# CNPC methane MRV system construction and practice in whole process of oil and gas production

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**Geneva, Switzerland**

**2024-03-20**

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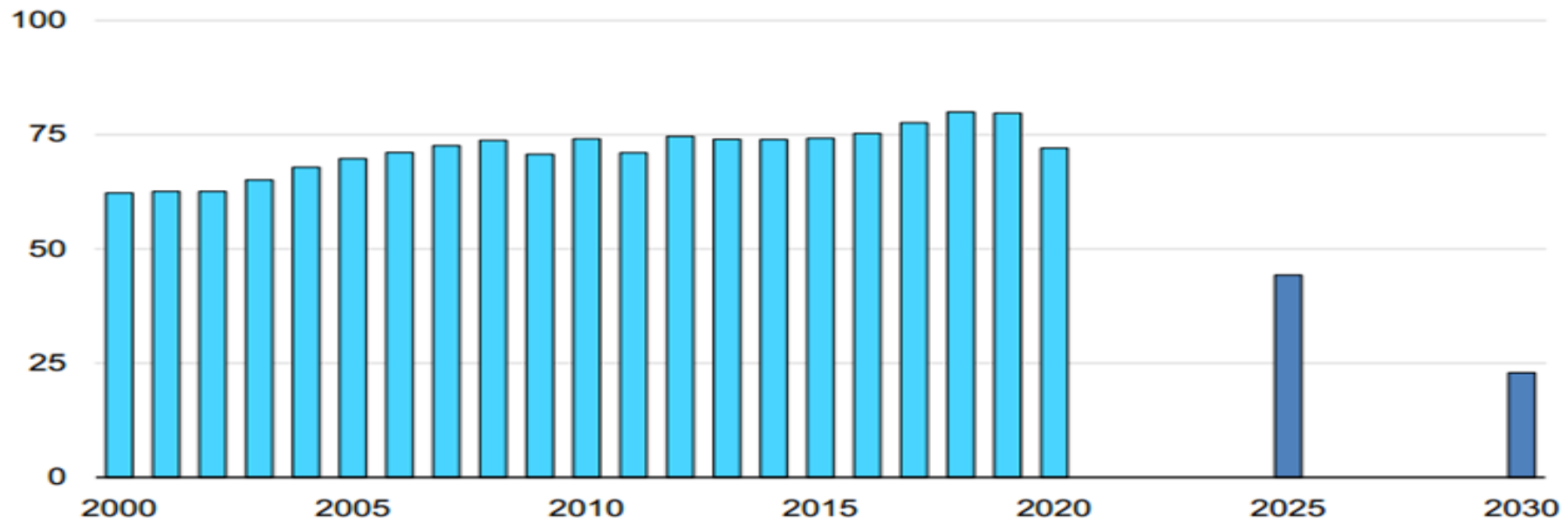
# Methane emissions from China's oil and gas industry

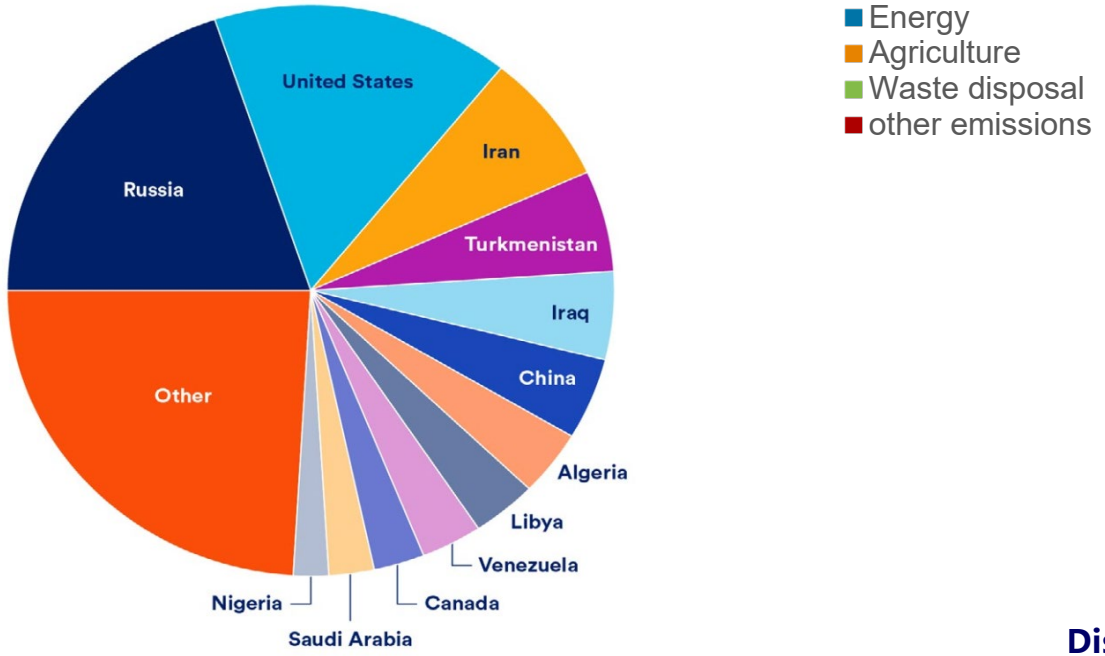
- The global oil and gas industry emits about 80 million tons of methane annually. (IEA,2022)



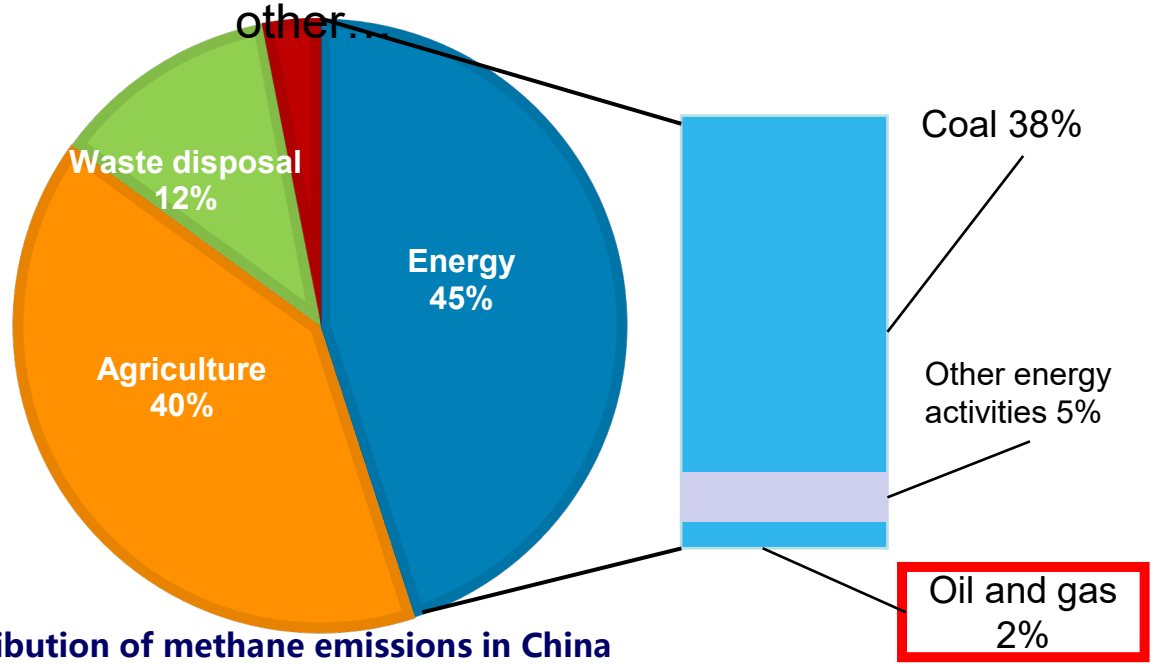

Prediction of methane emission from oil and gas industry(IEA)

# Methane emissions from China's oil and gas industry

- Methane emissions from the oil and gas industry in the USA, Russia, Iran, Turkmenistan and Iraq, account for more than 50% ;
- It is estimated that methane emissions from China's oil and gas industry account for about 2% of the country's total.




Distribution of methane emissions from the global oil and gas industry(CCAC, 2022; IEA 2022)




Distribution of methane emissions in China (Second Climate Change Communication, 2018)

# Alliance is committed to actively carry out methane emission control

- In May 2021, China Oil and Gas Enterprises Methane Emissions Control Alliance was announced, with a commitment to strive for methane control to approach the world's advanced level in 2025.
- In 2022, member number has reached 10, covering nearly 90% of the total national oil and gas production. It is an influential organization in China that spontaneously carries out methane emissions control.
- CNPC is one of the key initiators and currently serves as the chairman of the board of directors.

中国油气企业甲烷控排联盟
CHINA OIL AND GAS METHANE ALLIANCE

中国石油 中国石化 SINOPEC 中国海油 cnooc 国家管网 PipeChina 北京燃气 BEIJING GAS 華潤燃气 CR GAS ENN 新奥 新奥能源控股有限公司 ENN Energy Holdings Limited

# Actively implement independent methane emissions control action

| | China Oil & Gas Methane Emissions Control Alliance |
|---|---|
| Overall direction | 1. Incorporate methane emission control into the development strategies<br>2. Formulate methane emission control targets and action programmes<br>3. Support government's methane emission control policy and ensure financial investment<br>4. Continuously improve the transparency of methane emission data. |
| Specific measures | 1. Building a high-quality and open platform for technical experience sharing and co-operation<br>2. Strengthening MRV technology system at the facility level<br>3. Promoting LDAR and other effective emission control measures<br>4. Reducing conventional flaring and increase the recycling of vent gas<br>5. Accelerating the standardization of methane detection and measurement<br>6. Supporting scientific research and technological innovation<br>7. Sharing emission control experience and promote best practices |

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# CNPC is one of the world's major oil and gas producers and suppliers

China National Petroleum Corporation (CNPC) is a comprehensive international energy company integrating oil and gas exploration and development and new energy, refining and sales and new materials, support and services, capital and finance, etc., and carries out oil and gas investment business in 32 countries and regions around the world.

- China's largest supplier of oil and gas products and major petrochemical refiner
- Ranked the third in the overall ranking of the world's 50 largest oil companies
- Ranked the fourth in Fortune magazine's Global 500 ranking of the world's largest companies

# CNPC gas production accounts for 52.5% of total oil and gas production

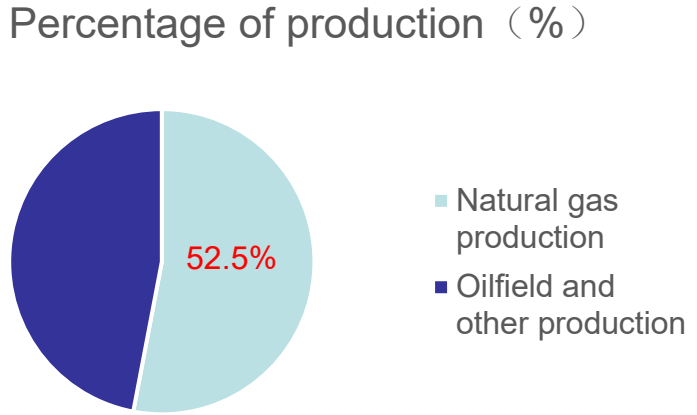
- In 2022, CNPC's domestic oil and gas production was 220.9 million tones equivalent, and natural gas production accounted for 52.5% of the total oil and gas production, exceeding the production of crude oil.
- CNPC develops new energy business, adding 10.06 million square meters of new geothermal heating area in the year, with a total area of 25 million square meters; accumulatively completing the installed scale of wind and solar power generation of more than 1.4 million kilowatts; and adding 1,500 tones of new high-purity hydrogen production capacity in the year, with the total high-purity hydrogen production capacity reaching 3,000 tones per year.

New domestic geological reserves of proven oil 862.16 million tons

New domestic geological reserves of proven natural gas 684.5 billion cubic meters

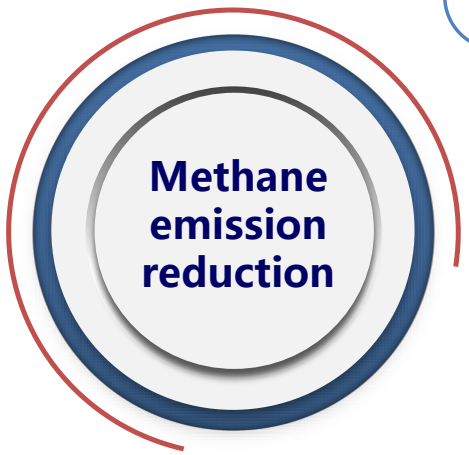
China's domestic crude oil production 105 million tons

China's domestic gas production 145.5 billion cubic meters



# Development of CNPC methane control measures

- In 2020, Methane Emissions Control Action Program
- In 2024, Methane Emissions Control Action Enhancement Program



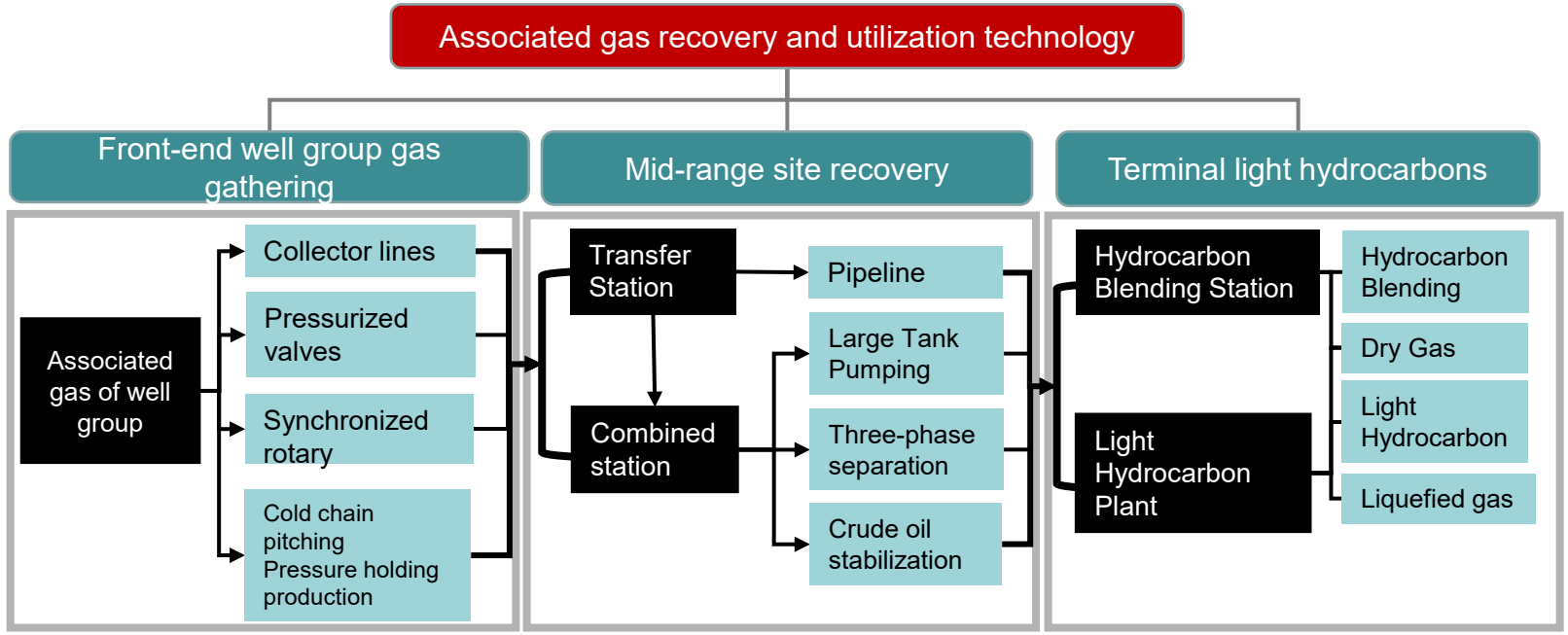

1. Monitoring and accounting system for methane emissions
2. Conventional flare-out projects
3. Overall closed process modification projects
4. LDAR system construction projects
5. The Wellbore Emission Gas Recovery Projects
6. Gas emission control project for construction

# Methane emission reduction technologies

CNPC has actively explored and practiced many methane emissions reduction technologies, such as forming typical technologies including associated gas recovery and utilization, wellhead fixed pressure valve recovery of casing gas, and natural gas recovery during tight gas fracking, and built a number of methane control demonstration projects.

- **Wellhead fixed-pressure valve**, the installation ratio of wellhead recovery casing gas devices in the northwestern oil fields has reached 45.6%, and the utilization rate of associated gas has increased to 90.3% after associated gas recovery and comprehensive utilization.

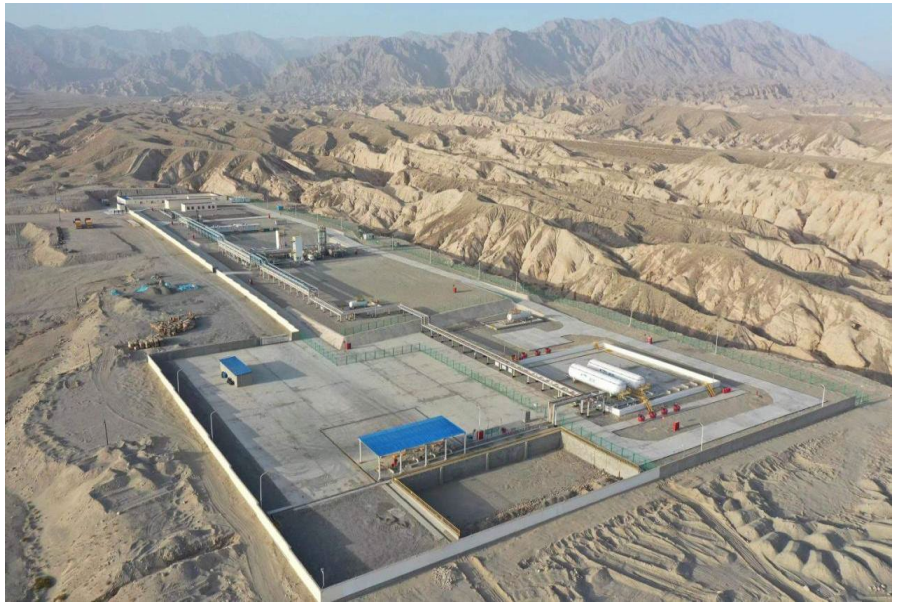

Direct-reading anti-frozen blockage constant pressure recovery valve



# Scattered gas recovery projects

- **Scattered gas recovery project:** Oil fields in western China, facing the practical difficulties such as vast area, scattered wells, complex gas components and lack of ground facilities, has developed LNG and CNG technologies, with equipments of skid-mounted and modular construction, which is able to quickly collect scattered gas recovery in remote areas, accumulating 7 billion cubic meters of scattered gas since 2009, approaching the scattering gas recovery rate of 98%.

Natural gas recycling unit based on LNG technology



Vent gas recycling unit based on skid-mounted design + modular construction

# Methane leakage-free demonstration projects

- **Methane Control Demonstration Project:** the Southwest Oilfield implemented methane control project to reduce fugitive emissions through the measures of scattered gas recovery, conventional flare extinguishing, gas recovery during inspection and maintenance , LDAR, etc., and achieved significant environmental benefits.


Methane Leakage Gas Cloud Imaging Monitoring System

Skid-mounted LNG Fractional Gas Recovery Project

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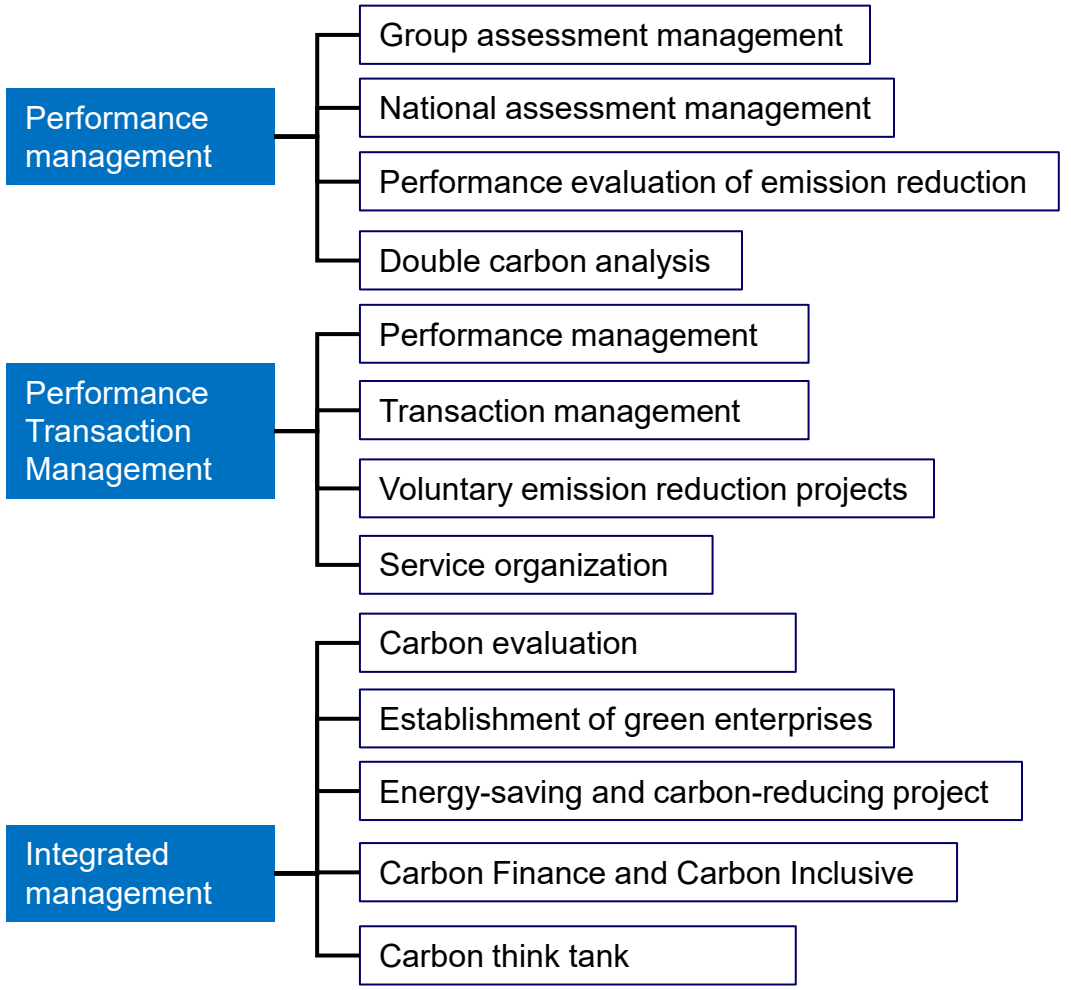
# Methane control platform

CNPC's carbon asset centralized control platform covering the full range of elements such as methane monitoring, emission reporting, compliance trading, comprehensive management and performance management was initiated in 2023.

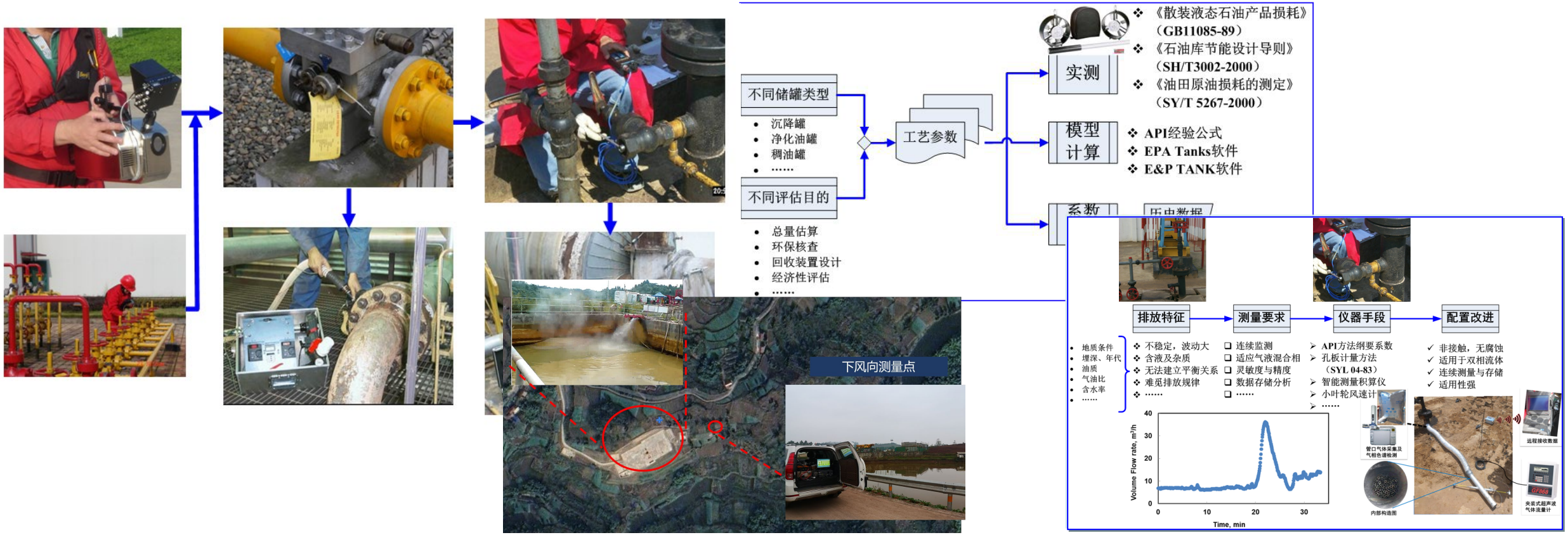
the key tasks of a more effective methane MRV system and platform:

1. Improve the digital and intelligent level of methane management
2. Explore the establishment of localized methane emission accounting factors
3. Eliminate digital silos, strengthen the linkage with the production&operation system



# Methane emission detection capacity in phases

- **Phase I: since 2007, built the capacity of methane/VOCs emission detection at component level, on-board monitoring system, and OP-FTIR method via line concentration, and initially clarified the methane emissions and intensity of our shale gas and coalbed methane production process.**



# Whole Process LDAR to Control Methane Leaks

- **Phase 2: conduct fugitive methane measuring and leak detection for equipments, pipelines and component sealing points throughout the whole production process using LDAR technology.**

Oil and gas wells

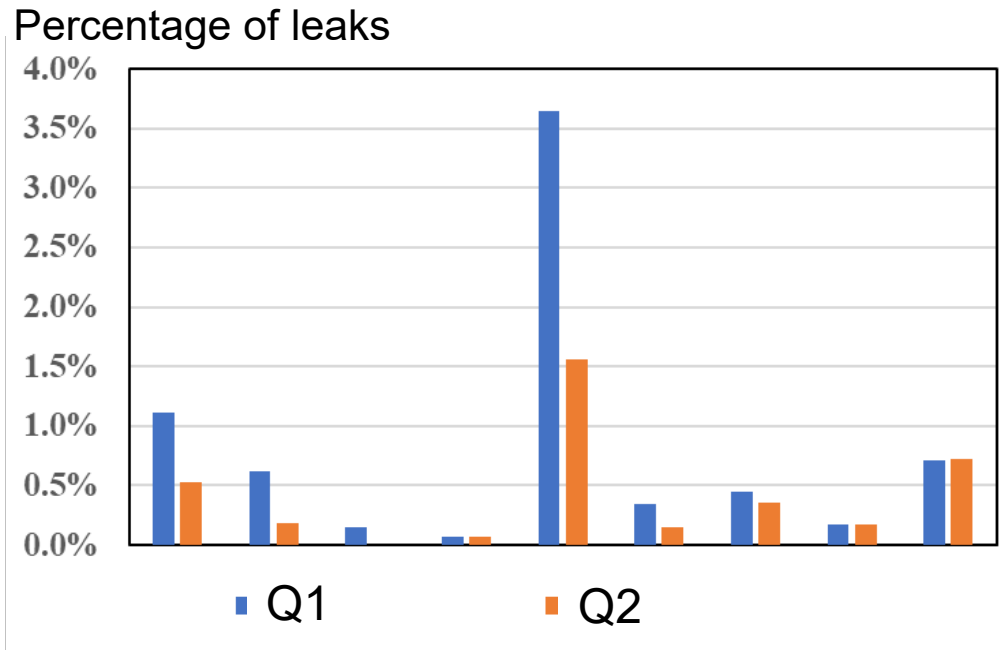
Single-well oil storage tanks

Oil in single well tanks

Compressors

# A significant reduction in methane leakage rates at the field stations

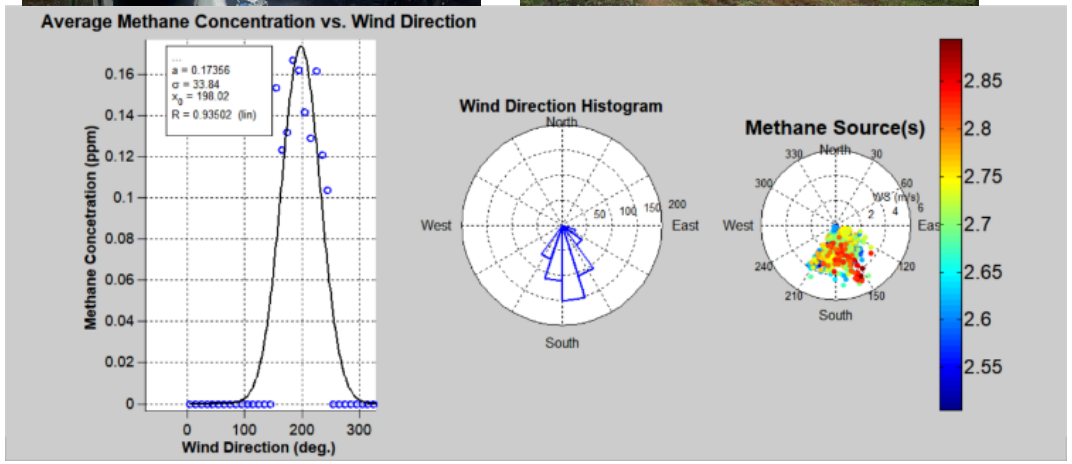
- After multiple rounds of LDAR, the leakage rates significantly reduced
- To solve the problem of insufficient means of quantifying methane emissions, an instrument for methane emission quantification was developed to form a full-range methane leakage quantification capability, and on-site validation was completed.

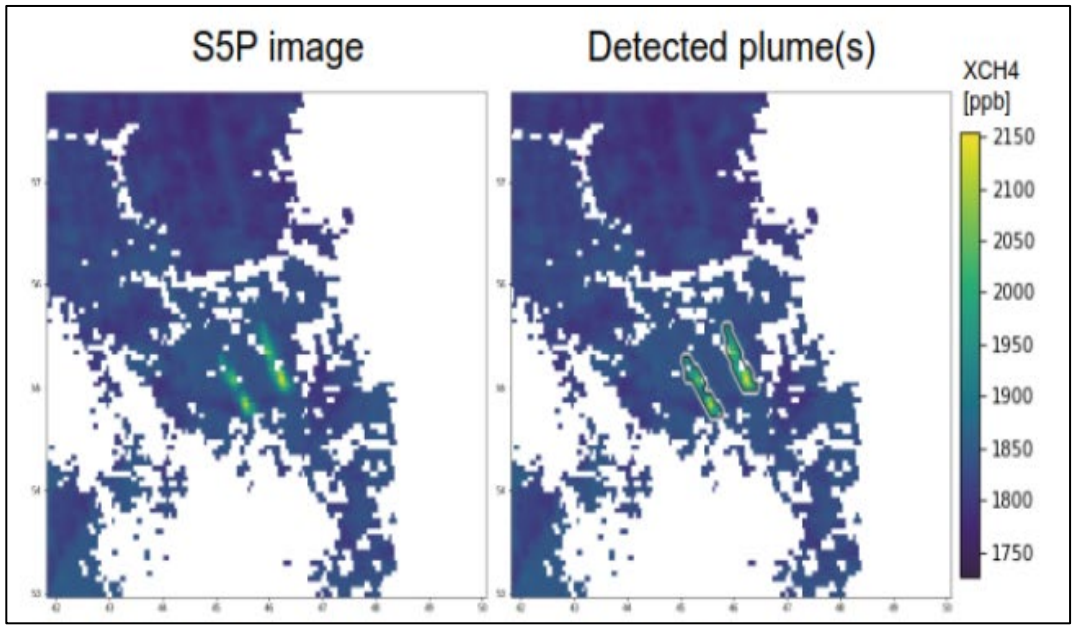



| Indicators / Manufacturers | CNPC Research Institute | American BACHARACH | Canada Solutions |
|---|---|---|---|
| Model number | Methane emission quantitative detector | HIFLOW | HETEK |
| Application technology | TDLAS* | Catalytic oxidation + thermal conductivity | Catalytic oxidation + thermal conductivity |
| Measuring range | • 20～20000ppm（0-2%VOL）high precision；20000～1000000ppm（2~100%VOL）full range | 0-5%(high precision)<br>5-100%(full range) | 0-5%(high precision)<br>5-100%(full range) |
| accuracy | • ≤± 20ppm(< 100ppm)<br>• ≤±50ppm(100~10000ppm)<br>• ≤ *truth value* ±3%（1~2%）<br>• ≤ *truth value* ± 5%（>20000ppm） | ±5% or 0.02% of the reading number | 5% of the reading number |
| Accuracy of leakage calculation | ±4% | ±5% | ±5% |

# UAV and on-board testing, satellite remote sensing

- Field validation of UAV/vehicle-based and other detection tools was conducted at over 20 sites and 50 wellheads and compared to site-level accounting data.
- Remote sensing to identify sources of high methane emissions, and valid flare emissions.




Example of high methane emission point screening based on TROPOMI data

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# Challenges


1. The methane accounting and reporting system is basically complete, but still a gap between the accounting data and the actual ones.
2. The level of methane emission accounting needs to be upgraded.
3. Measurement-based databases of methane emission factors at the site level and component level need to be upgraded.
4. The quantitative verification technology for different ground engineering conditions still needs to be verified.
5. Lack of policies and technologies to enhance the economics of emission reductions for hard-to-recover methane.

# Actions


1. Gradually promote the formation of a localized methane emission factor database by on-site detections.
2. Continuously improve accounting levels and standards for methane accounting and reporting.
3. Continuously expand the implementation of LDAR, conduct measurement and validation, and explore the establishment of component-level emission factors.
4. Development of technologies for the utilisation of difficult-to-recover fractional gas and establishment of CCER methodologies.
5. Enhance international communication and cooperation on MRV of methane control.

# Thanks for your listening

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