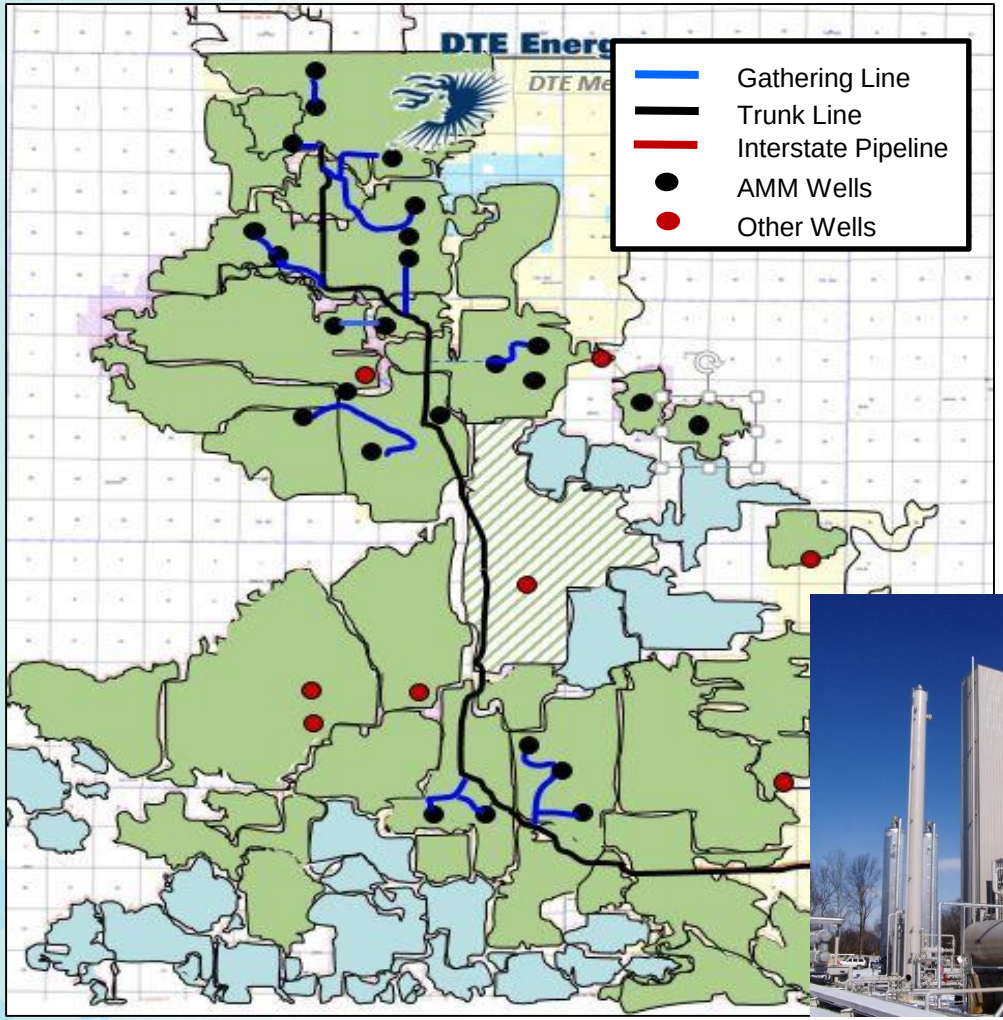
Example AMM Project – Illinois, U.S.



- 14 mines
- 31 wells
- 70% CH_4
- 34,000 hectares
- 11 field stations
- 85 mM^3/day

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Conclusions

- AMM projects offer unique set of opportunities and challenges
- Preparing an active mine for methane extraction following closure is important step to ensuring successful AMM projects
- Perform a proper methane resource evaluation to adequately size the project
- Aggregating several abandoned mines into a single project can be economically beneficial

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Thank You

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