Coal mine methane in China: potential uses and benefits for both climate and air quality

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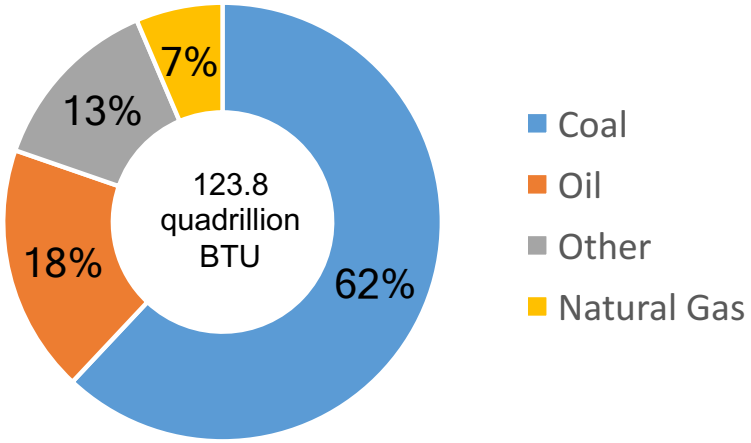
Outline

- *Summary of coal in China*
- Overview of coal mine methane (CMM) emissions
- Pathways for utilizing CMM as a source of electricity or heat
- Results & Conclusions

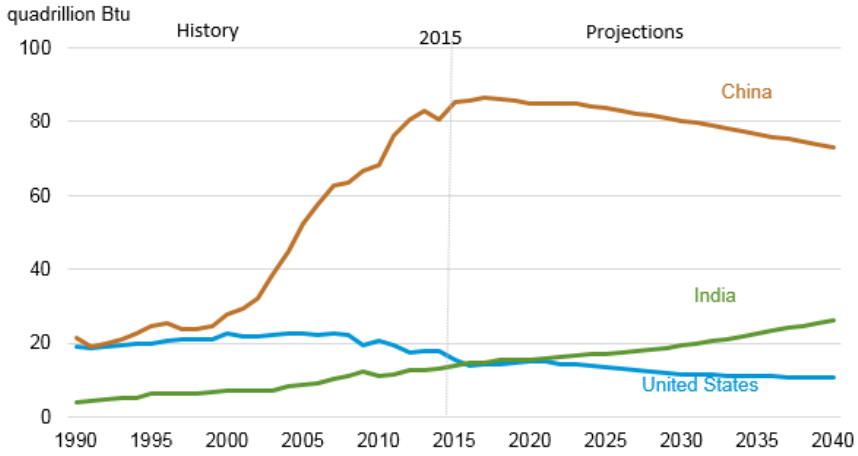
Coal is the largest primary energy source in China

Total Primary Energy Consumption in China by Fuel Type (2016)



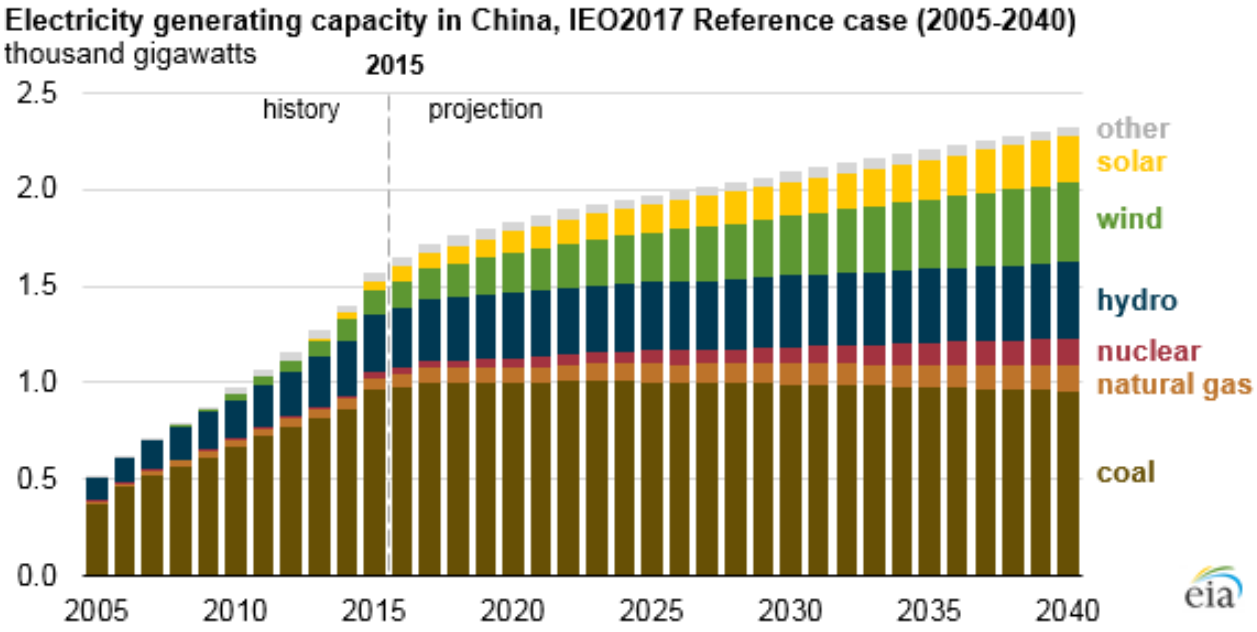
SOURCE: China Energy Statistics,, 2017

Coal consumption in China, India, and the United states



SOURCE: US EIA, 2016

Electricity sector consumes most of China's coal



Source: U.S. Energy Information Administration, *International Energy Outlook 2017*

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What is Coal Mine Methane (CMM)

CMM is the methane gas produced or emitted in association with coal mining activities from the coal seam

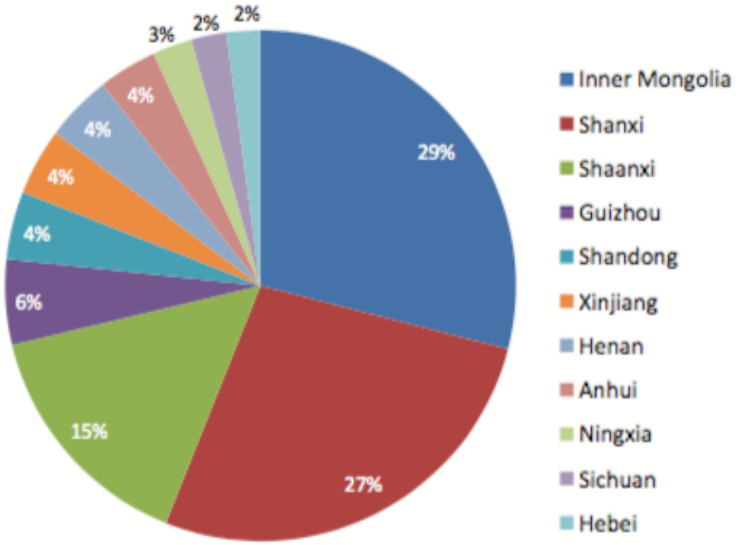
CMM is a common cause of mine explosions and injuries when methane (CH_4) and oxygen are present at certain ratios (i.e., CH_4 concentration between 5%-15%.)

Methane it is one of the most potent greenhouse gases. The 20-year global warming potential of methane is 84.

China's Coal-related Methane emission

The amount of CMM generated depends on the productivity of the coal mine, the gassiness of the coal seam, and geological conditions

Inner Mongolia & Shanxi produces 56% of the coal in China



Total Coal Production: 3,874 Mt SOURCE: US EIA, 2016

CMM emissions in 2012 by province

Estimated by the most recent version of the EDGAR emissions inventory

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Policy

13th(2015-2020) Five Year Plan for China's Natural Gas(NG) Development

- Increase the use of NG to equal over 10 % of national primary energy consumption by 2020.
- Extract 24 billion cubic meters methane per year from coal seams and utilize at least 67% by 2020.

Reference: National Development and Reform Commission of China. Thirteenth Five Year Plan for China's Natural Gas Development, 2016.

Would support existing CO_2 emissions and air quality policies

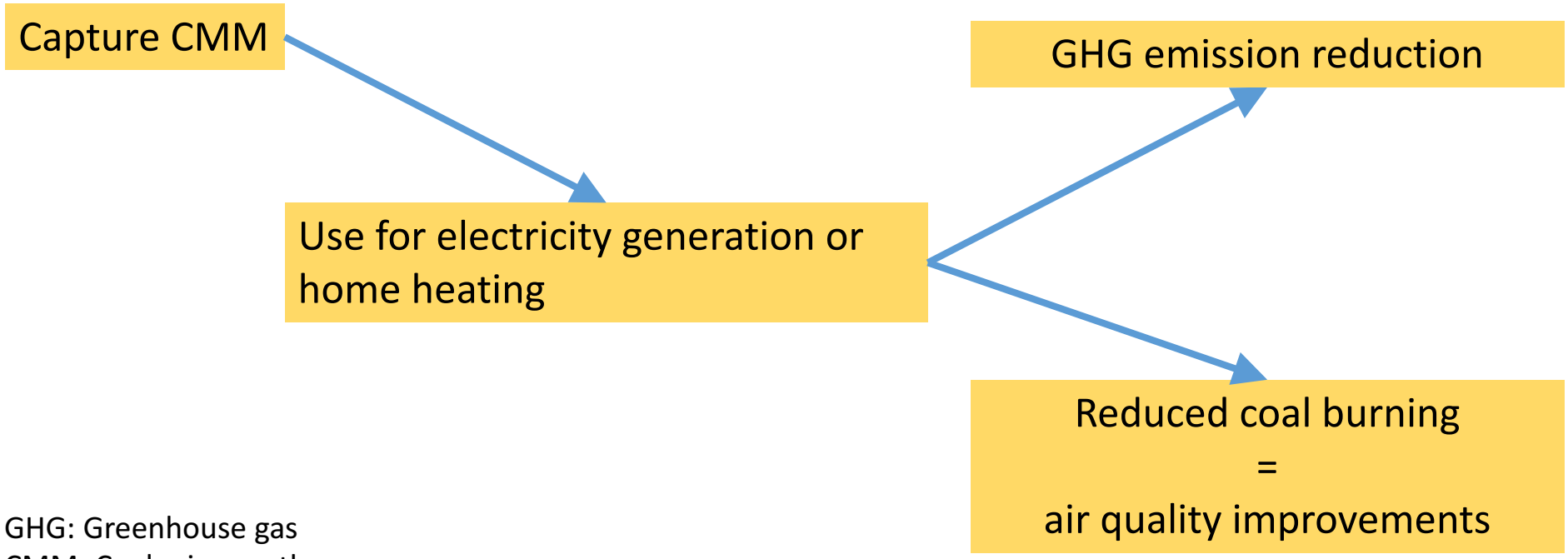
- Clean winter heating plan for Northern China (2017-2021)
  - ➢ Encourage householders to switch fuel for home heating from coal to NG or electricity.

- 2018-2020 *Three-year Action Plan for Winning the Blue Sky War*
  - ➢ China has significantly tightened its air pollution control policies nationwide, with more stringent targets in major metropolitan regions.

- Paris agreement: China pledge to peak its CO_2 emissions by 2030.

References:
National Development and Reform Commission of China. Thirteenth Five Year Plan for China's Natural Gas Development, 2016.
National Development and Reform Commission of China, National Development and Reform Commission of China, 2018.
Peter Christoff (2016) The promissory note: COP 21 and the Paris Climate Agreement, Environmental Politics, 25:5, 765-787, DOI: 10.1080/09644016.2016.1191818

A general Strategy:



GHG: Greenhouse gas
CMM: Coal mine methane

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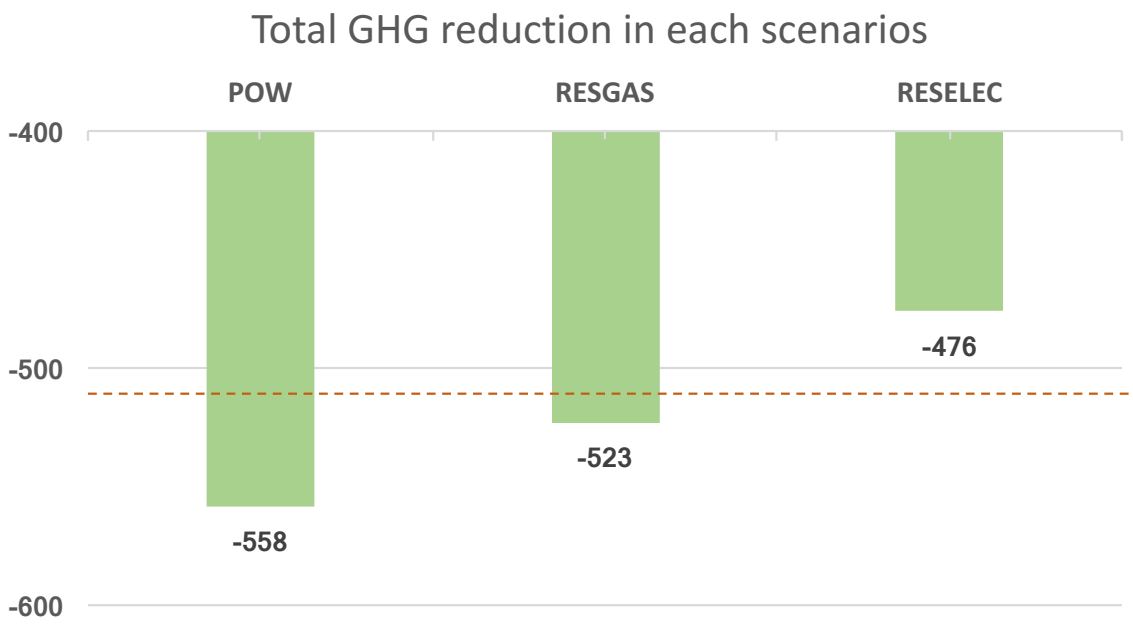
Utilization scenarios

Scenario	Potential generation (TWh)	Potential Heat supply (MMBTU)
Use CMM for power generation to displace inefficient coal power plants	103	-
Displaces household coal-based stoves with gas stoves and uses CMM to satisfy the additional gas demand	-	770 million
Use CMM for power generation to displace household coal-based stoves using electric stove	103	340 million

Potential benefits for GHG emissions

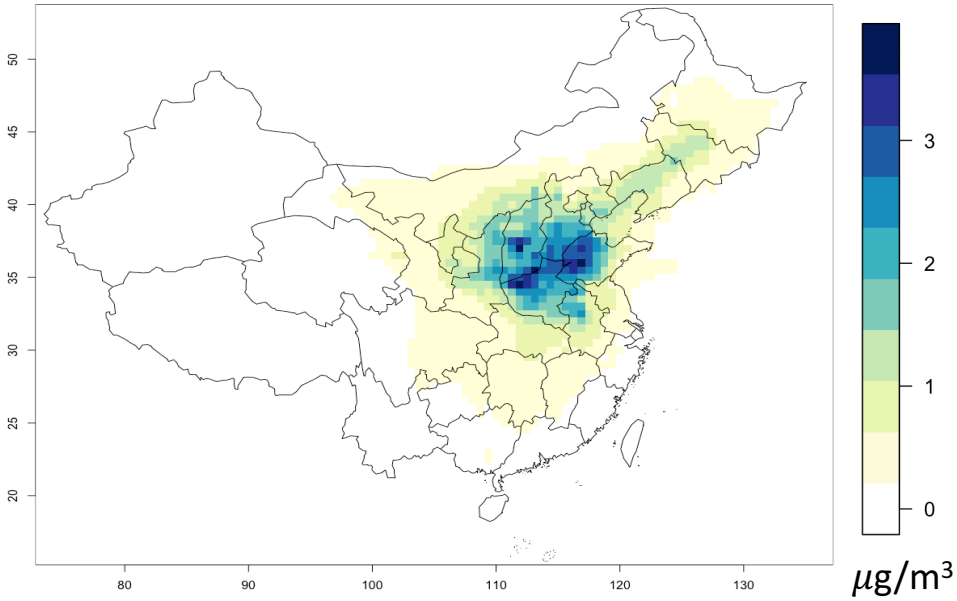
Total GHG emission from business-as-usual scenarios: ~ 12500 $MtCO_2e/yr$



Unit: Mt CO_2e/yr

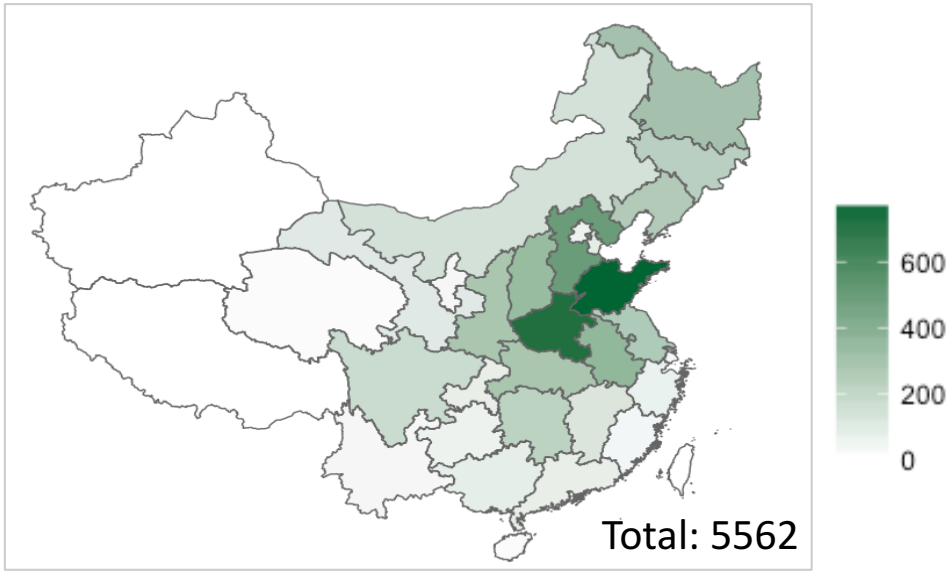
Potential benefits for air quality and health

Mitigated PM2.5 pollution due to CMM use in power sector



Simulated using GEOS-Chem nested grid

Total Avoided Mortalities



Estimated based on the method from Global Burden of Disease study

References:
1. Global Burden of Disease Study

Challenges

- No published coal power plant location data-set
- The methane concentration and methane quality are variable
- Long-distance NG pipeline is sparse in China and is still not available in numerous small to medium cities

Thank you

Questions?