Incentives for CMM/AMM Projects in China

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GMI Coal Mines Subcommittee Meeting
November 7, 2019
Incentives for CMM and AMM Project Opportunities in China

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GMI Coal Subcommittee
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1. 中国煤层气资源
2. 煤层气（煤矿瓦斯）开发技术
3. 煤层气（煤矿瓦斯）利用
4. 废弃煤矿瓦斯开发利用
5. 结论

1. CBM Resources in China
2. CBM/CMM Development Technology
3. CBM/CMM Utilization
4. Development and Utilization of AMM
5. Conclusion
1. CBM Resources in China

- CBM recoverable resources and proven reserves
  - The recoverable resources amount to 12.5 trillion m³, with high, medium and low coal rank accounting for 1/3 respectively;
  - The total proven reserves in China were 711.1 billion m³, and 14.7 billion m³ were newly discovered in 2018, up by 40.3% over the previous year.

- Coalbed methane recoverable resources and proven reserves
  - CBM recoverable resources amount to 12.5 trillion m³, with high, medium and low coal rank accounting for 1/3 respectively;
  - The total proven reserves in China were 711.1 billion m³, and 14.7 billion m³ were newly discovered in 2018, up by 40.3% over the previous year.
2. 海层气（煤矿瓦斯）开发技术
2. CBM/CMM Development Technology

- 采煤采气一体化——晋城模式
- Integration of Coal Mining and Gas Drainage-Jincheng Mode

[Diagram showing various drainage modes and techniques for CBM/CMM development.]
2. 煤层气（煤矿瓦斯）开发技术
2. CBM/CMM Development Technology

- 先采气后采煤、采气采煤一体化—晋城模式
- Coal Mining after Gas Drainage and Integration of Coal Mining and Gas Drainage—Jincheng Mode

寺河矿定向钻孔抽采技术
Directional Drilling Technology in Sihe Coal Mine

高位钻孔抽采技术
High level borehole drainage technology

采动区L型井抽采技术
Extraction Technology of L-shaped Well in Mining Area

地面和井下联合抽采技术
Combined surface and underground drainage technology
2. CBM/CMM Development Technology

- 煤与瓦斯共采—淮南模式
- Coal and Gas Co-mining-Huainan Mode

无煤柱Y型通风沿空留巷煤与瓦斯共采技术
Co-mining Technology of Coal and Gas in Gob-side Entry Retaining with Y-type Ventilation without Coal Pillar

保护层开采+底板巷穿层卸压技术
Protective layer mining + floor roadway cross-layer pressure relief technology

保护层开采与地面钻井联合抽采瓦斯治理技术
Gas control technology by combined drainage of protective layer mining and surface drilling.
3. CBM/CMM Utilization

- **High Concentration (CH₄ > 30%)**
  - (CH₄ > 90%) all use purposes
  - (CH₄ > 40%) household cooking fuel
  - (CH₄ ≥ 30%) Power generation
  - (CH₄ > 35%) CBM/CMM liquefaction
- **Low Concentration (1% < CH₄ < 30%)**
  - LCG Power Generation
  - CMM compression
- **VAM (CH₄ ≤ 0.75%)** Font Size 4
  - Oxidation destruction or Utilization

### CBM/CMM Utilization Scheme

- **Coal Bed Methane (CBM) and Coal Mine Methane (CMM)** Utilization
- **Coal Bed Gas (CBG)** Utilization
- **Coal Seam Gas (CSG)** Utilization
3. CBM/CMM Utilization

- Utilization Technology for VAM
  - Thermal oxidation
  - Catalytic oxidation
  - Auxiliary fuel for boiler or gas engine
3. CBM/CMM Utilization

**Sangzhang VAM Power Generation Project in No.2 Coal Mine of Shanxi Yangquan Coal Industry (Group) Co., Ltd.**

- **Investment scale:** 180 million RMB
- **Oxidation devices:** 6 units, installed capacity of steam turbine: 15 MW
- **Annual destruction volume of methane:** 830,000 tons CO₂ equivalent
- Since November 1, 2018, heating has been started for the air shaft of the Coal Mine.
- After completing the grid connection project in December 2018, grid-connected power generation was began.
3. Coalbed Methane (CBM/CMM) Utilization

GAOCHENG Coal Mine Central District and Taoyuan Districts Power Generation Projects (Planning)

- The design scales of Gucheng Coal Mine Central District Project and Taoyuan District Project is the same.
- Investment scale: $2 \times 1.85$ billion RMB
- Oxidation devices: $2 \times 10$ units
- Annual destruction volume of methane: $2 \times 1.38$ million tons CO$_2$ equivalent
- Installed capacity of steam turbine: $2 \times 25$ MW
- Combined heat and power supply in winter replaces 20-ton/hour coal-fired boilers respectively.
3. 煤层气（煤矿瓦斯）利用

3. CBM/CMM Utilization

■ 矿井通风瓦斯
  - 2013年，信息院承担《煤矿乏风甲烷氧化Pd基整体催化合成动力学模型》项目。
  - 2017年，信息院承担自然科学基金《负载型铜锰多孔通风瓦斯利用催化剂调控及催化性能研究》项目。

■ Ventilation Air Methane (VAM)
  - 在2013年，CCII承担了《通风气甲烷Pd基整体催化剂合成动力学模型》项目。
  - 在2017年，IIEM承担了《通风气甲烷Pd基整体催化剂合成动力学模型》项目。

国家自然科学基金委员会
项目批准通知

关于批准资助2013年度第二项目的通知

国家自然科学基金委员会

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4. 废弃煤矿瓦斯开发利用
Development and Utilization of AMM

- 大量煤矿关闭
  - 1997年高达8.2万处
  - 2018年5900处
  - 2011-2018年期间，累计关闭煤矿约11200处

- Large number of coal mines were closed
  - Up to 82,000 in 1997
  - 5900 in 2018
  - From 2011 to 2018, a total of 11,200 coal mines were closed.
4. Development and Utilization of AMM

- **Risks of abandoned mines**
  - Potential safety hazards: gas escape and surface subsidence
  - On October 1, 2018, a gas explosion occurred in Xuandong Coal Mine of Jizhong Energy Zhangkuang Group during the sealing of the air shaft, resulting in 4 injuries and damage to some vehicles on the Beijing-Zhangjiakou Expressway over one hundred meters away.
  - On October 15, 2018, a gas explosion occurred in Liyuanba Coal Mine, Shihao Town, Qijiang District, Chongqing City, during the sealing operation of the shaft wellhead, causing 5 deaths.
4. Development and Utilization of AMM

- CCII has long been committed to the research on the resources and basic theories of AMM.
- From 2014 to 2016, CCII undertook three projects funded by the British Prosperity Fund for three consecutive years.
  - 2014 - Policy Recommendations to Improve China’s AMM Extraction and Utilization
  - 2016 - Utilising UK Expertise to Promote the Commercialisation of AMM Recovery in China
- Researchers from CCII went to Britain, Germany, the United States and Canada to exchange waste Coal Mine Methane development and utilization technologies and on-site inspections.
4. 废弃煤矿瓦斯开发利用
Development and Utilization of AMM

信息研究院长期致力于推动中国废弃煤矿瓦斯开发利用工作

- 带领晋城蓝焰煤层气公司、陕西省煤层气公司赴英国和德国参观学习先进技术、成功经验并进行现场考察。

CCII has long been committed to promoting AMM development and utilization in China.

- Organizing Shanxi Lanyan CBM Group and Shaanxi Coalbed Methane Development Company to visit the Britain and Germany to learn advanced technology, successful experience and conduct on-site inspection.

德国DMT公司面对面技术交流会
Face-to-Face Technical Exchange Meeting with DMT

参观德国报废煤矿瓦斯发电厂
Visit Germany's AMM Power Plant

与英国专家进行技术交流
Technical exchange with British experts

参观英国报废煤矿瓦斯发电厂
Visit Britain's AMM Power Plant

访问英国煤矿工业管理局
Visit Coal Authority of the UK
4. Development and Utilization of AMM

- Information Research Institute has long been committed to the research on the resources and basic theories of AMM.
- Accompanying the leaders of the Coal Department of the National Energy Administration to visit the Britain and Germany to learn advanced technologies for AMM development and utilization and exchange successful experiences.
Development and Utilization of AMM

- The Institute has undertaken the project "Policy Research on Exploitation and Utilization of AMM Resources in Closed Mines, entrusted by the National Energy Administration".

- Field Investigation
  - Shaanxi: Shaanxi Coalbed Methane Development Co., Ltd.
  - Liaoning: Shenyang Coal Trade Group
  - Chongqing: Chongqing Energy Group
  - Hunan: Energy Administration of Hunan Province, Hunan Coal Group
  - Inner Mongolia: Energy Administration of Inner Mongolia, Baotou Shiguai Industrial Park

- Drafted "Guiding Opinions on Promoting Gas Control and Utilization in Closed Mines" (Draft for Comments)
4. 废弃煤矿瓦斯开发利用
Development and Utilization of AMM

- 举办报废煤矿瓦斯开发利用研讨会
  - 报废煤矿瓦斯开发利用研讨会列为国际煤层气暨页岩气研讨会的重要专题
  - 推动了报废煤矿瓦斯开发利用方面的技术交流，为国外企业提供了技术服务展示平台

- Organizing a workshop on AMM development and utilization.
  - The workshop on AMM development and utilization was listed as an important topic in the International Symposium on CBM/CMM and Shale Gas in China.
  - It has promoted technical exchanges in the AMM development and utilization and provided a platform for foreign enterprises to display technical services.
4. Development and Utilization of AMM

- 黑龙江龙煤集团废弃煤矿瓦斯项目
  - 2017年3月，信息院院技术人员陪同英国何尔东方能源公司托马斯•布雷赫尼总裁赴黑龙江龙煤集团鹤岗南山煤矿和鸡西梨树煤矿现场调研废弃煤矿瓦斯开发利用潜力。

- Heilongjiang Longmay Mining Holding Group Co., Ltd. Abandoned Coal Mine Methane Project
  - In March 2017, technical experts from CCII accompanied Mr. Thomas Breheny, President of HEL-EAST Company, to visit Nanshan Coal Mine of Hegang Company and Lishu Coal Mine of Jixi Company, Heilongjiang Longmay Mining Holding Group Co., Ltd., and investigate the potential of AMM development and utilization.
4. 废弃煤矿瓦斯开发利用
Development and Utilization of AMM

宁夏回族自治区

中节能宁夏新能源股份有限公司——乌兰煤矿（2016年5月关闭）

- 残存煤层气资源量为6.91亿m³
- 截止2018年6月，累计开发利用废弃煤矿瓦斯3582.69万立方米（纯量）;
- 截止2018年6月，提供清洁能源电量9315万KWh;
- 截止2018年6月，实现销售收入3648.68万元，减少温室气（CO₂）排放51.75万吨

Ningxia Hui Autonomous Region

CECEP Ningxia New Energy Resources Joint Stock Co., Ltd.-Wulan Coal Mine (Closed in May 2016)

- Remaining CBM resources amount to 691 million m³
- Accumulative development and utilization volume of AMM: 35.8269 million m³ (pure) by June 2018;
- Providing 93.15 million KW·h of clean energy by June 2018;
- Achieved sales revenue of 36.486 million RMB and reduced greenhouse gas (CO₂) emissions by 517,500 tons by June 2018;

乌兰煤矿残存煤层气开发厂区、抽采管道和发电站
AMM development plant area, drainage pipeline and power station in Wulan Coal Mine
4. 废弃煤矿瓦斯开发利用
Development and Utilization of AMM

辽宁省
辽宁省红阳煤层气清洁能源开发有限公司——清水二井（2016年10月31日关闭）
- 清水二井关闭施工先导性试验井5口
- 1号井平均自喷产气量2300m³/d
- 1号井最大自喷产气量：2700m³/d。

Liaoning Province
Liaoning Hongyang CMM Clean Energy Development Co., Ltd-
Qingshui No.2 Well (closed on October 31, 2016)
- Qingshui No.2 Well constructed 5 pilot test wells when closed.
- Average flowing gas production of No. 1 Well 1 is 2300m³/d.
- Maximum flowing gas production of No. 1 Well : 2700m³/d.
面临问题

矿权问题
- 矿权归属不明确
- 煤层气矿权申请周期存在周期长，环节多。

关闭法规和标准
- 煤矿关闭主要采取拆除设备、填实井筒等措施，未对次生灾害防范等做出要求。

Problems

Mining rights
- The ownership of mining rights is not clear
- The application period of CBM mining rights is long and has many links.

Regulations and standards for coal mine closure
- Coal mine closure mainly takes measures such as dismantling equipment and filling the shaft, and does not require prevention of secondary disasters.
4. Development and Utilization of AMM

- 面临的问题
  - 开发技术问题
    - 关闭煤矿地质条件复杂，地区差异大，目前废弃矿井瓦斯赋存、储量评估、运移、有利区选择等关键技术尚未突破；
  - 缺乏示范引领
    - 对技术可行性和经济性信心不足。

- Problems
  - Technical issues in development
    - The geological conditions for abandoned coal mines are complex, with large regional differences. At present, key technologies for gas storage, reserves assessment, migration and favorable area selection in abandoned mines have not been broken through.
  - Lack of demonstration and guidance
    - Lack of confidence in technical feasibility and economy.
中国煤层气资源丰富，开发潜力巨大；
地面煤层气开发、井下煤矿瓦斯抽采和井上下联合煤层气（煤矿瓦斯）抽采技术逐渐成熟；
中高浓度瓦斯民用、发电或用于工业燃料、低浓度瓦斯发电、低浓度瓦斯提纯和通风瓦斯热氧化利用技术逐渐成熟；
废弃矿井瓦斯回收利用工作取得积极进展。

中国有丰富的CBM资源，开发潜力巨大。
地面煤层气开发、井下煤矿瓦斯抽采和联合抽采技术逐渐成熟。
中高浓度瓦斯民用、发电或用于工业燃料、低浓度瓦斯发电、低浓度瓦斯提纯和通风瓦斯热氧化利用技术逐渐成熟。
废弃矿井瓦斯回收利用工作取得积极进展。
Thank You