

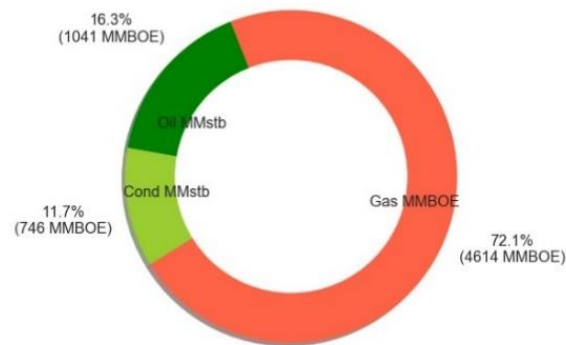
Thailand's Upstream Industry In-Brief

Introduction

Thailand has an integrated energy ecosystem spanning a material developed resource base. The exploration and production sector had its genesis with first production in late 1950s, but output remained at low levels until the onshore Sirikit field commenced production in 1983¹. The growth and transformation of the upstream sector since then till now can be attributed to the establishment of a concession based fiscal regime in the 1970s and the significant commercial discoveries in the 1980.

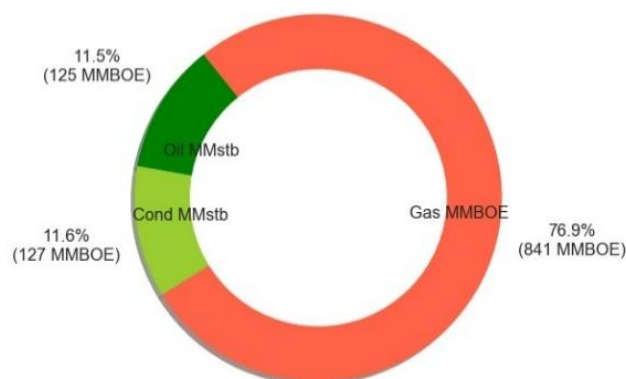
While Thailand currently has 48 concessions², a relatively low number of fields – Erawan Area, Bongkot, Pailin, Arthit, and B8/32 contribute towards most of the oil and gas production. Thailand has produced 6,403 MMboe⁴ of oil, gas and condensate and has a Proved Reserves base of 1,095 MMboe⁴ as of December 2019. Gas makes up more than 70% of Thailand's upstream production and Reserves, and 90% of the production is from offshore Gulf of Thailand (GoT) while production from the fields onshore make up the remaining 10%. The offshore Andaman Sea is still being explored with no significant discoveries made.

Thailand Cumulative Production as of December 2019 (MMBOE)



Source: Thailand's Cumulative Production Petroleum Mix³

Thailand Proved Reserves as of December 2019 (MMBOE)



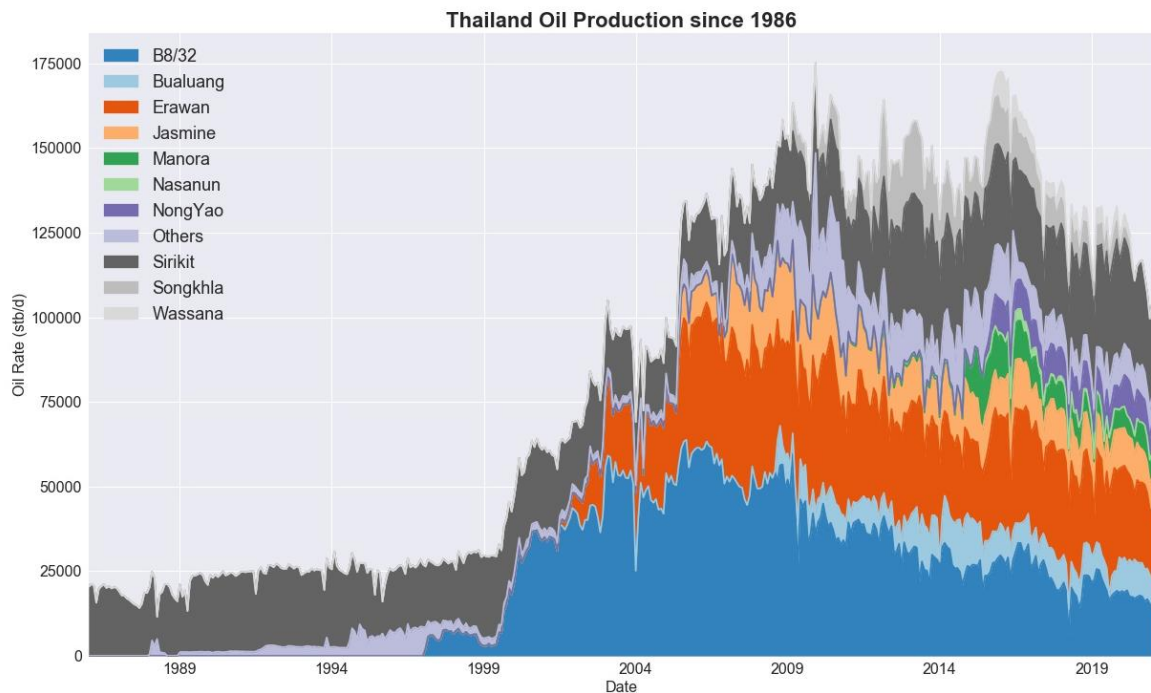
¹ The Petroleum Institute of Thailand. 2013. Thailand's Petroleum Exploration & Production Factbook 2007 – 2011 with Addendum for 2012

² DMF E&P Summary Report. Retrieved from: <https://dmf.go.th/public/epsummary/data/index/menu/1100/>

³ Department of Mineral Fuels, Ministry of Energy

Production History

Commercial oil production in Thailand began onshore in 1983 at the Sirikit field but oil ramp up only occurred 16 years later from offshore fields in the Erawan and B8/32 areas in the Gulf of Thailand. Subsequently, smaller fields and accumulations such as Jasmine, Bualuang, Songkhla, Lanta, etc located in the vicinity of the producing areas in the Gulf of Thailand were brought onstream to achieve a peak production rate of 175,288 stb/d⁵ in December 2009. Following this, the nation's crude oil production began to decline. Additional accumulations such as Manora, NongYao, Wassana, etc were then brought onstream to arrest the decline. Thailand then achieved its second highest crude oil production output of 172,572 stb/d in January 2016^{Error! Bookmark not defined.}. Production since then has been on a downward trend with current rate of 105,570 stb/d^{Error! Bookmark not defined.}.

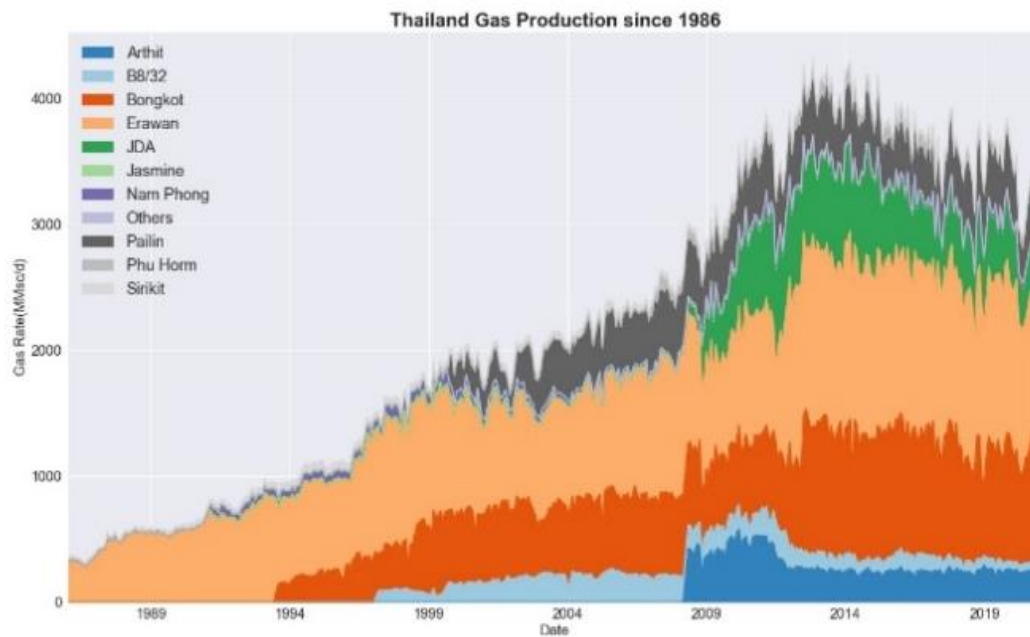


Thailand's Oil Production History by Field since 1986^{Error! Bookmark not defined.}

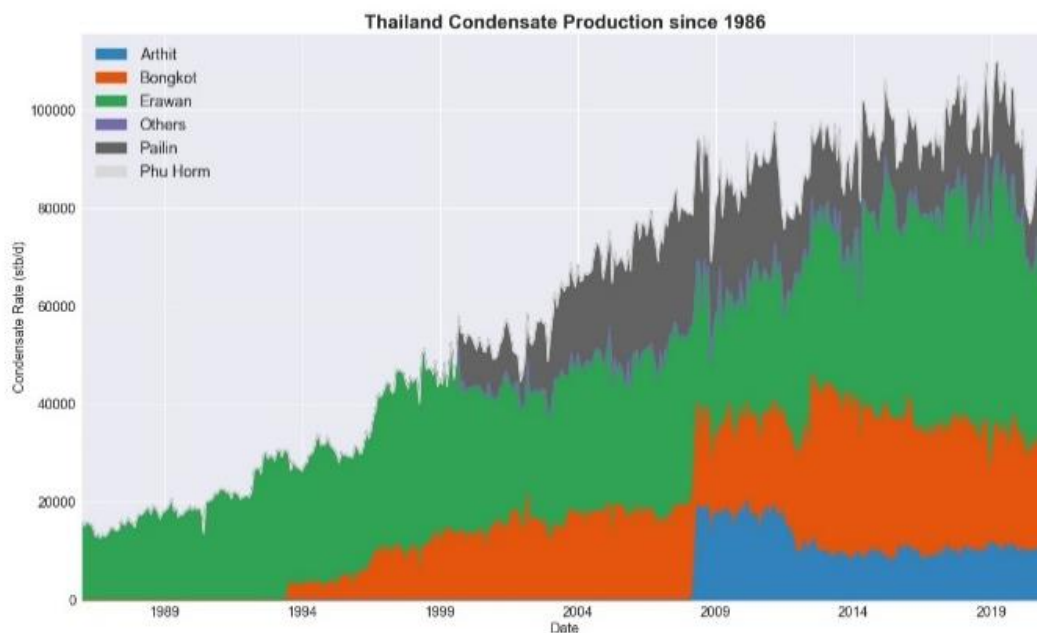
Production of natural gas and condensate from Erawan field commenced in 1981⁴. This was followed by other major gas fields such as Bongkot, B8/32 fields and Pailin being brought online by 2000. Gas output in December 1999 was 1.77 Bscf/d^{Error! Bookmark not defined.}. Peak Production of 4.31 Bscf/d was achieved in November 2012^{Error! Bookmark not defined.} after addition of production from Arthit and the fields located in the JDA (Joint Development Area) with Malaysia. Production rate has since declined and current rate as of February 2021 is 3.6 Bscf/d^{Error! Bookmark not defined.}. Thailand's condensate production is mainly from Erawan, Bongot, Arthit and Pailin. Current condensate production rate as of February is 83,837 stb/d^{Error! Bookmark not defined.}.

⁴ Department of Mineral Fuels, Ministry of Energy

⁵ EPPO Energy Statics. Retrieved from: <http://www.eppo.go.th/index.php/en/en-energystatics/indicators>



Thailand's Gas Production History by Field since 1986^{Error! Bookmark not defined.}



Thailand's Condensate Production History by Field since 1986^{Error! Bookmark not defined.}

Stakeholders and Upstream Players

The dominant players in Thailand, Chevron⁶ and PTTEP⁷, contribute 88% gross, 71% net of the cumulative production as of December 2019. MOECO⁸, as a non-operator has around 11% net. Although, MOECO only has two operated blocks in Thailand, they are heavily invested as non-operated partner in Thailand. The Erawan area currently contributes 29% of the country's production and is to

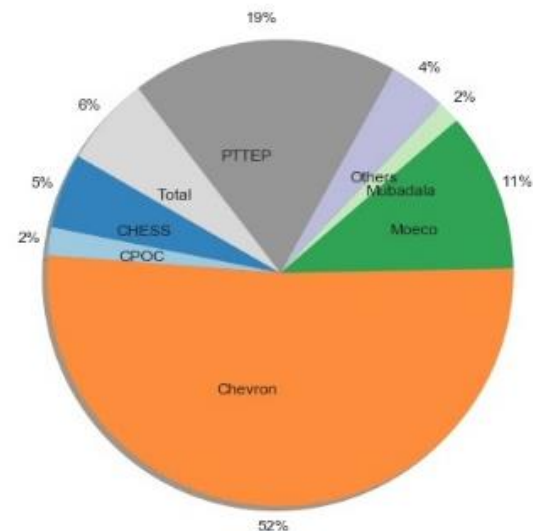
⁶ Chevron Thailand Factsheet. Retrieved from: https://thailand.chevron.com/-/media/thailand/news/documents/APR2021_Factsheet.pdf

⁷ PTTEP Exploration and Production Business. Retrieved from: <https://www.pttep.com/en/OurBusiness/Explorationandproduction.aspx>

⁸ MOECO Project. Retrieved from: <https://www.moeco.com/en/project/thailand.html>

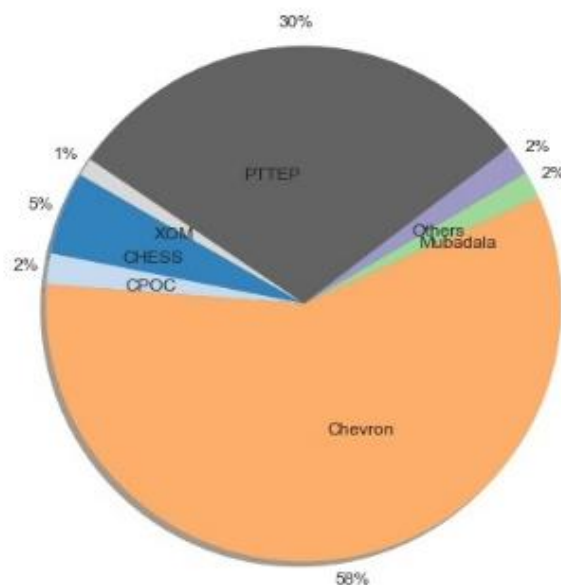
be transferred from Chevron to PTTEP (60% operatorship) and Mubadala (40%) in 2022⁹. This would make PTTEP the dominant player taking over from Chevron in the upstream sector. The transfer would also reduce MOECO's footprint in Thailand while increasing Mubadala's footprint to 6%.

Thailand Cumulative Production (MMBOE December 2019) by Block Ownership



Thailand's Cumulative Production (as of December 2019) split by block ownership⁴

Thailand Cumulative Production (MMBOE December 2019) by Operatorship



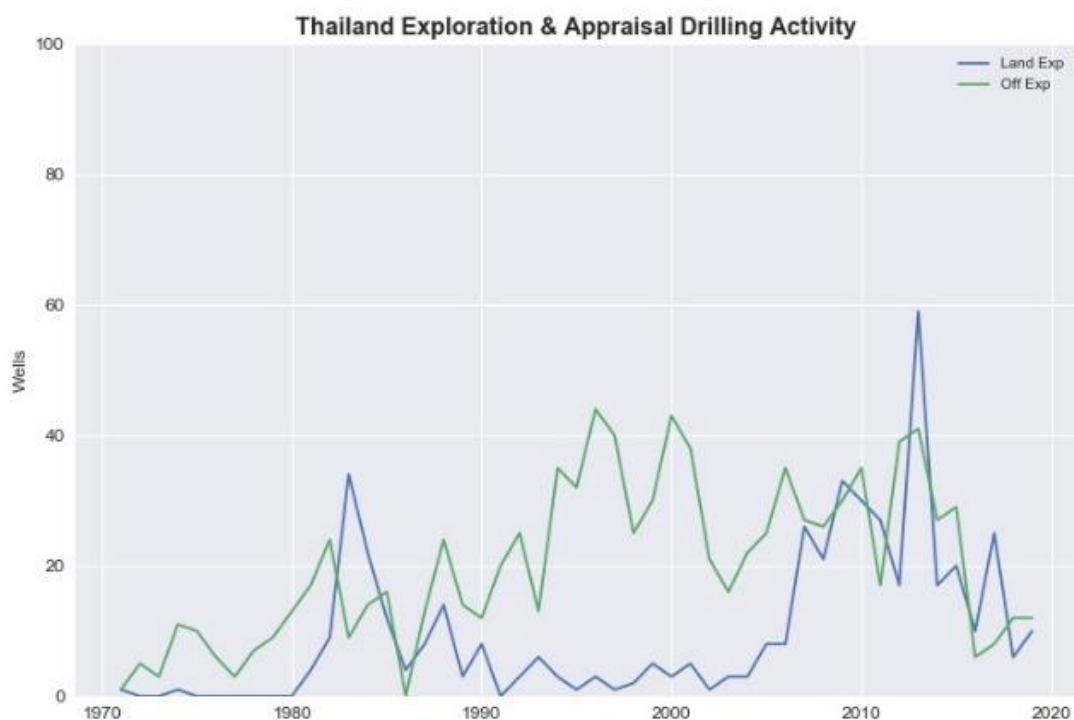
Thailand's Cumulative Production (as of December 2019) split by Block Operatorship⁴

⁹ The Signing of Production Sharing Contracts for Exploration Blocks offshore the Gulf of Thailand No. G1/61 and G2/61. Retrieved from: <https://www.pttep.com/en/Investorrelations/Regulatorfilings/Setnotification/TheSigningofproductionsharingcontractsforexplorationblocksoffshorethegulfofthailandnog161andg261.aspx>

Reserves, Drilling Activity and Sector Performance

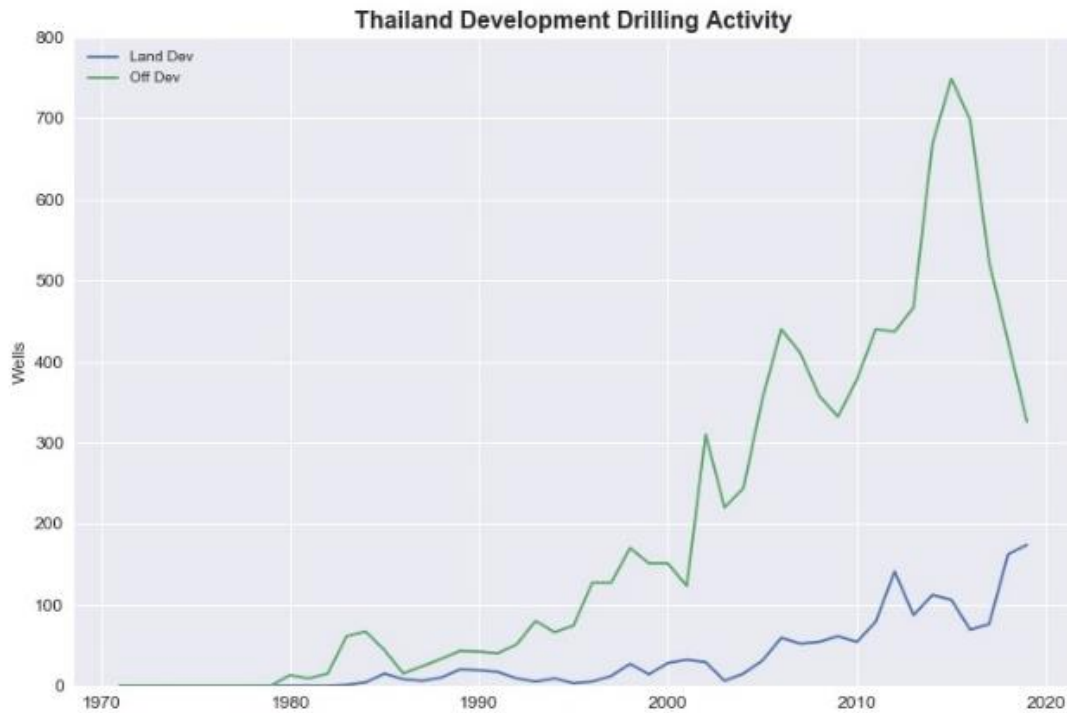
The complexity of the Gulf of Thailand's geology, the dominant E&P area, results in the presence of many small accumulations across multiple thin sands and thus requires a larger number of slots available. Operators follow a phased development approach based on 'factory' drilling and multiple near-identical platforms resulting in low costs over the longer term. Exploration and appraisal wells are drilled as each development platform is installed. They aim to uncover additional fault block hydrocarbon potential both in the vicinity of the platform as well as identifying future development targets on previously undrilled fault blocks.

A total of 12,283 wells have been drilled as of December 2019, with 83% offshore⁴. There have been 625 exploration and 861 appraisal wells drilled. Since 2015, 138 exploration and appraisal wells have been drilled in total and 72 were successful resulting in a success rate of 52%. Drilling activity was at its peak in 2015 with a total of 904 wells drilled but has been on a general decline trend since⁴, *Error! Bookmark not defined.* It did not recover following the 'mid-2014 to early 2016' oil price decline and only 522 wells were drilled in 2019.



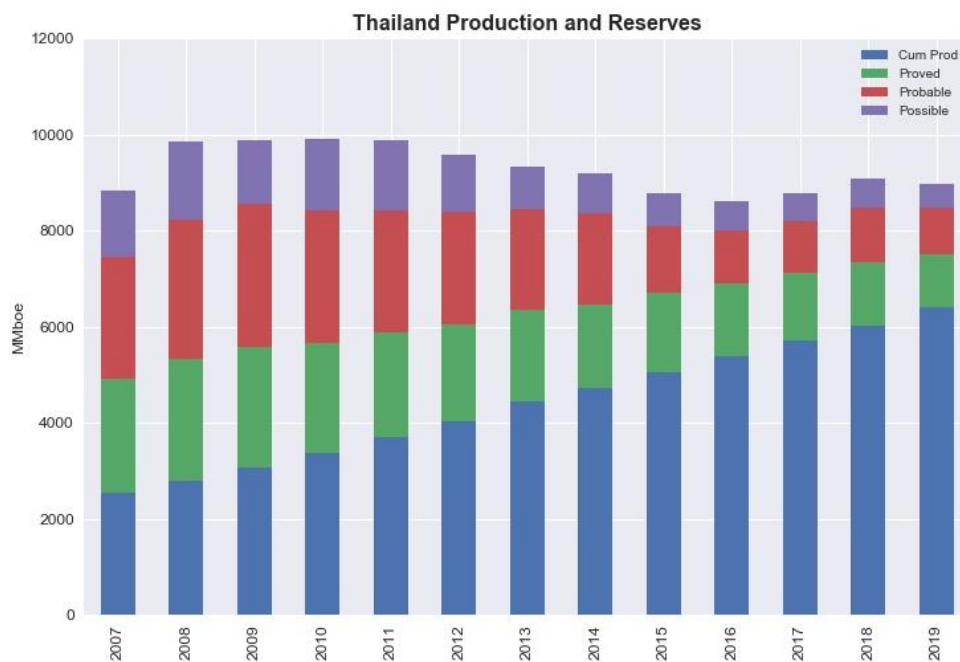
History of Exploration and Appraisal Drilling Activity in Thailand^{1,4}

¹⁰ Oglesby.C.A. et al. 2014. SPE172134 Jasmine Field, Gulf of Thailand: How a 7 MMbbl Oil Field produced 50 MMbbl and is Still Producing.



History of Development Drilling Activity in Thailand^{1,4}

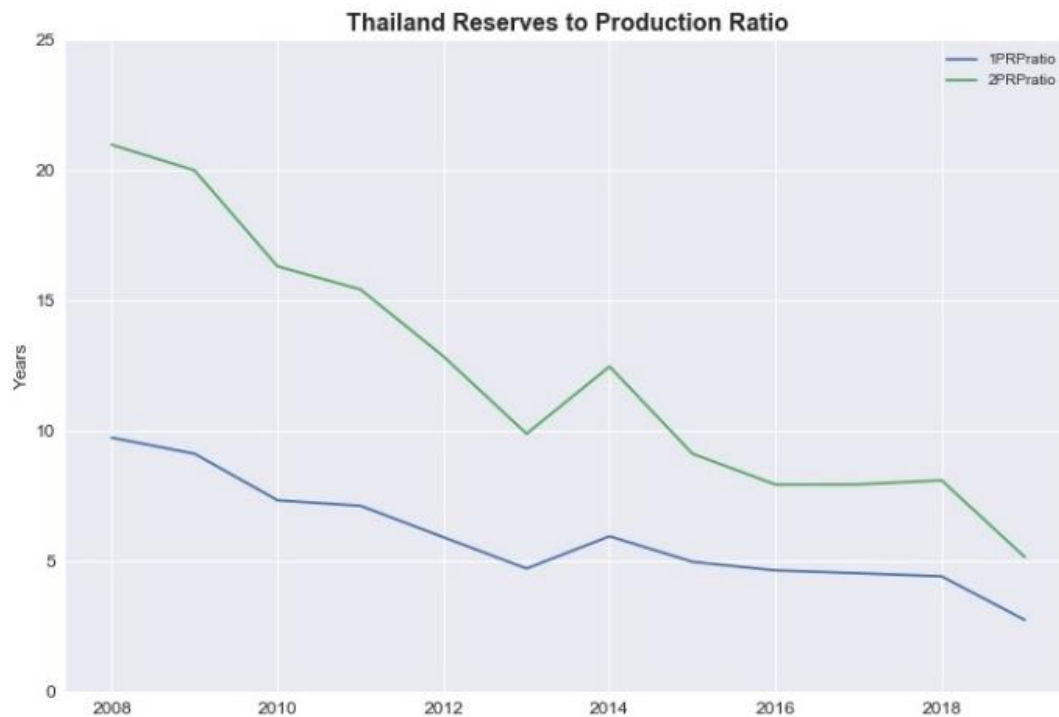
There have been no new commercial discoveries since the 1990s while the last cluster of smaller fields was discovered in 2009 (Manora, Nong Yao, Wassana). This has resulted in a steady downward trend of the reserves and the Proved (1P) reserves to production (R/P) ratio has declined from 10 years in 2008 to 3 in 2019⁴. The Proved + Probable (2P) R/P ratio has declined from 20 to 5 years during the same period⁴.



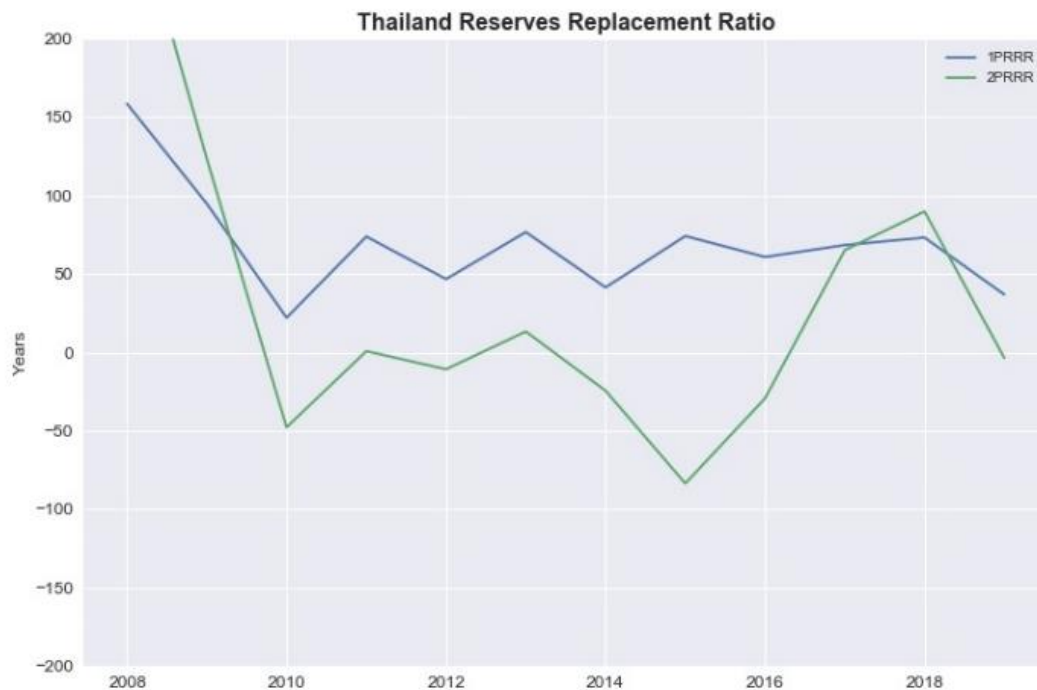
Thailand's Production and Reserves and Metrics History⁴.^{Error! Bookmark not defined.}

However, the rate of decline of the reserves to production ratios has been arrested in the last five years due to the continuous step-out appraisal drilling next door to existing production areas that

resulted in discoveries of many small accumulations. This has also kept the 1P Reserves replacement ratio steady at an average of 57%. Although the 2P Reserves to replacement ratio have been negative for majority of the years since 2008, it has seen a revival recently to an average of 78%.



Thailand's Reserves to Production Ratio History⁴Error! Bookmark not defined.



Thailand's Reserves Replacement Ratio History⁴Error! Bookmark not defined.

State of Play

Developing Thailand's small, multiple reservoirs in multiple fault blocks is challenging but the industry has learned a lot in the last 30 years, thus reducing the geological risk. The understanding gained from producing reservoirs of the initial core development areas was applied to later phases to better quantify expected volumes and better target subsequent development wells.

PTTEP has five-year plan investment of \$23.6 billion to maintain production and accelerate exploration activities for both its domestic and international assets¹¹. Domestically, the majority off the funds will be allocated to maintaining production at larger fields: Erawan, Bongkot, Sirikit and Arthit. The award of the first Production Sharing Contracts (PSCs) in Thailand for Erawan and Bongkot is expected to boost investor confidence and attract more investment as Thailand takes a stake in these contracts ensuring that the stakeholders' interests are more aligned. The increasing investments and policy revamp is expected to drive Thailand's mature upstream market and help maintain its production and Reserves.

Note: Data visualisation was constructed using python from data available publicly from DMF and EPPO, Ministry of Energy Thailand. Notebook is available here: <https://github.com/Vasanth1984/Thailand-Upstream/blob/main/ThailandProd.ipynb>

¹¹ PTTEP allots \$23.6bn for 5-year plan. Retrieved from: <https://www.bangkokpost.com/business/2029235/pttep-allots-23-6bn-for-5-year-plan>