

# Thailand's Developing Gas and Petrochemical Industry



Presented by  
Prasert Bunsumpun  
President, PTT Public Company Limited

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## Abstract

The development of the natural gas and gas-based petrochemical industry in Thailand began three decades ago with the onset of the 1973 oil crisis. At that time, oil imports represented about 90 percent of total demand. The oil crisis had a significant impact on the national economy and threatened the security of our energy supply.

In response, the government policy moved towards reduction of imported energy. The exploration of petroleum resources both onshore and offshore in the Gulf of Thailand was expedited, leading to commercial discoveries of natural gas. The government then established the Petroleum Authority of Thailand (currently PTT Public Company Limited or PTT), by merging the Fuel Organization of Thailand and the Natural Gas Organization of Thailand, to develop the natural gas and petrochemical industries.

The development of the natural gas and petrochemical industries has been driven by the continued growth of demand to fuel electricity generation, which has grown at a compound average rate of 10.3 percent per annum over the past two decades. Our gas industry started with a modest volume of 25 million cubic feet per day in 1981 and grew at 22.7 percent per annum to 2.8 billion cubic feet per day (BCFD) in 2004. Over the next two decades, the demand for electricity is projected to grow at 6.9 percent per annum, with total demand for natural gas to grow at 7 percent per annum, reaching 5 BCFD by 2010.

The rich natural gas in the Gulf of Thailand has enabled the development of a robust gas and liquids based petrochemical industry. Our petrochemical industry started with ethylene and propylene production at 0.40 and 0.13 million tons per annum, respectively, and has grown to 2.34 and 1.11 million tons per annum, respectively. The gas-based petrochemical industry has added significant value to our indigenous natural gas and has been a strong contribution to the national economy.

Throughout the past 30 years, PTT has been a core engine driving economic growth of the country through the development of natural gas and petrochemical industry along their full value chain. We have enjoyed growth, and we have suffered and survived the recessions over the years. Our gas and gas-based petrochemical industries have matured and we are now developing a more sophisticated downstream market, with higher-end and specialty products as a focus. Since the inception of our gas and petrochemical industry, we have invested over USD 39 billion, with potential for continued growth into the future.

## **Introduction**

Three decades ago, Thailand's dependence on import oil was over 90 percent of total domestic demand. Our demand for oil tripled from 1980 to 2003 at an average rate of 8 percent per annum. The oil crisis in 1973 prompted the government to reduce the country's reliance on imported energy and intensify exploration activities domestically, leading to discoveries of natural gas at commercial scale.

At present, oil represents 47 percent of the total energy consumption, followed by natural gas, coal/lignite, and hydro at 36 percent, 15 percent, and 2 percent, respectively.

### **1. Natural Gas Industry**

The natural gas industry in Thailand came into existence with the discovery of natural gas reserves in the Gulf of Thailand by Unocal Thailand Limited and Texas Pacific Thailand Inc. in 1973. Amidst the oil crisis, the Royal Thai Government decided to develop natural gas to substitute import oil, particularly to fuel power generation by replacing fuel oil whose price became excessively high, and to enhance national energy security.

The main goal of developing natural gas was to substitute fuel oil and mitigate the impact of high fuel prices. With fuel oil prices soaring at USD 15-20 per barrel (unprecedented at the time), Thailand was facing tremendous economic hardship. At the time, the government established the Natural Gas Organization of Thailand (NGOT) to negotiate natural gas purchase contracts with the concessionaires.

#### **1.1 Gas Pipeline System**

In 1978, Petroleum Authority of Thailand (PTT) was established to carry out the NGOT's crucial mission of laying a gas transmission system from gas supply sources in the Gulf of Thailand to power plants operated by Electricity Generating Authority of Thailand (EGAT) and to other gas users onshore. The first offshore pipeline connecting the Erawan Field in the Gulf of Thailand to Map Ta Phud in Rayong Province was commissioned in 1982, with a length of 425 kilometers and a diameter of 34 inches. The offshore system connected to the 167-kilometer onshore system to EGAT's Bangpakong and South Bangkok Power Plants.

When our natural gas transmission system materialized, manufacturing companies and industrial firms expressed an interest in utilizing natural gas as a fuel. Siam Cement Company Limited was the first private enterprise to purchase natural gas from PTT for their cement plants in Taluang and Kangkoi in Ayudhya and Saraburi Provinces, respectively.

PTT set up PTT Natural Gas Distribution (PTTNGD) Company Limited in 1996 as a pilot project to promote the use of natural gas. Several other industries and power plants converted to natural gas replacing LPG, diesel, and fuel oil. The incentives were clear: competitive pricing, ease of storage and transportation, cleanliness, environmental friendliness, high combustion efficiency, and low operating and maintenance costs. Industrial customers located near metropolitan Bangkok included manufacturers of ceramics, sanitary ware, glass and mirror, iron, copper, metal, and chemicals.

To serve the anticipated high demand for natural gas during the economic boom in the mid-1990s, PTT commissioned a second offshore pipeline in 1996 and began importing natural gas from Myanmar in 1998.

At present, about 74 percent of the domestic natural gas demand is supplied by indigenous sources in the Gulf of Thailand. The balance is imported from our neighboring country, Myanmar. To meet further demand growth, we are building a Third Gas Transmission Pipeline to supply additional gas from the Gulf of Thailand to our network on the Eastern Seaboard. This new pipeline will start up in 2006 and is projected to be fully utilized by 2010. The Third Gas Pipeline will enable Thailand to secure up to 1,860 MMSCFD of gas from the Gulf of Thailand, including Unocal and Arthit fields, and the Joint Development Area with Malaysia. This volume replaces 295,000 barrels per day of fuel oil.

PTT currently owns and operates the national gas transmission grid, which links gas fields to consumers in the East, West, and Southern part of the country. The combined length of our network currently extends over 2,600 kilometers. With the Third Pipeline in place in 2006, our network will be capable of handling 5.21 billion cubic feet of gas per day.

## **1.2 Gas Separation Plants – First Step Value Creator**

The natural gas from the Gulf of Thailand has a rich liquids content which can be separated to capture higher value ethane, propane, butane, and other gas liquids. PTT capitalized on this by constructing Gas Separation Plants to extract the gas liquids and spearheaded the development of petrochemical and related industries in Thailand. The power and gas-based petrochemical sectors are closely linked – increasing gas consumption in the power sector creates the potential for more petrochemical feedstock. The rapid growth in gas-fueled generation capacity has provided Thailand with the opportunity to expand our petrochemical industry and become a major player in this region.

PTT currently owns and operates 5 gas separation plants (GSPs) in Rayong and Khanom with a combined capacity of 1.7 billion cubic feet per day. Our fifth GSP was just recently commissioned in January 2005.

Products from our GSPs are used as feedstock for petrochemical industry and also produce significant volumes of LPG for cooking gas and fuel for taxis, transforming Thailand from an LPG importer into a self sufficient nation, and ultimately into an LPG exporter.

## **1.3 Gas Exploration and Production**

At present, there are 33 petroleum concessions in Thailand covering 43 exploration blocks. We invest about USD 1.2 billion per annum. As of December 2003, our 3P reserves total was 33 trillion cubic feet (TCF), with a reserve life of approximately 40 years.

To secure supply for downstream activities, it was essential for PTT to establish itself as a fully-integrated value chain player. PTT, therefore, established PTT Exploration and Production Company (PTTEP) in 1985 through the buyback of the S1 concession from Texas Pacific Thailand Inc. Initially, PTTEP held a 25 percent stake, with its share of oil production at approximately 20 thousand barrels per day. Since then, PTTEP has developed into a dominant player in the domestic and regional upstream sector with aspirations to expand into areas including the Middle East and Africa. In 2004, PTTEP's combined gas and oil production was 134 thousand barrels per day of oil equivalent.

## **1.4 Gas Application**

PTT introduced natural gas for vehicles (NGV) in the transportation sector as a replacement for diesel fuel. Currently, 4 MMSCFD of gas is dedicated for NGV use. There are 28 stations in service, 17 under construction, and a total of 120 targeted for completion by 2008. There are currently about 4,300 NGV vehicles in operation today, with 40,000 targeted by 2008.

PTT is also in the process of developing a gas district cooling application for Bangkok Suvarnabhumi International Airport to be completed for commercial operation by this year. We are also studying the feasibility of implementing gas district cooling at a major shopping and recreation center. These projects could serve as a prototype for similar projects, enabling Thailand as a whole to benefit from the use of clean, efficient, safe, and environmentally friendly form of energy.

## 2. Petrochemical Industry

To maximize the value creation from our natural resources and to satisfy the increasing domestic demand for a range of different products and materials, PTT expanded further into petrochemical manufacturing. The First and Second Petrochemical Complexes combined can produce a wide variety of raw materials, intermediate and derivative products, and have significantly reduced Thailand's dependence upon imports.

### 2.1 The First Petrochemical Wave: 1980-1989 (National Petrochemical Complex 1)

The use of petrochemical products in Thailand has been widespread for several decades before the development of a domestic petrochemical industry, but the country had to rely upon imported raw materials and end products. Over thousand small plastic plants existed at that time with the demand on the rise.

Prospects for investments in the petrochemical industry in Thailand were attractive. The country possessed sufficient supply of raw materials, i.e. natural gas, at commercial scale while the demand for plastic products was high and was expected to continue to increase. As a new and technologically intensive industry, Thailand initially lacked the necessary expertise to develop the petrochemical industry. To maximize investment value and efficiency, the government decided to spearhead the development of the upstream in conjunction with the private sector and left the downstream to private enterprise alone. PTT acted as a catalyst in developing the petrochemical industry, particularly to foment the confidence of private joint ventures.

National Petrochemical Corporation (NPC) was established on 23 February 1984 as a joint venture between PTT, the Crown Property Bureau, the Industrial Finance Corporation (IFC), and four private enterprises, with an investment totaling USD 360 million. An olefins plant was constructed and began to operate in 1989.

During 1980 to 1989, there was a clear need to develop the Eastern Seaboard by using the infrastructures to drive the development. There was also a need for domestic petrochemical products driven by import substitution while also adding value to our indigenous natural gas. At the time, the market was purely domestic and the country had to incur grass root investments for infrastructure such as roads, ports, raw water, and electricity supply. Investments were made through public and private sector cooperation. The feedstocks were gas-based ethane and propane, while products were basic commodities such as olefins and derivatives.

### 2.2 The Second Petrochemical Wave: 1989-1995 (National Petrochemical Complex 2) 1995-2004 (Liberalization)

With the strong economic growth Thailand experienced during the 1980s, coupled with the strategic change of the industrial sector from being domestically-oriented to being export-oriented, the government decided to proceed with a second petrochemical complex. This time the private sector expressed its interest in directly participating in petrochemical and related manufacturing activities.

PTT continued to play a leading role in developing the second phase of the petrochemical industry and maintained the strategy of participating through joint investment in upstream petrochemical manufacturing. During this phase, both olefins and aromatics were developed to cover the entire range of raw materials for the intermediate and downstream industries.

Thai Olefins Company Limited (TOC) was established on 5 January 1990 and it began commercial operations in June 1995. Aromatics (Thailand) Company Limited (ATC) was established on 25 December 1989 and its plant started up in February 1997.

With a total investment of over USD 1.8 billion, construction of the two petrochemical complexes combined employed over 60,000 workers and prompted investments in several other related industries. Upon completion, domestic production substituted almost USD 1.0 billion worth of imports of plastic products, while also satisfying most of the domestic demand for plastic raw materials.

From 1989 to 1995, the focus was on establishing a manufacturing base for a wider product range to further reduce import substitution. The period saw improved management of the environment and our people rapidly developed experience in plant operations.

With the advent of liberalization from 1995 to 2004, and the desire to expand domestic exports, the industry needed to strengthen its international marketing capabilities.

### **2.3 Third Petrochemical Wave: 2004-2018**

The Thai government has recently developed a master plan for the next wave of petrochemical growth. Over the next 15 years, we will focus on increased competitiveness, asset integration, and strategic alliances to be used as tools for growth and add more value to natural gas. Given the strong foundation in upstream petrochemical manufacturing we intend to develop further down the value chain into specialty products. To achieve this goal, our human resources need more international experience and additional R&D is required for more sophisticated product development.

The petrochemical master plan indicates opportunity for 25 petrochemical products with combined capacity of 10 million tons per year. Over 40 commercially viable projects have been identified with a total investment of about USD 10 billion spread over the next 15 years, generating over USD 7 billion per annum in revenue.

Together with our subsidiaries, we have started to explore potential investment in some of these plants. We have also started to study the viability of Gas Separation Plant 6 to supply feedstock to this gas-based petrochemical complex. At present, PTT and our subsidiaries are vertically integrating into the downstream to capture opportunities along the full value chain.

## **3. Our Future: Liquefied Natural Gas (LNG)**

LNG has become a major factor in the global gas industry. There are now abundant potential supply sources for Thailand, such as Malaysia, Indonesia, Australia, Russia, and the Middle East. LNG price has come down because of technology improvement and competition. The supply is more flexible with an increasing trend of spot or short term contract sales.

For Thailand, LNG will be one part of our long term gas supply solution. As the Third Pipeline will be filled by 2010, LNG will serve as a bridge before the Forth Pipeline is commissioned. PTT recently set up a company to joint invest in LNG's full value chain. A location for the re-gasification terminal has also been planned to optimize the use of our current distribution system. As cryogenic energy generated during re-gasification can also be used in other processes, the terminal will be developed in conjunction with gas separation or petrochemical plants to collectively optimize energy efficiency.

Map Ta Phud is the location for our LNG receiving terminal given its port facilities, and the potential for integration with the gas separation plants and the pipeline transmission system. The environmental impact assessment has been approved, both for land reclamation and construction of the receiving terminal.

The project involves an investment of USD 650 million to build a receiving terminal capable of processing 5 million tons per annum of LNG, equivalent to 650 MMSCFD. PTT received grants from the US Trade Development Agency (USTDA) for the feasibility study of the project which is expected to be complete by September 2005.

## Conclusion

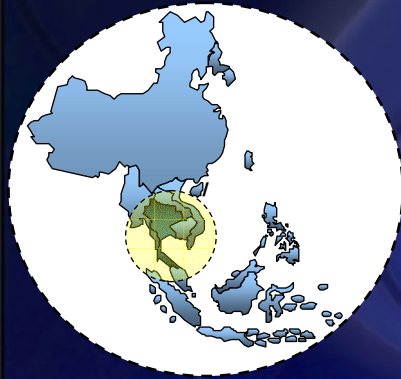
The development of natural gas in the Gulf of Thailand has been the key economic driver for the country over the last 20 years. Natural gas has become our primary energy resource, creating competitiveness for electricity generation, and adding value through the petrochemical value chain. Through development of our natural gas industry, Thailand has been able to successfully evolve its economic base from agriculture-based to become a world-scale manufacturing centre.

Through steady investment and development Thailand has become the eighth largest petrochemical producer in the world. Our petrochemical industry generates an income over USD 6 billion, with the potential for ongoing growth.

Our demand for natural gas will surpass 5 BCFD by 2010 and our Third Wave petrochemical industry will be commissioned by year-end 2008. Thailand is indeed the choice for prospective investors given our well-equipped infrastructure and competitive edge.



## Thailand at a Glance



Thailand is located in the heart of SE Asia

- Population of 63 million and 2004 GDP of USD 163 Bn

Since the crisis, Thailand has recovered to be one of the more robust economies in the region

- Growth of 6% over the last 3 years

We have a strong competitive position in many sectors

- Automotive hub for SE Asia
- Emerging leadership position in manufacturing

Our natural gas industry has been one of the key engines of economic growth

- Low cost and efficient electricity generation
- World class petrochemical manufacturing encompassing the entire value chain

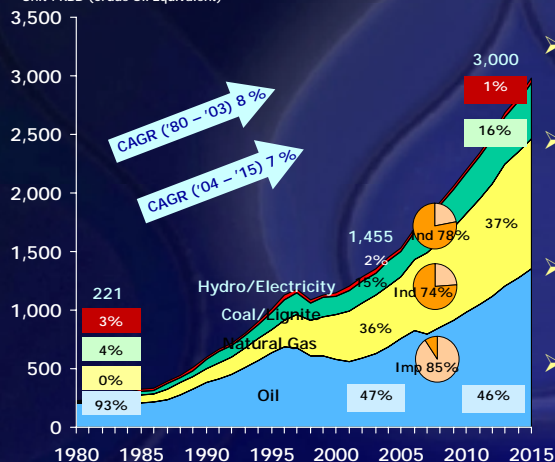
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## Thailand Energy Supply – More Gas Less Oil



### Commercial Primary Energy Supply Sources

Unit : KBD (Crude Oil Equivalent)

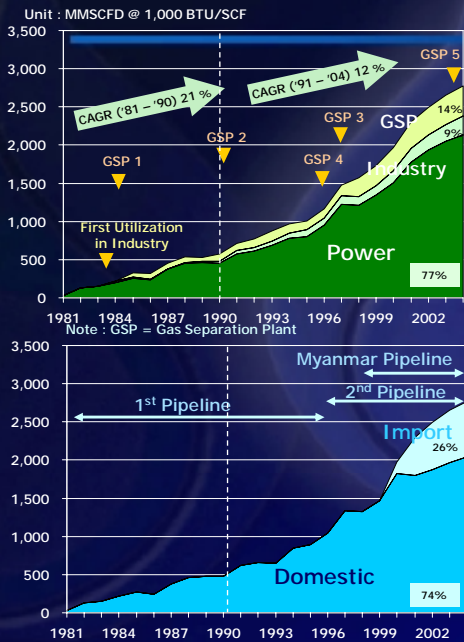


Source : Energy Policy and Planning Office, Department of Alternative Energy Development and Efficiency

- Current energy demand at 1.5 million barrels per day
- Energy demand projected to grow at 7% CAGR to 3 million barrels per day by 2015
- Today, Oil imports reduced from 90% to 47%
- Meanwhile, natural gas has grown to 36% of overall energy supply

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## Power Sector Has Dominated Demand



### Demand to Date

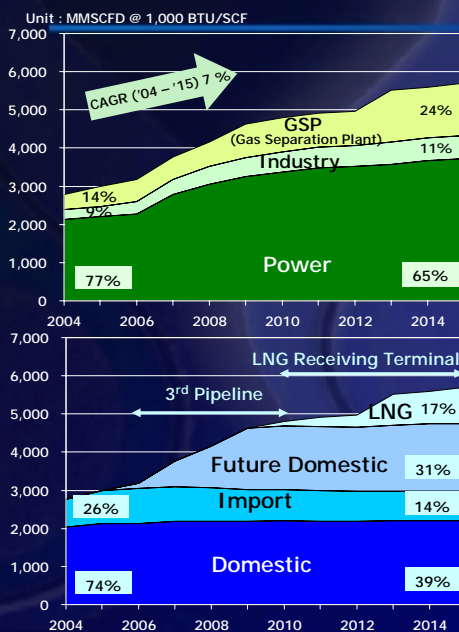
- Rapid demand growth of 12% CAGR over the last decade
- Power generation sector dominates with about 75% share
- Gas has 70% share of generation fuel
- Increasing share of demand for feedstock and industrial use

### Supply to Date

- Mainly domestic offshore gas from the Gulf of Thailand through two main offshore pipelines
- Imported gas from Myanmar since 2000 to secure supply

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## GSP/Feedstock Demand Poised To Expand



### Demand in the Future

- Continued robust demand in line with economic growth
- Strong demand for petrochemical feedstock increases GSP share to 24%
- Expanded demand base through combined cycle, NGV, cogeneration, and district cooling technology

### Supply in the Future

- 3<sup>rd</sup> offshore pipeline to expand domestic supply by 1,860 MMSCFD
- Plans for LNG import underway

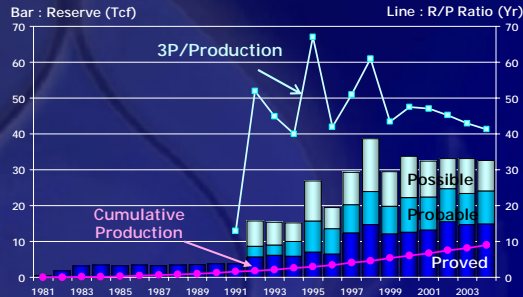
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# Thai E&P Industry Offers Strong Potential

Thailand Petroleum Concessions



Natural Gas Reserves vs R/P Ratio



- E&P sector maturing but continues to offer strong production growth potential
- USD 1.2 Bn per year investment
- Only about 10% of explored acreage currently producing
- >40 years production remaining

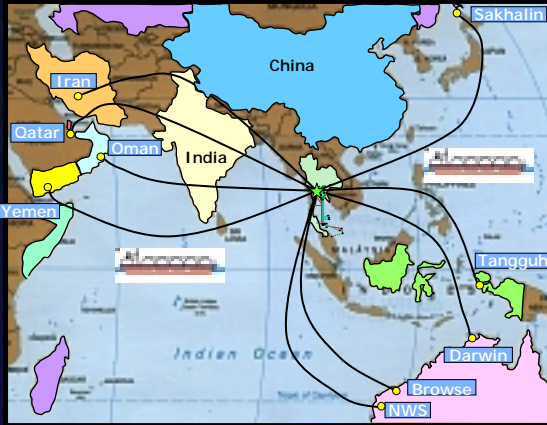
# Gas Network Well Established and Growing



- 3rd pipeline network to be commissioned in early 2006
- Total offshore capacity will be increased to 4,000 MMSCFD
- Pipeline from Myanmar has capacity of 1,200 MMSCFD
- Potential for 4th offshore pipeline under review

> Maximum Capacity  
 • 3rd Pipeline : 1,860 MMSCFD  
 • Existing Offshore Pipeline : 2,150 MMSCFD  
 • Western Pipeline : 1,200 MMSCFD  
 > Total Capacity 5,210 MMSCFD  
 — Revised Master Plan 3 Pipeline  
 — Existing Offshore Pipeline

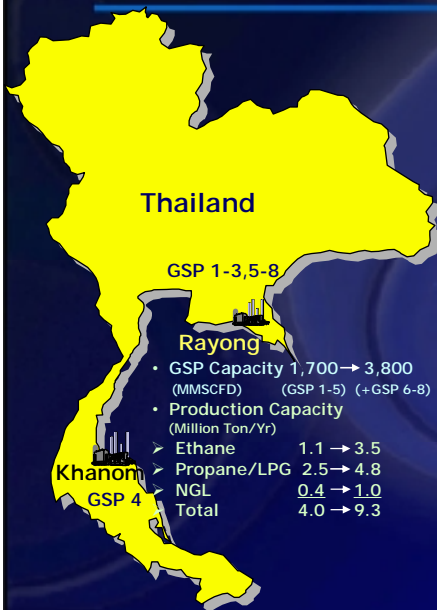
## LNG Complements Our Domestic Gas Supply



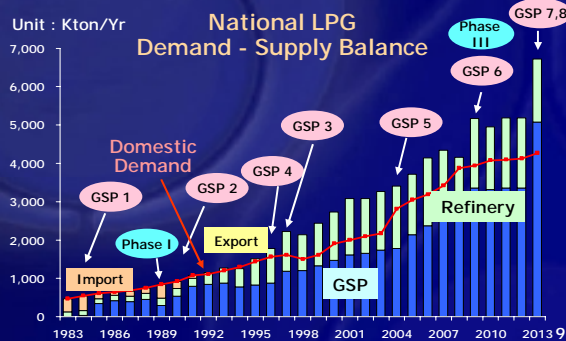
- LNG is an attractive complement to domestic and regional supplies
- Plans to commission 5 MTPA LNG receiving terminal by 2010
- Terminal to be located on the Eastern Seaboard (near Bangkok) to enable seamless integration with existing supply network

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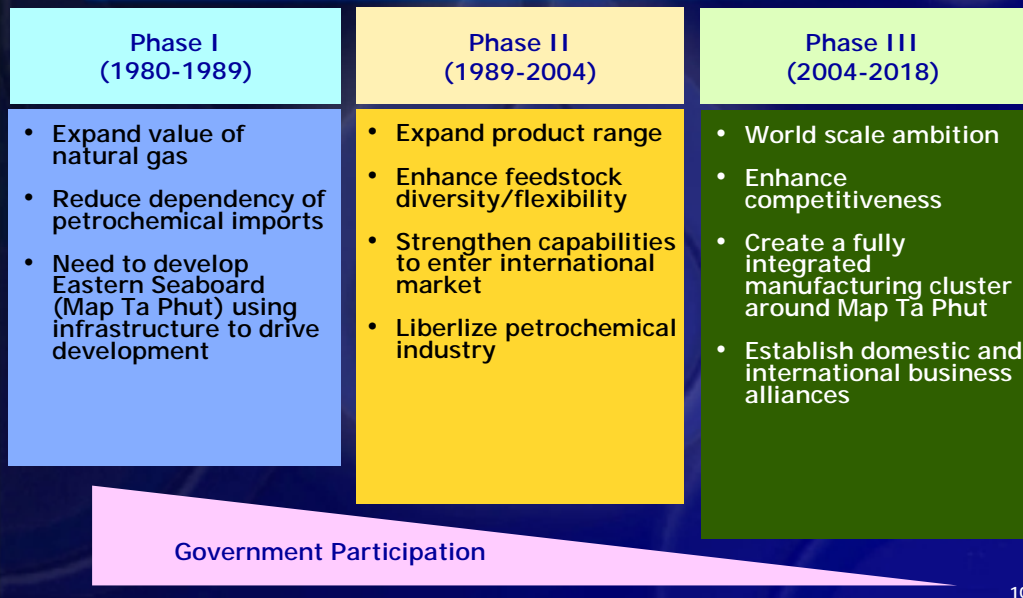
## Capturing Gas Liquids Adds Value To Our Gas



- Thailand has become a major LPG exporter due to steady growth in processing capacity
- Gas separation has established a foundation for petrochemical feedstock supply

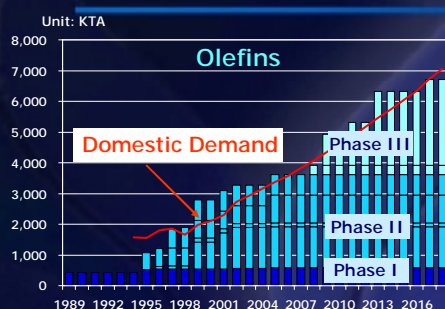


## Three Waves Of Petrochemical Development



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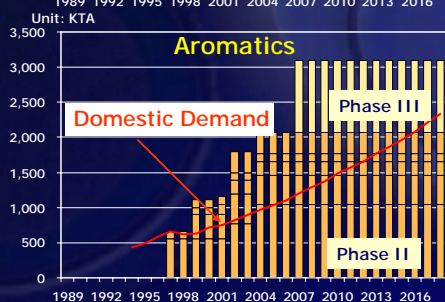
## Commitment to Petchem Sector Growth



Thailand is committed to grow the petrochemical sector

### Wave I and II (1980 – 2004)

- Total investment of USD 22 Bn
- Total revenues generated ~ USD 6 Bn or 4.5% of GDP @ 2002



### Wave III (2004 – 2018)

- Fully integrated with existing gas supply infrastructure
- Total investment of USD 21 Bn
  - E&P & Gas Infrastructure USD 11 Bn
  - Petrochemical USD 10 Bn
- Expect revenues generated ~ USD 7 Bn

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## Conclusion



- Thailand has abundant rich natural gas reserves and a thriving upstream E&P industry
- Natural gas demand continues to grow through the steady expansion of power generation and petrochemical capacity
- Our supply will mainly come from our own domestic reserves but we will complement this with LNG imports
- Huge investments are required across the value chain
- Continued economic growth and prosperity are linked to getting our gas industry solution right
- We are off to a great start!

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