Vietnam Oil & Gas

A primer look



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Executive summary

- Oil and gas is the top priority sector for economic growth and energy security for Vietnam and the country has great potential in oil and gas reserves. Vietnam is ranked 25th of the countries that have proven oil and gas reserves.
- The Government of Vietnam controls the upstream segment and the downstream has been opened to foreign companies.
- In the upstream segment, international oil companies (IOCs) are allowed to independently explore for oil and gas. While the presence of PVN is required in all producing projects, IOCs are allowed to hold majority stakes and receive a share of output. The downstream segment is also dominated by PVN's subsidiaries such as PV Oil, PV Gas, and Binh Son Refinery and Petrochemical as the first refinery under operation and has now been opened to private sector and foreign companies for equity participation.
- The majority of Vietnam's oil and gas reserves are located offshore in the Cuu Long and Nam Con Son basins, in Southern of Vietnam.
- The oil and gas reserves of Vietnam expanded at slow pace over the past few years, due to a combination of low and volatile oil prices, financial constraints of PVN. Thus, PVN started to restructure via divestment in some arms, including PVOIL, Binh Son Refinery, etc. Moreover, PVN is shifting its investment preference toward to natural gas projects.
- The government has been trying to attract investment into exploration and production in new deep-water blocks as oil and gas consumption growth continues to run ahead of production. Onshore, the investment focuses on thermal power plants including gas-fired.
- Vietnam's crude oil production capability is forecast to decline significantly from 2019 as this is the natural decline at aging fields such as White Tiger, and will subsequently impact the Vietnam crude oil export revenue.
- The country will see considerable shortage of gas supply over the coming years due to under investment in new projects. The government has planned to import Liquefied Natural Gas (LNG) to meet the increasing energy demand of the country. Due to its cleaner attributes, LNG holds a bright prospect when Vietnam is committed to cutting down on greenhouse emission.
- The refinery and petrochemical industry is a growing sector in Vietnam.
- Gas fired power generation is also becoming an important contribution to Vietnam energy market. PVN and Electricity Group of Vietnam are the two main investors.
- The revision of the Law on Petroleum (2008) is likely to rake place over 2019-20, which includes shortening key approval process for oil and gas activities, simplifying procedures and boosting incentives for foreign and local investors to develop smaller fields, as well deep-water projects.

I. Vietnam Oil & Gas Overview

VIETNAM OIL & GAS OVERVIEW

Key milestone of Vietnam Oil & Gas

1961 – 1976

Origins

11/27/1961: Geological exploration No.36 was established to discover and investigate oil & gas in Vietnam

09/03/1975: The Vietnam Oil & Gas group was established under the Decree No.170/CP

07/25/1976: Discovered the first natural gas reserve (1.3 bcm) in drilling station No.61 in Tien Hai, Thai Binh province (Northern Vietnam)

1977 – 1986

Further explorations, studies and strategic cooperation

1977 – 1986: Surged in investigation and exploration activities with partners from Soviet Union

09/09/1977: PetroVietnam (PVN) was established under Decision No.251/CP

06/19/1981: Vietsovpetro was established

06/26/1986: Vietsovpetro extracted the first tonne of crude oil from Bach Ho field which marked the born of Oil & Gas industry

1990 – 1999

Foundation stage

07/06/1993: Law on Petroleum was implemented putting higher standards in the industry

04/17/1995: Finished the pipeline to transport associated gas extracted from Bach Ho oil field to Vung Tau power plant

07/09/1999: Dinh Co LPG plant came into operation after 2 years of construction with a total capacity of 1.5bn cbm of gas/year

2001 – 2011

Developing stage (I)

2001: 100mn tonnes of crude oil exported

08/29/2006: PVN was chosen to be the parent company of the Vietnam Oil and Gas group under the Decision No.199/2006/QD-TTg

01/06/2011: Dung Quat refinery came into operation marking a new era for the Oil & Gas industry in Vietnam

2012 - 2018

Developing stage (II)

The world's oil price decreased dramatically from 2014 to the end-2016 with mild recovery in 2017

From 2017 onwards, oil price has been recover to help Vietnam to improve their production activities. However, PetroVietnam has not recover yet and still lacking of finance to executive its projects.

Nghi Son refinery, the second refinery complex in Vietnam, commenced commercial operation in 3Q18.

Since 2019

Developing stage (III)

Vietnam has target an ambitious plan to develop Vietnam oil and gas industry, especially in natural gas with deep processing natural gas, diversify products to enhance using value of gas and effectiveness of oil products.

Due to the decline in natural gas reserve, the government has set targets to study solutions, promote collection of gas from small fields, which is scatter in southern area. Meanwhile, they aim to start construction of the giant gas production projects – Blue Whale since 2020 and expect to operate in 2023.

VIETNAM OIL & GAS OVERVIEW

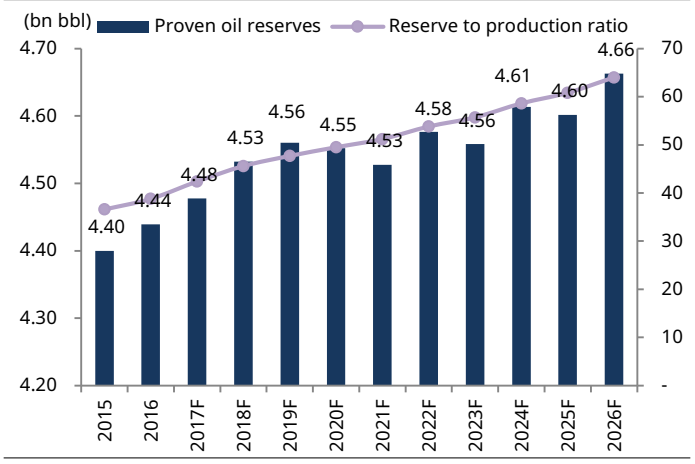
Comparison of Oil & Gas statistic in Asia Pacific

SEA crude oil & natural gas proved reserves at end-2018

	Philippines	Thailand	Vietnam	Indonesia	Malaysia	Brunei
Crude oil (bn bbl.)	0.1	0.3	4.4	3.2	3.0	1.1
Rank	**6**	**5**	**1**	**3**	**2**	**4**
Natural gas (tcm)	0.1	0.2	0.6	2.8	2.4	0.3
Rank	**6**	**5**	**3**	**1**	**2**	**4**

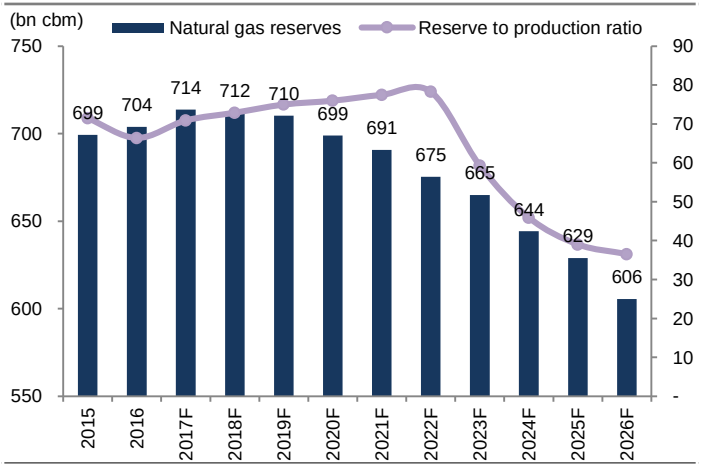
Source: BP Statistic 2019

Vietnam oil reserves & production



Source: BMI, EIA

Vietnam natural gas reserves an production



Source: BMI, EIA

Oil & Gas industry is the backbone and major driver of Vietnam's economic growth, accounting for a substantial part of GDP and export's revenues.

Vietnam is the 4th largest oil and gas producer in Southeast Asia and ranks 6th out of 15 Asia-Pacific countries.

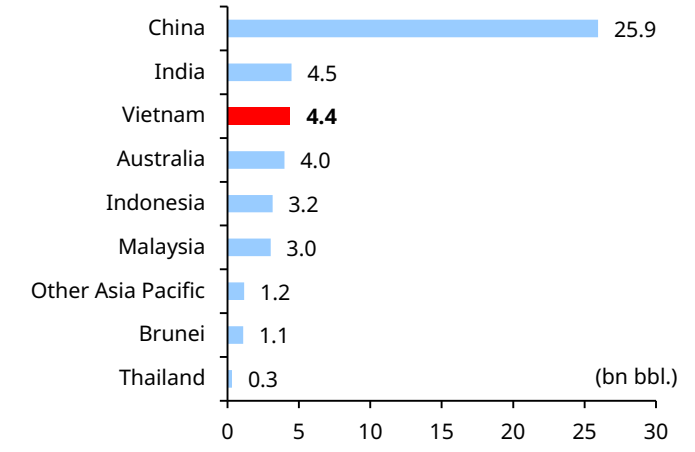
The annual fuel consumption per capita of Vietnam is only **one barrel**, one-fifth compared to global average. Therefore, until 2020 when Vietnam expects to be fully industrialized, annual domestic fuel demand is expected to increase considerably.

Proven gas reserves stood at **645 bcm**, implying significant potential and **60 years** of production

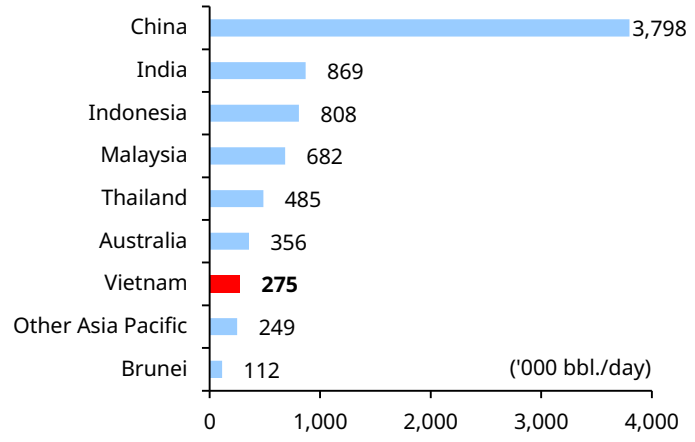
VIETNAM OIL & GAS OVERVIEW

Comparison of Oil & Gas statistic in Asia Pacific

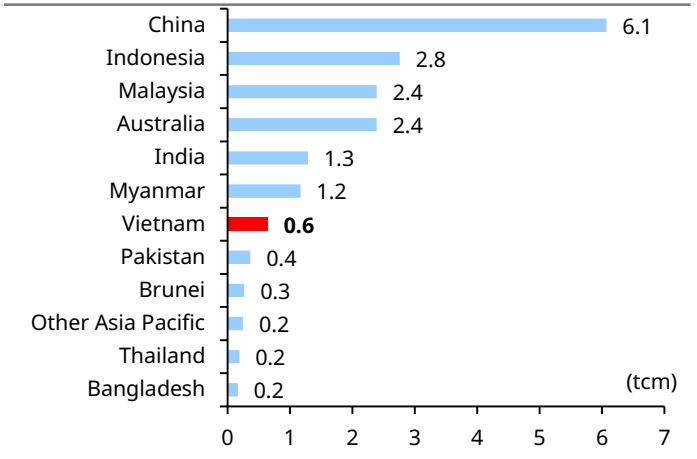
Asian Pacific proven oil reserves by end-2018



Asian Pacific oil production by in 2018

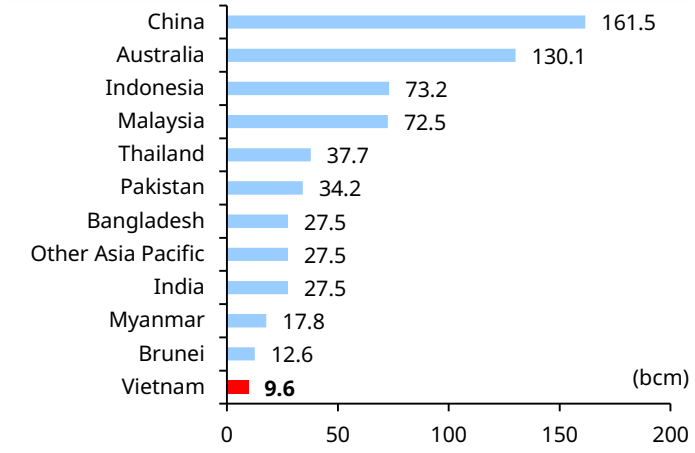


Asian Pacific proven natural gas reserves in 2016



Source: EIA, BP

Asian Pacific natural gas production in 2018



Source: EIA, BP

Data as of June 2019

Vietnam produced 275,000 bbl. Day, down -7.9% YoY. This trend seems likely to continue to be play in 2019.

Natural gas production reached 9.6 bcm, slightly up +1.3% YoY.

Vietnam is reportedly planning to reduce its crude import bill by exporting more of its low Sulphur Bach Ho crudes, which often trade at a premium to other Asia markets, and substitute domestic refining feedstock with competitively priced crude from the US.

VIETNAM OIL & GAS OVERVIEW

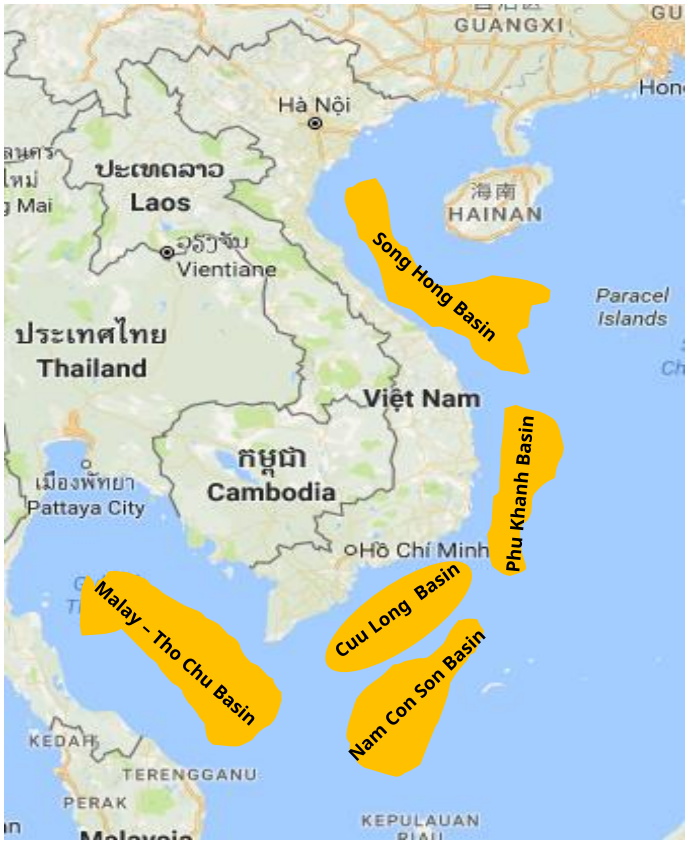
Detail of Vietnam oil & gas field

Nam Con Son Basin

- Area: 60,000 km^2
- Product: Oil and Associated Gas
- Reserves: 18% of total reserves
- Fields: Lan Tay, Lan Do, Rong Doi, Rong Doi Tay, Moc Tinh

Cuu Long Basin

- Area: 55,600 km^2
- Product: Oil and Associated Gas
- Reserves: 22% of total reserves
- Fields: Bach Ho, Vom Bac, Doi Moi, Rang Dong, Su Tu Den, Su Tu Trang, Te Giac Trang, Hai Su Den, etc.



Song Hong Basin

- Area: 150,000 km^2
- Product: Dry gas
- Reserves: 16% of total reserves
- Fields: Ham Rong, Tien Hai C

Phu Khanh Basin

- Area: 57,000 km^2
- Product: Oil and Associated Gas
- Reserves: 13% of total reserves

Malay – Tho Chu Basin

- Area: 85,000 km^2
- Product: Oil and Associated Gas
- Reserves: 9% of total reserves
- Fields: PM3-CAA, 46 Cai Nuoc

Active
Idle

Most of Vietnam's proven oil and gas reserves lie in offshore and deep-water in areas, concentrated in the Nam Con Son and Cuu Long basins, off the country's Southern coast.

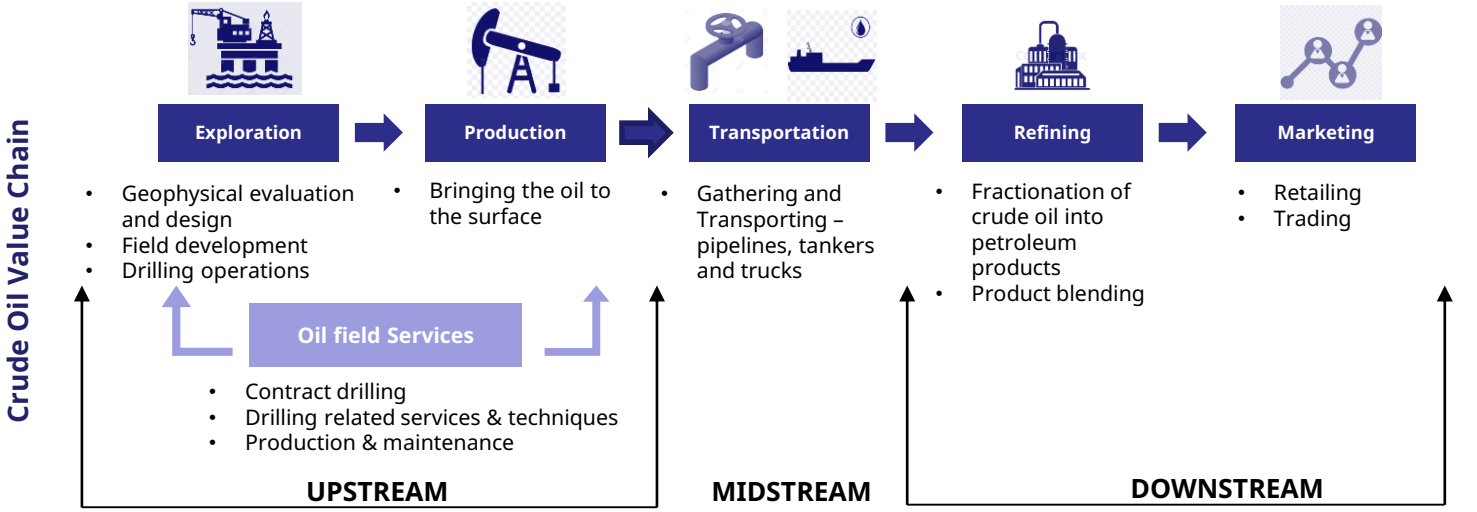
Vietnam currently has **4 active and 1 idle basin** with total oil reserves reaching 4.4bn bbl. and 645bcm of gas reserves by end-2018.

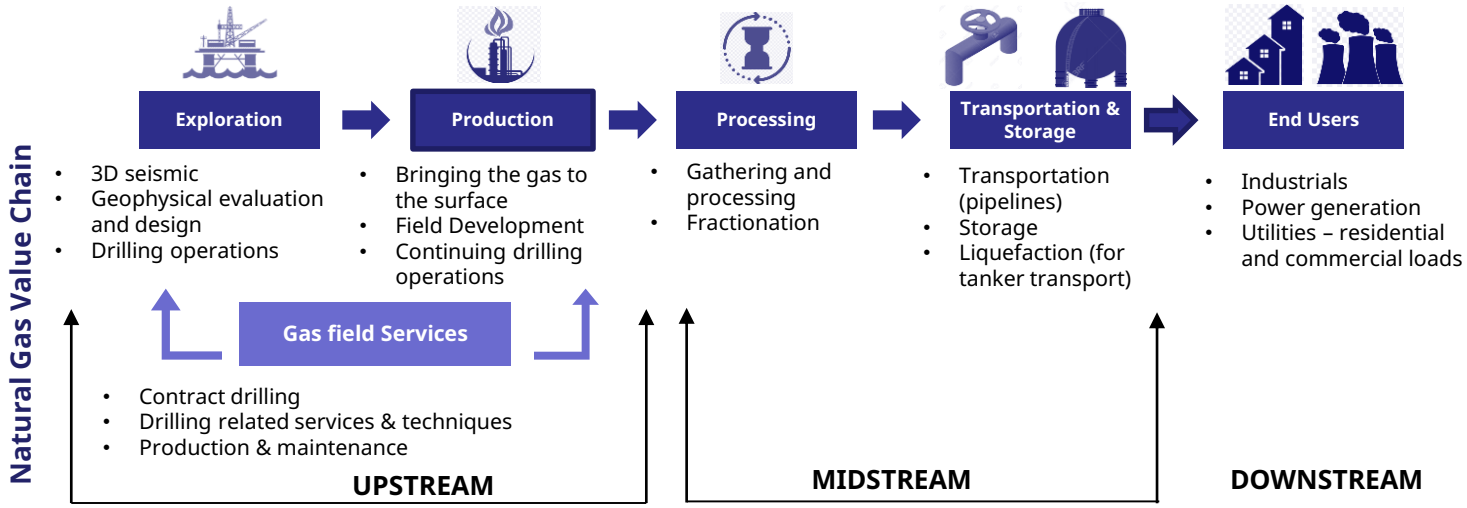
Most current E&P activities are taking place in Cuu Long, Nam Con Son and the Malay Tho Chu basin.

Bach Ho field of Cuu Long basin, which accounts **60%** of total oil output, has been declining in production over the past few years.

VIETNAM OIL & GAS OVERVIEW

Global Oil & Gas value chain





VIETNAM OIL & GAS OVERVIEW

Vietnam Oil & Gas Mechanism

Descending degrees of government control

Upstream	Midstream	Downstream
▪ PVN is the **exclusive player** via its subsidiary, **PV Exploration and Production (PVEP)** ▪ PVEP can either work alone or choose a domestic/foreign partner under production sharing contracts (PSCs) or joint ventures (JVs) for oil exploration	▪ **Only 2 PVN's subsidiaries – PVOil and PVGas** are allowed to distribute and trade crude oil and natural gas	▪ This space is **more open to private sectors**, with many players – traders of refined oil products and LPGs,...
PVN: 100.00%	PVN: 92%	PVN: 95.76%

Upstream and Midstream Oil & Gas activities are heavily dependent on the state's control through PVN

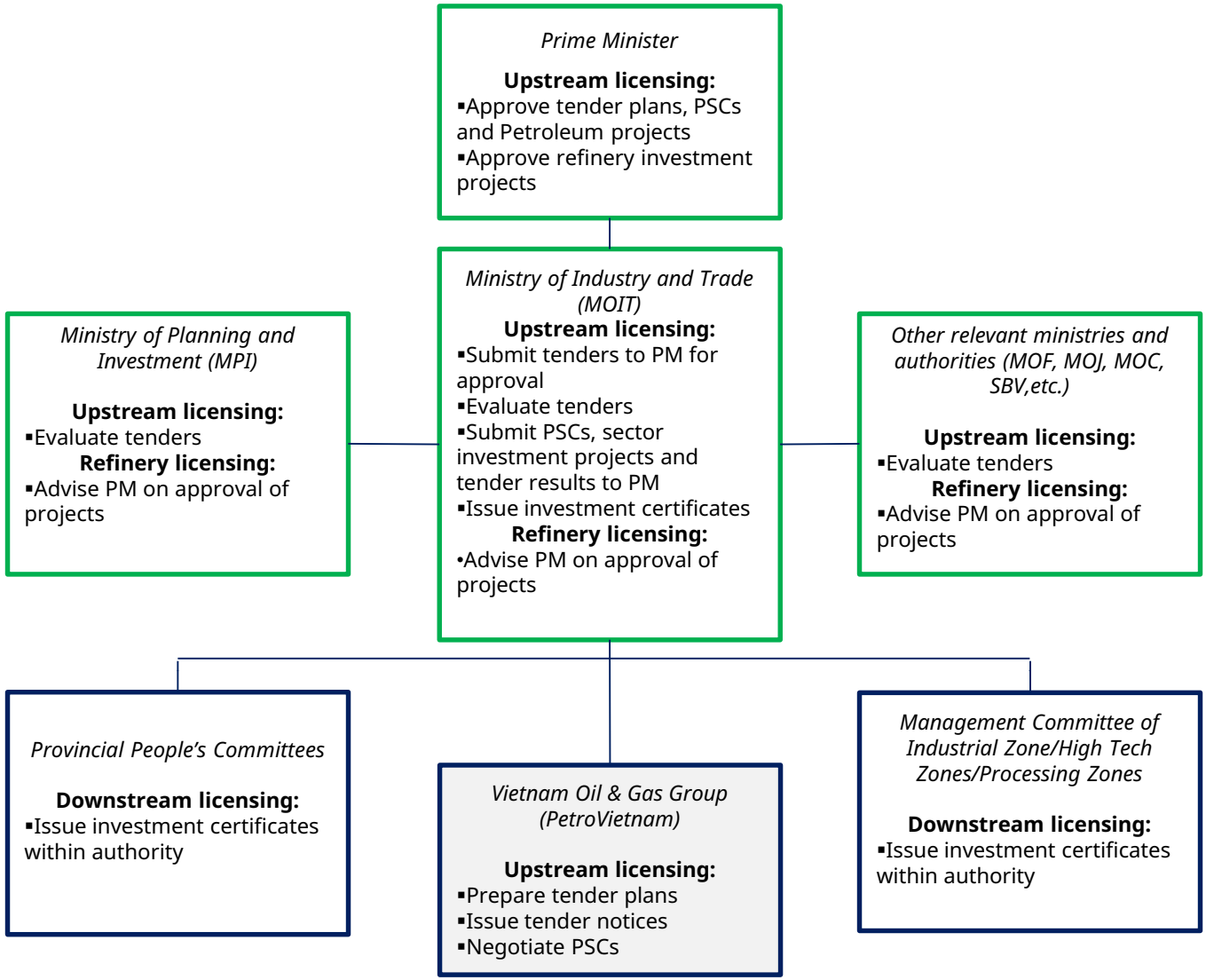
In Vietnam, PetroVietnam (PVN) is the Key Player Delegated By the government to oversee the oil and gas industry. With 40 years of experience (established in 1977), PVN has extensive footprint throughout the industry with subsidiaries engaging in the whole value chain. In other words, PVN itself can represent the whole Vietnam's Oil & Gas industry

PVN plans to decrease its ownerships in PVOil and PVGas to 35.1% and 65% respectively after 2020.

PVN also targets to lower its stakes in its subsidiaries operating in downstream activities (such as PVN's targeted holding in DPM, DCM of 51% in 2017 - 2018, in PVT of 36% in 2018 – 2019).

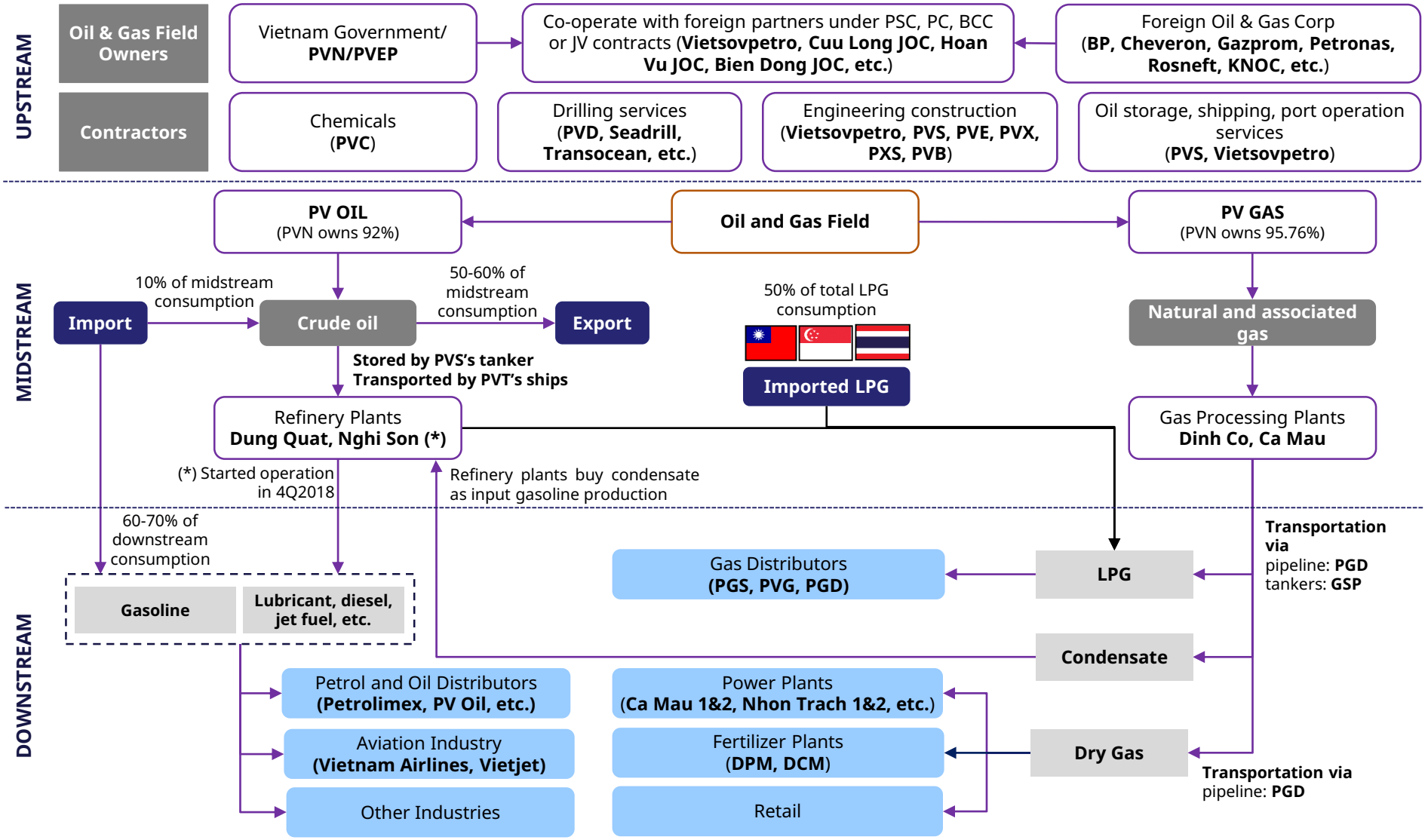
VIETNAM OIL & GAS OVERVIEW

Approval Hierarchy for Oil & Gas Activities



Vietnam Oil & Gas overview

Vietnam's Oil & Gas value chain



Vietnam Oil & Gas overview

Key legal framework of Vietnam Oil & Gas

Law on Petroleum 2008	Law on Enterprise 2014	Law on Investment
Decree No 19/2016/ND-CP ▪ Govern gas trading business	**Decree No. 83/2014/ND-CP** ▪ Govern petrol and oil trading business	**Decree No. 95/2015/ND-CP** ▪ Detail instruction for some articles of the Petroleum Law
Decree No 67/2017/ND-CP ▪ Regulate financial fine in the petrol, Oil & Gas trading business	**Decree No 06/2015/ND-CP** ▪ Govern the financial regulation of PVN's parent company	**Decision 04/2015/QD-TTg** ▪ Regulate safety standards in the Oil & Gas industry
Decision 60/QD-TTg ▪ Development strategies of the gas industry of Vietnam by 2025 with vision to 2035	**Decision 84/2010/QD-TTg** ▪ Govern oil and gas extraction	**Circular 36/2016/TT-BTC** ▪ Instruction on tax issues for institutions and individuals engage in upstream activities

The revision of the Law on Petroleum (2008) is likely to take place over 2019-2020.

Details of the revision are not yet available, although it is believed that focus would be given to measures to boost oil and gas exploration, attract foreign investment and promote the development of petroleum technology. These include shortening key approval processes for oil and gas activities, simplifying procedures and boosting incentives for foreign and domestic investors to develop smaller, marginal fields, as well as deep-water projects.

PVN proposed to amend the Petroleum Law to change special mechanisms that would allow PVN to bolster its E&P activity. Notable changes would be:

1) allowing PVN to establish an "E&P fund" by extracting **17%** of revenue from O&G projects;
2) extracting **30%** from pre-tax profit to make provision for exploration risks;
3) retaining a minimum **32%** interest of the host country from Production Sharing Contract (PSC) vs 25% presently

VIETNAM OIL & GAS OVERVIEW

Key projects of Vietnam Oil & Gas

2018

Nghi Son Refinery & Petrochemical

Capital: USD9bn

Capacity: 10mn tonnes / year



2020



Block B – Omon Gas Field & Pipeline

Capital: USD6.8 bn (Gas Field)
+ USD1.2bn (Pipeline)

Design Capacity:
- Natural gas production: 5.1 bcm/year (Gas Field) and
- Natural gas transportation: 20.3 mcm (Pipeline)

Son My LNG Terminal

Capital: USD1.3bn

Capacity: 3.6mn tonnes / year



2022

Long Son Petrochemical Complex

Capital: USD5.4 bn

Capacity: 1.6mn tonnes of olefin / year



2023

Ca Voi Xanh (Blue Whale) Project

Capital: USD4.6bn

Capacity: 150 bcm of natural gas

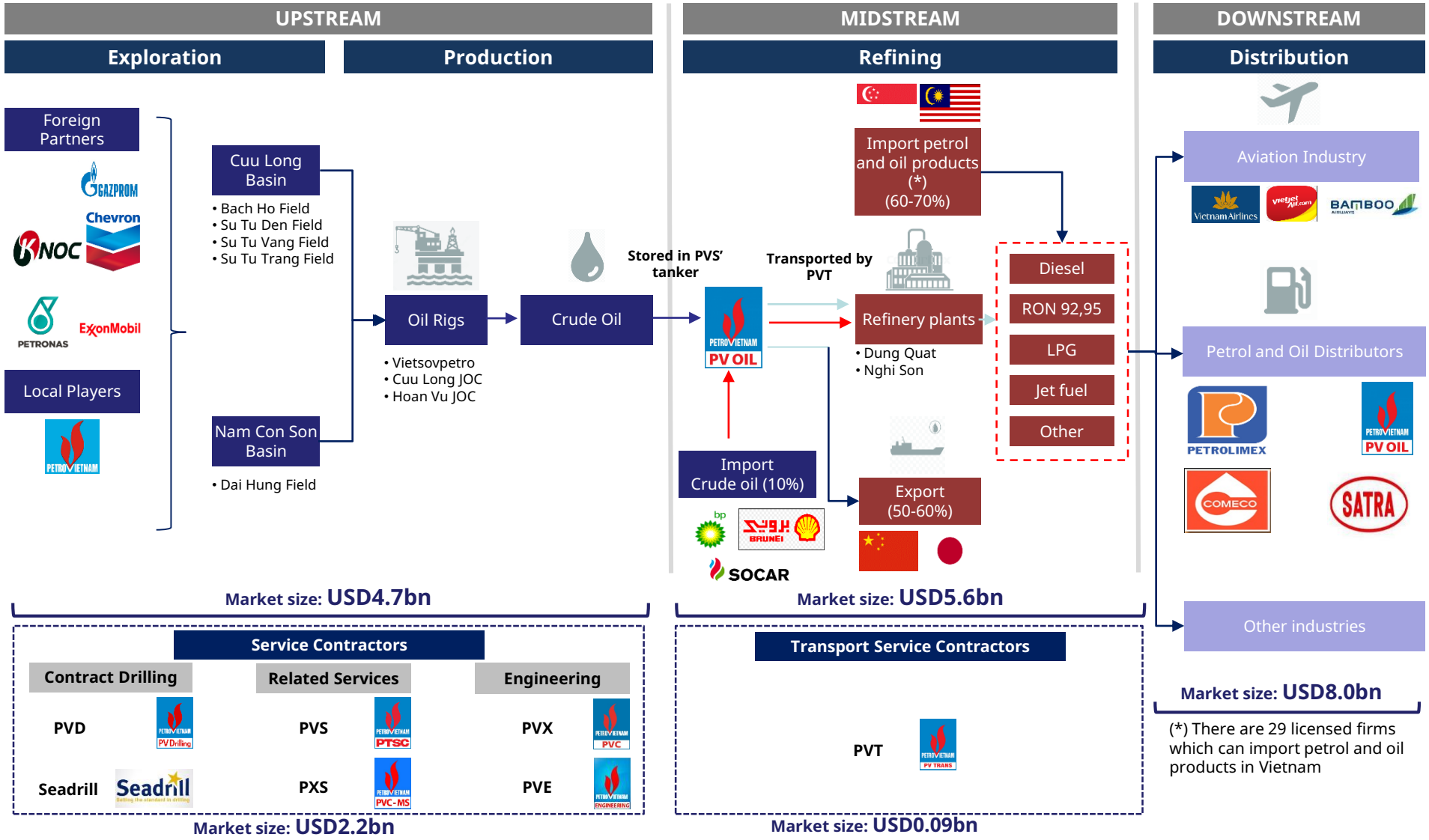


- Upstream Project
- Midstream Project
- Downstream Project

II. Vietnam Oil Industry

VIETNAM OIL INDUSTRY

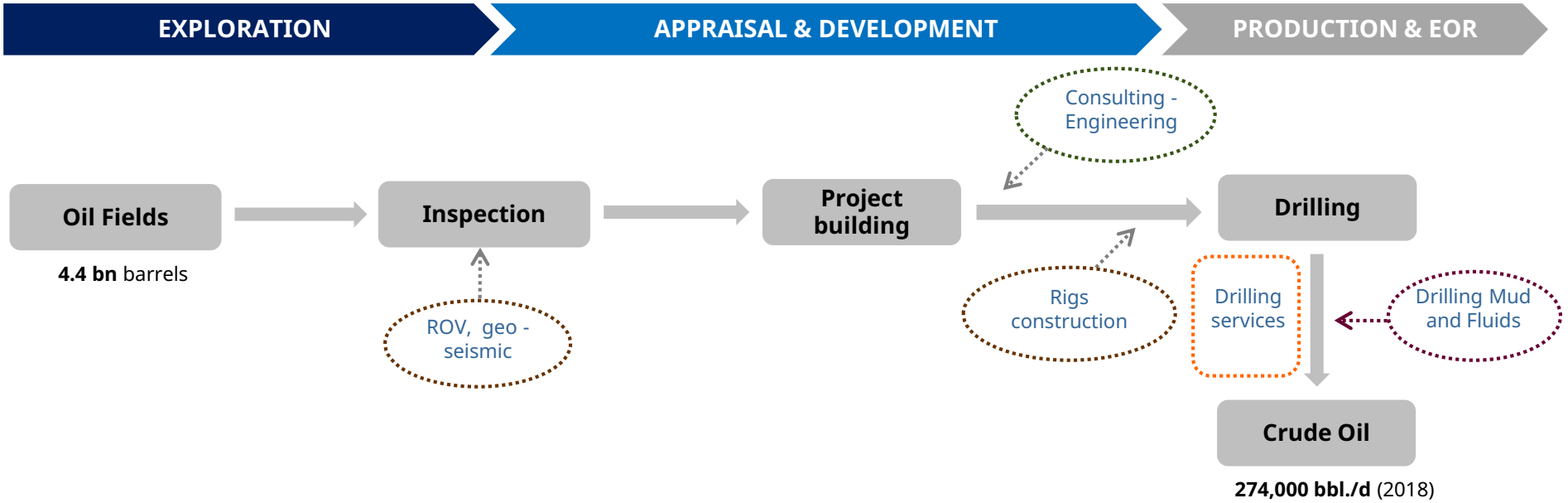
Vietnam oil industry value chain



(*) There are 29 licensed firms which can import petrol and oil products in Vietnam

VIETNAM OIL INDUSTRY

Vietnam oil upstream activities overview



OIL EXPLORATION AND PRODUCTION ACTIVITIES ARE MANAGED EXCLUSIVELY BY PVEP AND ITS JVS UNDER THE DIRECTION OF VIETNAM GOVERNMENT WITH THE SUPPORT OF OTHER SERVICE CONTRACTORS

OIL & GAS FIELD OWNER	**Vietnam Government/ PVN/PVEP**	Co-operate with foreign partners under PSC, PC, BCC or JV contracts **(Vietsovpetro, Cuu Long JOC, Hoan Vu JOC, Bien Dong JOC,...)**	Foreign Oil & Gas Corporation **(BP, Cheveron, Gazprom, Petronas, Rosneft, KNOC,...)**
CONTRACTOR FOR SUPPORT SERVICES	Chemicals (**PVC**)	Drilling services (**PVD, Seadrill, Transocean**,...)	Engineering construction (**Vietsovpetro, PVS, PVE, PVX, PXS, PVB**)	Oil storage, shipping, port operation services (**PVS, Vietsovpetro**)

Data as of June 2019

VIETNAM OIL INDUSTRY

Vietnam oil production is in downward trend

Cuu Long Basin

Bach Ho Oil Field
- Block: 09-1
- Operator: VietsovPetro
- Peak capacity: 263,000 bbl/d
- Daily capacity: ~75,000 bbl.

Su Tu Den, Su Tu Vang, Su Tu Trang & Su Tu Nau Fields
- Block: 15-1
- Operator: Cuu Long JOC
- Peak capacity: 82,000 bbl./d
- Daily capacity: ~70,000 oil bbl.

Te Giac Trang
- Block: 16-1
- Operator: Hoang Long JOC
- Peak capacity: 55,000 bbl./d
- Daily capacity: ~40,000 oil bbl.

Tho Trang Field
- Block: 09-1
- Year of Production: 2017
- Operator: VietsovPetro
- Main product: Crude oil & Natural gas
- Daily capacity: ~ 21,000 oil bbl.

Hai Su Den, Hai Su Trang Oil Field
- Block: 15-2/01
- Operator: Thang Long JOC
- Peak capacity: 35,000 bbl./d
- Daily capacity: ~15,000 bbl/d

Ca Ngu Vang Field
- Block: 9-2
- Operator: Hoang Vu JOC
- Peak capacity: 20,000 bbl./d
- Daily capacity: ~10,000 bbl.

Nam Con Son Basin

Dua Field
- Block: 12E
- Operator: POVO
- Peak capacity: 8,000 bbl./d
- Daily capacity: ~8,000 bbl.

Dai Hung Field
- Block: 05.1A
- Operator: PVEP POC
- Peak capacity: 18,000 bbl./d
- Daily capacity: 14,000 bbl.

Chim Sao Field
- Block: 12E-12W
- Operator: POVO
- Peak capacity: 30,000 bbl./d
- Daily capacity: 25,000 bbl.

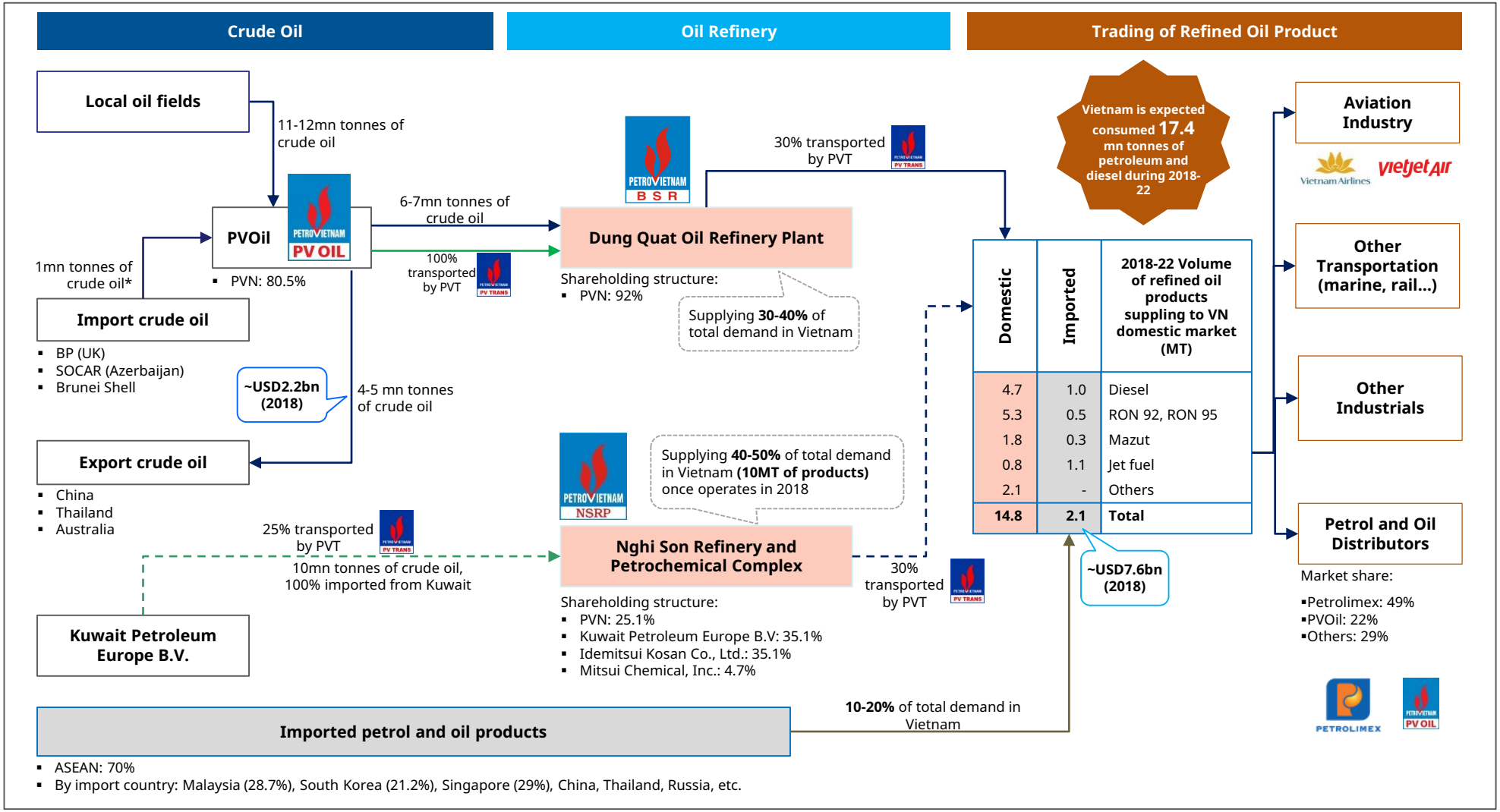
Hong Ngoc Field
- Block: 01&02
- Operator: PCVL
- Peak capacity: N/A
- Daily capacity: 20,000 bbl.

Malay – Tho Chu Basin

PM3-CAA
- Block: PM3-CAA
- Operator: TML
- Peak capacity: 60,000 bbl./d
- Daily capacity: 30,000 bbl.

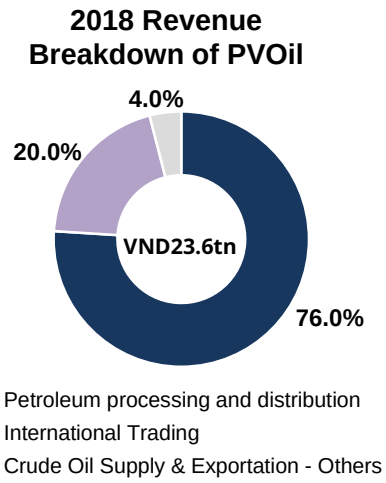
VIETNAM OIL TRADING & REFINERY

Vietnam oil trading & distribution overview



VIETNAM OIL TRADING

PV Oil overview



Crude oil trading accounted for a small amount, VND1.22tn in PVOil's 2018 revenue while petroleum makes up for 3/4.



Petroleum Processing

- PVOil operates a condensate processing plant of 13,000 tonnes per year capacity in Vung Tau
- It also operates a lubricant processing plant of 20,000 tonnes per year capacity in HCMC



Supply and Export of Crude Oil

- PVOil is the only company allowed to export crude oil in Vietnam
- It is also the one company supplying crude oil to Vietnam's only refinery plant – Dung Quat



Petroleum Distribution

- The Company distributes refined oil products via its 3,000 petroleum stations in 63 provinces and cities
- Petroleum retail distribution brands including PVOil, Comeco, Timexco and Petec



Bio-fuels Processing and Distribution

- PVOil operates 3 bio-fuel plants with total capacity of 300,000m^3 per year, supplying to more than 300 E5 (5% ethanol) petrol stations in Vietnam



International Trading

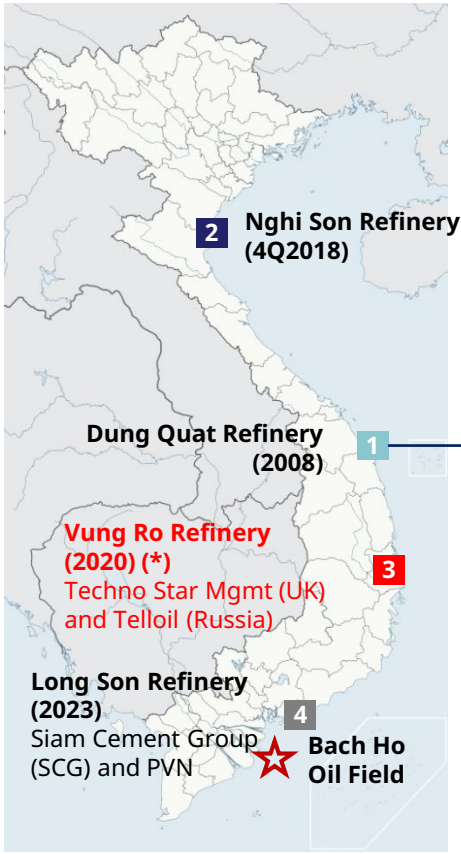
- To enhance crude oil and petroleum products trading in the international marketplace, the Company established PVOil Singapore (2011), PVOil Laos (2011) and PVOil Cambodia (2014)
- PVOil Laos currently holds 20% market share in Laos' retail petroleum distribution market, ranks second

Source: PVOil

VIETNAM OIL REFINERY

Key refinery plants in Vietnam

	1 Dung Quat Oil Refinery Plant	2 Nghi Son Refinery and Petrochemical Complex
Entity	Binh Son Refining and Petrochemical Co., Ltd	Nghi Son Refinery and Petrochemical LLC
Location	Quang Ngai Province	Thanh Hoa Province
Year of commercial operation	**2008** Began construction: 2003 October	**4Q2018** Began construction: 2013 May
Total Investment Cost	USD3 bn	USD9 bn
Shareholding Structure	▪ Vietnam Oil and Gas Group (PVN): 100.0% ▪ IPO in 1Q2018 to lower PVN ownership to 92%	▪ Vietnam Oil and Gas Group (PVN): 25.1% ▪ Kuwait Petroleum Europe B.V. (KPE): 35.1% ▪ Idemitsui Kosan Co., Ltd. (IKC): 35.1% ▪ Mitsui Chemical, Inc. (MCI): 4.7%
Capacity	**6.5 mn tonnes/year** **(or 148,000 bbl./day)**	**10 mn tonnes/year** **(or 200,000 bbl,/day)**
Product quality	Euro 2	Euro 2
Source of crude oil materials	- Local: Bach Ho Oil Field - Import (*)	- 100% imported from Kuwait
Products (kt = thousand tons)	- Diesel: 2,900 – 3,200 kt - RON 92: 1,400 – 1,800 kt - RON 95: 600 – 700 kt - LPG: 400 – 420 kt - Jet fuel: 80 – 400 kt - Propylene, Polypropylene, FO: 330 – 400 kt	- Premium diesel: 2,204 kt - Regular diesel: 1,470 kt - RON 92, RON 95: 1,153 kt - LPG - Jet fuel - Petrochemical products
Import tax	▪ 7% gasoline, 5% LPG, 3% petroleum products from 2012 to 2018	▪ 7% gasoline, 5% LPG, 3% petroleum products for 10 years from official start of production
Corporate income tax	▪ Income tax of 10% for 30 years. 4 years income tax exemption. 50% rate for the first 9 years after begins earning taxable incomes	▪ Income tax of 10% for 30 years. 4 years income tax exemption. 50% rate for the first 9 years after begins earning taxable incomes
Notes	▪ Revenue and net profit in 2018 was at VND556.9bn and VND16bn, respectively. ▪ Binh Son Refining is planning to spend USD1.8bn to raise capacity by 2mn tonnes by 2021, and enable the production of Euro 5 compliant fuels.	▪ One of the largest-ever FDI projects in Vietnam ▪ Fuel products offtake agreement to guarantee output consumption by PVN



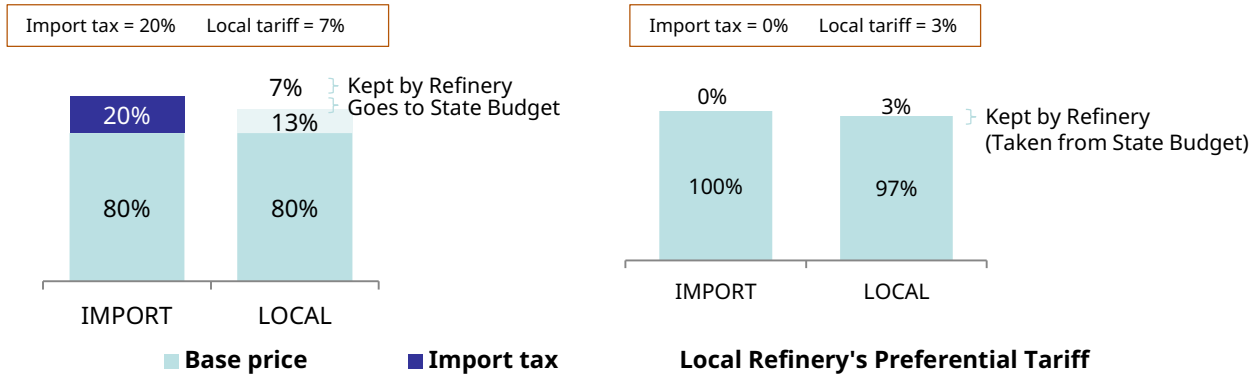
Dung Quat's 2016 sales volume was 57.4 mn tonnes of products, accounting for ~40% of total oil & gas consumption in the country.

(*) Vung Ro was cancelled due to drop in gasoline price

VIETNAM OIL REFINERY

Government policy in refinery activities

Sample Breakdown of Refined Oil Price By Product Origin



1) When import tax rate > local refinery's preferential tariff income, the local refinery keeps the tariff income, the **difference between the import tax and the tariff income will be transferred to the State Budget**

2) When import tax rate < local refinery's preferential tariff rate, the local refinery will get **reimbursement from the Government** to match their set out preferential tariff rate

Products	Current favorable import tax rates (MFN)	Preferential tariff				
		ASEAN Trade in Goods Agreement (ATIGA)	Vietnam – Korea (VKFTA)	ASEAN – China FTA	Binh Son Refining & Petrochemical Co., Ltd	Nghi Son Refinery & Petrochemical LLC
Gasoline	20%	20%	10%	20%	10%	7%
Diesel oil (DO)	10%	0%	5%	8%	0%	3%
Mazut (FO)	10%	0%	0%	5%	0%	3%
Kerosene	13%	0%	5%	10%	0%	3%
Jet fuel	10%	0%	5%	15%	0%	3%
Effective since		*2010*	*2015*	*2010*	*2017 Decision 1725/QD -TTg*	*2018 Government Guarantee Undertaking*

These preferential tariffs are guaranteed support from Government

Local refineries are facing increasing competition because imported products enjoy preferential tariffs following national commitments for FTAs in recent years.

Starting from 2018, Binh Son Refinery is allowed to lower its tariff on domestic gasoline sales to 10% from 20%, while tariff on other oil products was lifted. The reduction allowed Binh Son to compete with products imported from South Korea and ATIGA.

In the first 10 years, the Government guarantees that if tariff falls below the rates applied to Nghi Son, PVN will make up for the difference. **It is estimated that PVN would have to offset VND1.8-2.5tn (USD80-110mn) in annual losses for Nghi Son Refinery when it starts operation**

However, in recent developments, Nghi Son refinery may not be eligible for preferential selling price because their products do not meet the Euro 4 standard requirement as set out in Decision 49/2011/QD-TTg.

MIDSTREAM OF OIL SEGMENT

There remains opportunity in supporting services

1 OIL TRADING
Vietnam's trade of crude oil is expected to contract, due to limited supply and demand

- Due to limited exploration initiatives and many of legacy fields entering the latter-half of their production cycles, PVEP will witness a significant decline in production volume, and in turns, affecting PVOil
- Crude oil export from Vietnam cannot compete with world' price, especially from oil-abundant countries in the Middle East
- Crude oil import is limited as demand from the only refinery, Dung Quat, has reached max capacity, and the new Nghi Son refinery has signed contracts to get its direct crude oil supply from Kuwait starting 2018

Oil trading has few opportunities as Vietnam's trade of crude oil is expected to contract, due to limited supply and demand.

2 OIL REFINERY
Rising price competition from FTAs hurts oil refinery business

- Rising price competition from FTAs might hurt oil refinery business, making it tough for local refineries to compete with import products on price
- In addition, possible changes in Government policy regarding price support compared with previously will create a more level playing field against the two

Outlook for oil refinery segment is not positive.

3 SUPPORTING
Potential for transportation services

- The operation of Nghi Son Refinery Plant (from 2018) and increasing demand for refined fuels will support the development of transportation services

Potential opportunities to invest in supporting services.

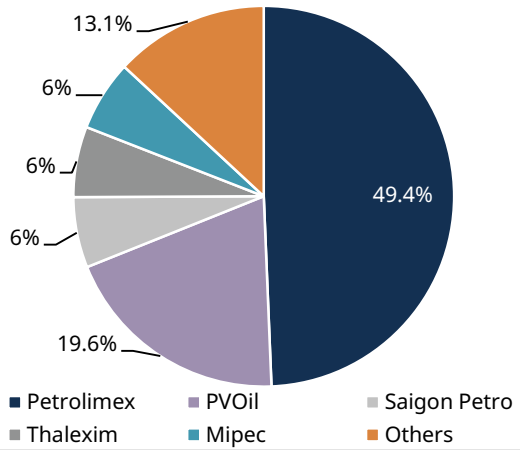
DOWNSTREAM OF OIL SEGMENT

Key characteristic of gasoline distribution

List of licensed Petroleum Importers 2017

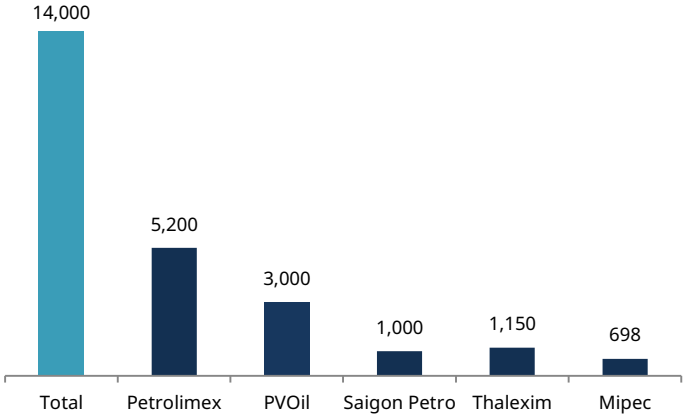
1	Petrolimex JSC	11	STS Petroleum	21	Bach Khoa Viet Trading
2	Military Petrochemical	12	Hai Linh Co	22	Petrolimex Aviation (Jet fuel only)
3	Hoa Khanh Trading	13	Dong Thap Petroleum	23	Hung Phat Trading
4	PV Oil	14	Nam Song Hau Trading	24	SATRA
5	Hai Ha Waterway Transport	15	Hoan My Aviation (Jet fuel only)	25	Nam Viet Oil
6	Duong Dong -Saigon JSC	16	Vietnam Air Petrol (Skypec) (Jet fuel only)	26	Duong Dong – Hoa Phu JSC
7	Saigon Petro	17	Thai Son Petro	27	Petro Binh Minh Ltd
8	Orient Oil & Gas JSC	18	Hong Duc Petrol	28	Nam Phu Investment JSC
9	Long Hung Trading	19	Thalexim	29	Viet Oil Ltd
10	MIPEC	20	Trading & Transport Material Import-Export JSC		

Market Share in terms of Volume in 2016 of Petroleum Distributors



Source: Company data

Number of Gas Station in 2016



Source: Company data

Vietnam has more than **14,000 gas stations** - 30% belong to the State and 70% belong to private companies.

In 2020, Vietnam is planning to increase the number of gas stations to 18,000.

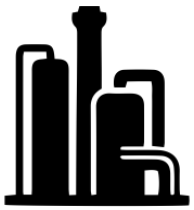
Vietnam National Petroleum Group (**Petrolimex**) was established in 1956, under the order of **Ministry of Commerce.** Its main scope is to import, export and deal in petroleum, refined and petrochemical products.

Petrolimex is the biggest petroleum products importer and distributor with a market share of nearly 50%. PV Oil and Saigon Petro rank second, and third respectively

In recent years, the competitiveness of locally-produced fuels suffered against imported fuels due to unfavorable tax rates imposed on domestic output, while a host of FTAs Vietnam signed with the ASEAN and South Korea (10%, effective as of 2015) rendered fuel imports cost-competitive

VIETNAM PETROCHEMICAL

Key milestone of Vietnam Oil & Gas



Oil Refinery Plant

Petrochemical Products

Olefin	▪ Includes ethylene, propylene and butadiene ▪ Applications: **industrial chemicals**, **plastic products**, **synthetic rubber**
Aromatics	▪ Includes benzene, toluene, xylenes ▪ Applications: manufacturing of **dyes**, **synthetic detergents**, **plastics**, and **synthetic fibers**
Synthesis gas	▪ Mixture of carbon monoxide and hydrogen used to make ammonia and menthol ▪ Applications: manufacturing of **fertilizer (urea)**, **solvent and chemical intermediate**

→ **Currently, almost all input materials for Vietnam's plastic and textile industries are imported because they have cheaper price and satisfactory quality**

→ **Vietnam's gas industry provides sufficient amount for national fertilizer (urea) industry**

PetroVietnam Petrochemical & Textile Fiber JSC (PVTex) was the first polyester fiber manufacturing plant to be built in Vietnam to produce PSF from raw materials (output of refinery plants)

- Location: Hai Phong
- Capacity (per day): 400 tonnes of PSF, 100 tonnes of Filament, and 180 tonnes of PET
- Investment costs: USD325 mn
- Start operation in: 05/2014

It was expected that the plant would satisfy around **40%** of local demand for PSF and **12%** for yarns

The plant halted production in 10/2015 due to losses after first year of commercial operation

Main Reasons for Failure

- Products were **more expensive** than imported ones
- **Inconsistent quality**
- Production costs were **unusually high** and other costs were also much higher than expected

Current Status

- After nearly 2 years of halting operation, PVTex now has **accumulated losses of over VND3tn** (~ USD130.5mn)
- PVN and Vinatex (2 current shareholders) are **looking for investors to restart the project**

DOWNSTREAM OF OIL SEGMENT

Mixed outlook in downstream segment

1 Technology on petrochemical not competitive

- Petrochemical is still new technology in Vietnam. However, via PVTex, it showed that it will be some time until Vietnam's petrochemical business can take off and compete with import products in terms of price and quality

2 Opportunities in the petroleum retail market due to rising demand

- Refined fuels consumption in Vietnam will develop strongly over 10-year forecast period, driven by stable macroeconomic trends, high growth in the transportation and household sectors. Moreover, with the plan of the State to double the amount of quality petrol stations from now to 2030, Vietnam will be a potential market of refined petroleum products, especially in the retail market, especially for foreign investors

3 Supporting

- The operation of Nghi Son Refinery Plant (from 2018) and increasing demand for refined fuels will support the development of transportation services

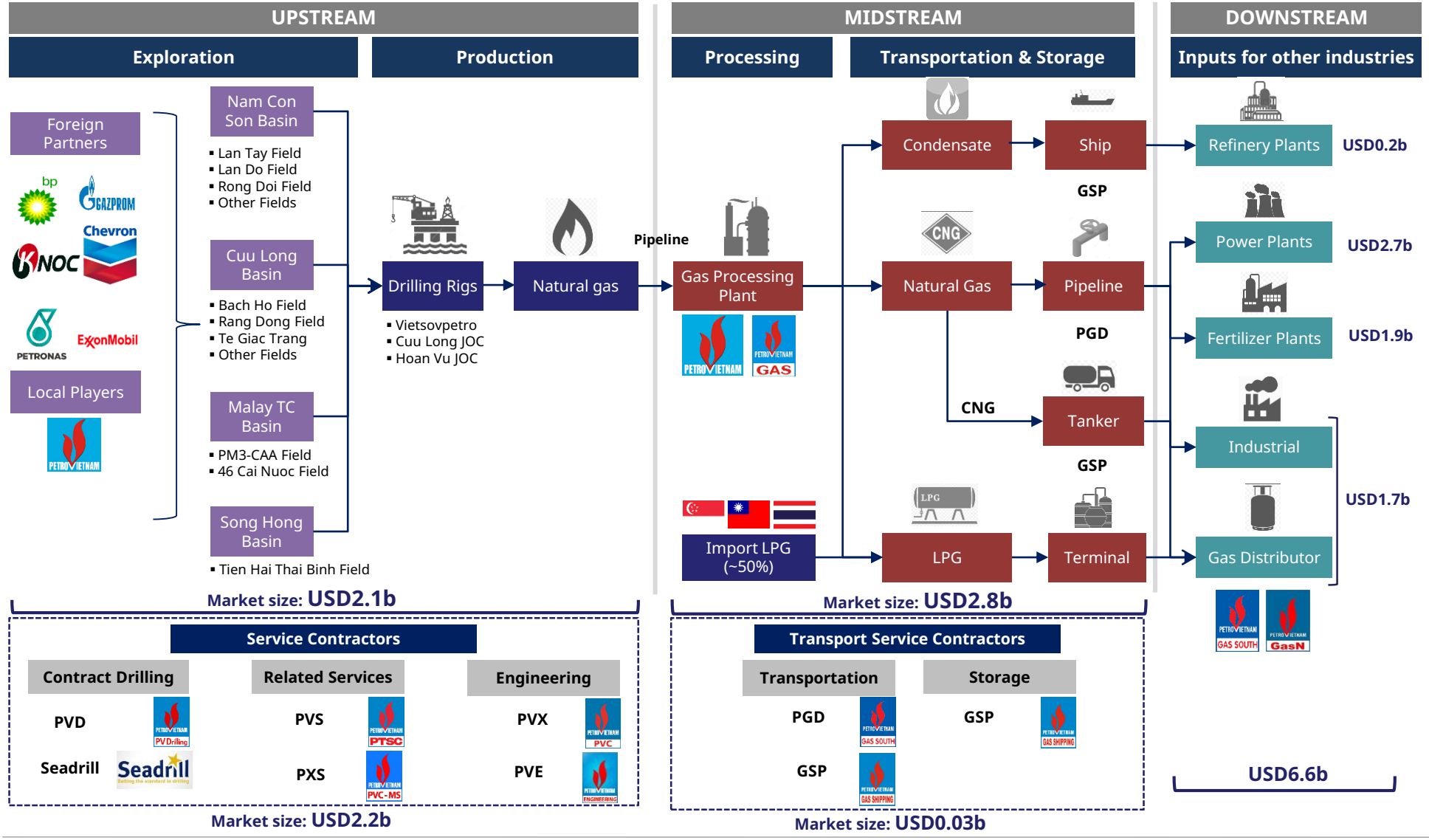
Outlook for petrochemical segment is not positive.

Potential opportunities to invest in petroleum retail and supporting services.

III. Vietnam Gas Industry

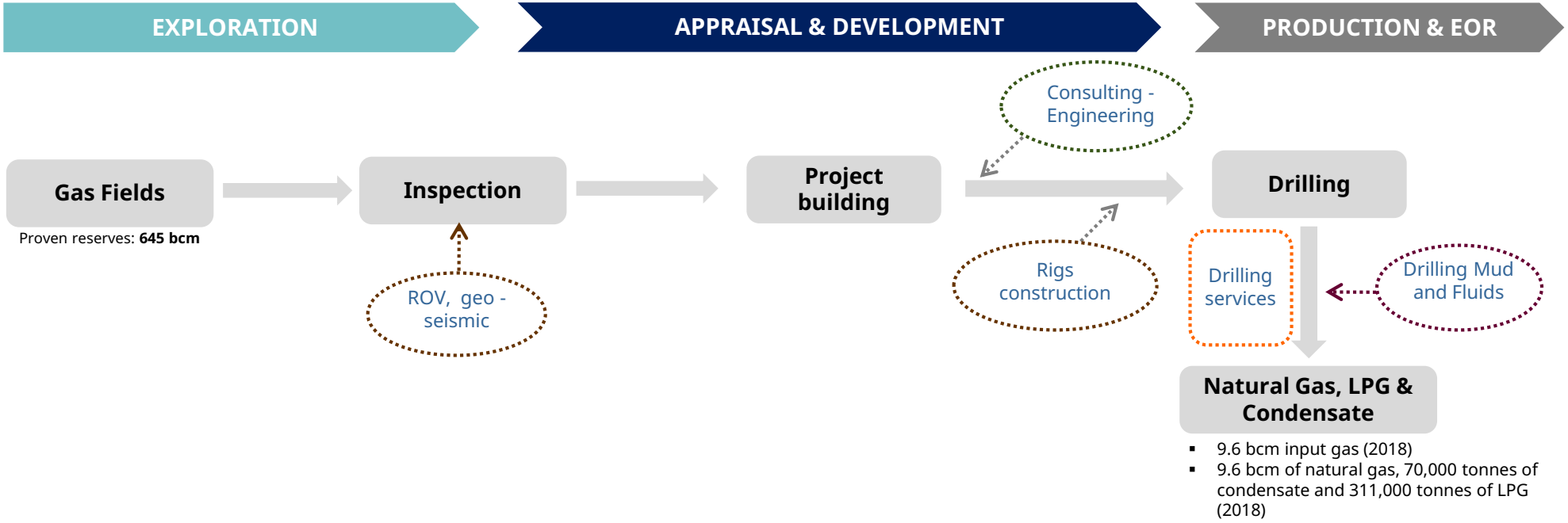
VIETNAM GAS INDUSTRY

Value chain of Vietnam gas industry



GAS EXPLORATION AND PRODUCTION

Vietnam gas upstream activities overview



KEY PARTICIPANTS IN THE UPSTREAM ACTIVITIES

OIL & GAS FIELD OWNER	**Vietnam Government/ PVN/PVEP**	Co-operate with foreign partners under PSC, PC, BCC or JV contracts (**Vietsovpetro, Cuu Long JOC, Hoan Vu JOC, Bien Dong JOC,...**)	Foreign Oil & Gas Corporation (**BP, Cheveron, Gazprom, Petronas, Rosneft, KNOC**,...)
CONTRACTOR FOR SUPPORT SERVICES	Chemicals (**PVC**)	Drilling services (**PVD, Seadrill, Transocean**,...)	Engineering construction (**Vietsovpetro, PVS, PVE, PVX, PXS, PVB**)	Oil storage, shipping, port operation services (**PVS, Vietsovpetro**)

GAS EXPLORATION AND PRODUCTION

Key gas production projects

Nam Con Son Basin

Lan Tay – Lan Do Fields
- Block: 06-1
- Operator: Rosneft
- Main product: Natural gas
- Yearly peak capacity: ~5,800 mcm
- Production (2016): 3,203 mcm

Rong Doi – Rong Doi Tay Fields
- Block: 11-2
- Operator: KNOC
- Main product: Natural gas
- Yearly peak capacity: ~1,300 mcm
- Production (2016): 1,062 mcm
- Last by 2024

Chim Sao Field
- Block: 12W
- Operator: POVO
- Main product: Natural gas
- Production (2016): 318 mcm

Hai Thach – Moc Tinh Fields
- Block: 05-2 and 05-3
- Operator: Bien Dong POC
- Main product: Natural gas
- Yearly peak capacity: 3,102 mcm gas
- Production (2016): 2.035 cm

Malay – Tho Chu Basin

Block PM3-CAA & 46CN Fields
- Block: PM3-CAA & 46CN
- Operator: TML
- Main product: Natural gas
- Yearly peak capacity: 3,000 mcm
- Production (2016): 1,993 mcm

Song Hong Basin

Ham Rong – Thai Binh Field
- Block: 102 - 106
- Operator: PV Gas
- Main product: Natural gas
- Production (2016): 143 mcm

Cuu Long Basin

Bach Ho, Vom Bac, Rong and Doi Moi Fields
- Block: 09-1, 09-3
- Operator: VSP
- Main products: Natural gas
- Yearly peak capacity: N/A
- Production (2016): 745 mcm

Te Giac Trang, Hai Su Den, Hai Su Trang Fields
- Block: 16-1
- Operator: Hoang Long JOC, Thang Long JOC
- Main product: Natural gas
- Yearly peak capacity: N/A
- Production (2016): 169 mcm

Ca Ngu Vang Field
- Block: 09-2
- Operator: Hoang Vu JOC
- Products: Natural gas
- Yearly peak capacity: 1,000 mcm
- Production (2016): 114 mcm

Su Tu Den, Su Tu Vang, Su Tu Trang Fields
- Block: 15-1
- Operator: Cuu Long JOC
- Main product: Natural gas
- Production (2016): 576 mcm
- Last by 2023 (except Su Tu Trang)

Thien Ung, Dai Hung Field
- Block: 04-3
- Operator: Petrovietnam
- Products: Natural gas
- Yearly peak capacity: 700 mcm
- Production (2016): 142 mcm

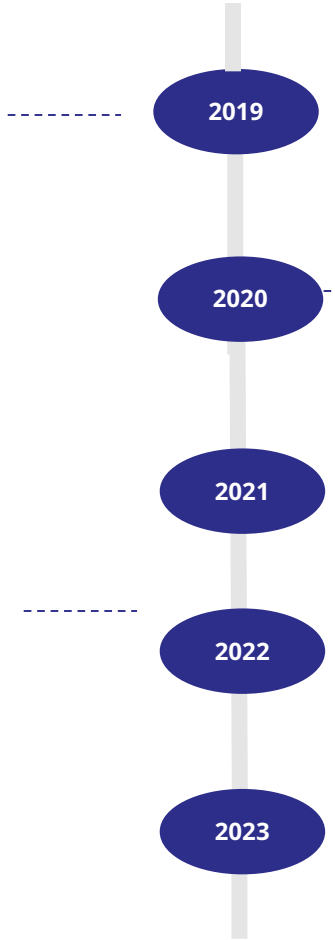
Tho Trang Field
- Block: 09-1
- Year of Production: 2017
- Operator: VietsovPetro
- Main product: Natural gas
- Estimated production: 540 mcm

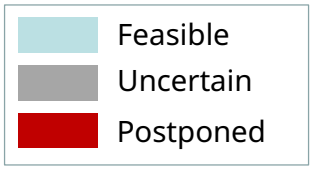
GAS EXPLORATION AND PRODUCTION

Many uncertainties in gas projects

CA RONG DO GAS PROJECT

- Scale: Block 07/03
- Reserves: 45.3 mn bbl. of oil and 172 bcf of gas
- Expected output: 25,000 bbl./d and 613.2 mcm meters of gas
- First production expected in 2019F, but the development was postponed due to opposition from China in 2017





PHASE II OF SU TU TRANG PROJECT

- Scale: Block 15-1
- Reserves: 24 bcm
- Expected annual output: 1.5 bcm
- Expected timeline: between 2020 and 2035

BLOCK-B O MON GAS PROJECT

- Investment cost: USD10 bn for both upstream and pipeline
- Scale: Block B, 49/95 and 52/97
- Reserves: 107 bcm and 12.6 mn bbl. of condensate
- Expected annual output: 5.07 billion cubic meters
- Expected production period: 20 years
- Mainly supplying for the power industry in the South

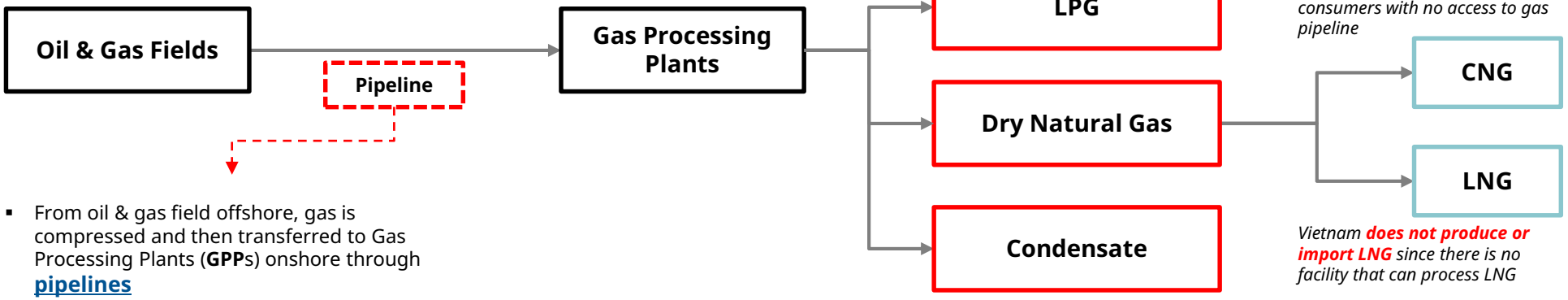
CA VOI XANH (BLUE WHALE) GAS PROJECT

- Scale: Block 117, 118 and 119
- Reserves: 150 bcm
- Expected annual output: 10 bcm at peak
- Mainly supplying for the power industry and other industrial industries

GAS TRADING AND DISTRIBUTION

Vietnam gas processing overview

MIDSTREAM



*CNG can be transported by trucks within a **100km range** from a compressor station, supplying consumers with no access to gas pipeline*

*Vietnam **does not produce or import LNG** since there is no facility that can process LNG*

- From oil & gas field offshore, gas is compressed and then transferred to Gas Processing Plants (**GPP**s) onshore through **pipelines**
- The designing and construction of these pipelines **require major capital expenditure** and the pipelines cannot be re-route

PVGas, as being a subsidiary of PVN, is the **only company** in the market to own and operate these pipelines, ***dominating the gas trading and distribution market in Vietnam***

Dinh Co & Ca Mau GPPs

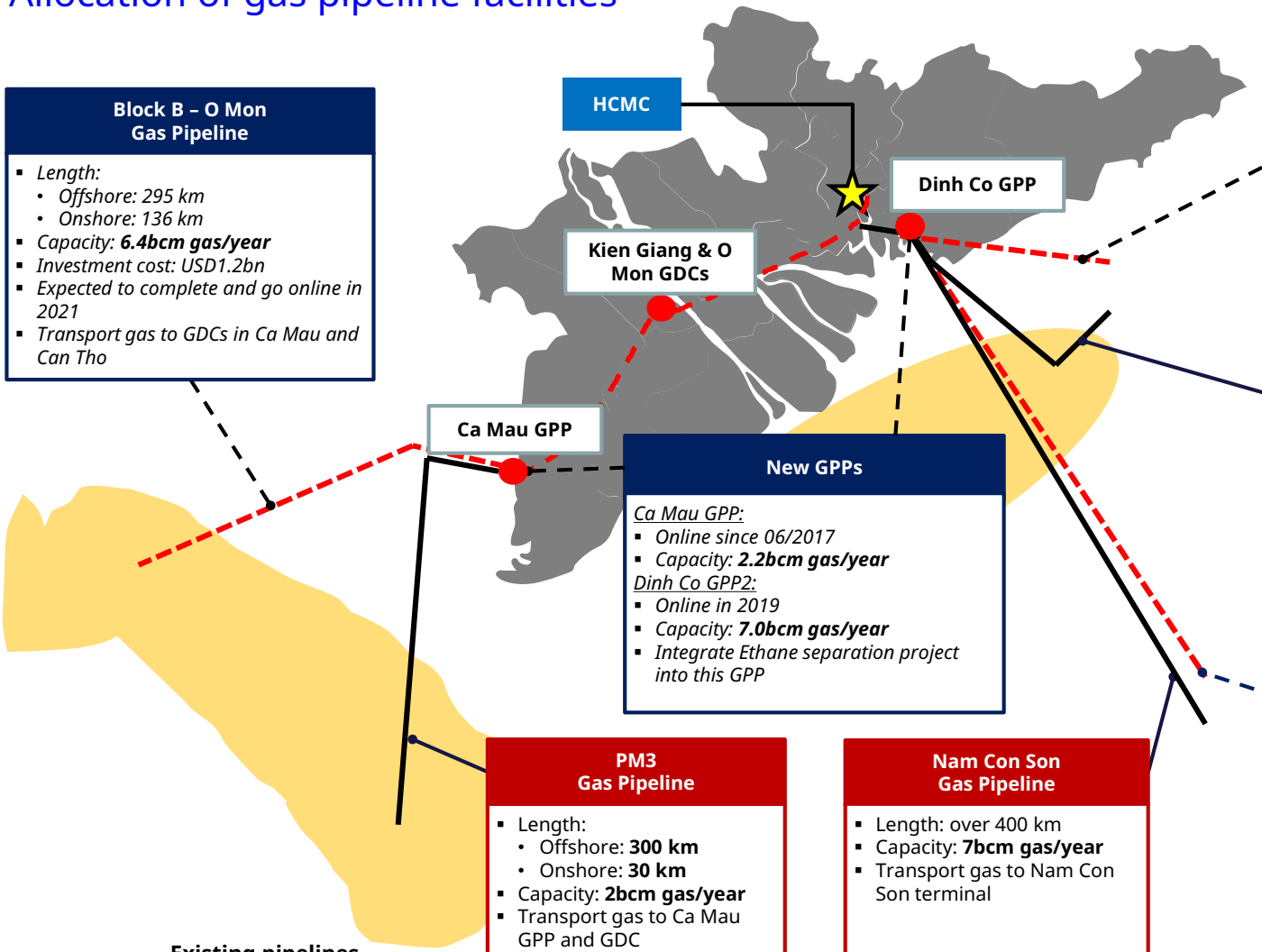
- *Dinh Co GPP* is the main gas processing plant in Southern Vietnam and has been operating since 1995
- Wet gas from oil & gas field is transported to this GPP in Ba Ria – Vung Tau for processing with main products consisting of dry gas, LPG, and condensate
- Dry gas is transported to *Nam Con Son Terminal* (also a part of *Dinh Co GPP*)
- *Ca Mau GPP* received the first gas-in flowing from Malay – Tho Chu Basin in Mar 2017

New GPP

- In Jan 2017, ExxonMobil signed agreements with PVN relating to extraction at *Ca Voi Xanh (Blue Whale) gas field* in Quang Nam, Vietnam
- PVN plans to construct a *new GPP* there (in Nui Thanh district, Quang Nam province) in order to process gas transported from Ca Voi Xanh field

GAS TRADING AND DISTRIBUTION

Allocation of gas pipeline facilities



Block B – O Mon Gas Pipeline

- *Length:*
  - *Offshore: 295 km*
  - *Onshore: 136 km*
- *Capacity: **6.4bcm gas/year***
- *Investment cost: USD1.2bn*
- *Expected to complete and go online in 2021*
- *Transport gas to GDCs in Ca Mau and Can Tho*

Su Tu Trang Gas Pipeline

- *Length: 156 km*
- *Capacity: **1.5bcm gas/year***
- *Expected to complete and go online in 2020*
- *Transport gas to Dinh Co GPP*

New GPPs

Ca Mau GPP:
- *Online since 06/2017*
- *Capacity: **2.2bcm gas/year***

Dinh Co GPP2:
- *Online in 2019*
- *Capacity: **7.0bcm gas/year***
- *Integrate Ethane separation project into this GPP*

Cuu Long Gas Pipeline

- Length: 197 km
- Capacity: **2 bcm gas/year**
- Transport gas from Cuu Long Basin to Dinh Co GPP

PM3 Gas Pipeline

- Length:
  - Offshore: **300 km**
  - Onshore: **30 km**
- Capacity: **2bcm gas/year**
- Transport gas to Ca Mau GPP and GDC

Nam Con Son Gas Pipeline

- Length: over 400 km
- Capacity: **7bcm gas/year**
- Transport gas to Nam Con Son terminal

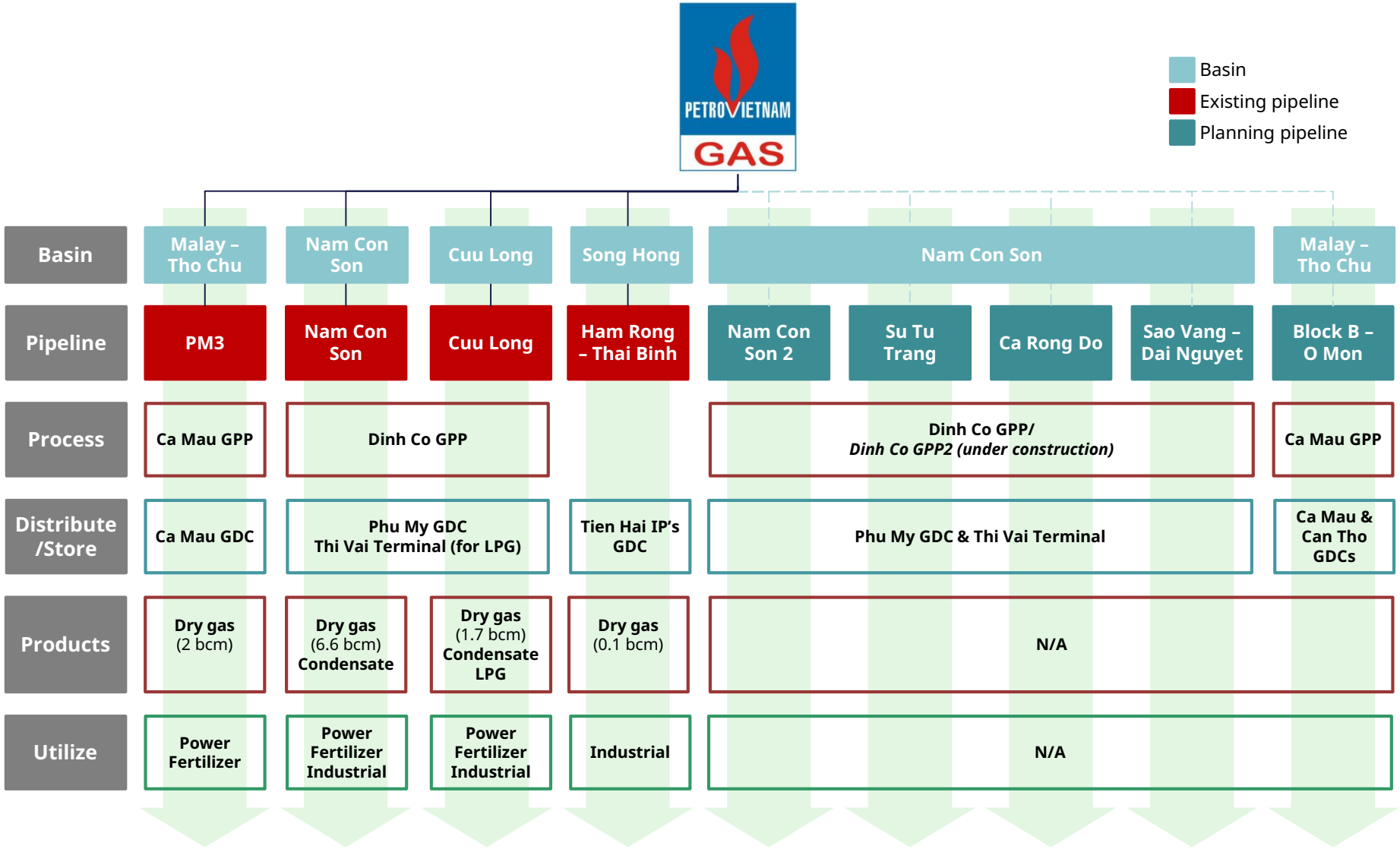
Nam Con Son 2 Gas Pipeline

- *Length: 330 km*
- *Capacity: **6bcm gas/year***
- *Investment cost: USD1.5 min (2 phases)*
- *Phase 1 started operating in 2016*
- *Transport gas to Nam Con Son terminal*

Existing pipelines
Planning pipelines

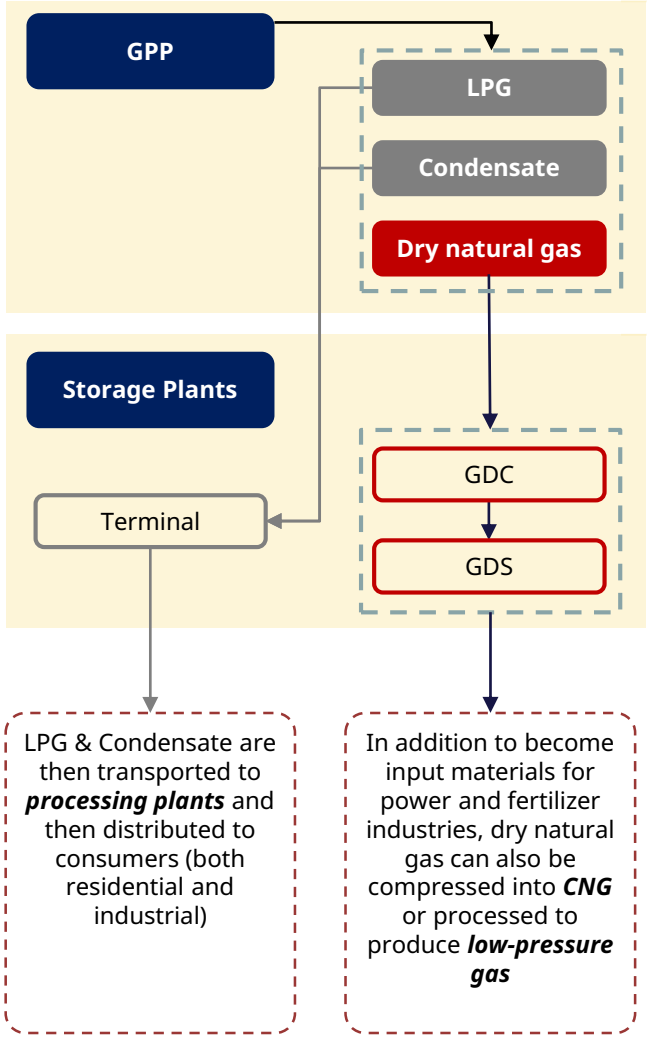
GAS TRADING AND DISTRIBUTION

PV GAS is sole player in Vietnam gas sector



GAS TRADING AND DISTRIBUTION

Production, Storing, and Distribution to Consumers



Capacity	Gas output	Production	
		LPG	Condensate
Dinh Co GPP	2 bcm/year	900 tonnes/day	130 tonnes/day
Ca Mau GPP(*)	2.2 bcm/year	600 tonnes/day	34 tonnes/day

(*) Ca Mau GPP starts producing LPG from June 2017

Capacity at **Thi Vai Terminal**:
- LPG: 60,000 tonnes (cold storage)
- Condensate: 12,000 tonnes

LPG & Condensate are transported via pipeline from ***Dinh Co GPP*** to ***Thi Vai terminal,*** stored in tankers and then distributed to consumers via tankers or vessels (LPG) and to PVOil's condensate plant via pipeline

A new terminal, Mui Tram, is under construction at Ca Mau to store LPG and condensate produced by ***Ca Mau GPP***

Phu My GDC: receives and transports gas from ***Dinh Co GPP*** to consumers; ***Phu My GDC*** is also responsible of balancing gas from both Nam Con Son and Cuu Long pipelines

Phu My GDS: receives and transports gas from ***Dinh Co GPP*** to Ba Ria power plant and other consumers

Nhon Trach & Hiep Phuoc GDS: receives and transports gas from ***Dinh Co GPP*** to power plants, IPs, and residential consumers in Dong Nai, HCMC, and regional area

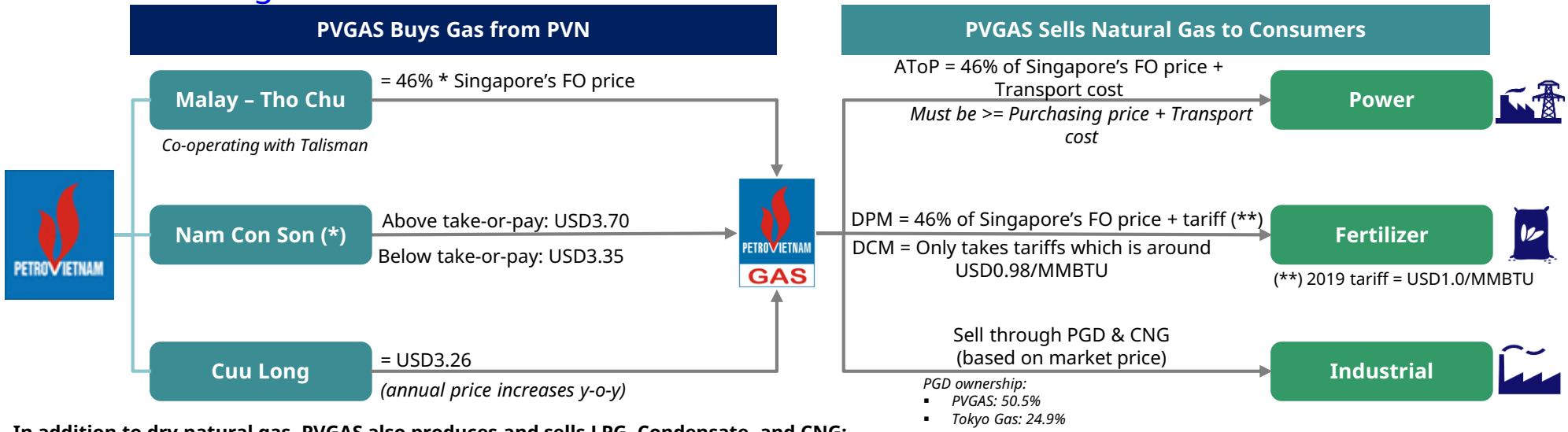
Ca Mau GDC & GDS: receives and transports gas from ***Ca Mau GPP*** to Ca Mau's power plants, fertilizer plants

Tien Hai Industrial Park's GDC: receives and transports gas from ***Ham Rong – Thai Binh pipeline*** to industrial consumers inside the IP

Source: PVGas

GAS TRADING AND DISTRIBUTION

Products Pricing



In addition to dry natural gas, PVGAS also produces and sells LPG, Condensate, and CNG:

- Wholesaling prices of *LPG*, *Condensate, and CNG* to buyers (PVOIL, PGS, CNG Vietnam, etc.) are determined on the basis of oil price
- In general, dry natural gas is **20% cheaper than LPG**

Although gas selling price is correlated to oil price, PVGAS' revenue basically comes from transport cost, which depends on the volume of gas transported via the company's pipeline systems. Therefore, the higher the volume of gas consumption, the higher revenue for PVGAS.

(*) PVGAS signed agreement with PVN and other owners of Nam Con Son basin to determine the price and the cap level for the take-or-pay agreement (154 MMBTU)

Unit: USD/MMBTU

ToP (take or pay)	AToP (above take or pay)
A take-or-pay contract is a rule structuring negotiations between companies and their suppliers. With this kind of contract, the company either takes the product from the supplier or pays the supplier a penalty. For any product the company takes, they agree to pay the supplier a certain price.	The buyers, through negotiation, must pay concessions amounts including premium price or tariffs for above take-or-pay levels.

GAS TRADING AND DISTRIBUTION

LNG and CNG will have higher role in Vietnam gas sector

	Current	Future
CNG	▪ Current CNG capacity is around **150 mcb/year** (mainly produced by PVGAS South and CNG Vietnam, subsidiaries of PVGas) ▪ PVGas also invested in a **new CNG processing plant** in Tien Hai IP, complementing to Ham Rong – Thai Binh gas pipeline that transports dry gas to Tien Hai IP	▪ After the CNG processing plant in Tien Hai IP going online, total CNG capacity can be increased to nearly **300 mcb/year** ▪ Thanks to its benefits, CNG is **going to be applied widely**, both for industrial and residential purposes
LNG	▪ At the moment, Vietnam **cannot produce or import** LNG because the country does not have the required technology and facilities to utilize LNG ▪ In July 2016, an entity called **LNG Vietnam JSC** was established with shareholders consisting of PVGAS (51%), Bitexco (39%), and Tokyo Gas Asia (10%), aiming to develop a LNG value chain in Vietnam ▪ At the end of 2016, PVGas was planning for the construction of **3 LNG storage facilities** in Thi Vai, Son My, and South-West Vietnam	▪ According to Decision no.60/QD-TTg, by 2025, government aims to **construct 4 LNG storage facilities** for distribution to industrial parks ▪ When the current 3 LNG storage facilities start operating, the total **supply of natural gas will increase**, satisfying demand for natural gas consumption from both industrial corporations and residential households

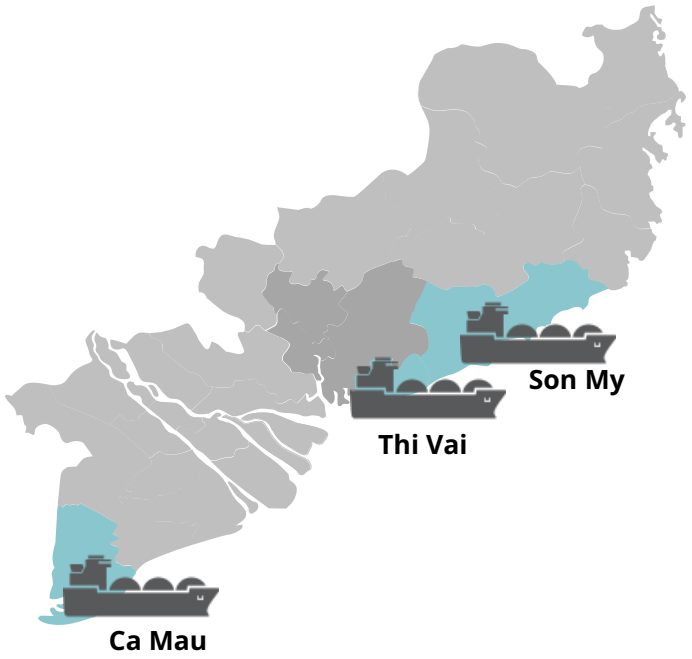
CNG is more environmental friendly than other fuels with higher efficiency and more affordable price

On the other hand, because of high technology required, Vietnam cannot utilize LNG at the moment since there is no facility that can store and regasify LNG

However, understanding the increasing supply shortage of natural gas, Vietnam's government is planning to develop a number of LNG storage and regasification facilities to process the imported LNG

GAS TRADING AND DISTRIBUTION

Upcoming LNG projects receive foreign investors' attention



LNG Son My – Phase 1

- Start operation in **2023**
- Investment cost: USD1.35bn
- Capacity: **3.6 mn tonnes LNG/year**
- Status in 2016: PVGas has studied and evaluated the overall LNG project chain
- In the future, LNG Son My will receive further investment to increase the capacity to 6 mn tonnes/year

LNG Thi Vai

- Start operation in **2020**
- Investment cost: USD286mn
- Capacity: **1 mn tonne LNG/year**
- Status in 2016:
  - PVGas signed MoU for LNG usage with *Nhon Trach 3 electricity project*, *Hiep Phuoc electricity plant*, and signed HOA with EVN
  - PVGas completed the assessment of reception capacity, navigation channels, frequencies, safe areas of imported vessels and ports
- LNG Thi Vai is also a project mentioned in Tokyo Gas' 2017 Main Initiatives, indicating that the Japanese investor is also putting effort into the construction of this LNG terminal
- The project's ownership is being transferred from PVGas to LNG Vietnam JSC

LNG in South-West (expected in Ca Mau)

- Start operation in **2022**
- Capacity: **1 mn tonnes LNG/year**
- Status in 2016: PVGas completed the preparation of Pre-FS, preparing the steps to set up FS

GAS TRADING AND DISTRIBUTION

Potential growth opportunities

Gas-Related Services

Gas Gathering

- Gas from basins is gathered and then transported to ***GPP*** via pipelines
- ***PVGas*** involves in gas gathering services through its subsidiaries and affiliates like ***PVGAS-SE***, ***PVGAS-CM*** by appointing those companies to operate the pipeline as well as look for new investments in gas gathering projects

Gas Transportation & Distribution

- After being gathered and then processed at GPP, gas and its derivatives are transported to destinations (other processing plants or end-consumers)
- Transportation and distribution services include operating the pipeline, operating the ***GDC*** and ***GDS***, and managing the movement of tankers and vessels containing LPG, CNG, or Condensate

Other Services

Engines Conversion

- Since CNG has become more and more popular, it is necessary to *convert gasoline and oil-powered engines to CNG fuel*
- The increasing in CNG usage will eventually lead to an increase in demand for converting the traditional engines to CNG-fueled engines

Maintenance

- Repair and maintenance services are critical to the operation of gas industry; these services include:
  1) Maintenance of gas equipment;
  2) Upgrade technology;
  3) Design and install tanks, pipelines, etc.
  4) Other related services

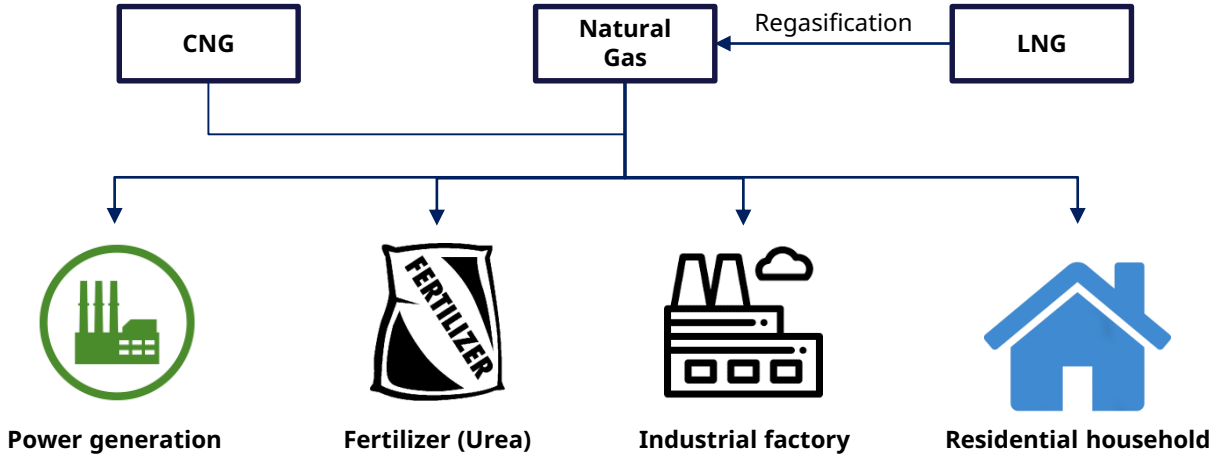
Pipeline's Additional Services

- Coating services: anti-corrosion by:
  1) Fusion bonded Epoxy (FBE)
  2) Three layer polyethylene (3LPE)
  3) Three layer polypropylene (3LPP)
- Provide steel pipes

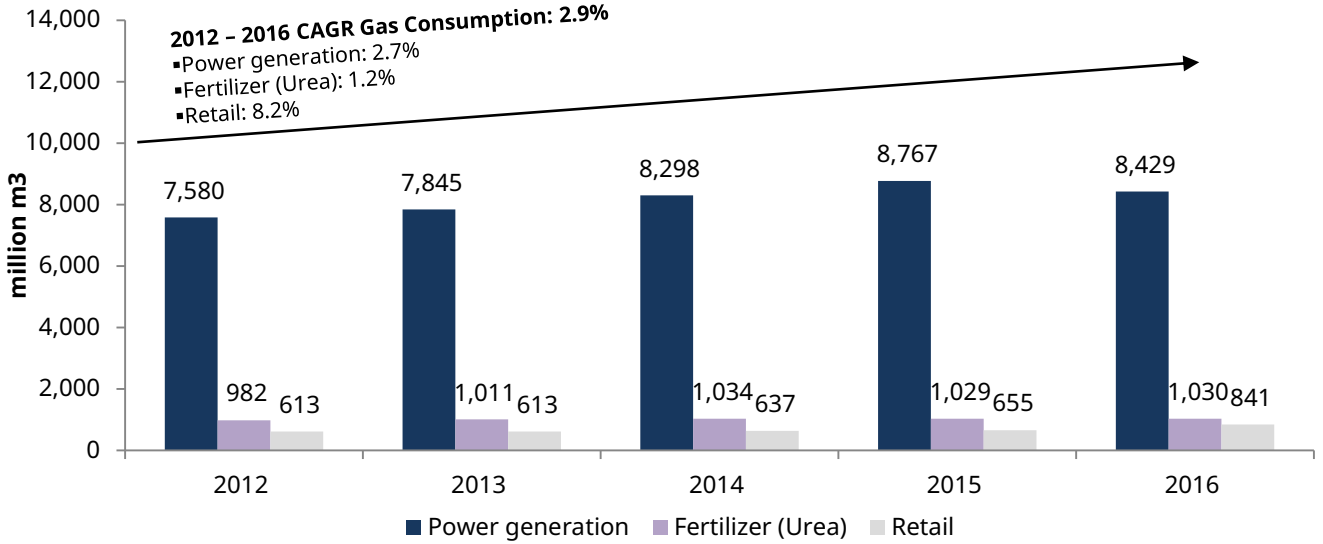
With the current development of Vietnam's gas industry, related services which support the industry's growth will also see optimistic opportunities, especially when current developing projects (i.e. new pipelines, LNG import, etc.) go online.

DOWSTREAM OF GAS SEGMENT

Vietnam gas downstream overview



2012 – 2016 Applications of Dry Natural Gas



Natural gas is used in power generation, in fertilizer (urea) manufacturing, and in industrial factories and residential households.

During 2012 – 2016, over 80% of dry natural gas output was consumed by power sector.

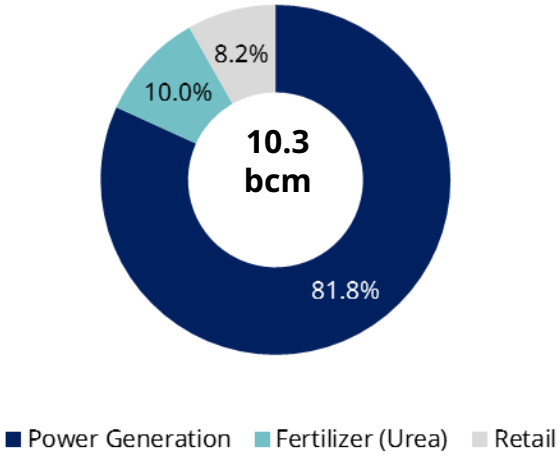
Retail sector experienced highest CAGR during 2012 – 2016 period, gas output consumed in retail sector increased from 613mn m^3 to 841 mn m^3, accounted for 8.2% of total gas output in 2016.

At the moment, Vietnam's gas consumption is capped by domestic production; the construction of LNG facilities will surely increase the nation's gas consumption, especially for power generation, industrial factories, and residential households.

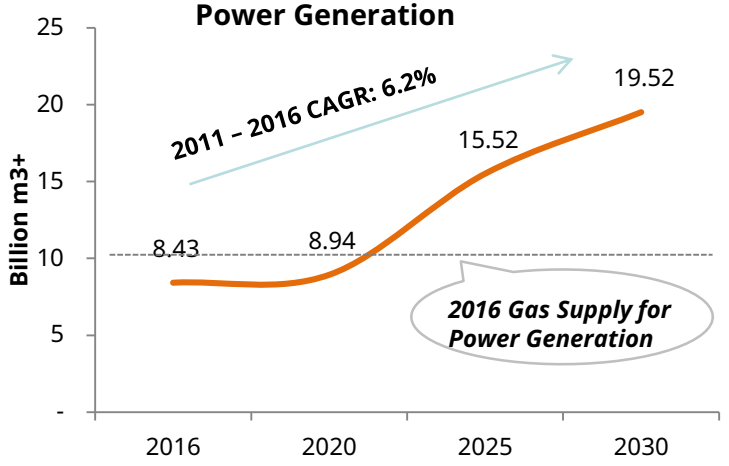
DOWSTREAM OF GAS SEGMENT

Gas-fired power generation has been rising demand

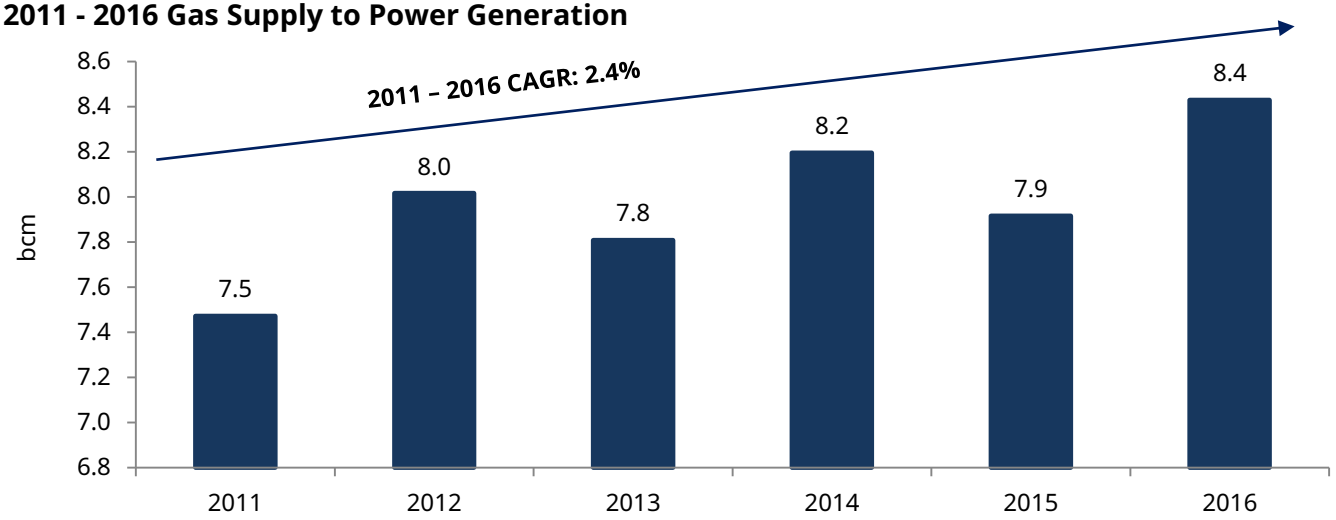
2016 Total Gas Consumption



2016 - 2030F Projected Gas Demand for Power Generation



2011 - 2016 Gas Supply to Power Generation



In the last 5 years, gas supply to power plants grew slightly with a CAGR of 2.4%. The slowly increasing gas produced could lead to a shortage in gas supply for power plants in the future. It is because the demand for power plants is projected to increase significantly, especially in 2020 – 2030 with a CAGR of **8.1%.**

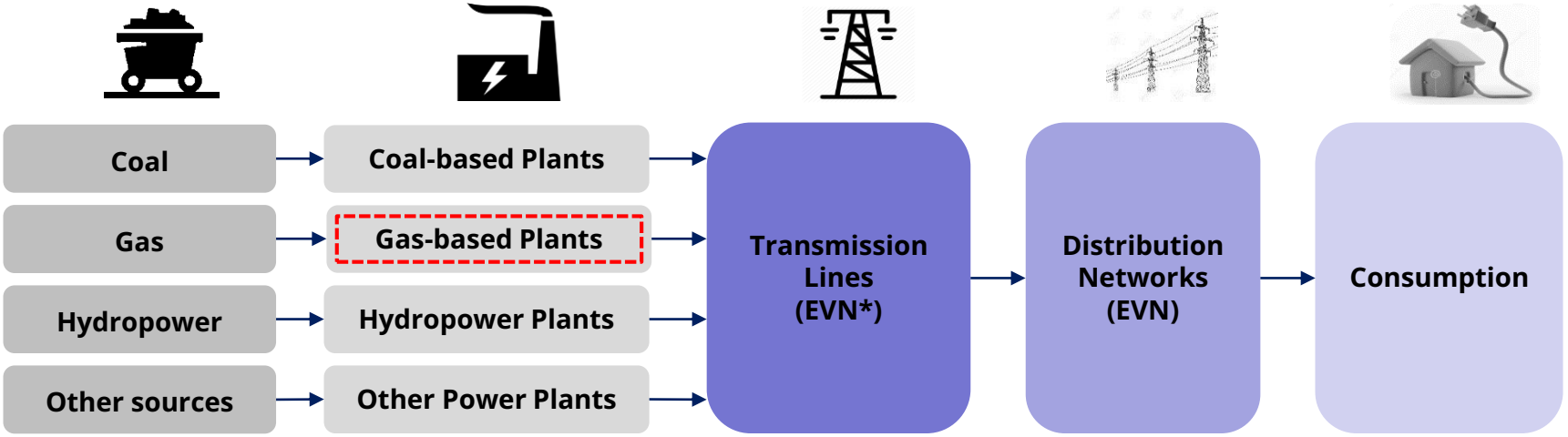
If the gas supply remains stable as it was in 2016, power generation will witness a gas shortage of **7.1bcm** in 2025.

To resolve the problem, PV Gas has been preparing infrastructure for importing LNG since 2008. The Company is currently carrying out 2 projects: **Thi Vai LNG terminal** and **Son My LNG terminal** with processing capacity of 1 mn & 3.6 mn tonnes of LNG, respectively. Together, the 2 projects could provide **6.35 bcm** of natural gas for consumption when coming online in 2020 - 2021

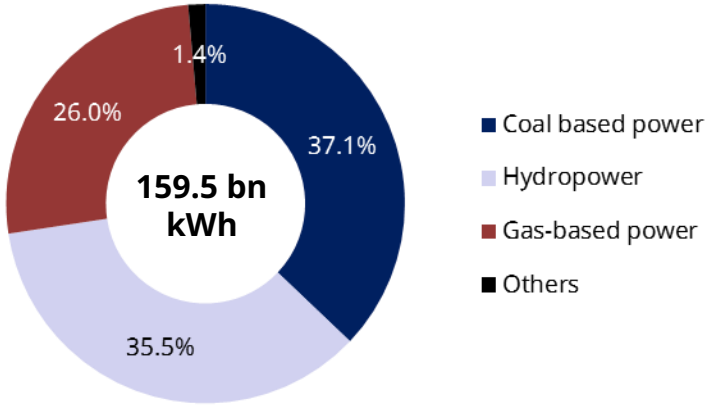
DOWSTREAM OF GAS SEGMENT

Vietnam power generation overview

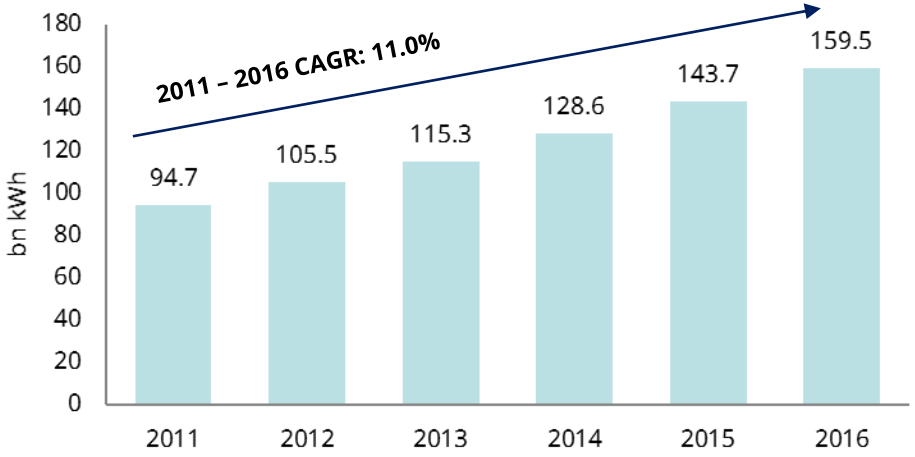
Power Generation Value Chain



2016 Power Generation by Fuel Type (**)



2011 – 2016 Power Generation

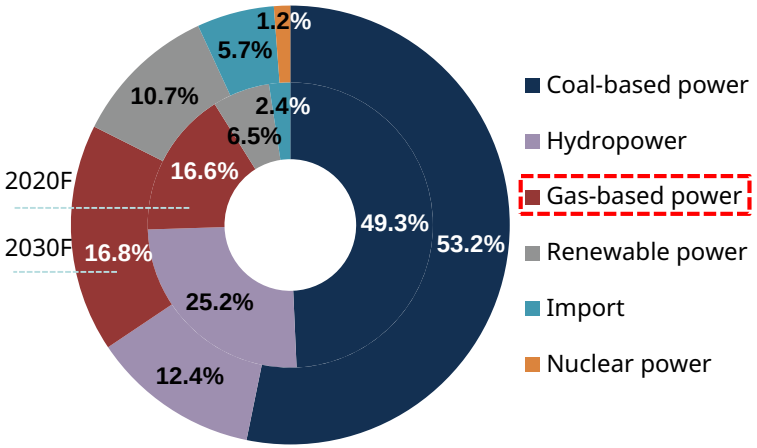


(*) EVN is the Vietnam Power Group holding a monopoly position on power purchase & distribution
(**) Excluding imported power

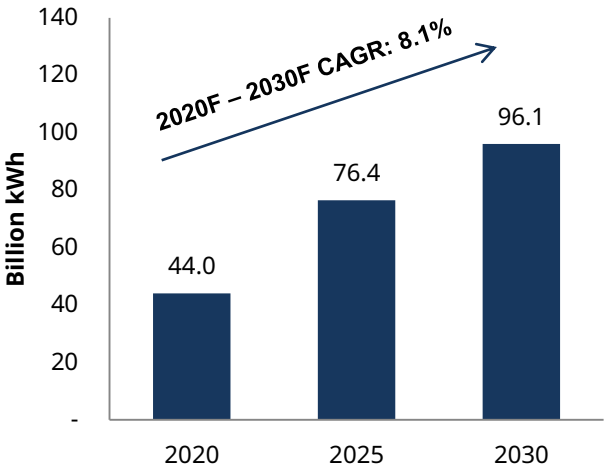
DOWSTREAM OF GAS SEGMENT

Gas-fired power generation has been rising demand

2020F & 2030F Projected Power Generation*



2020F - 2030F Projected Gas-based Power Generation



2016 Power Generation Capacity by Region

	Northern Vietnam	Central Vietnam	Southern Vietnam
Total Capacity	15,516 MW	9,275 MW	15,455 MW
Hydropower	51.8%	43.8%	31.3%
Coal-based power	48.2%	55.7%	15.2%
Gas-based power	0%	0%	49.8%
Others	0%	0.5%	3.7%

According to the National Power Development Plan (the revised Power Plan VII), Coal-based & Gas-based power together will replace Hydropower to become the dominants in power generation in 2030 to maximize the power supply, especially to **ensure power for dry season** in the whole country.

Indeed, Gas-based power's portion will increase 0.2% from 16.6% to **16.8%**, equivalent to 96.1 billion kWh in 2030 and the generated power is projected to increase significantly with a **CAGR of 8.1%** in the period of 2020 – 2030.

Currently Gas-based power generation plants are located in Southern Vietnam due to ease of access to gas basins in the South namely Nam Con Son, Cuu Long, Malay – Tho Chu. In 2016, gas-based power generation plants account for **49.8% of total power capacity of Southern region.**

DOWSTREAM OF GAS SEGMENT

Gas-fired power sector is dominated by EVN & PVPower

Dong Nai:

1.Nhon Trach 1 – 465 MW

2.Nhon Trach 2 – 750 MW

Ca Mau:

1.Ca Mau 1 – 771 MW

2.Ca Mau 2 – 771 MW

Total Installed Capacity:

2,758 MW

Ba Ria – Vung Tau:

1.Phu My 2.2 – 733 MW

2.Phu My – 733 MW

Total Installed Capacity:

1,466 MW



Ba Ria – Vung Tau:

1. Phu My 1 – 1,108 MW
2. Phu My 2.1 – 896 MW
3. Phu My 4 – 458 MW
4. Ba Ria – 389 MW

Can Tho:

1. O Mon 1 – 660 MW

Total Installed Capacity:

3,511 MW

At the moment, the gas-based power sector is dominated by only 2 large corporations namely EVN and PVPower* which altogether account for **81% of total installed capacity**. However, the vital difference between them is that along with power generation, **EVN** is the **only wholesale buyer** and also the only corporation to operate the distributor network to end-users.

DOWSTREAM OF GAS SEGMENT

Upcoming Gas-based Power Plant Projects until 2025

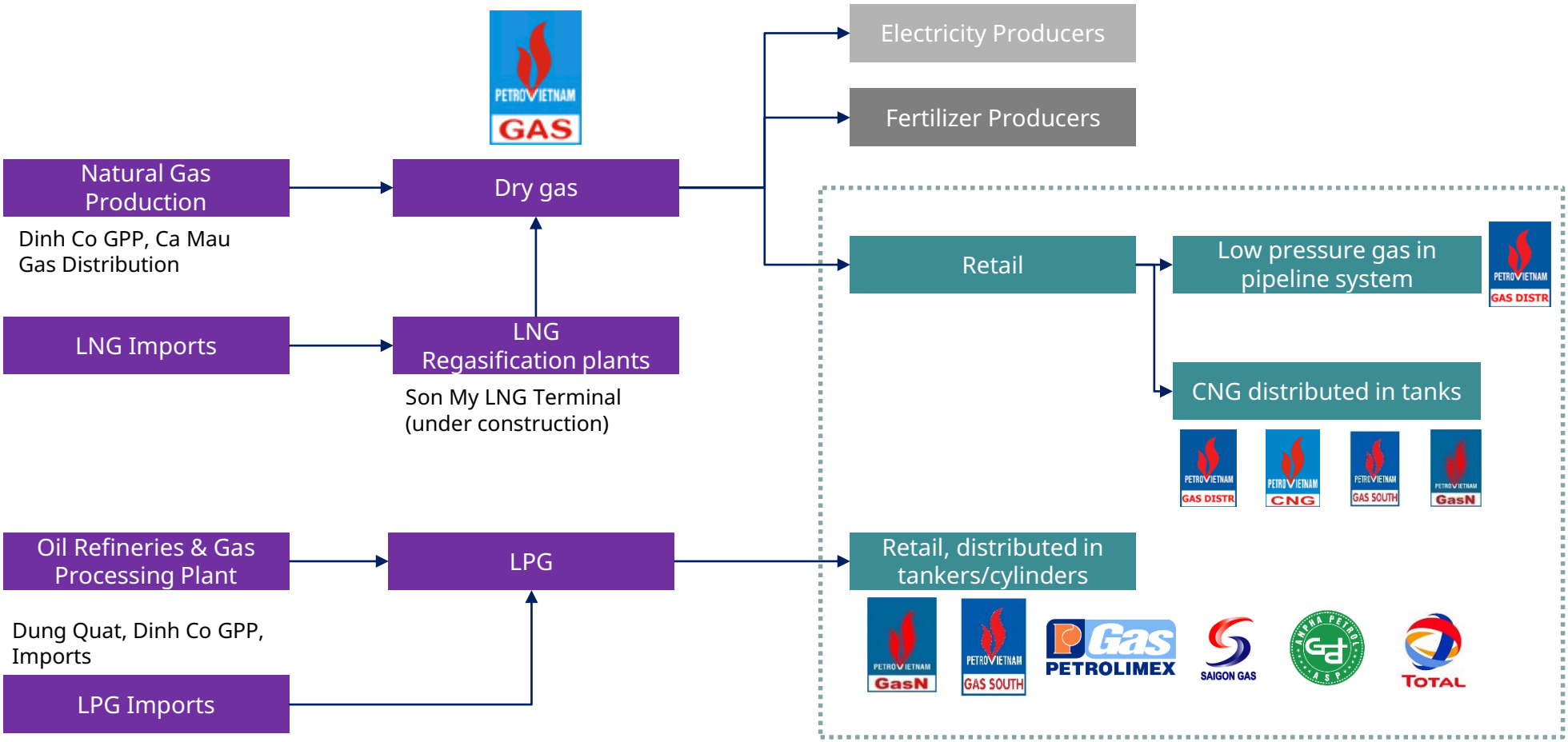


No.	Project Name	Capacity (MW)	Location	Operation Year	Cost (USDbn)	Gas source	Developer(s)
1	O Mon III	750	Can Tho	2020	NA	Block B	EVN
2	O Mon IV	750		2021	NA		
3	Nhon Trach III	750	Dong Nai	2020	1.5	LNG	PETROVIETNAM PV Power
4	Nhon Trach IV	750		2021	NA		
5	Mien Trung I	750	Quang Nam	2023	1.7	Blue Whale	
6	Mien Trung II	750		2024	NA		
7	Son My I	2,000	Binh Thuan	2023	1.3	LNG	
8	Son My II	2,000		2024	NA		
9	Kien Giang I	750	Kien Giang	2021	0.5	Block B	
10	Kien Giang II	750		2022	NA		
11	Hoa Binh	3,200	Bac Lieu	NA	7.8	LNG	Delta Offshore
12	Ca Na	6,000	Ninh Thuan	2025	4.3		Gulf Energy

With the total capacity of processing **4.6 mn tonnes* of imported LNG**, when coming online (2020 – 2021), Thi Vai (1 mn tonne) & Son My (3.6 mn tonnes) LNG Terminals will help to supply gas to new gas-based power plants. Indeed, the 2 terminals will be able to satisfy **approximately 41% of the gas demand** for power in 2025.

GAS RETAILING

Overview of gas retail in Vietnam



GAS RETAILING

Natural Gas and LPG comparison

	CNG – Compressed Natural Gas	LNG – Liquefied Natural Gas	LPG – Liquefied Petroleum Gas
Constituents	**Natural gas** (mainly methane) **compressed** at high pressure to shrink volume by 200-250 times	**Natural gas** (mainly methane) **liquefied** by cryogenic refrigeration at minus 162oC to shrink volume by 600 times	Propane, Propylene, and Butane (AutoGas or **Petroleum Gas**)
Source	Obtained from natural gas-and-condensate wells, oil wells, coal bed methane wells		By-product of cracking process during crude-oil refining or extract from gas reservoir
Transportation	Compressed gas in tanks to end-users (100 km radius) 	Transport (liquid) → Regasification → Pipelines (gas) 	Ship in cylenders (liquid-form) to end user 
Uses	Substitute for gasoline in automobiles, used for industrials (steel and other manufacturing plants)	Very limited use in Vietnam due to lack of infrastructure Only used in big industrial plants due to high cost nature	Mostly used as cooking fuel four households in Vietnam; used to produce cryogenics, dry agricultural products
Advantage	▪ More safety than LPG ▪ Releases lesser greenhouse gas ▪ Easily disperses, hence risk of ignition is minimized ▪ Less expensive than petrol		▪ Low initial capital requirement ▪ Convenient for transportation and distribution ▪ Releases CO_2 which is a greenhouse gas but is cleaner when compared to gasoline
		More concentrated than CNG More efficient to transport internationally Easier for transportation to end-users through pipelines	
Disadvantage	CNG tank requires more storage in vehicle than petrol tank	Heavy investment of infrastructure (dispensing stations, production plants and distribution)	▪ Poor quality with inconsistent composition ▪ Difficult to disperse and higher risk of fire

DOWNSTREAM OF GAS SEGMENT

Opportunities in Vietnam's downstream of gas segment

1 ELECTRICITY: Gas-based power will become the 2nd biggest power generation source

- Gas-based and coal-based power will replace Hydropower to become the dominants in power generation in 2030, according to the National Power Development Plan
- Thi Vai LNG terminal and Son My LNG terminal when going online in 2020 – 2021 can provide 41% gas demand for power in 2025
- 2 key players (EVN and PVPower) dominate the gas-based electricity with 81% market share

2 FERTILIZER: Gas-based fertilizer producers benefits from high efficiency to prevail competitors

- Only four companies in Vietnam can produce urea fertilizer and just a few can produce high quality NPK using chemical granulation
- Producing urea and NPK by natural gas has major advantages over coal thanks to its high efficiency and environmental friendliness
- **New entrants find it impossible to compete with incumbents due to monopolistic access to raw materials and high investment costs**
- As agricultural land remains stable at around 10.8 thousand hectares and is degrading, increasing uses of fertilizer is a vital way to increase crop yield. **Demand for fertilizer has expand at 6.6% CAGR in 2008-2016 with NPK and urea uses make up 57% of total demand**

3 GAS RETAIL: Opportunity to invest in natural gas distribution infrastructure

- Of the two types of gas currently used in Vietnam, LPG and natural gas, LPG makes up majority of household uses. Despite fast growth rate, **margins for LPG are tightened due to low barriers of entry**
- Natural gas in Vietnam are currently provided to end-users in compressed form (CNG). **Strengthened growth in demand for natural gas is supported by rapid expansion of gas intensive manufacturers and increasing demand for CNG as alternative fuel for vehicle**
- With the start-up of Son My LNG Import terminal in 2020, **major investment opportunities in associated distribution infrastructure could be unleashed as Vietnam will import LNG for the first time**

There remains opportunity in gas-based power segment.

Attractive opportunities to invest in gas-based fertilizer and natural gas distribution infrastructure.

DOWNSTREAM OF GAS SEGMENT

Potential growth opportunities

Gas-Related Services

Gas Gathering

- Gas from basins is gathered and then transported to ***GPP*** via pipelines
- ***PVGas*** involves in gas gathering services through its subsidiaries and affiliates like ***PVGAS-SE***, ***PVGAS-CM*** by appointing those companies to operate the pipeline as well as look for new investments in gas gathering projects

Gas Transportation & Distribution

- After being gathered and then processed at GPP, gas and its derivatives are transported to destinations (other processing plants or end-consumers)
- Transportation and distribution services include operating the pipeline, operating the ***GDC*** and ***GDS***, and managing the movement of tankers and vessels containing LPG, CNG, or Condensate

Other Services

Engines Conversion

- Since CNG has become more and more popular, it is necessary to *convert gasoline and oil-powered engines to CNG fuel*
- The increasing in CNG usage will eventually lead to an increase in demand for converting the traditional engines to CNG-fueled engines

Maintenance

- Repair and maintenance services are critical to the operation of gas industry; these services include:
  1) Maintenance of gas equipment;
  2) Upgrade technology;
  3) Design and install tanks, pipelines, etc.
  4) Other related services

Pipeline's Additional Services

- Coating services: anti-corrosion by:
  1) Fusion bonded Epoxy (FBE)
  2) Three layer polyethylene (3LPE)
  3) Three layer polypropylene (3LPP)
- Provide steel pipes

With the current development of Vietnam's gas industry, related services which support the industry's growth will also see optimistic opportunities, especially when current developing projects (e.g. new pipelines, LNG import, etc.) go online.

IV. Appendix

Appendix

Abbreviation	Term	Definition
	Condensate/Natural-gas condensate	A low-density mixture of hydrocarbon liquids that are present as gaseous components in the raw natural gas produced from many natural gas fields. Condensate is further processed to produce petrol, diesel, jet fuel, or can be used as feedstock to other petrochemical industries
CNG	Compressed Natural Gas	CNG is basically natural gas stored at ambient temperature and high pressure. CNG can be used as fuel in place of gasoline, diesel fuel, and propane (or LPG). CNG is made by compressing natural gas to less than 1% of volume it occupies at standard atmospheric pressure. It is stored and distributed in hard containers at a pressure of 20 – 25 MPa.
	Crude oil production	Average daily production per calendar year of total volumes of crude oil, natural gas plant liquids and other liquids extracted from domestic oil reservoirs. The amount is expressed in terms of production during a 24-hour period (thousands of barrels per day). Includes lease condensates; excludes refining processing gains. (Definition based on EIA classification and definition)
GPP	Gas Processing Plant	A processing plant that is used to “clean” raw natural gas by separating impurities and various non-methane hydrocarbons and fluids to produce “pipeline quality” natural gas. GPP can also recover natural gas liquids like condensate, natural gasoline, or LPG
	Gas production	The volume of natural gas withdrawn from reservoirs less (i) the volume returned to such reservoirs in cycling, repress ring of oil reservoirs and conservation operations; less (ii) shrinkage resulting from the removal of lease condensate and plant liquids; and less (iii) non-hydrocarbon gases where they occur in sufficient quantity to render the gas unmarketable. Includes vented and flared natural gas. (Definition based on EIA classification and definition)
	Gas reserves	Proven reserves of dry natural gas are the estimated quantities of all natural gas, which geological and engineering data demonstrate with reasonable certainty (90%) to be recoverable in future years from known reservoirs under existing economic and operating conditions. Volumes of natural gas placed in underground storage are excluded. (Definition based on EIA classification and definition)
LNG	Liquefied Natural Gas	LNG is basically natural gas stored at low temperature (-162^{0}C) and nearly ambient pressure, converting to liquid form for ease and safety of non-pressurized storage or transport. LNG is principally used for transporting natural gas to markets, where it is regasified and distributed as pipeline natural gas

Appendix

Abbreviation	Term	Definition
LPG	Liquefied Petroleum Gas	LPG is prepared by refining petroleum or “wet” natural gas, and is almost entirely derived from fossil fuel sources, being manufactured during the refining of petroleum or extracted from petroleum or natural gas streams as they emerge from the ground. LPG evaporates quickly at normal temperatures and pressures and is usually supplied in pressurized steel vessels.
MMBTU BTU	Million of British Thermal Unit British Thermal Unit	BTU is a traditional unit of heat. It is defined as the amount of heat required to raise the temperature of 1 pound of water by 1 degree Fahrenheit. One BTU is about 1,055 joules. For natural gas price conversion, 1,000 m^3 = 36.906 MMBTU
	Natural Gas	Natural gas is a naturally occurring hydrocarbon gas mixture consisting primarily of methane. Natural gas is a fossil fuel used as source for energy generating, fuel for vehicles, chemical feedstock in the manufacture of plastics and other commercially important organic chemicals. Natural gas is found in deep underground rock formations or associated with other hydrocarbon reservoirs in coal beds. Petroleum is another resource and fossil fuel found in close proximity to and with natural gas.
	Oil reserves	Proven reserves of crude oil are the estimated quantities of all liquids defined as crude oil, which geological and engineering data demonstrate with reasonable certainty (90%) to be recoverable in future years from known reservoirs under existing economic and operating conditions. Excludes natural gas liquids. (Definition based on EIA classification and definition)
RPR	Reserves to production ratio (years)	A measure of maturity of total oil/dry natural gas production, the ratio of total reserves volumes over production volumes each calendar year, which shows the number of years of remaining production of current reserves as of that calendar year. (Definition based on EIA classification and definition)