



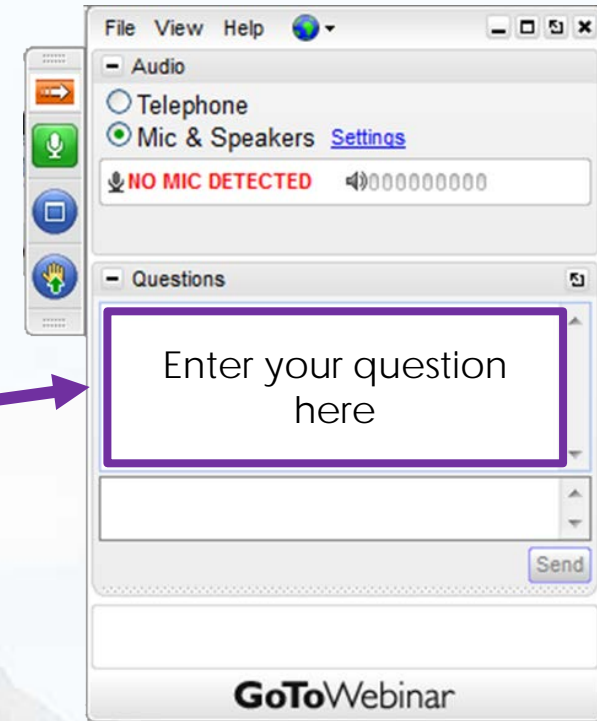
U.S. EPA CMOP Webinar Market Incentives for U.S. Coal Mine Methane Projects

September 12, 2018



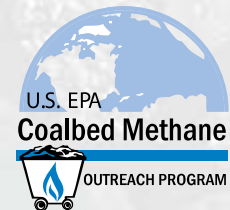
Webinar Notes

- All participants (except speakers) are in listen-only mode
- Questions submitted during the webinar will be reviewed at the end of the webinar
 - Type a question here
- If you are experiencing technical difficulties, please let us know using the Questions pane on the right side or contact Jay Gallo at 203-687-9432



Welcome and Webinar Overview

- Agenda
 - Overview of EPA's CMOP
 - Phil Kong, Advanced Resources International
 - Eric Ripley, American Carbon Registry
- Question and Answer
- Wrap Up



U.S. EPA's Coalbed Methane Outreach Program (CMOP)



- Our Focus

- Greenhouse gas emission reduction opportunities: coal mine methane (CMM) rather than coalbed methane (CBM)

- Our Mission

- Work with private sector to cost-effectively reduce CMM emissions through recovery and use projects

- Our Activities

- Identify profitable opportunities for CMM recovery
- Identify and help overcome market, regulatory, and technical barriers
- Offer technical and analytic support where appropriate
- Conduct direct outreach to coal mines

- Our Accomplishments

- Roughly 80% of methane from U.S. coal mine degasification systems is recovered and used today, compared to ~25% in 1993



Financial and regulatory incentives for U.S. CMM projects, including requirements for CMM emission offsets in compliance and voluntary markets



Phil Kong
Advanced Resources International

Coalbed Methane Outreach Program Webinar
September 12, 2018



Coal Mine Methane

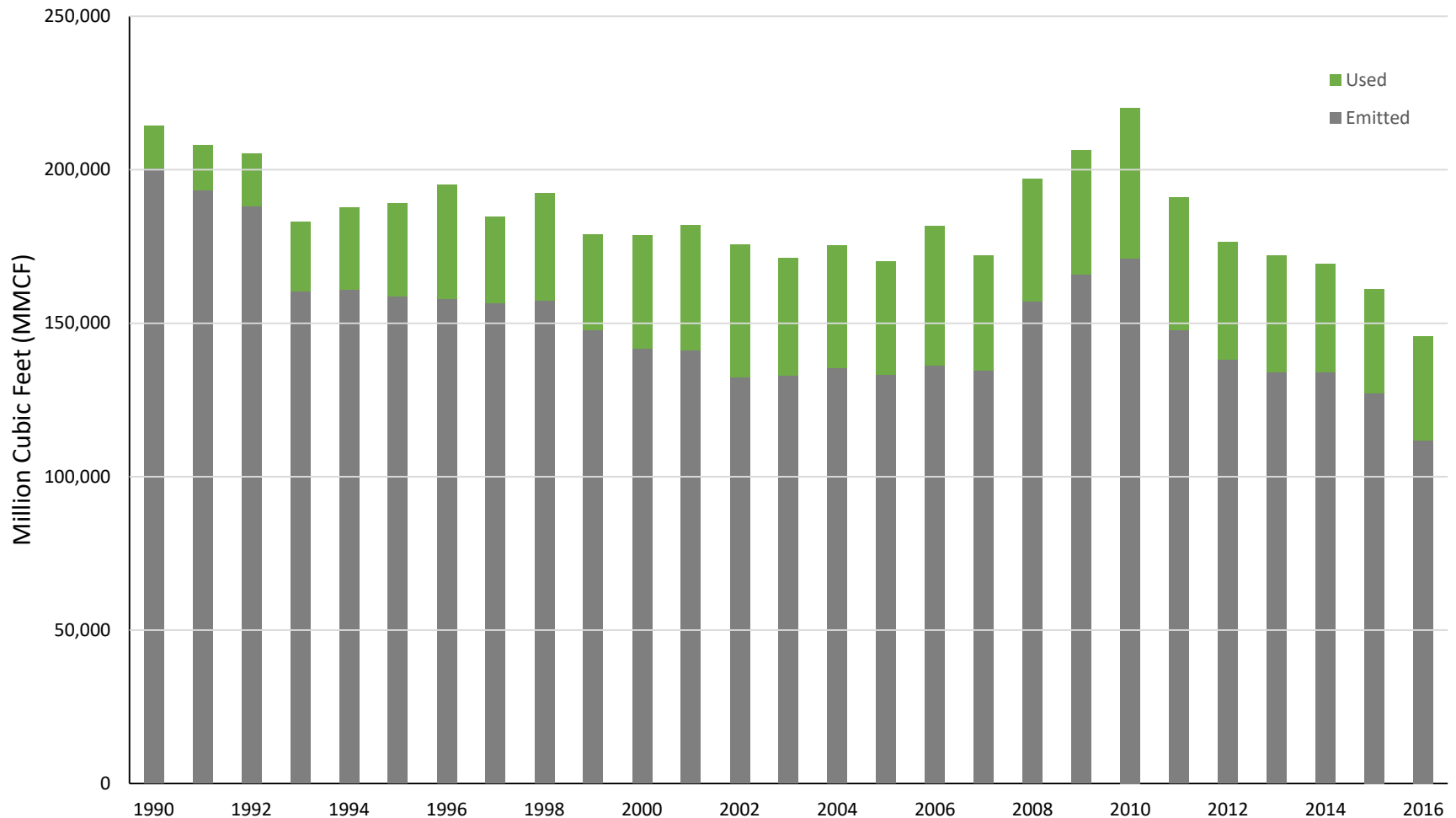
Coal Mine Methane (CMM): Methane released from coal and surrounding rock strata resulting from mining activities.

CMM can be emitted from:

- Degasification systems
- Ventilation shafts
- Surface Mines
- Abandoned Mines
- Post-mining emissions (i.e., processing, storage, transportation)

The majority of CMM is generated from underground coal mines.

U.S. CMM Emissions 1990-2016



U.S. EPA (2018): Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016

Benefits of CMM Recovery and Use

- Reduced greenhouse gas emissions
- Improved air quality and mine safety
- A source of clean, local energy
- Additional revenue stream for the coal mine
- Skilled job creation and economic development

Markets for CMM Projects

- Energy use on-site
- Energy distribution and sales off-site
- Greenhouse gas markets
- Renewable energy credits

Coal Mine Methane – Energy Commodity

Potential Uses of CMM

Regional and Export Gas Sales



Power Generation



Power Plant with 500 kW Gensets

Combined Heat & Power



Flaring



Cooling



Industrial Use



Greenhouse Gas Markets

- CMM projects are eligible for several voluntary or compliance GHG registries that issue carbon credits or offsets.
- Voluntary carbon markets are driven by corporate social responsibility
- Compliance carbon markets, like the California Air and Resources Board (ARB) cap and trade, are driven by caps on greenhouse gas emissions. In a cap and trade program, participants can generate and trade offset credits.
- CMM projects participating in these markets install and operate equipment to capture and destroy mine methane that would otherwise be vented into the atmosphere.
- To participate in markets, CMM offset projects must be listed on a recognized offset registry.

Greenhouse Gas Registries

- Role of registries
 - Develop and approve carbon offset accounting standards and protocols
 - Oversee project registration process
 - Manage the verification process conducted by independent entities
 - Track transactions and retirements of issued offsets
- Three major U.S. GHG registries:
 - American Carbon Registry
 - Climate Action Reserve
 - Verra
- Registries
 - Approved Offset Project Registries (OPR) for the California Air and Resources Board (ARB) for Cap and Trade program.
 - List voluntary emission reduction projects

American Carbon Registry

- Founded in 1996
- CMM Standards, methods, and protocol based on International Standards Organization 14064
- Accepts CMM projects from active underground, abandoned, and surface coal mines worldwide
- Has 11 active/proposed CMM projects
 - Ventilation Air Methane (VAM) Abatement
 - CMM Destruction (Flare)
 - Electricity Generation
 - Issued ~1.7 million offset credits
 - All projects listed with ARB
 - Website: <http://www.americancarbonregistry.org>

Climate Action Reserve

- Founded in 2008
- CMM protocol accepts projects from active or intermittent underground mines and category III trona mines within the U.S.
- Accepts VAM and Drainage Methane destruction projects
 - Methane must be used or destroyed onsite
 - Natural gas pipeline sales projects at active mines are not eligible to be listed
- Has listed 4 CMM projects
 - Two VAM abatement, two drainage projects
 - Projects were listed as Early Action Offset Projects with the California Air and Resources Board
 - Issued ~1.2 million offset credits
- Website: <http://www.climateactionreserve.org>

Verra

- Founded in 2005
- Manages the Verified Carbon Standard (VCS) program, a voluntary carbon credit market for carbon reduction projects worldwide
- Uses Clean Development Mechanism (CDM)'s baseline and monitoring methodology (ACM0008)
 - Accepts projects from Active underground, surface, and abandoned mines
- Has 35 CMM/AMM projects listed (all projects inactive)
 - Gas sales to pipeline
 - Electricity Generation
 - VAM Abatement
 - CMM Flaring
 - Issued ~10.3 million offset credits
- Website: <http://www.verra.org>

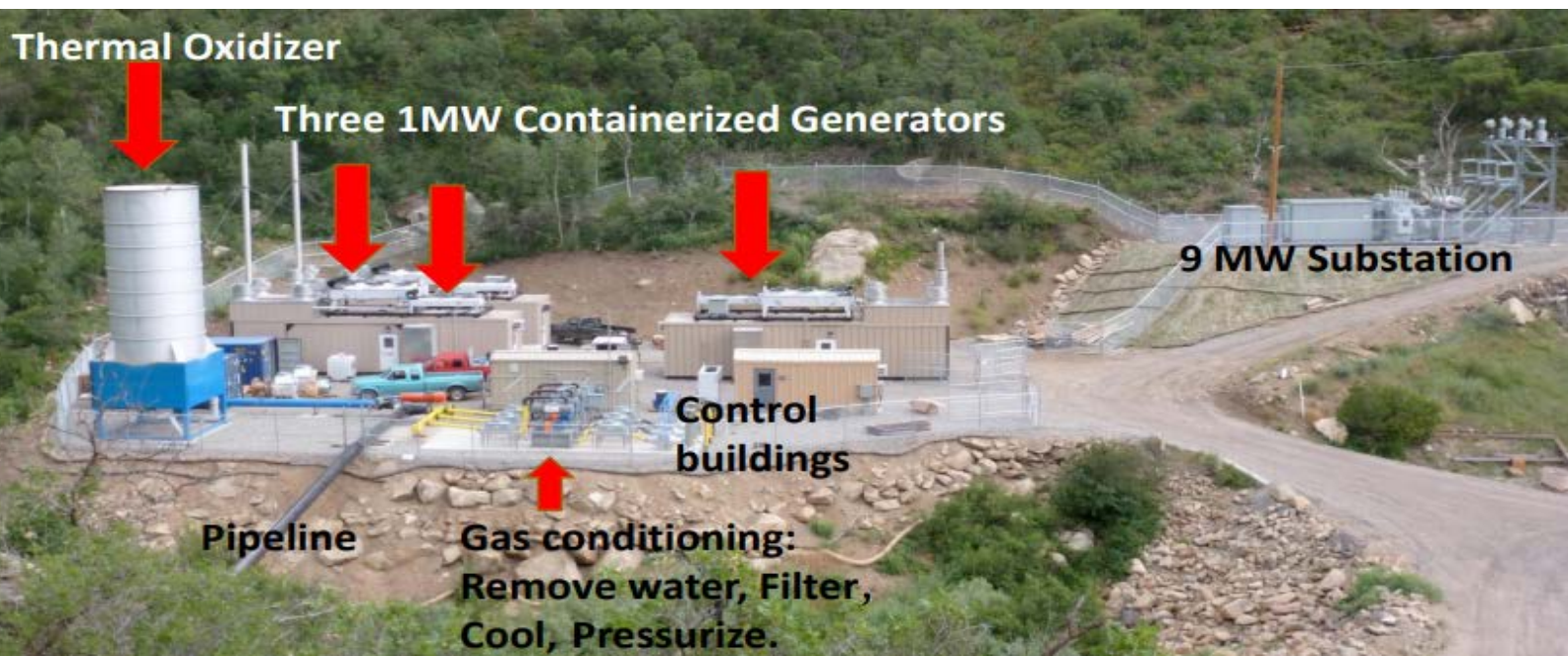
Renewable Energy Markets for CMM Projects

Several major coal-producing states have alternative energy and renewable energy programs that include CMM as a targeted renewable or clean energy source.

State CMM Incentives		
State	Definition of CMM	Incentives and Programs
Colorado	CMM is a renewable energy resource if the end-use electricity is GHG-neutral	Renewable Energy Standard • RECs
Indiana	CBM (coalbed methane) is defined as an alternative energy source and clean energy resource	Voluntary Clean Energy Portfolio Standard • Incentives to help pay for compliance projects
Ohio	CMM/AMM is a renewable energy resource	Alternative Energy Resource Standard • Renewable energy certificates (RECs) Advanced Energy Program • Forgivable and non-forgivable loans
Pennsylvania	CMM is an alternative energy resource	Alternative Energy Portfolio Standard • Alternative energy credits
Utah	CMM is a renewable energy resource	Renewable Portfolio Standard • RECs

Examples of U.S. CMM Projects

- Possible royalty relief for operators that capture methane
 - **West Elk Mine (Arch Coal):** requested a reduction in royalties paid to the federal and state government, currently under review.
- Generation of offset credits from methane destruction
 - **Corinth AMM Recovery Project (Keyrock Energy):** AMM recovered from vertical boreholes and transport the gas to a pipeline
 - **Elk Creek Mine (Vessels Coal Gas):** Drainage gas is used for power generation and also sent to a thermal oxidizer



Contact Information

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Carbon Offset Markets and U.S. CMM Project Development

September 12, 2018

- Winrock and American Carbon Registry Intro
- California Compliance offsets
- ICAO CORSIA
- CMM Methodology overview

Non-profit organization that works in the U.S. and around the world to empower the disadvantaged, increase economic opportunity, and sustain natural resources

- U.S. Domestic & International Primary Program Areas: *Agriculture and Sustainability, Clean Energy, Climate Change, Economic Opportunity, Forest and Natural Resource management, Gender Equality and Human Rights, Leadership for Change, International Youth Education, Water*
- Operates in ~60 Countries w/ ~1000 staff
- \$100 Million+ Annual Revenue
- Headquartered in Arkansas – U.S. offices in Washington, D.C. and Sacramento, CA



- **Founded in 1996 as the first private voluntary GHG registry & joined Winrock in 2007**

Issued to date over 135 million tons of verified emissions reductions (carbon offsets or carbon offset credits) from:

- Forestry
- Agriculture
- Industrial Processes
- Transportation Efficiency
- Energy (renewables & efficiency)

- **Registry Roles:**

- Develop and approve carbon offset accounting standards & methodologies
- Oversee independent verification by accredited entities
- Review GHG emissions reduction projects and issue serialized offsets on a transparent registry platform

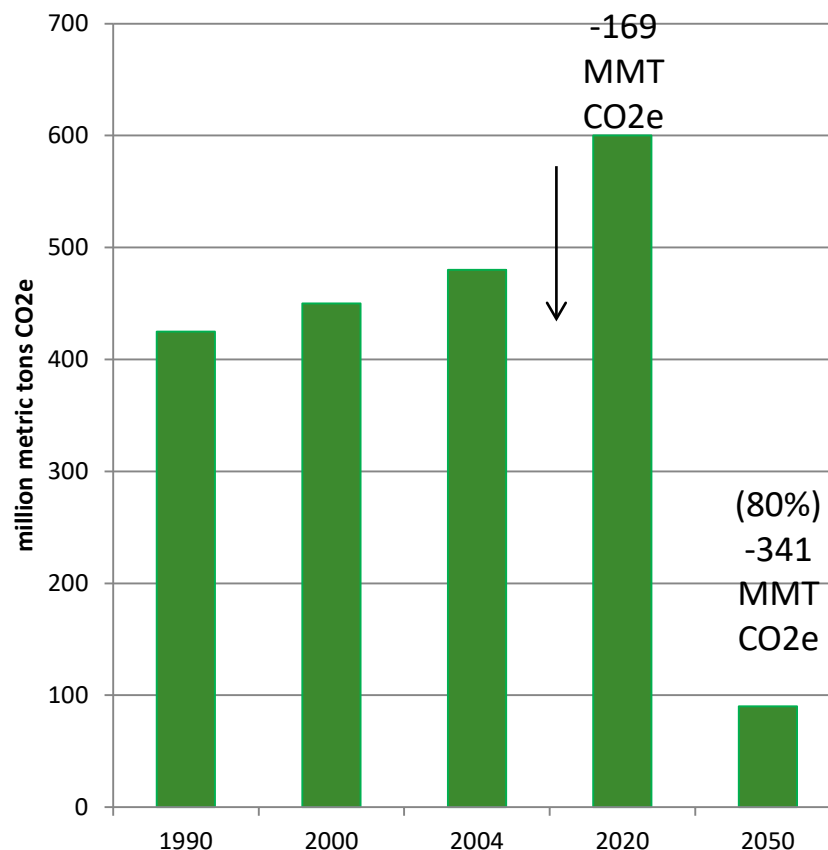
- **Approved in December 2012 as California Offset Project Registry (OPR)**



California 2006 Global Warming Solutions Act (Assembly Bill 32)



Reduce 2020 emissions to 1990 levels & target of reducing 2050 emission to 80% below 1990



CA Climate Action Post 2020

September 2016:

Four-term California Governor Jerry Brown signed into law SB32 to reduce California's GHG emissions by 40% below 1990 levels by 2030.

July 2017

California cap-and-trade program extended to 2030 with passage of AB398 with a 2/3 super majority in both chambers



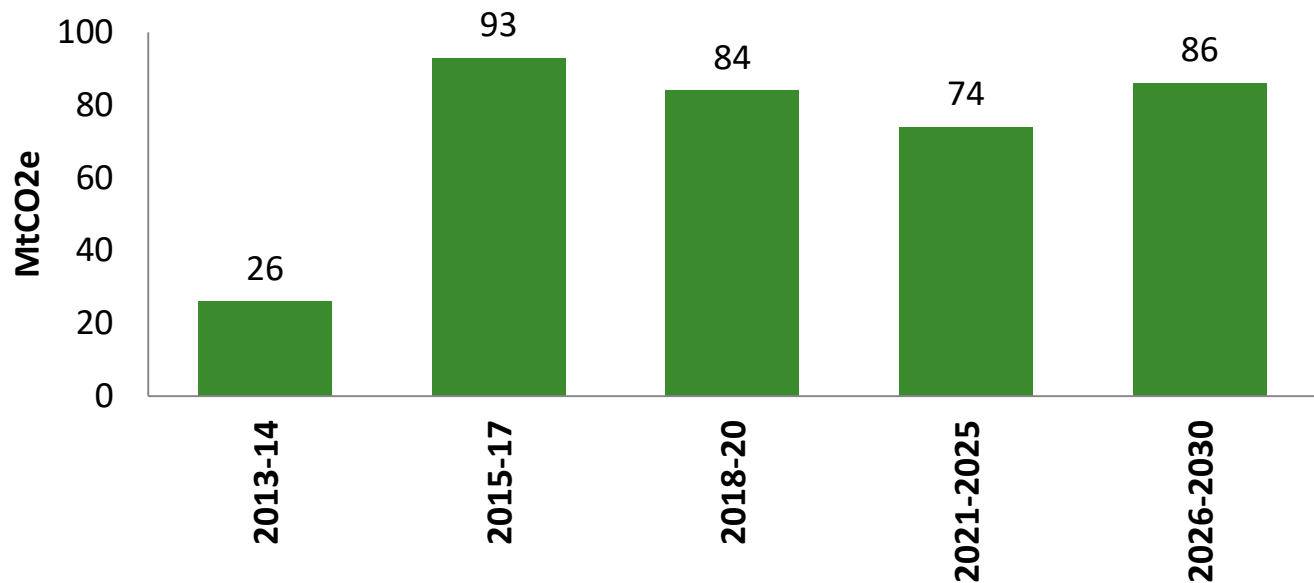
CA Compliance Offsets

- Reductions must meet AB 32 criteria:
 - Real, additional, quantifiable, permanent, verifiable, and enforceable
 - Additional = beyond regulation or what would otherwise occur
- Offsets must result from CARB-adopted compliance offset protocols
 - Mine Methane
 - Ozone Depleting Substances Destruction
 - Livestock (anaerobic digestion)
 - Forestry
 - Urban Forestry
 - Rice (methane reduction)
- Offset credits cannot be issued for GHG emission reduction activities already covered under the cap
- Offsets can currently be used for up to 8% of compliance obligation

CA Carbon Offsets Maximum Demand

Offsets can be used for over 200 million tons through 2020

Offsets can be used for an additional 160 million tons through 2030*



International Civil Aviation Carbon Market

- In October 2016 the International Civil Aviation Organization (ICAO) passed an Assembly Resolution for carbon neutral growth starting in 2020
- 66 states (over 86% of international airline emissions) have joined the voluntary phase beginning in 2021 - including the U.S.
- ICAO currently developing rules for offsets and approved offset programs for its Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)
- 2.5 billion tonnes of emissions to be reduced or offset through 2035; ICAO projects annual offset demand of 142-174MM tonnes to 2025 & 443-596MM tonnes to 2035

CMM Methodology Overview

CMM Eligibility and End Uses

- Installation/operation of equipment to capture and destroy mine methane or ventilation air methane that would otherwise be vented into the atmosphere as a result of mining operations
- Project types: Active Underground VAM, Active Underground, Active Surface Mine, Abandoned Underground
- Location: United States (federal lands are eligible)
- Project developer must have legal authority to implement the project
- Project commencement/start date is the date on which methane capture and destruction equipment begins capturing and destroying methane upon completion of an initial start-up period
- Captured methane is destroyed through an eligible end use management option:
 - Injection into natural gas pipeline
 - Power generation
 - Heating
 - Incineration
 - Thermal Oxidation

Active Underground and Surface Mine Emission Sources

- Active Underground Mines
 - Ventilation Air Methane (VAM)
 - Ventilation systems
 - Methane drainage systems from which mine gas is extracted and used to supplement ventilation air
 - Pre-mining surface or in-mine boreholes
 - Gob wells
- Active Surface Mines
 - Pre-mining surface or in-mine wells, existing CBM wells to be shut in due to mining activities, reactivated abandoned wells, converted dewatering wells

Quantification – Active Underground/Surface

- **Active Underground & Surface Mines**
 - Baseline emissions - project emissions = emission reductions
 - Monitoring equipment: gas flow meters, methane analyzers, etc.
 - Methane GWP = 21, uncombusted methane (not biogenic), destruction efficiencies
 - Subtract non-qualifying devices (pre-2007, pipeline gas)

Marshall County VAM Project



- Eligible Methane Sources
 - Pre-mining surface wells drilled into the mine during active mining operations
 - Pre-mining in-mine boreholes drilled into the mine during active mining operations
 - Post-mining gob wells drilled into the mine during active mining operations
 - Surface wells drilled after the cessation of active mining operations
- A qualifying destruction device must not have been operational at the mine prior to offset project commencement
 - Injection into a natural gas pipeline is not an eligible end use in situations where, when active, the mine injected gas to pipeline
- Projects cannot:
 - Account for virgin coal bed methane extracted from coal seams outside the mine extents or from outside the methane source boundaries
 - Use CO₂, steam, or any other fluid/gas to enhance mine methane drainage

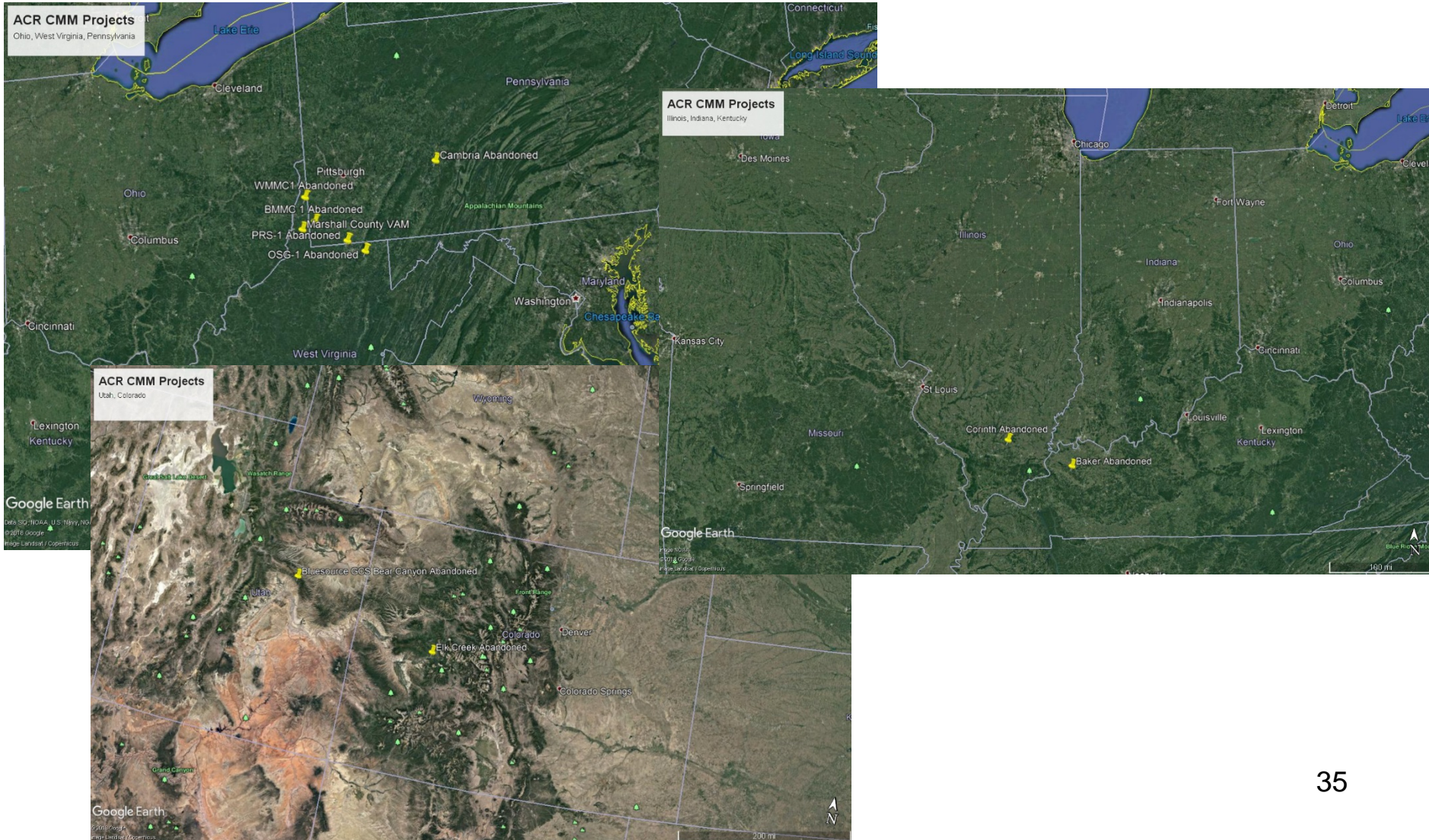
Quantification – Abandoned

- Abandoned Underground Mines
 - Baseline emissions: Use a single default hyperbolic emissions rate decline curve for all U.S. mines (sealed and vented) or a site-specific decline curve for vented mines
 - Decline curve estimates the emission rate of an abandoned mine over time
 - Metering of actual project conditions also required
 - Baseline emissions are lesser of emission calculated using decline curve or measured methane

Elk Creek Abandoned Mine Methane Project



ACR CMM Projects





Thank You!

Questions?

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Questions



Thank you!

Please reach out with any questions or comments

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