Safe, Green, and Smart Sinopec Guangzhou Empowered by 5G

> The success of the 5G + smart petrochemical project has empowered 15 application scenarios in six major business fields, reducing accident rate by 20% and harmful gas emissions by 30%, and creating an annual economic benefit of RMB 30 million. Based on the 5G cloud network, Sinopec Guangzhou has transformed into a safe, green, and smart enterprise, and strives to become a paradigm in terms of both "clean energy" and "transformation", taking the lead in driving the growth of the petrochemical industry.

Huang Haibin
Head of the Information Centre at Sinopec Guangzhou Petrochemical Company

Partners

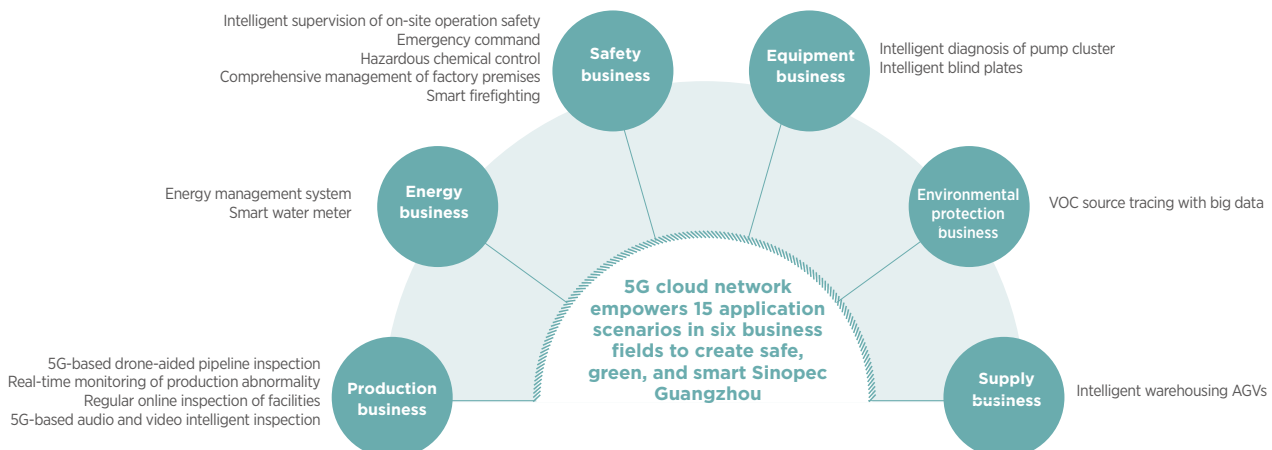Sinopec   China Telecom   HUAWEI   GDCN   PCITC   GPDI

Case Overview

The petrochemical industry plays a significant role in the national economy and people's livelihood. China's GDP in 2020 stood at RMB 101 trillion, and the petrochemical industry contributed RMB 11 trillion of revenue, accounting for 10.89% of the national GDP. Sinopec Guangzhou Petrochemical Company (hereinafter referred to as Sinopec Guangzhou), is one of the largest modern petrochemical enterprises in South China and the only super-large refinery facility of Sinopec in the Pearl River Delta region, boasting an A-level informatisation level and a crude oil processing capacity of more than 10 million tons.

Sinopec Guangzhou is recogised by Sinopec Group as a key pilot enterprise for the "world-class green and low-carbon urban refinery demonstration enterprise construction". In line with the "safe, green, and smart" development of the petrochemical industry, Sinopec

Guangzhou established partnerships with China Telecom, Petro-Cyberworks Information Technology Co., Ltd., Huawei Technologies Co., Ltd., Guangdong Communications and Networks Institute, and Guangdong Telecom Planning and Design Institute to undertake the special project of the Department of Science and Technology of Guangdong Province and the key research and development tasks of Sinopec Group in September 2020. Relying on the overall architecture of data + platform + applications, Sinopec Guangzhou was able to upload various on-site terminal data to the local data centre in a real-time and secure manner via the 5G private network. Leveraging the intelligent cloud platform's key capabilities in edge-cloud coordination, big data operation, AI applications and business platforms, the company has achieved safe, green, and intelligent applications in 15 major scenarios of six major business fields.

Intelligent supervision of on-site operation safety
Emergency command
Hazardous chemical control
Comprehensive management of factory premises
Smart firefighting

Safety business

Equipment business
Intelligent diagnosis of pump cluster
Intelligent blind plates

Energy management system
Smart water meter

Energy business

Environmental protection business
VOC source tracing with big data

5G-based drone-aided pipeline inspection
Real-time monitoring of production abnormality
Regular online inspection of facilities
5G-based audio and video intelligent inspection

Production business

5G cloud network empowers 15 application scenarios in six business fields to create safe, green, and smart Sinopec Guangzhou

Supply business
Intelligent warehousing AGVs

Industry Challenges

Large state-owned petrochemical enterprises led by Sinopec in China are among the first to explore and systematically propose the concept of smart factories and put them into practice, which has produced an impressive result. By learning from foreign counterparts' best practices in information-based development, Sinopec successfully built its own smart factories, which offered an excellent example for players in the petrochemical industry. However, China's petrochemical industry still has a long way to go with regard to the digitalized and intelligent levels.
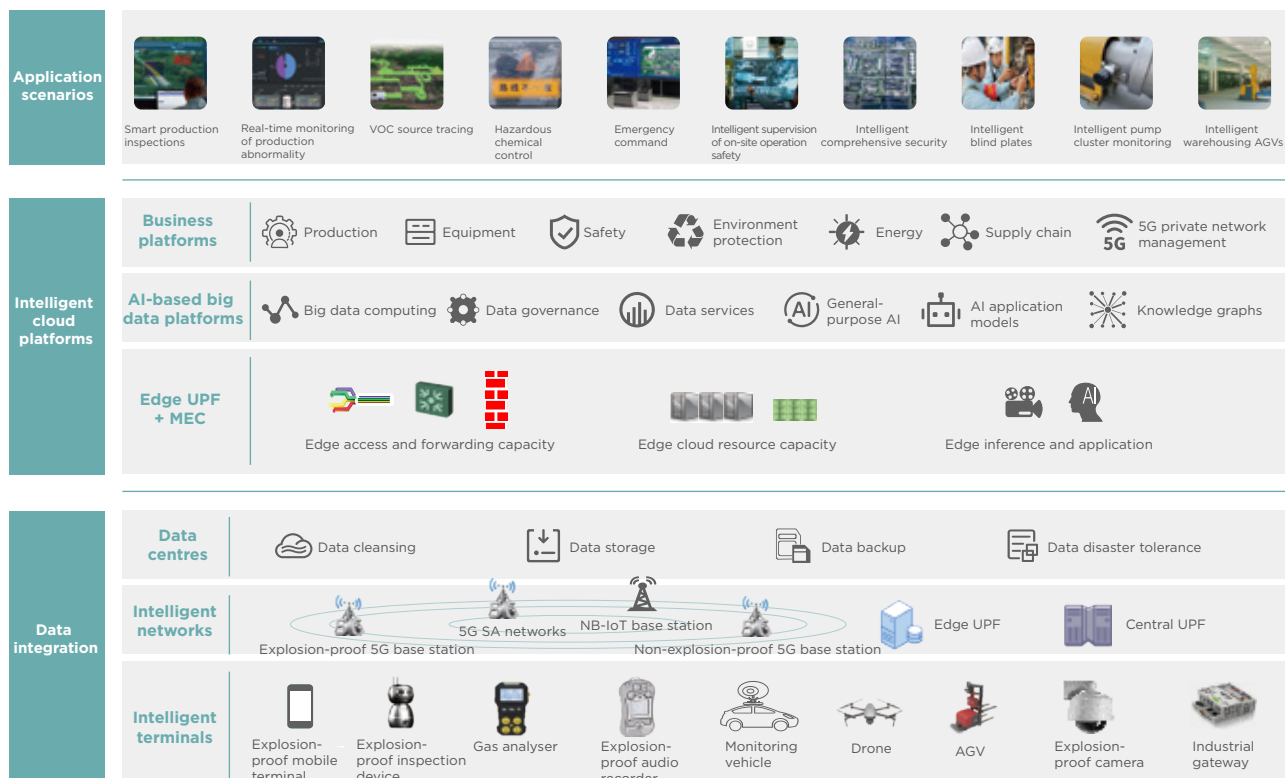
Sinopec Guangzhou identified the following issues during its production. 1. The joint emergency response and command capabilities were insufficient and integrated communications were not available. 2. With respect to collection and transmission of production and equipment operation data, some factories had remotely located control centres from their equipment and used traditional copper wires or optical fibers for wired transmission, which increased the network deployment cost. 3. Grid monitoring of VOCs and odors across the factory premises was in place, but the VOC emissions, fugacity prediction, and emission traceability were not effectively monitored

and managed. 4. The information-based operation management was not well executed due to the large workload on the site. 5. The existing pump equipment status monitoring could not meet the requirement for equipment health management, and the security and availability of the wireless data transmission network needed to be improved. 6. The traditional inspection mode without information-based control was inefficient. 7. The manual collection, delivery, and sorting of bulky cargoes resulted in a heavy workload and a low efficiency.

Therefore, Sinopec Guangzhou had an urgent need to improve automation and intelligent levels in the factory by integrating 5G + advanced technologies, in an effort to achieve lean production, collaboration optimisation, safety enhancement, energy conservation and environmental protection, green and low-carbon development, as well as cost reduction and efficiency enhancement. The "5G + Smart Petrochemical" project has injected new impetus into enterprise management reform, resource optimization, business innovation and efficiency enhancement, providing strong support for building first-class enterprises.

Solutions and Benefits

The overall architecture of data + platform + applications enabled the company to upload on-site terminal data to the data centre in a real-time and secure manner via the 5G (including NB-IoT) private network. Leveraging the intelligent cloud platform's key capabilities in edge-cloud coordination, big data operation, AI applications, and business platforms, the company was able to achieve dynamic sensing, forecast and pre-warning, informed decision-making, and targeted execution in six business fields, namely production, equipment, safety, environmental protection, supply chain, and energy, bringing down the accident rate by 20% and the VOC emissions by 30%, and creating an annual economic benefit of RMB 30 million.

Application scenarios										
	Smart production inspections	Real-time monitoring of production abnormality	VOC source tracing	Hazardous chemical control	Emergency command	Intelligent supervision of on-site operation safety	Intelligent comprehensive security	Intelligent blind plates	Intelligent pump cluster monitoring	Intelligent warehousing AGVs

Intelligent cloud platforms

Business platforms: Production · Equipment · Safety · Environment protection · Energy · Supply chain · 5G private network management

AI-based big data platforms: Big data computing · Data governance · Data services · General-purpose AI · AI application models · Knowledge graphs

Edge UPF + MEC: Edge access and forwarding capacity · Edge cloud resource capacity · Edge inference and application

Data integration

Data centres: Data cleansing · Data storage · Data backup · Data disaster tolerance

Intelligent networks: 5G SA networks · NB-IoT base station · Explosion-proof 5G base station · Non-explosion-proof 5G base station · Edge UPF · Central UPF

Intelligent terminals: Explosion-proof mobile terminal · Explosion-proof inspection device · Gas analyser · Explosion-proof audio recorder · Monitoring vehicle · Drone · AGV · Explosion-proof camera · Industrial gateway

▲ 项目整体架构

5G+ Smart Manufacturing

01   Integrated solution of 5G private network

Wireless network coverage

Four 5G explosion-proof micro stations in explosion-proof areas and 13 macro stations in non-explosion-proof areas have been deployed across the factory which covers an area of 4.45 million square meters, with 5G signal coverage rate reaching 95.80%. Blind areas and poor signal coverage areas of 5G networks in explosion-proof areas will be addressed based on project requirements.

5G private network solution

The Adjacent and Wide-area dual private network mode has been adopted for the first time in the petrochemical industry. Currently, the Adjacent mode with UPF deployed on lower layers is adopted in the production environment to achieve exclusive sharing of base stations and keep data for exclusive use within the industry park, thereby ensuring data security. The project adopts a Wide-area 5G private network that fully reuses the operator's public network as a backup. When the lowered UPF fails, the data services can be seamlessly switched to the Wide-area private network to ensure high availability of the 5G network.

02   Intelligent supervision of on-site operations improves safety

The deployment of mobile 5G cameras allows for real-time site monitoring and online AI analysis, which facilitates the transition from in-event supervision and post-event traceability to pre-event prevention. Online intelligent monitoring is now available for all on-site operations, which increases the standardized operation rate by 30% and secures an annual economic benefit of RMB 5 million.
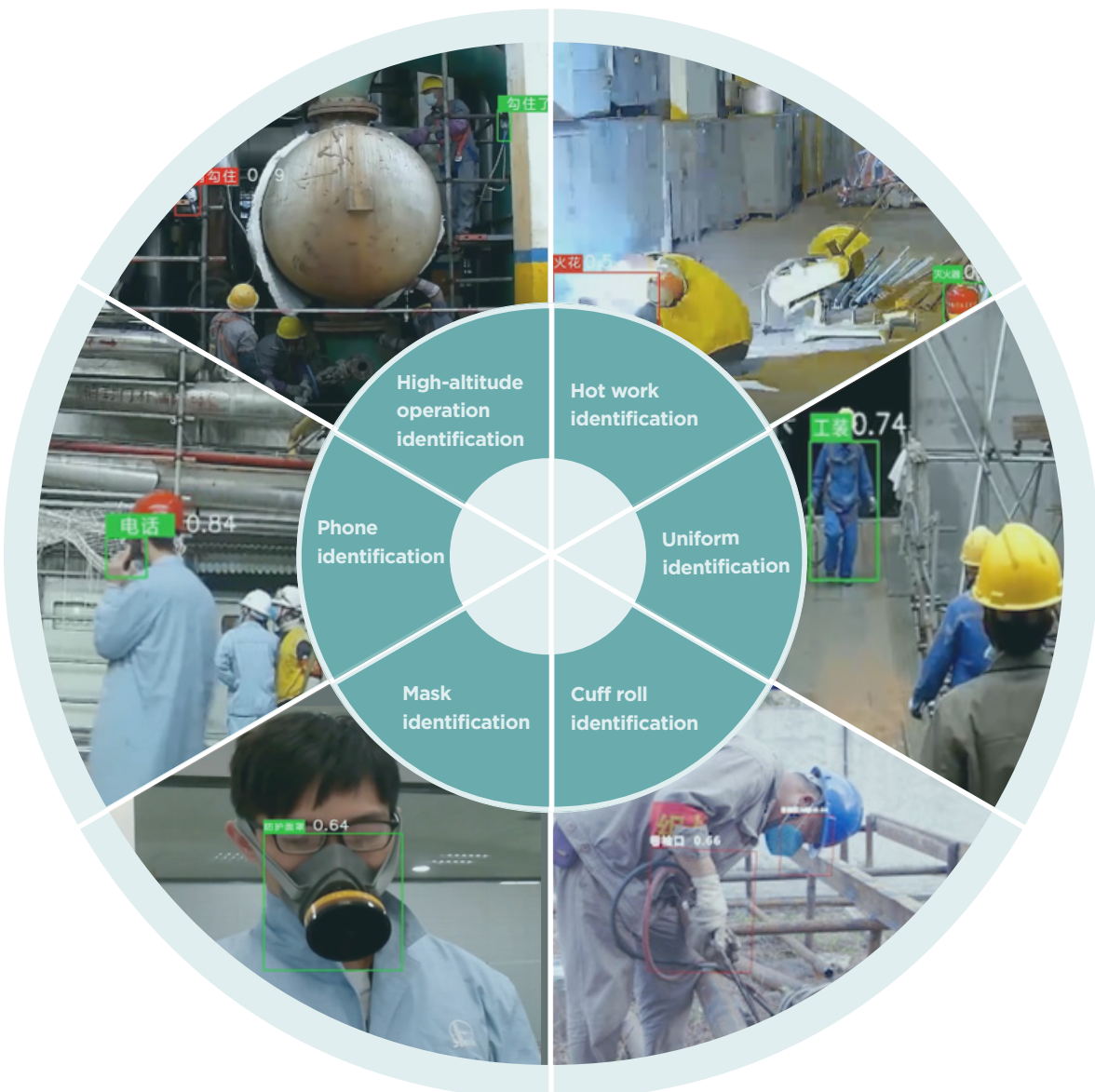
## 03 VOC traceability improves environmental protection

By leveraging 5G and AI technologies, a multi-source integrated 3D monitoring, pre-warning, and traceability system has been established to serve the full life cycle management of environmental protection, covering pollution prevention, source reduction, process control, and final treatment. This has led to a higher accuracy, more monitoring items, reduced early warnings, and a wider scope of traceability. Specifically, the accuracy rate has been increased from 50% to 70%, the number of monitoring items has expanded from 45 to 330, the number of early warnings has dropped by 10% year-on-year, and the scope of traceability has been extended to areas out of the factory.


▲5G distributed point monitoring

▲5G-based monitoring vehicle
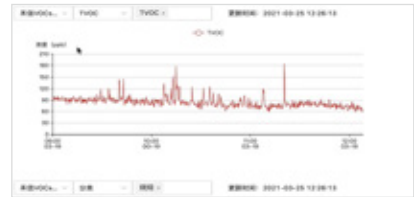
▲5G multi-source, multi-dimensional big data model

04   Intelligent production improves quality and efficiency

Take pipeline inspection as an example. Traditional manual inspection of pipelines have such problems as a low frequency, a high risk, a heavy workload, and difficult implementation. The use of 5G + drones has effectively solved these problems by photographing pipeline conditions from the top and sending the images to the edge nodes in real time for online AI analysis. This has enhanced the pipeline inspection efficiency by 10-fold, with the overall efficiency increased by 30% and the cost saved by RMB 1 million per year.
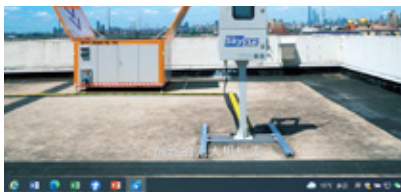
▲5G connected drone

▲Drone-aided inspection

▲Remotely controlled drone

🗐 Solutions and Benefits

The 5G + smart petrochemical project highlights the following six successful practices

High-bandwidth uplink backhaul in explosion-proof areas. The project team and its partners simultaneously completed the explosion-proof transformation of Huawei pRRU and ZTE pRRU nationwide for the first time to address 5G signal coverage in explosion-proof areas.	5G explosion-proof terminals. The project team developed 5G explosion-proof cameras, 5G AR helmets, 5G explosion-proof mobile phones, 5G audio and video inspection devices, 5G on-site intelligent monitoring stations and other 5G terminals to address 5G terminal challenges in the petrochemical industry.	5G explosion-proof terminals. The project team developed 5G explosion-proof cameras, 5G AR helmets, 5G explosion-proof mobile phones, 5G audio and video inspection devices, 5G on-site intelligent monitoring stations and other 5G terminals to address 5G terminal challenges in the petrochemical industry.
Multiple types of 5G private networks. The project production environment used the Adjacent 5G private network with UPF deployed on lower layers, with Wide-area private network serving as a backup to ensure higher availability of 5G network.	Integrated operation of 5G private network and NB-IoT network. The project enabled local data offloading of NB-IoT networks via the lowered UPF for the first time in the industry and provided an operation management platform integrating both the NB-IoT and 5G private networks for visualised management and control of the networks.	Based on the 5G + intelligent cloud platform for the petrochemical industry + application, the project has created 15 application scenarios in six major fields.

The 5G + smart petrochemical solution of Sinopec Guangzhou will be replicated and promoted in 32 refineries under Sinopec Group, and the 5G + petrochemical industry application standards will be outputted. Furthermore, its best practices will be promoted in the petrochemical industry at home and abroad.