2024 Global Methane Forum

Mobilizing Methane Action

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China's Progress in VAM Utilization & Emission Reduction

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Global Methane Initiative
Leading methane action since 2004

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Global Methane Hub

CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS
a UNEP convened initiative

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1. VAM utilization and emission reduction policy in China

- *Development and Utilization Plan for Coalbed Methane (Coal Mine Methane) during the 13th Five-Year Plan:* to promote the utilization of VAM, develop zero-emission demonstration projects, and establish a low-carbon circular development model.
  - Encourage the safe utilization, cascaded utilization, and large-scale utilization of coal mine methane by means of household use, CNG, LNG, concentration, power generation, oxidation of VAM, etc..
  - Develop key equipment for intelligent rapid drilling in underground coal mines, distributed utilization of low concentration gas, safe and efficient utilization of ultra-low concentration gas and VAM, and form a a technical and equipment system for coal mine methane extraction and utilization.

1. VAM utilization and emission reduction policy in China

- The Ministry of Ecology and Environment(MEE), the National Development and Reform Commission(NDRC), and the National Energy Administration(NEA) jointly issued the *Notice on Further Strengthening the Management of Environmental Impact Assessment for Coal Resource Development*, encouraging the exploration of comprehensive utilization for gas extracted from coal mines with methane concentration ranging from 2% (inclusive) to 8%, as well as VAM.
- NDRC, NEA and other four departments jointly revised and issued the *Special Management Measures for Central Budget Investment in Coal Mine Safety Transformation*, optimizing the focus of funding and encouraging the increase in comprehensive utilization of coal mine methane.

1. VAM utilization and emission reduction policy in China

- Organize the application and selection of demonstration projects for the efficient extraction and utilization of coal mine gas and the exploration and development of coalbed methane, fully leveraging the role of technical demonstration in leading and driving, and improving the multiple benefits of resource, safety, and ecology of coalbed methane (coal mine methane) extraction and utilization. The first group of demonstration projects all involves VAM utilization, including:
  - Shaanxi Hancheng Wangfeng Coal Mine's cascade efficient utilization demonstration project has a utilization rate of 20% for VAM.
  - China Coal Group's Shanxi Daning Coal Mine has a high-efficiency utilization demonstration project for low concentration gas, with a utilization rate of 10% for VAM.

1. VAM utilization and emission reduction policy in China

- Led by CCII, the Methodology for Voluntary Emission Reduction of Coal Mine Methane is being developed to support the methane emission reduction in coal sector. The Methodology is going to be issued in 2024.

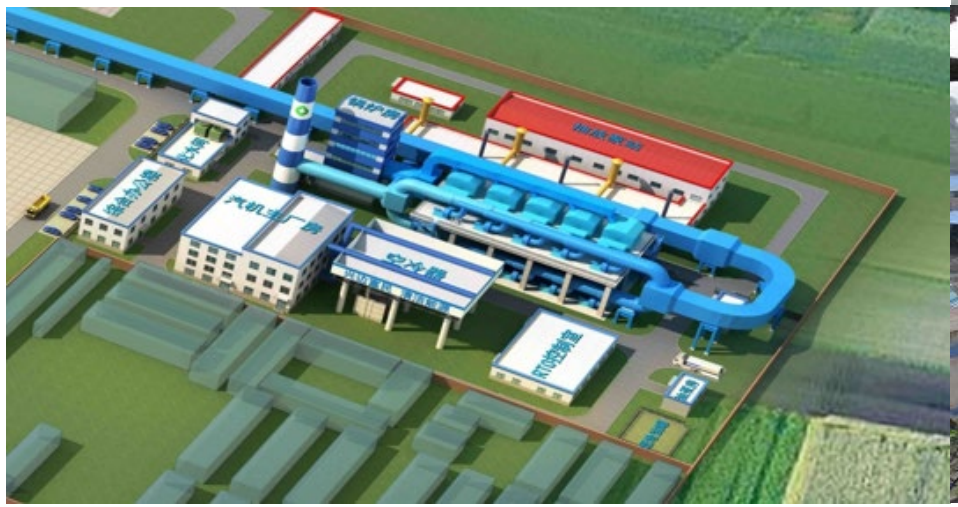
Kick-off Meeting for Methodology Preparation

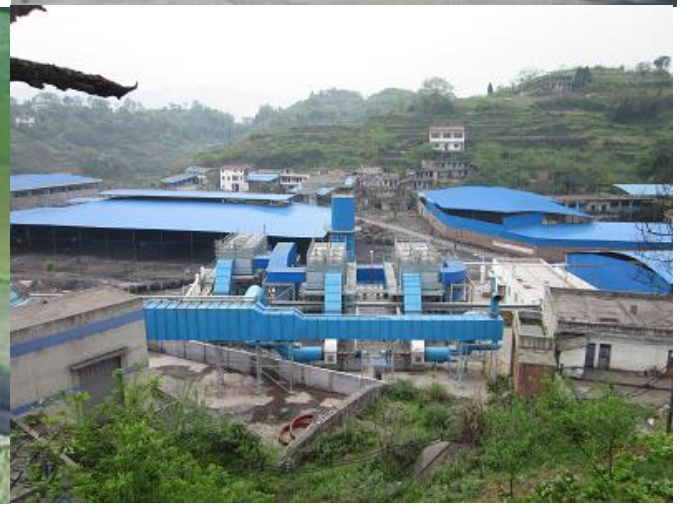
Attending the workshops on voluntary emission reduction methodology for coal mine methane

2. VAM utilization technology in China

VAM utilization technology

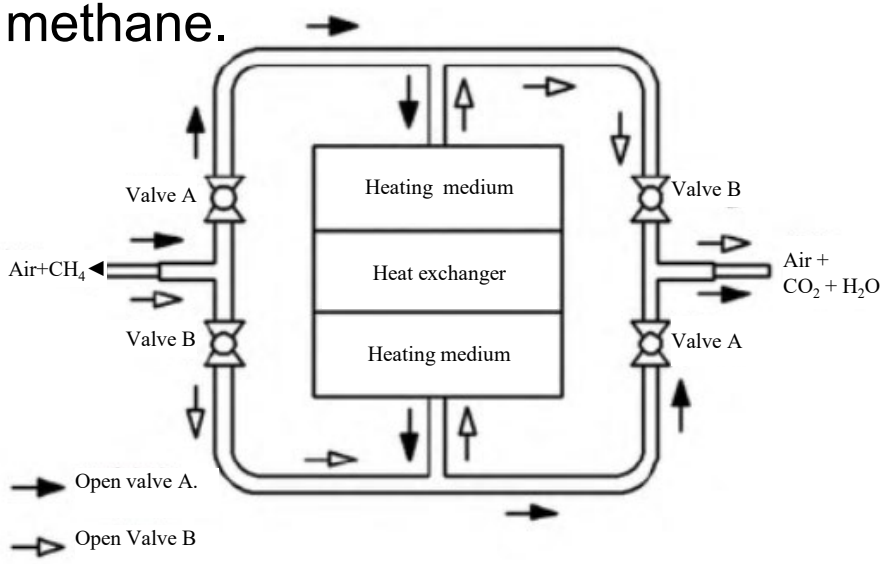
- Thermal oxidation
- Catalytic oxidation
- Boiler or gas engine auxiliary fuel





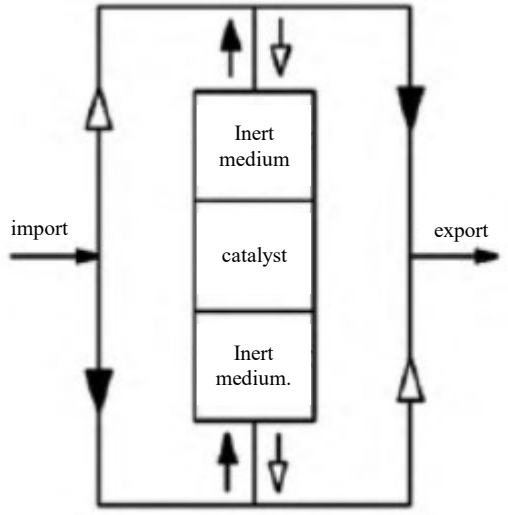
2. VAM utilization technology in China

Thermal oxidation: The high outlet flue gas temperature can be utilized for power generation and heating, mainly by mixing with coal mine methane.



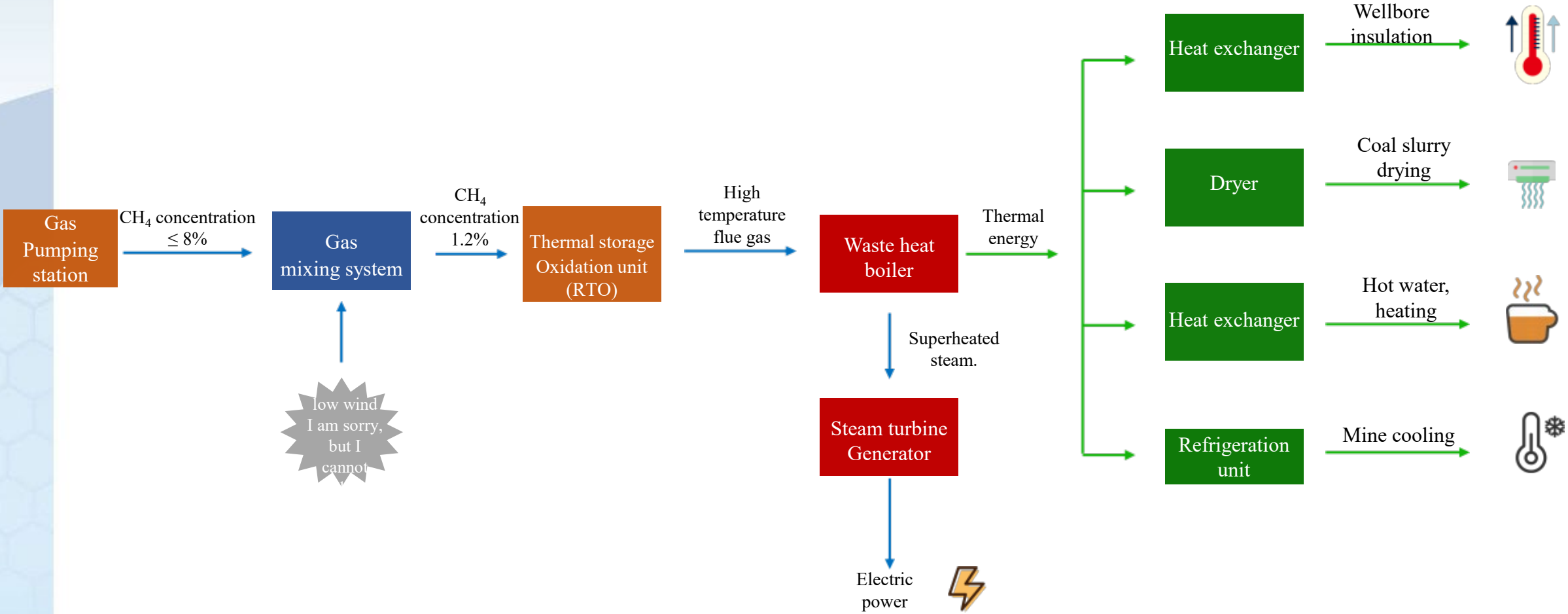
Thermal Flow Reversal Reactor

Catalytic oxidation: The outlet flue gas temperature is low, which can be used for heating. It is mainly used for the destruction of VAM and has great market potential.



Catalytic Flow Reversal Reactor

2. VAM utilization technology in China



VAM and ultra-low low concentration coal mine methane utilization and emission reduction technology roadmap

3. VAM demonstration projects in China

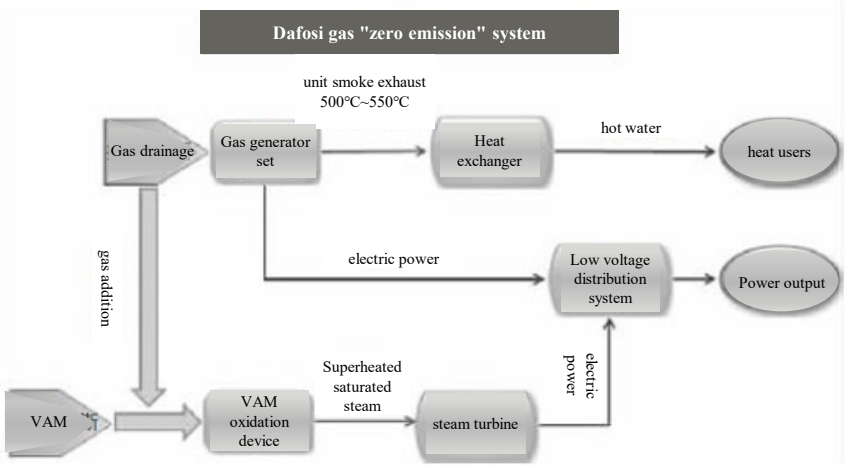
- Demonstration project for 30MW VAM oxidation power generation at Gaohe Coal Mine, Lu'an Group



Annual utilization volume of VAM: 92 million m^3, with power generation of 240 million kWh per year

3. VAM demonstration projects in China

- "Zero Emissions" Demonstration Project in Dafosi Coal Mine



Annual utilization volume of gas : 1.129 billion m^3

3. VAM demonstration projects in China

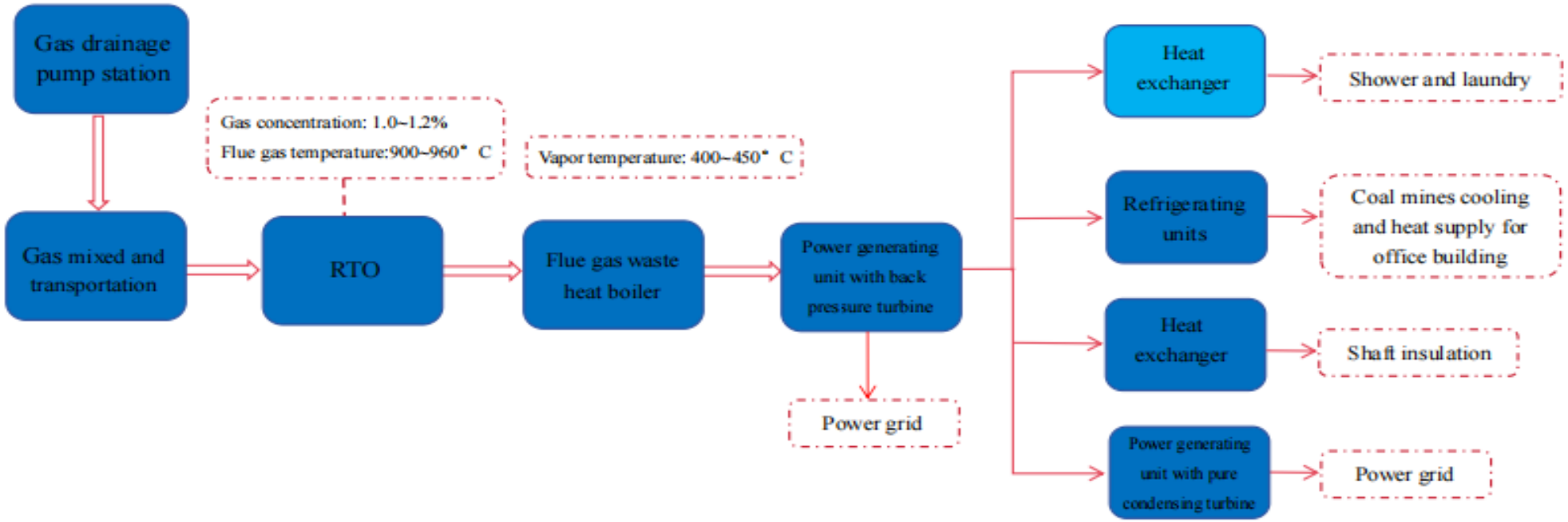
- CMM efficient utilization project for a full range of methane concentration in Dingji Coal Mine.
- Achieve comprehensive utilization of extracted gas by adopting low concentration gas generation, and heating and power generation system adopting RTO technology

Power generator for low concentration CMM (around 20%)

Coal slurry drying set powered by catalytic oxidation system for coal mine gas with methane concentration around 1% to 1.2%.

Heating and power generation system adopting RTO technology for ultra-low concentration coal mine gas(1% to 1.2%).

3. VAM demonstration projects in China



Ultra-low low concentration coal mine gas oxidation technology road map in Dingji Coal Mine.

- The utilization rate of extracted gas from the coal mine reaches 100%, with an annual utilization of 30 million m^3 of purified methane.
- It provides an annual heating supply of 233,600 GJ and generates 28 million kWh of electricity, equivalent to saving 42,000 tons of standard coal.

4. CCII's effort on VAM emission reduction and utilization

- Focus on source control: conducting basic research and engineering practice on coal mine methane extraction and utilization through underground and surface integrated approaches.

Coalbed methane (gas) content testing mobile laboratory (independent research and development)

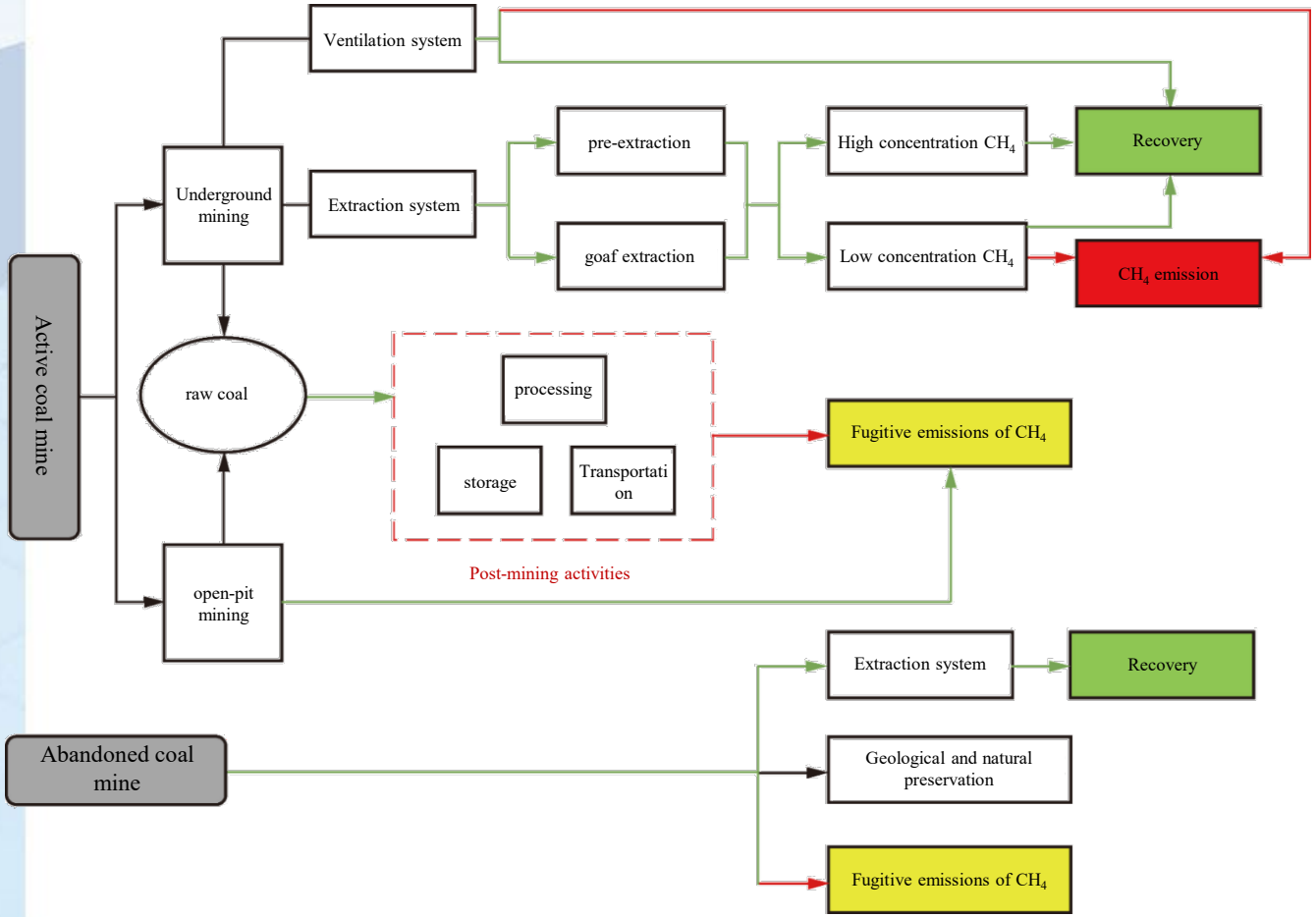
gravimetric adsorption instrument

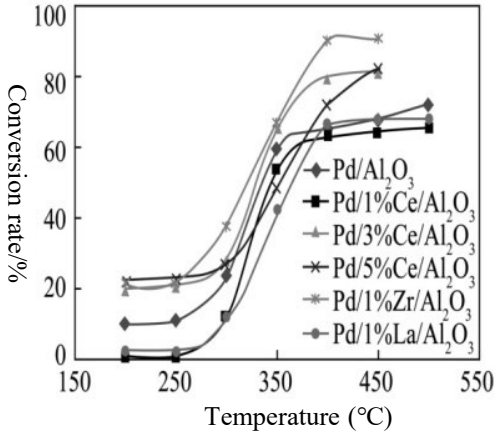
Fluid-structure interaction analysis and imaging system

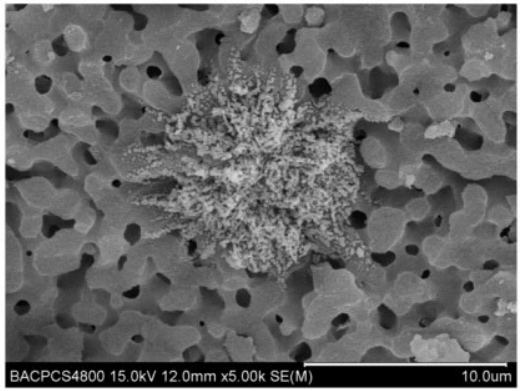
Multi-layered stacked gas reservoir joint development simulator

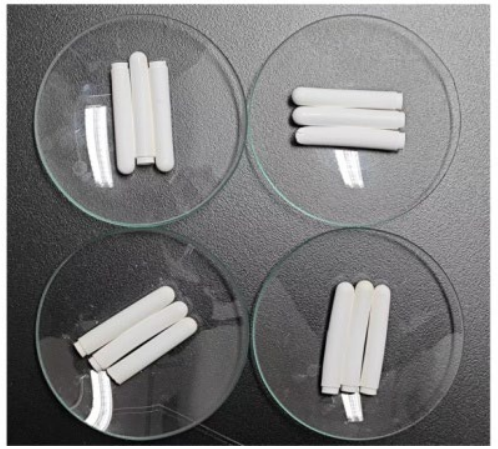
4. CCII's effort on VAM emission reduction and utilization

- Focus on end-use: relying on the National Natural Science Foundation project to address key and difficult issues in VAM utilization.









$$CH_4 \longrightarrow CH_3\cdot + H\cdot \quad (1)$$

$$CH_3\cdot + O\cdot \longrightarrow H{-}C(=O){-}H + H\cdot \quad (2)$$

$$H{-}C(=O){-}H \longrightarrow CO + H_2 \quad (3)$$

$$CO + O_2 \longrightarrow CO_2 \quad (4)$$

$$H_2 + O_2 \longrightarrow H_2O \quad (5)$$

4. CCII's effort on VAM emission reduction and utilization

- Focus on end-use: relying on the National Natural Science Foundation project to address key and difficult issues in VAM utilization.

Catalytic oxidation for VAM

- Catalytic reaction mechanism research
- Catalyst synthesis control strategy and product development
  - Pd/ porous Al_2O_3 support
  - Cu-Mn/Al-Zr-La multi-component support
- Catalyst engineering application research


发 明 专 利 证 书

发 明 名 称：一种通风瓦斯甲烷氧化整体式催化剂及其制备方法

发 明 人：刘文革；郭德勇；徐鑫；赵天波

专 利 号：ZL 2013 1 0743710.9

专利申请日：2013 年 12 月 30 日

专 利 权 人：国家安全生产监督管理总局信息研究院

授权公告日：2015 年 10 月 07 日

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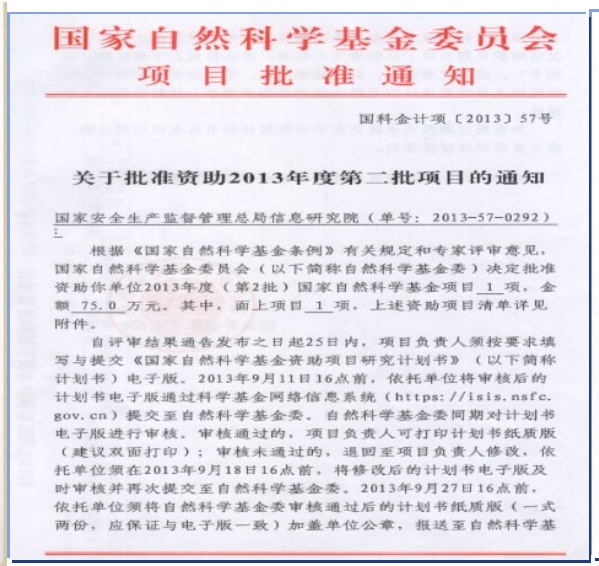

国家自然科学基金委员会
项 目 批 准 通 知

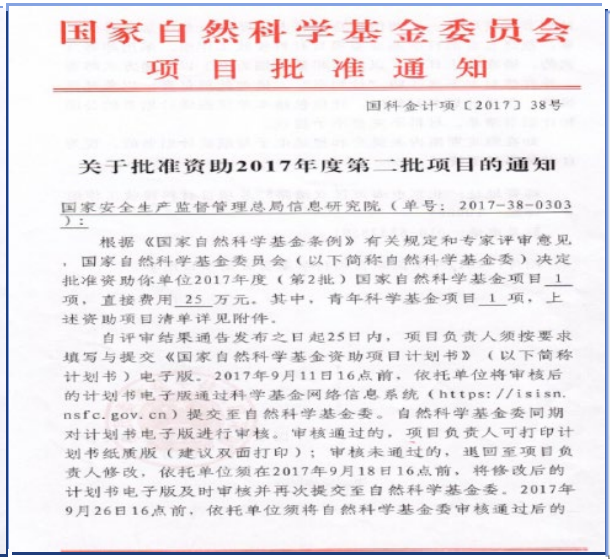
国科金计项〔2013〕57号

关于批准资助2013年度第二批项目的通知

国家安全生产监督管理总局信息研究院（单号：2013-57-0292）：

根据《国家自然科学基金条例》有关规定和专家评审意见，国家自然科学基金委员会（以下简称自然科学基金委）决定批准资助你单位2013年度（第2批）国家自然科学基金项目1项，金额75.0万元。其中，面上项目1项。上述资助项目清单详见附件。

自评审结果通告发布之日起25日内，项目负责人须按要求填写与提交《国家自然科学基金资助项目研究计划书》（以下简称计划书）电子版。2013年9月11日16点前，依托单位将审核后的计划书电子版通过科学基金网络信息系统（https://isis.nsfc.gov.cn）提交至自然科学基金委。自然科学基金委同期对计划书电子版进行审核。审核通过的，项目负责人可打印计划书纸质版（建议双面打印）；审核未通过的，退回至项目负责人修改，依托单位须在2013年9月18日16点前，将修改后的计划书电子版及时审核并再次提交至自然科学基金委。2013年9月27日16点前，依托单位须将自然科学基金委审核通过后的计划书纸质版（一式两份，应保证与电子版一致）加盖单位公章，报送至自然科学基


国家自然科学基金委员会
项 目 批 准 通 知

国科金计项〔2017〕38号

关于批准资助2017年度第二批项目的通知

国家安全生产监督管理总局信息研究院（单号：2017-38-0303）：

根据《国家自然科学基金条例》有关规定和专家评审意见，国家自然科学基金委员会（以下简称自然科学基金委）决定批准资助你单位2017年度（第2批）国家自然科学基金项目1项，直接费用25万元。其中，青年科学基金项目1项。上述资助项目清单详见附件。

自评审结果通告发布之日起25日内，项目负责人须按要求填写与提交《国家自然科学基金资助项目计划书》（以下简称计划书）电子版。2017年9月11日16点前，依托单位将审核后的计划书电子版通过科学基金网络信息系统（https://isisn.nsfc.gov.cn）提交至自然科学基金委。自然科学基金委同期对计划书电子版进行审核。审核通过的，项目负责人可打印计划书纸质版（建议双面打印）；审核未通过的，退回至项目负责人修改，依托单位须在2017年9月18日16点前，将修改后的计划书电子版及时审核并再次提交至自然科学基金委。2017年9月26日16点前，依托单位须将自然科学基金委审核通过后的


实用新型专利证书

实用新型名称：一种高效节能的矿井风排瓦斯催化氧化装置

发 明 人：刘文革；徐鑫；于雷；韩甲业；王海旺；邓贵昕；胡鹏程；贾宇坐；程国翔；隋建云

专 利 号：ZL 2019 2 1106658.5

专利申请日：2019 年 07 月 16 日

专 利 权 人：应急管理部信息研究院

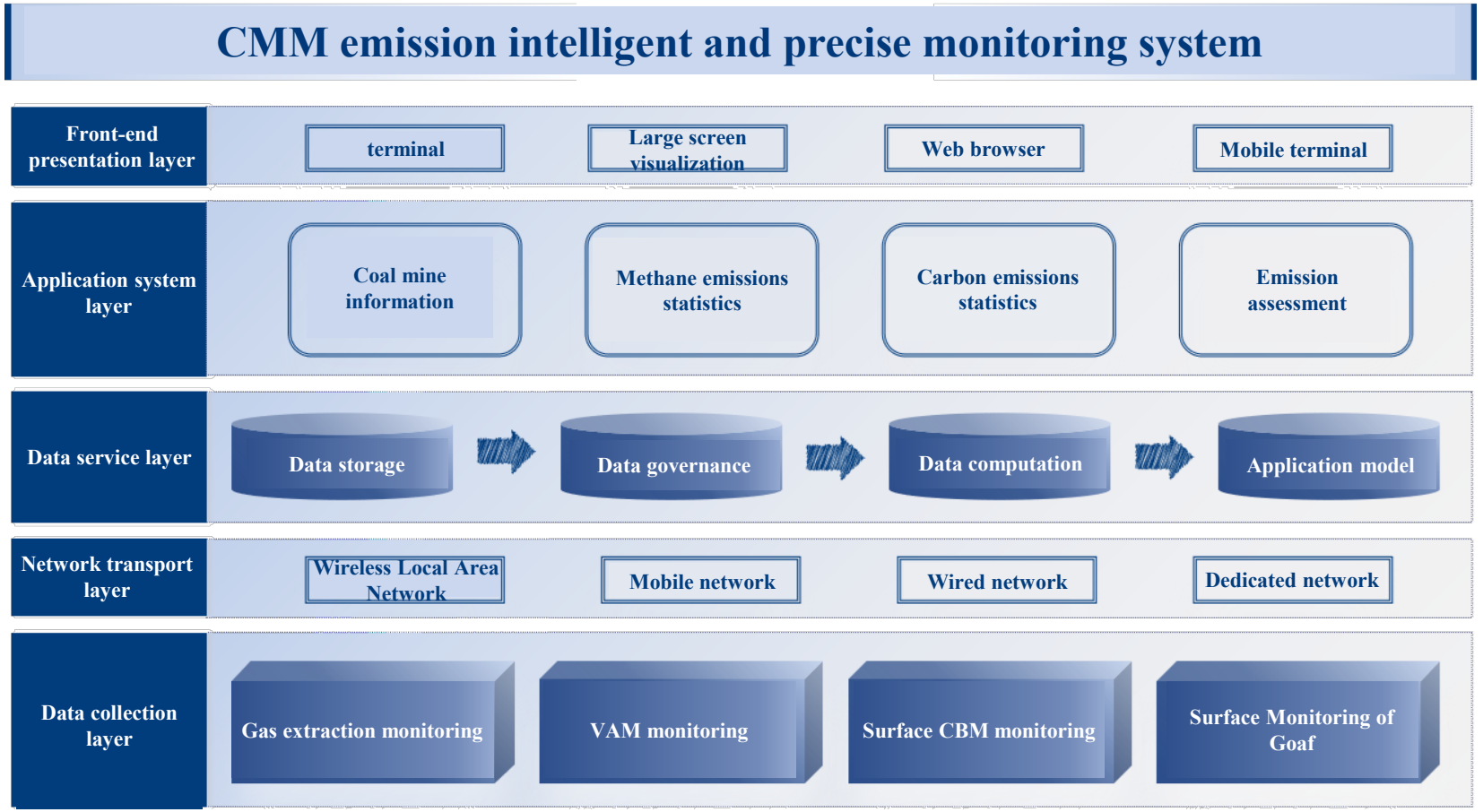
地 址：100000 北京市朝阳区芍药居 35 号楼

授权公告日：2020 年 04 月 17 日　　授权公告号：CN 210332279 U

局长 申长雨

4. CCII's effort on VAM emission reduction and utilization

- Accurate measurement and monitoring: developing Distributed matrix-type flow field VAM monitoring device Gas cloud imaging infrared spectroscopy gas monitoring technology, achieving the systematic technology and process for the measurement, monitoring, and utilization of VAM.



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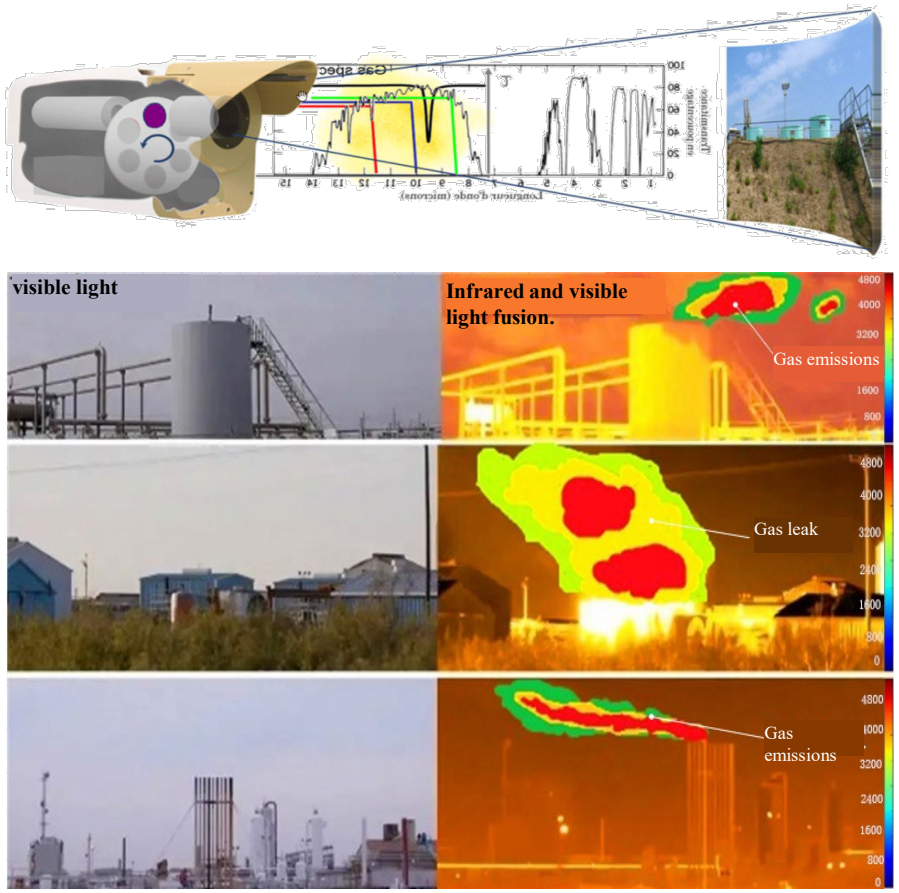


Surface leakage monitoring

Gas cloud IR video monitoring and early warning system

Utilizing unique infrared spectroscopic imaging technology
Capture visible light image and infrared image of methane gas.

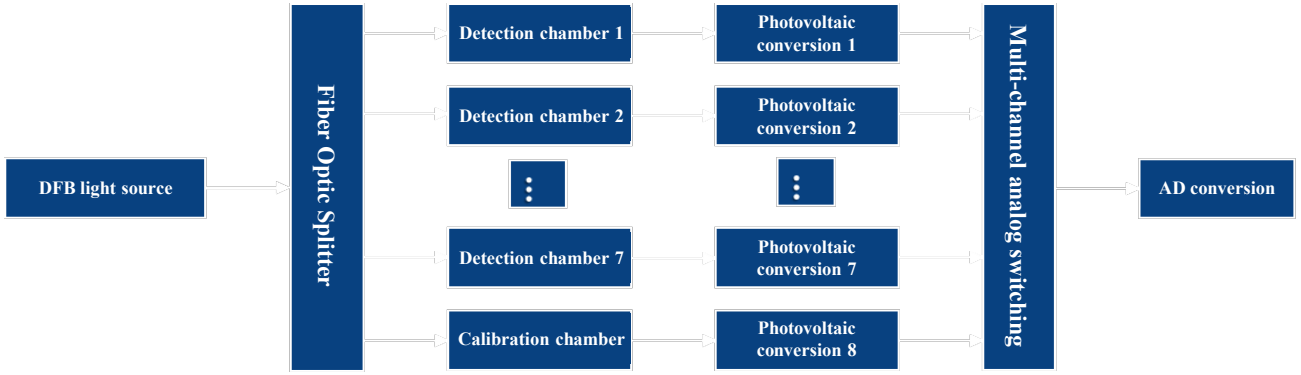
By capturing thermal radiation images of methane and performing inversion of concentration, gas concentration spectrum analysis can be achieved.

The dedicated image sensor detects changes in light intensity to form images of leakage clouds and changes in image intensity.

4. CCII's effort on VAM emission reduction and utilization

- Accurate measurement and monitoring: developing Distributed matrix-type flow field VAM monitoring device Gas cloud imaging infrared spectroscopy gas monitoring technology, achieving the systematic technology and process for the measurement, monitoring, and utilization of VAM.

Distributed matrix-type flow field VAM precise monitoring system



Ø Methane measurement range: (0.00 ~ 10.0)%CH_4;
Ø Error in methane monitoring:
When the concentration of CH_4 is between 0.00% and 1.00%, the uncertainty is ±0.06% CH_4.
When the CH_4 concentration is (1.00% ~ 10.0)%, the true value is within ±6%.
Ø Working mode: The probe operates in a passive mode and is connected via fiber.
Ø Communication interface: The device is equipped with a methane emission measurement monitoring system or a third-party monitoring system platform.

Thank you