

Methane to Markets (M2M) Partnership: Coal Mine Activities

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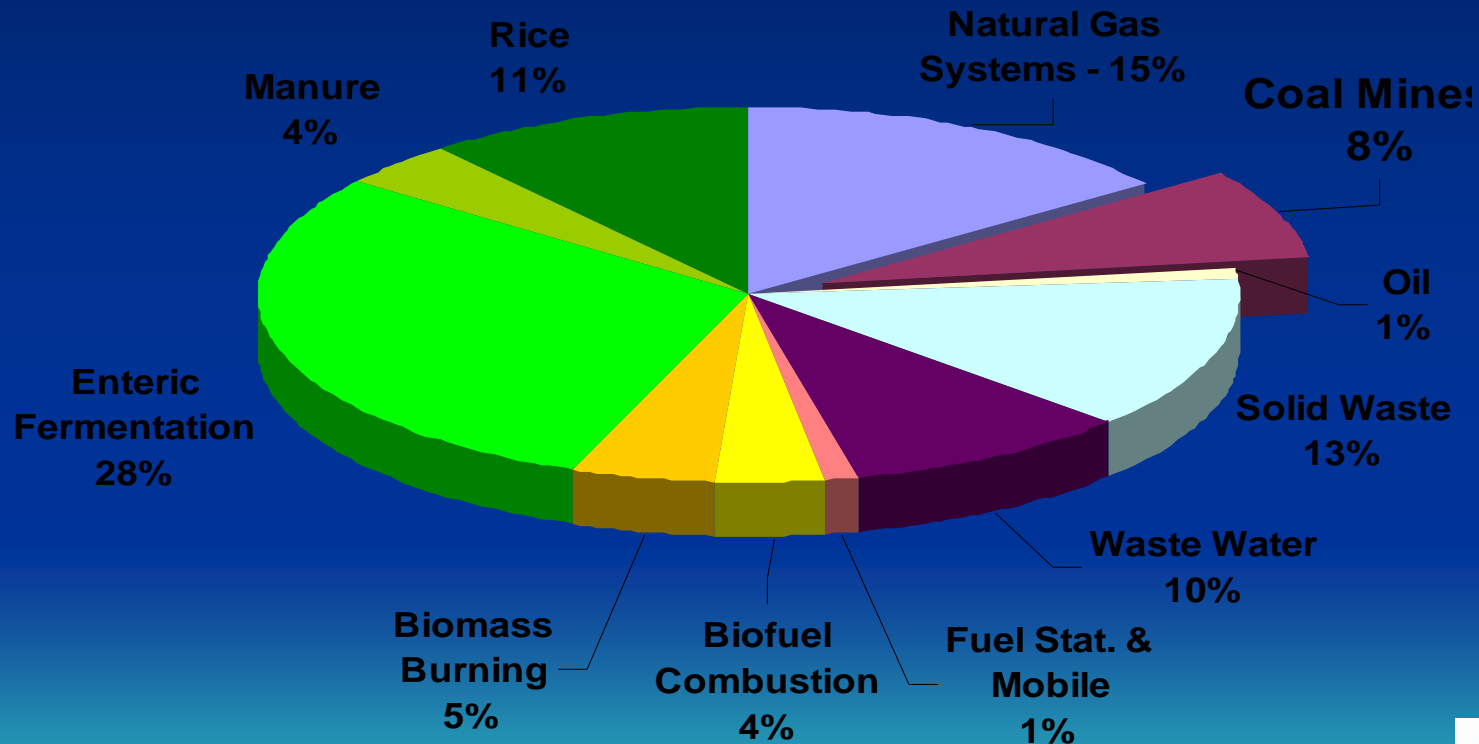
U.S. Environmental Protection Agency Climate Change
Division

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Anthropogenic Methane Emissions

Total CH₄ Emissions (2000) = 5,933 MtCO₂e



Source: US EPA



Methane

- Methane (CH₄) is a significant greenhouse gas that contributes to climate change
- Methane has a global warming potential 23 times greater than carbon dioxide
- Coal mining is a key source of methane



USEPA Coalbed Methane Outreach Program (CMOP)

- Voluntary climate change program since 1994
- Promote the profitable recovery and use of coal mine methane (CMM).
- Support CMM project development
- International Methane to Markets Partnership



Coal Mine Methane versus Coal Bed Methane

- Coal mine methane (CMM) is gas released from coal or surrounding rock strata during coal mining. CMM is an emissions reduction opportunity
- Coal bed methane (CBM) is an unconventional source of natural gas, not emitted to the atmosphere
- EPA focuses on CMM



Benefits of Recovering and Utilizing Coal Mine Methane

- Provides local clean energy source
- Improves air quality and mine safety
- Reduces greenhouse gas emissions
- Generates revenue
- Increases mine productivity



CMM Recovery and Use

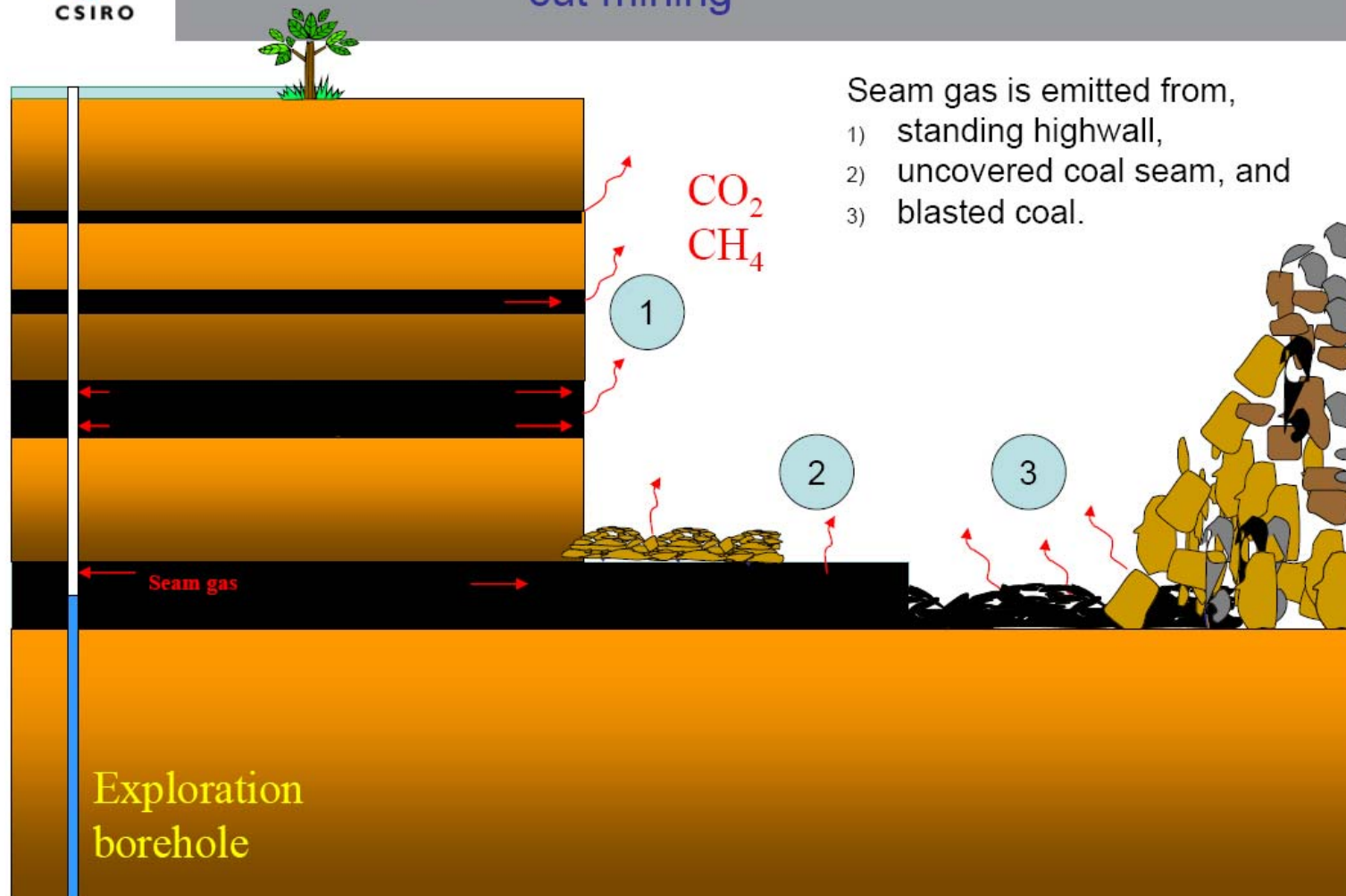
- Active Mines
 - Drained gas
 - Ventilation air methane
 - Gob gas
 - Surface mines
- Abandoned mines



Sources of Coal Mine Methane



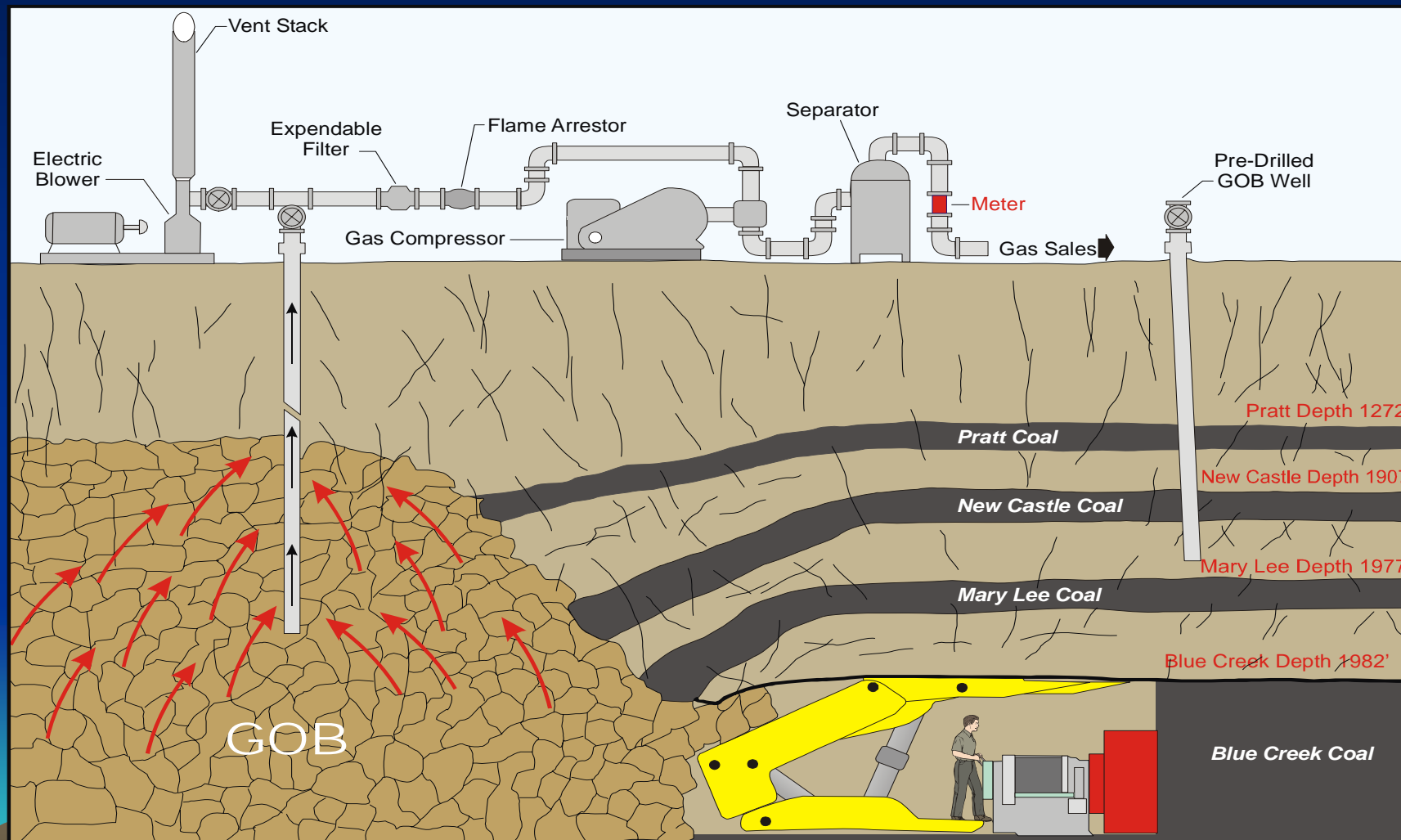
Sources of gas emissions from open cut mining



Seam gas is emitted from,

- 1) standing highwall,
- 2) uncovered coal seam, and
- 3) blasted coal.

Coal Mine Methane Recovery



Courtesy of CDX Gas

CMM End-Use Opportunities

High-Quality Gas

- Natural gas pipelines
- Vehicle fuel (LNG)
- Local distribution

Medium-Quality Gas

- Power generation
- Combined heat & power
- District heating
- Industrial applications
- Fuel cells
- Coal drying
- Boiler fuel

Low-Quality Gas & Ventilation Air Methane

- Oxidation
- Combustion air
- Lean burn turbines



Global CMM Activities

- 14 countries have CMM drainage at active mines
- 12 countries have CMM recovery and utilization activities at active and/or abandoned mines
- > 200 CMM projects worldwide
- > 3.8 billion cubic meters of methane emissions avoided per year

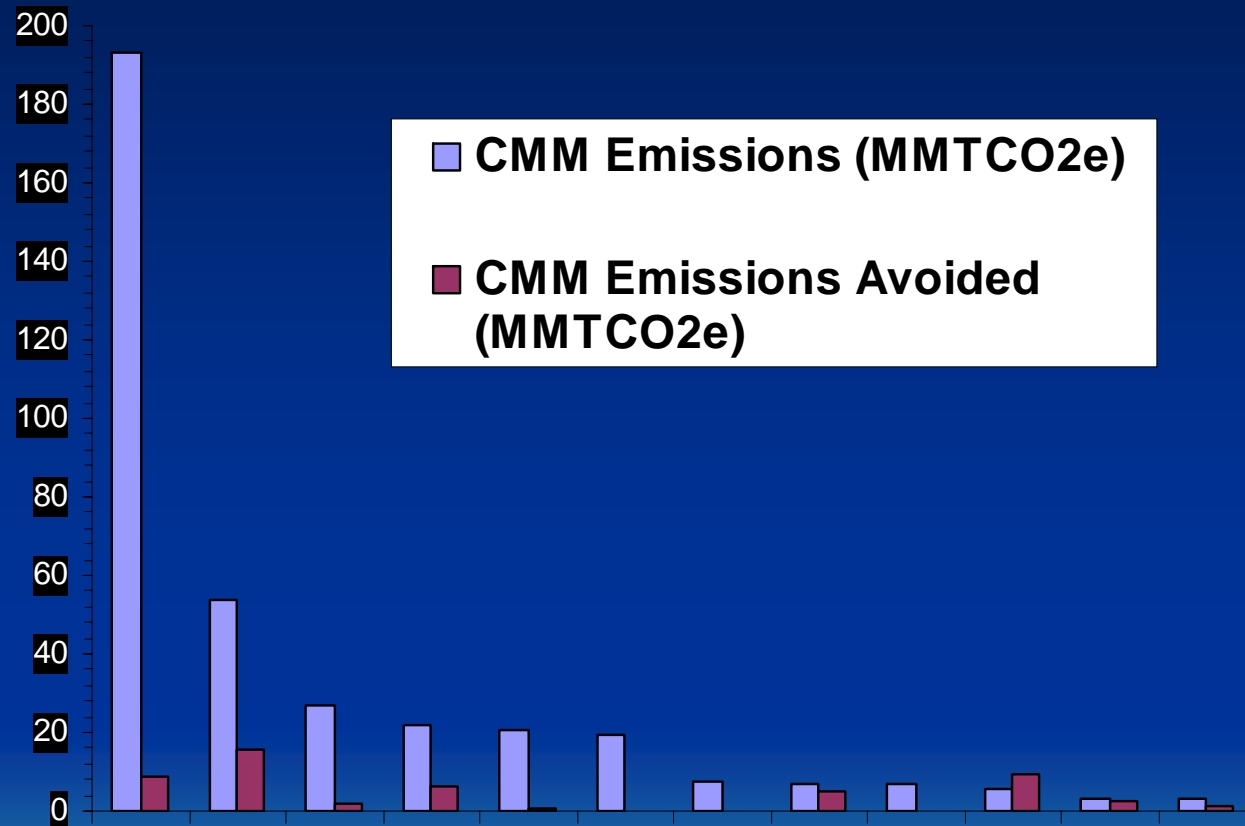


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Global Emissions of Coal Mine Methane



United States
Ukraine
Australia
Russia
South Africa
Poland
Kazakhstan
United Kingdom
Czech Republic





China: Opportunities for CMM Projects

- **CMM emissions: 1st globally**
 - Nearly 200 MMTCO₂e in 2004 (~ 14 billion cubic meters)
- **1st in global coal production**
 - ~90% of coal production is from underground mines
 - ~50% of large, state-owned mines are considered gassy
- **Challenges to CMM development:**
 - Most mines are not accessible to gas pipeline network
 - Limited drainage technologies/low drainage rates
 - Regulations for foreign project developers may be unclear



China: Opportunities for CMM Projects

- Over 200 mines have drainage systems (2004)
- ~ 60 CMM projects currently operating at active mines: total 240 million cubic meters/yr
 - Power generation: over 100 MW total installed capacity
 - Town gas (heating / fuel): over 500,000 households
 - Boiler fuel
 - Industrial applications
 - Vehicle fuel
- Many more CMM projects planned, under development (~240 million cubic meters/yr)
 - Power generation: Over 220 MW additional capacity
 - Town gas: 46,000 more households
 - Vehicle fuel
 - Industrial / chemical uses





United States

- CMM emissions: 2nd globally
 - 56 MMTCO₂e of CMM emissions in 2003 (~ 4 billion cubic meters)
- Ranks 2nd in global coal production
 - About one-third of coal is produced from underground mines
 - Fewer than 50 operating mines are considered gassy
 - 18 underground mines conduct drainage
 - Over 400 gassy abandoned mines identified as potential project sites
- Relatively few challenges to CMM/CBM development
 - Low electricity prices
 - Framework for methane utilization on federal lands can be unclear



United States

- ~10 CMM projects operating or being developed at active mines
 - Most projects inject natural gas into pipeline network
 - 90 MW total power generating capacity (mostly peaking)
 - 1.1 billion cubic meters per year emissions avoided (2004)
 - About 20 CMM projects use gas from ~ 30 abandoned mines
 - Demonstration ventilation air methane (VAM) oxidation project underway at a closed mine in West Virginia (CONSOL Energy, US DOE, US EPA, MEGTEC)





Ukraine: Opportunities for CMM Projects

- **CMM Emissions: 3rd globally**
 - 27 MMTCO₂e of CMM emissions in 2001 (about 1.9 billion cubic meters)
- **11th in global coal production**
 - Almost all coal production from underground mines, >75% considered gassy (2001)
- **Challenges to CMM development:**
 - Lack of investment in new degasification infrastructure
 - Poor degasification system maintenance
 - No competitive pricing or market system for coal or gas
 - Lack of natural gas transportation infrastructure





Ukraine: Current CMM Projects

- **About 10 CMM projects operating or being developed at active mines**
 - ~14% of liberated CMM is recovered and used: 178 million cubic meters avoided (2005)
 - 42 mines have degasification systems
 - CMM uses: power generation; heating / boiler fuel; industrial applications; vehicle fuel
- **Noteworthy projects**
 - Krasnolmanskaya Mine: US Dept. of Labor / US AID in-mine drilling project
 - Zasyadsko Mine: 131 MW generation project planned in stages (begun 2004)
 - US TDA grant for feasibility study for CBM / CMM project



Russia: Opportunities for CMM Projects

- **CMM Emissions: 4th globally**
 - ~ 21 MMTCO₂e of CMM emissions in 2003 (~ 1.4 billion cu. meters)
- **5th in global coal production**
 - 44% of mines are underground (2005); 85% of underground mines are considered gassy
- **Coal industry was restructured and privatized (1996 – 2001)**
 - 77% of coal now comes from independent producers
- **Challenges to CMM development**
 - Large competing natural gas resources with low, state-regulated gas sales price
 - Lack of appropriate technology
 - Complex rules on foreign investments





Russia: Current CMM Projects

- **CMM utilization projects at mines in Kuzbass and Pechora Basins**
 - ~ 43 million cubic meters emissions avoided, primarily in Pechora
 - Boiler fuel, power generation, mine heating projects
 - UNDP and GEF project (ongoing): remove barriers to financing and implementing CMM recovery and utilization projects





Australia: Opportunities for CMM Projects

- **CMM Emissions: 5th globally**
 - 22.6 MMTCO₂e of CMM emissions (estimated, 2005), ~1.6 billion cubic meters
- **4th in global coal production**
 - NSW: 59% from underground mines
 - 340 million tonnes produced (2004)
- **Few challenges to CMM/CBM development**
 - No national legislative framework for CMM (state level only)





Australia: Current CMM Projects

- About 11 CMM projects operating at active mines
 - At least 7 additional projects in development
 - 445 million cubic meters of emissions avoided per year
 - CMM projects generate 169 MW capacity
- World's first commercial-scale VAM oxidation project operating at West Cliff Colliery (WestVAMP)





India: Opportunities for CMM Projects

- **CMM emissions: 6th globally**
 - 14.3 MMTCO₂e (estimated 2005), ~ 1 billion cubic meters
- **3rd in global coal production**
- **About 15% of production is from underground mines**
 - ~24 underground mines classified as “Degree III” gassy mines
- **Currently no CMM projects operating, but some drainage in place**
- **Noteworthy projects / activities**
 - Global Environment Fund project: to demonstrate commercial feasibility of utilizing methane gas. CMM to be used for power generation and CNG for mine vehicles.



For more information, please contact us!

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