

Refining & Manufacturing Research Institute

The Refining & Manufacturing Research Institute is one of the three research institutes of the CPC Corporation, Taiwan. Its predecessor was a solvent factory in Chiayi set up in 1947; the name was formally changed to the Refining & Manufacturing Research Institute in 1989. As an industrial research institute, our missions include developing independent key technologies, supporting our business divisions to elevate plant operational efficiency, as well as helping with the company's transformation in creating new businesses. Our R&D focus on four dimensions, including the enhancement of refinery safety and performance, fuel quality improvement and applications, circular economy and resource recovery from waste, as well as the development of new products and technologies. We have 21 core technologies in different fields. Our business philosophy is "seeking development in stability, and seizing opportunities in changing situations." Based on three decades of R&D experience and new technologies development, our research has been actively invested in four forward-looking & innovative fields to follow our company's transformation policy in recent year, including "smart green energy, high-value materials, circular economy, and smart industrial safety & environmental protection" as the strong foundation for the sustainable development of the CPC.

R&D Focuses

Smart Green Energy

- Key material development and application testing for batteries
- Battery cell/pack performance testing
- Establishment and management of smart green energy stations
- Smart energy management system
- AI and big data application
- Clean energy application

High-value Materials

- Organic materials field
- High-value electronic materials
- Advanced carbon materials
- Development of lubricant products
- Development of raw materials for skincare products
- Development of car cosmetics products

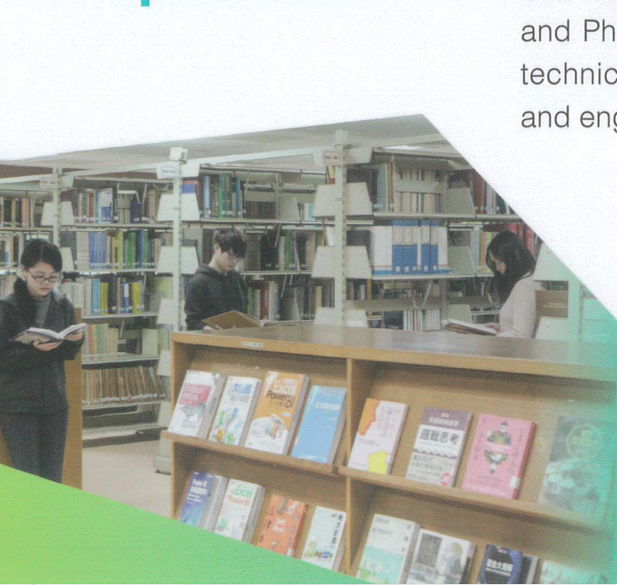
Circular Economy

- Development of carbon reduction process and technology
- Treatment and reuse of water resources
- Treatment and recovery of waste products
- VOC monitoring and vapor recovery
- Development of biomass plastics and derivatives

Smart Industrial Safety and Environmental Protection

- Process improvement and energy conservation
- Equipment safety and energy-saving/carbon reduction technology
- Smart pipeline corrosion defect detection technology
- Oil quality monitoring and performance enhancement
- Forward-looking analysis technology

R&D Capabilities



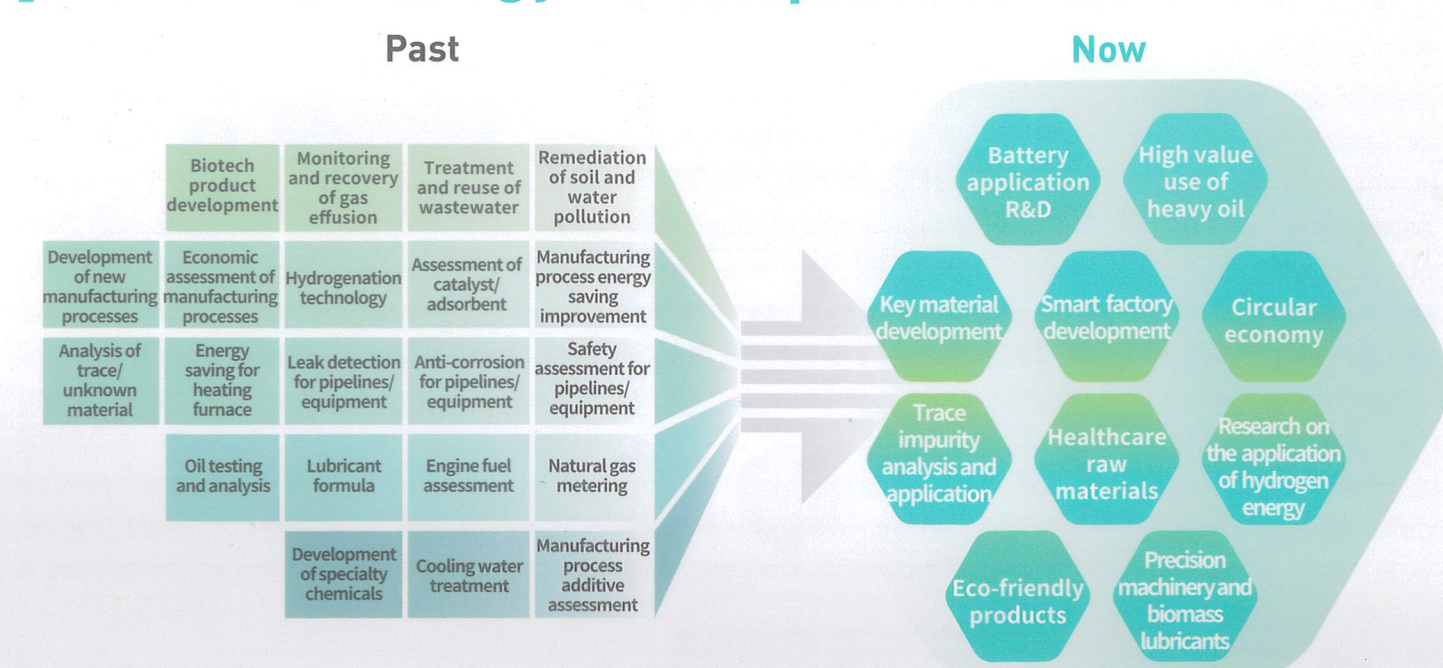
Human Resources

The Refining & Manufacturing Research Institute has approximately 240 R&D manpower, and the ratio of those with a master's degree and PhD is roughly 2:1. The most important tasks include providing technical services to business divisions, developing new products and engaging in forward-looking and innovative fields.

Library

The professional library mainly collects data in fields related to petroleum refining. The core collections include professional books, electronic journals, online databases and industry information, as well as shared resources such as other databases.

Core Technology Development Plan



Other On-site Technical Services

Marketing Business Division

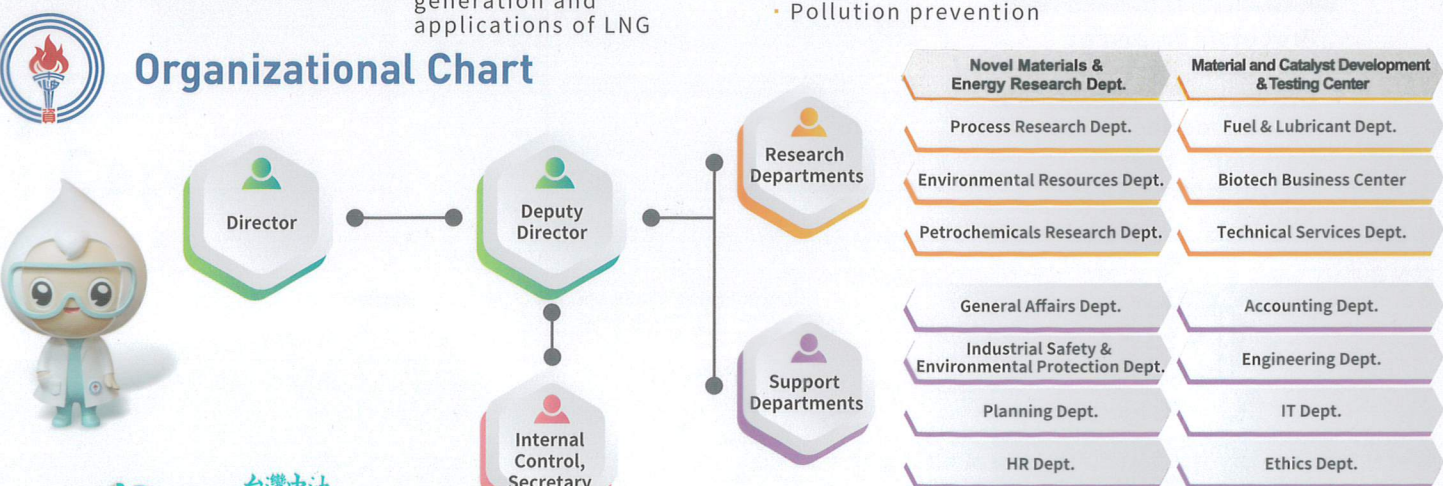
- Leakage monitoring of long-distance pipelines
- VOC monitoring for gas stations
- Development and application of low-pollution fuels
- Fuel optimization for advanced vehicles
- Research on clean fuels

Lubricant Business Division

- Solvent & Chemical Business Division
- Natural Gas Business Division
- Pipeline safety, energy saving and carbon reduction
- Development and application of natural gas
- Cold energy power generation and applications of LNG

Refining Business Division/ Petrochemical Business Division

- Improvement of refining structure
- Improve the efficiency of the refinery conversion process and clean operations
- Improve the operational efficiency of petrochemical naphtha cracking plants
- Process additive development and application
- Development and application of cleaning agents for the tubes in the convection zone of heating furnace
- Environment clean-up
- Risk assessment for soil and water remediation
- Green remediation technologies
- Pollution prevention



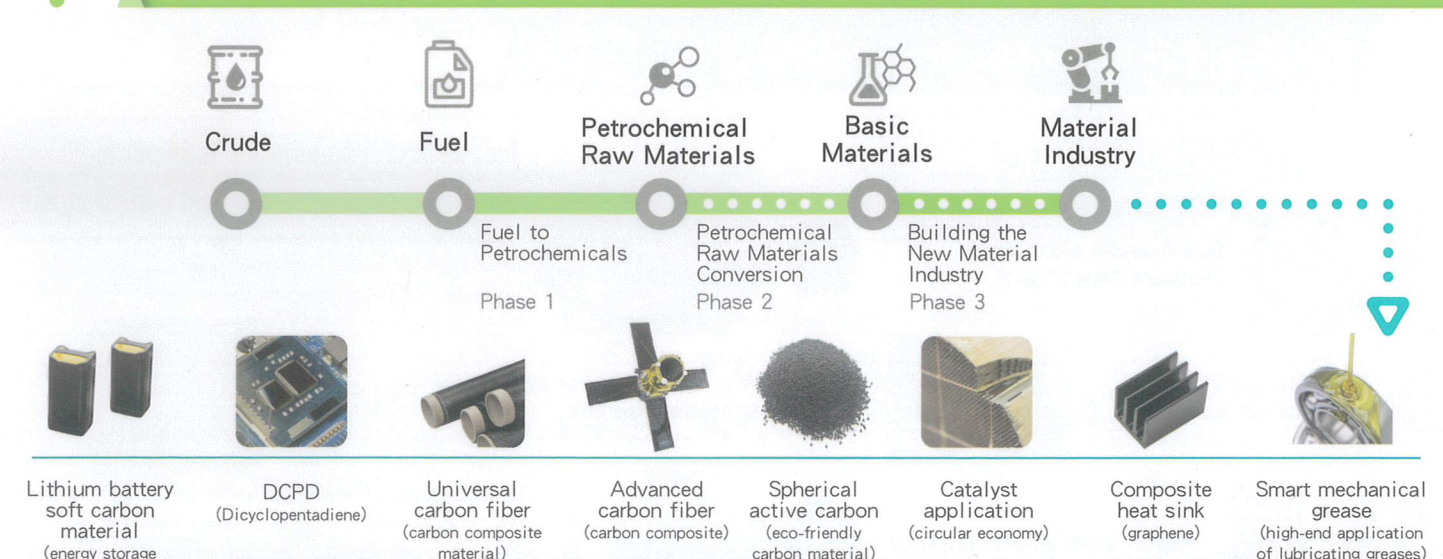
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Unique Analysis Technologies

- Oil/petrochemical analysis
- Biotech raw material/product analysis
- Catalyst characteristics analysis
- Identification of unknown substance
- Environmental monitoring and analysis (air, soil and water)

R&D Results

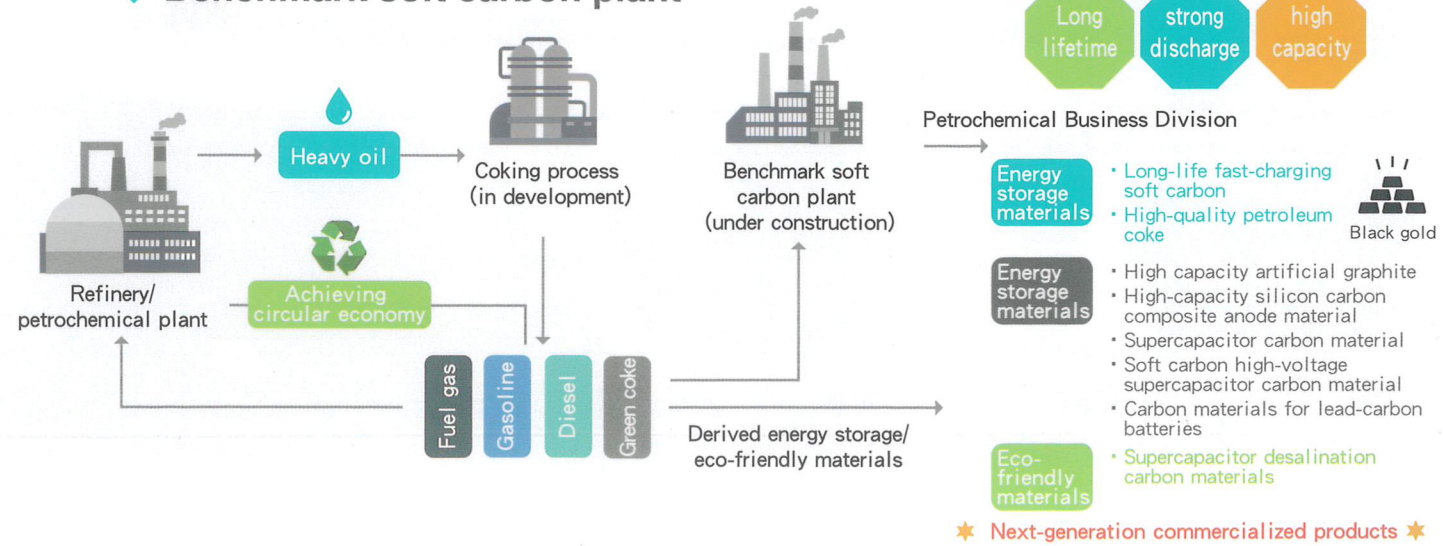
Highlight 1: New Industries of Key Materials (High Value Heavy Oil Technologies)



Highlight 2: Construction of Forward-looking Materials R&D Plant (Soft Carbon Plant)

Independent R&D of soft carbon anode materials from the laboratory to commercial mass production in response to the future market demand for high power batteries.

Benchmark soft carbon plant



Ensuring Industrial Safety and Environmental Protection

Industrial Safety

- Gold Award from the Ministry of Labor's non-disaster working hours record in 2016
- First place in Group C of the Excellent Model Unit of Industrial Safety from the Ministry of Economic Affairs in 2017
- National Outstanding Health Workplace given by the Health Promotion Administration of the Ministry of Health and Welfare in 2021

Environmental Protection

- Excellence Award in the R&D and Improvement Group of the "Excellent Toxic Chemical Substances Management" from the Environmental Protection Administration in 2016
- Bronze Award of the "25" ROC Enterprise Environmental Protection Award" from the Environmental Protection Administration in 2016
- Green Safe Alternative Award in the group of the "22" Green Chemical Application and Innovation Award" from the Environmental Protection Administration in 2020

R&D Patents

263 patents

Social Care

- Sponsorship for Chiayi City International Band Festival
- Financial assistance for installation of monitoring system in neighboring communities
- Disinfection of neighboring communities for disease vector control
- Quarterly blood donation activities



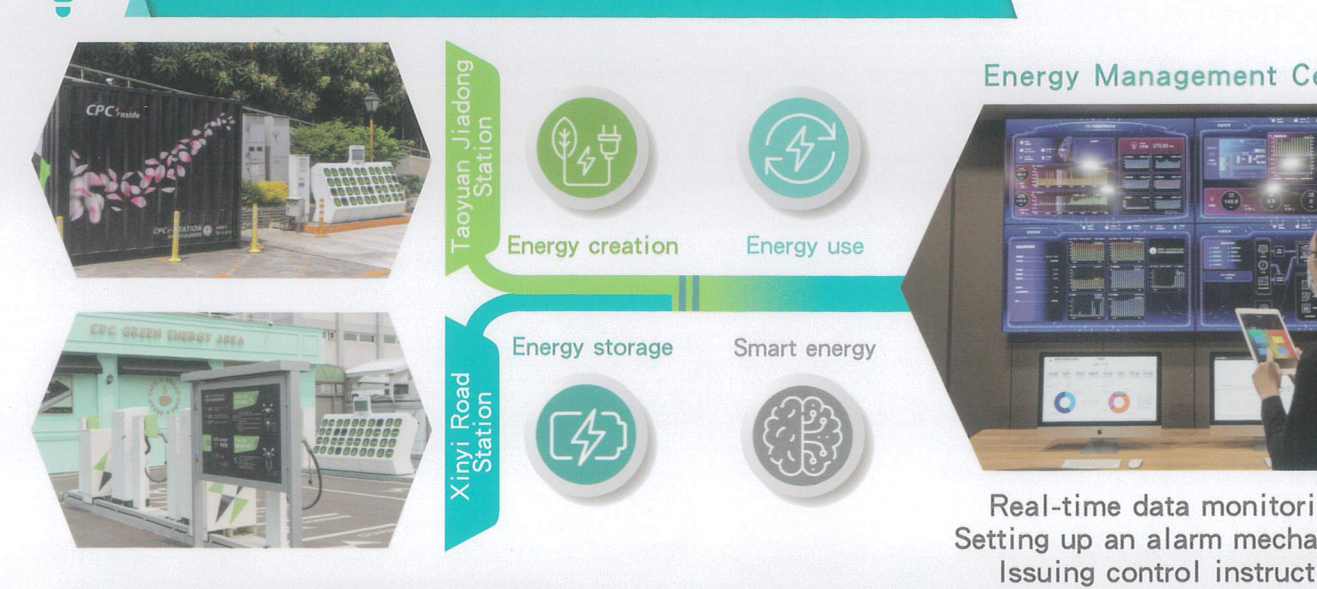
Employee Care

- Comprehensive health checks and workplace safety protection
- Full-time employees are entitled to eight 1-hour legal and psychological consultations each year
- Non-profit kindergarten for employees' children

Highlight 3: Verification of Soft Carbon Fast-charging Battery and Energy Storage System



Highlight 4: Smart & Green e-Stations



Highlight 5: Polymer Diffusion Particle Synthesis Technology (Upstream Electronic Raw Materials)

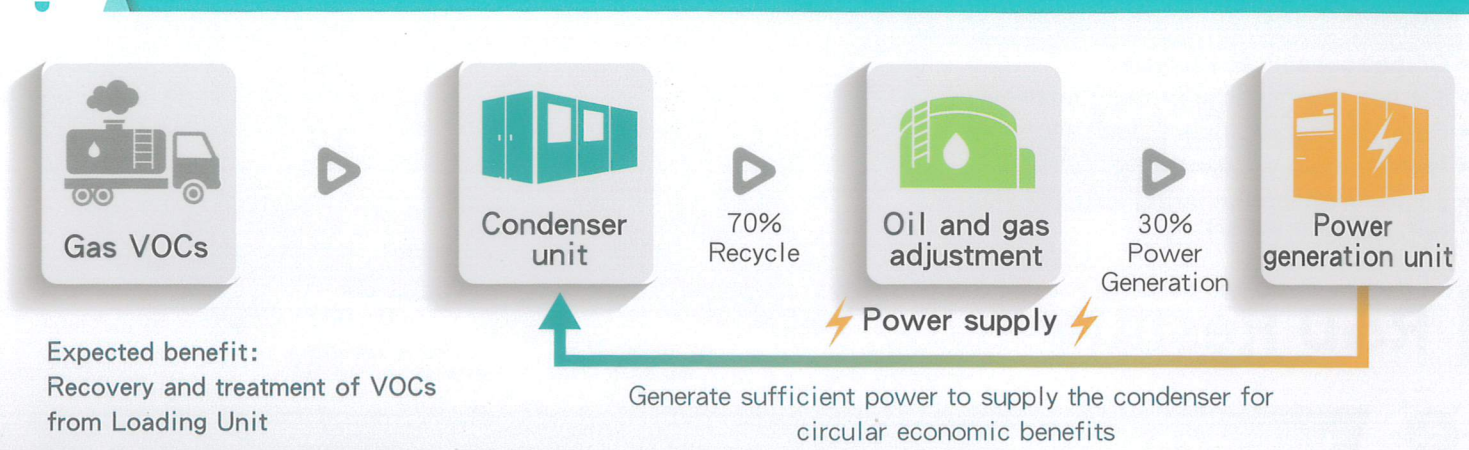
CPC light diffusion particles + BASF's new patented organic optical conversion material

	Before replacement	After replacement
Blue light	Obvious	Lowered
Color rendering (Ra)	73	95
Brightness (lumens)	1090	1270
Power consumption (Amp)	0.63/0.93	0.22/0.26

Commercialization Performance

- Low color rendering
- High color rendering
- Eye Protection
- High Fidelity
- Energy Saving

Highlight 8: Power Generation with Exhaust in Oil Transportation and Storage Operations



Highlight 9: R&D of Biotech Products

Technical Services

- Eco-friendly cleaning products (See Clean)
- Cosmetics/skincare products (Zoeven)
- Health supplement formulas

Forward-looking Research

- Development of biodegradable plastic PLA
- Raw materials for cosmetics/skincare products
- Development of vehicle water coating products

Highlight 10: Development of Supporting Technical Services (Natural Gas Metering)

Reason

Natural gas power generation is expected to reach 50% by 2025, this ensures the fairness of energy transactions.

Plan

Improvement of calibration ability and natural gas flowmeter correction

Mass-flow gas laboratory

Industrial Technology Research Institute (third party)

Natural gas distribution station

Natural gas customers

Natural gas customers

- Taiwan Power Company
- IPP power plant
- Gas company
- Industrial users

Precision

1-3% Precision 0.5% Precision 0.1%

Certification

- National Level 2 Standard Laboratory, TAF certification
- 2-12 inch turbine and ultrasonic gas flowmeter

Highlight 6: Trial Production of Key Materials for 5G Communication

Flex board (FPC)

DCPD-PPE dicyclopentadiene derivatives

Rigid board (PCB)

Cycloalkane copolymer

High-value application of own materials

- First-generation ton-scale trial production
- Second generation flame retardant
- Third generation ultra-low dielectric

Item

	Item	Unit	Trial production samples	Commercial products
Float	sec		>600	>600
Peel strength	lb/in (H/H)		3.30	3.30
Tg (DMA)	°C		273	266
TMA (288°C)	min		>60'	>60'
D ₁ /D ₂ @10GHz			3.81/0.0051	3.90/0.0054

Production of ton-level high-frequency PCB substrate resin materials (own technology)

Verified by copper foil substrate plant

Highlight 7: AI and Big Data Applications for the Diagnosis of Rotating Equipment

Technology 1: Prediction and Health Management

- Process/equipment operating data
- Estimate life expectancy with AI model
- Determine the equipment's health status

Health indicators

1 is normal, 0 is the most serious fault level

Current status of the unit

Automatic rotating microphone

Technology 2: Unmanned Inspection System

- Full soundscape data
- Motor abnormality detection and diagnosis
- Auxiliary personnel inspection

Identification of motor acoustic fingerprinting

Refining & Manufacturing Research Institute

Innovation · Transformation · Mutualism

煉製研究所

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Introduction

台灣中油煉製研究所

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