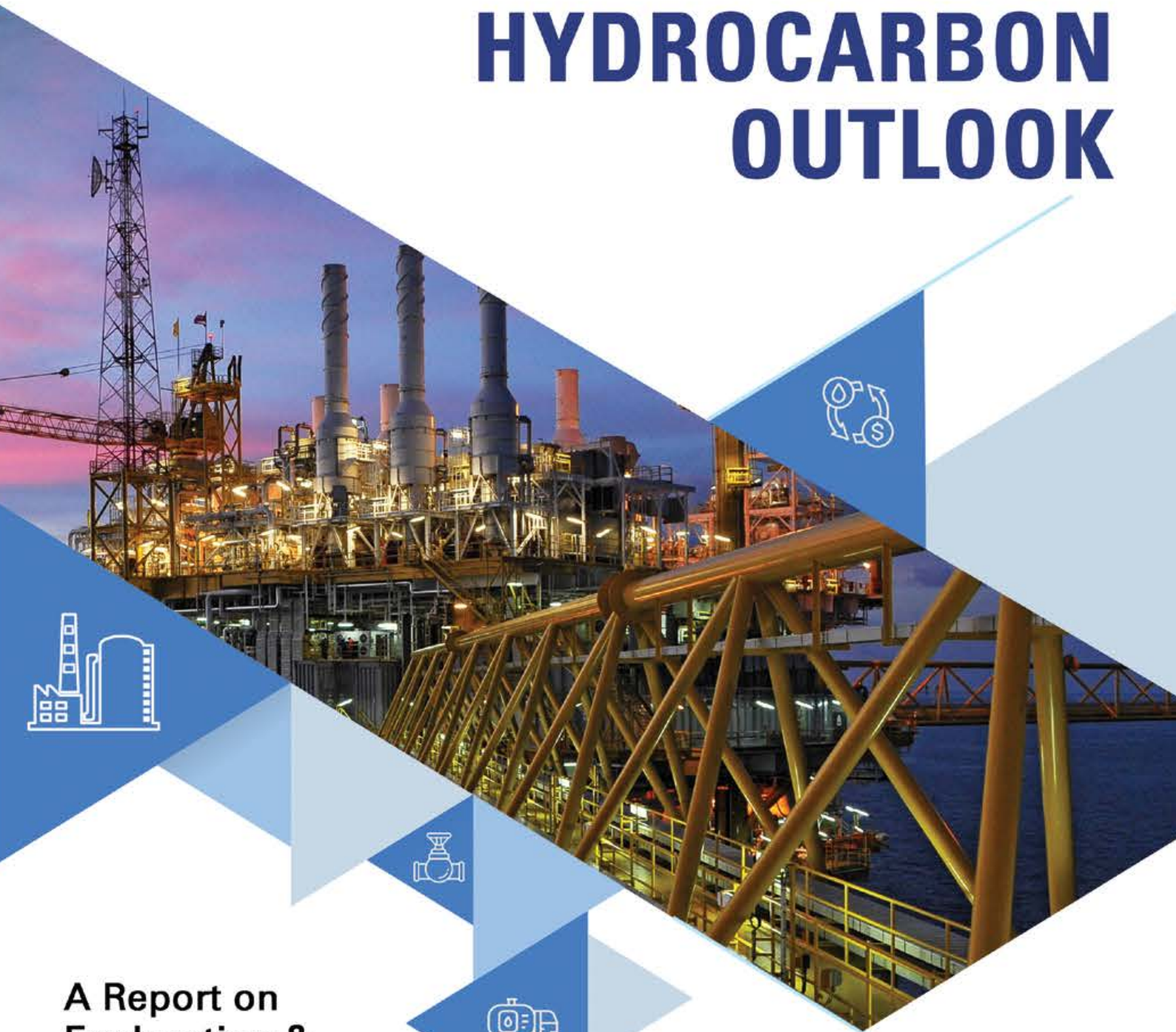
DGH

DIRECTORATE GENERAL OF HYDROCARBONS

Ministry of Petroleum & Natural Gas, Government of India

सत्यमेव जयते

INDIA'S HYDROCARBON OUTLOOK



A Report on Exploration & Production Activities

2020-2021

Creation

Directorate General of Hydrocarbons was formed through a Government of India resolution dated 08.04.1993 under the administrative control of Ministry of Petroleum & Natural Gas.

Objective

To promote sound management of the oil and natural gas resources while having a balanced regard for environment, safety, technological and economic aspects of the petroleum activity.

DGH

हाइड्रोकार्बन महानिदेशालय

पेट्रोलियम एवं प्राकृतिक गैस मंत्रालय | भारत सरकार

Directorate General of Hydrocarbons

Ministry of Petroleum and Natural Gas | Government of India

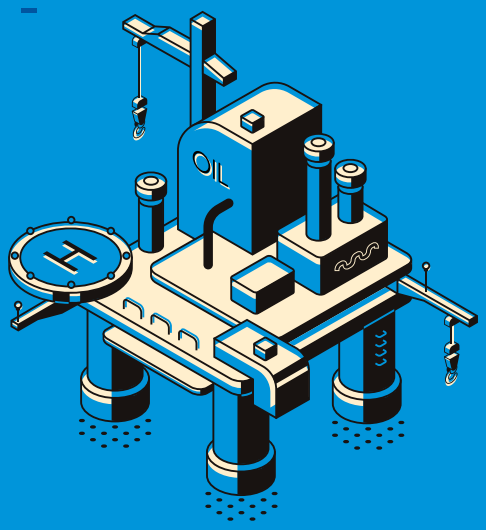
भारत का हाइड्रोकार्बन परिदृश्य

अन्वेषण व उत्पादन गतिविधियों पर एक रिपोर्ट 2020-21

India's Hydrocarbon Outlook

A Report on Exploration & Production Activities 2020-21

KEY HIGHLIGHTS OF 2020-21



30.49 MMT
Crude Oil Production

28.67 BCM
Natural Gas Production

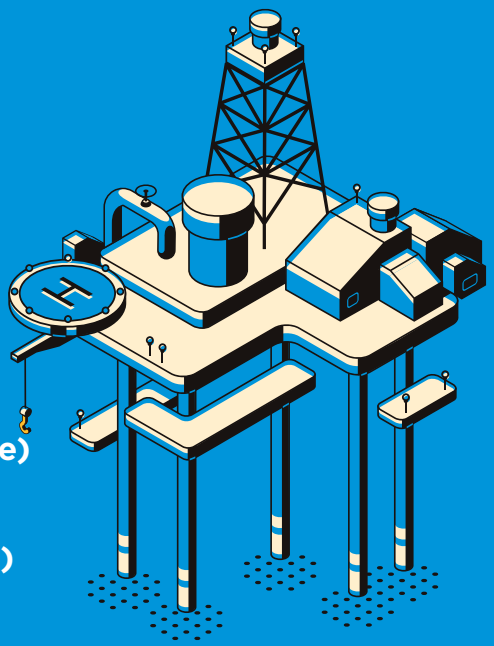
90.46 MMTOE (Million Tonne Oil Equivalent)
In-Place Accretion

41.61 MMTOE
Accretion of Reserves

13 Hydrocarbon Discoveries
3 DGH Reviewed Discoveries and 10 Operator Notified Discoveries

1 Declaration of Commerciality
Reviewed by Management Committee in PSC regime

19 Field Development Plan/RFDP/EDP
Approved by MC: 10 in PSC and 9 in RSC regime



73 Active PSCs
11 Pre-NELP exploration, 21 field, 41 NELP PSCs

143 Active RSCs and 8 Active CBM Blocks
RSC :105 in HELP and 38 in DSF

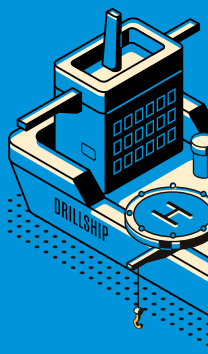
388 Active Nomination Acreages
10 PEL and 378 PML Acreages

17,051 LKM (7,748 Onland and 9,303 Offshore)
2D Seismic Data Acquired

9,362 SKM(3,130 Onland and 6,232 Offshore)
3D Seismic Data Acquired

468 Wells Drilled
115 Exploratory/appraisal and 353 Development wells

14,560 Essentiality Certificates
(9,483 for Import of Goods and 5,077 for indigenous supply of goods)
INR 37,070.7 Crores in value



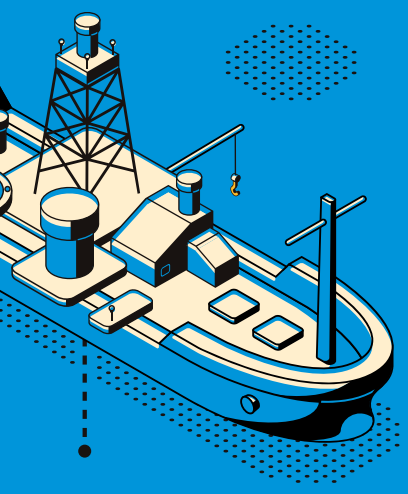
INR 3,746 Crore*
Profit Petroleum contribution to Exchequer

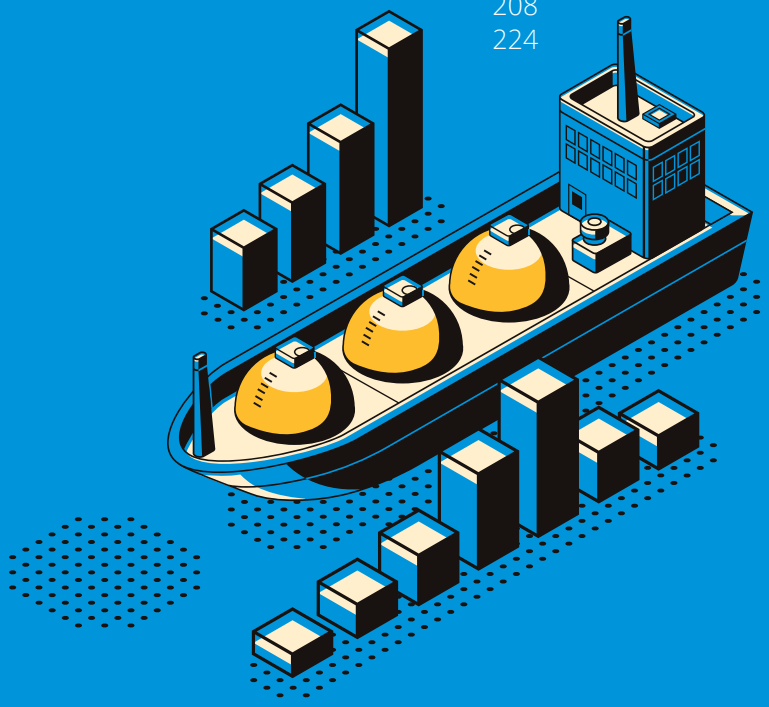
INR 3,558 Crore*
Royalty Contribution to Central Exchequer

** Provisional*

MMTOE (Million Tonne Oil Equivalent)

CONTENT





Hardeep S Puri

हरदीप एस पुरी

पेट्रोलियम एवं प्राकृतिक गैस;
आवासन और शहरी कार्य मंत्री
भारत सरकार

Minister of
Petroleum & Natural Gas;
Housing and Urban Affairs
Government of India

India's energy demand has doubled in the past two decades. Our per capita energy consumption is still one-third of global average. Our energy demand is expected to grow by 3% per annum till 2040, compared to the global rate of 1%, driven by the fast-paced economic growth.

The share of hydrocarbons in India's energy mix has increased to about 28% of our energy basket. In order to keep with India's blazing growth rate, India's hydrocarbon value chain, which has registered strong growth in upstream, midstream and downstream segments, will need to scale up even more.

We are transitioning to a cleaner gas-based economy, in line with our climate change goals, and will double the share of natural gas in our energy mix from the present 7% to 15%, as well as cover 96% of our population with City Gas Distribution networks. India is likely to see an expected investment of $60 billion by 2024 into its natural gas segment.

DGH has facilitated policy reforms such as HELP and OALP, which will double our net geographical area under exploration from 8% (0.25 million sq. km.) to 15% (0.5 million sq. km.) by 2025, expecting an investment of $58 billion in E&P sector. To enable this, DGH has made available 200 TB data, displaying the available 2D/3D/well data, PEL/ML areas, NELP/OALP/CBM blocks, active blocks, NO-GO areas, open acreage areas etc. relating to India's 26 sedimentary basins on National Data Repository for easy access by the Investors.

As the country's premier upstream technical advisory arm, Directorate General of Hydrocarbons (DGH) will play a huge role in the unprecedented expansion of India's petroleum sector.

Over the years, the annual publications of DGH namely 'India's Hydrocarbon Outlook' has become a de-facto handbook for investors, industries and policymakers. I am sure that the latest edition will keep up the tradition and prove to be a key catalyst for powering the growth of India's oil & gas sector.

I compliment the efforts of my colleagues at DGH and all those involved in bringing out the 'India's Hydrocarbon Outlook 2020-21'.

Hardeep S Puri

New Delhi
07.01.2022

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सत्यमेव जयते

Rameswar Teli

रामेश्वर तेली

राज्य मंत्री
पेट्रोलियम एवं प्राकृतिक गैस और
श्रम और रोजगार
भारत सरकार

Minister of State for
Petroleum and Natural Gas &
Labour and Employment
Government of India

India today is world's third largest energy consuming county, and its energy demand growth would be three times of that of world in coming decades. To maintain the thrust on economic growth along with growing energy demand, it is imperative that the country's Oil & Gas sector grows consistently to enable energy-security, equity and accessibility to its people. E&P sector becomes all more important for India as India imports 85% of country's crude oil demand and 55% of country's natural gas demand. The Oil and Gas will continue to be a mainstay of India's energy sector.

Government of India, cognizant of this growing demand, has simplified the Oil and Gas business ecosystem in India to give an impetus to domestic production and attain energy security. One key step in this direction is furthering greater stability and creating wider opportunities for exploration, development and production in the E&P business. North East India will play an important role in achieving the goal of increasing the domestic production which is also in line with Hydrocarbon Vision 2030 for North East Region. The Government has recognized how crucial quality E&P data is for making a project techno-economically viable and has ushered data driven reforms in the sector.

I am sure the stakeholders will take advantage of the huge opportunities India's E&P sector present in the form of OALP Bid Rounds, DSF Bid Rounds, Production Enhancement Contracts and Special CBM bid round. We have also introduced significant business process re-engineering in our applications and systems to bring efficiency in operational processes that facilities improved coordination and faster approvals. DGH has always been at the forefront in implementation of reforms and facilitation of stakeholders.

Let me also take this opportunity to thank all the operators for ensuring uninterrupted supply of oil and gas despite several on-ground challenges that you might have faced due to the pandemic. I congratulate all the stakeholders involved in compilation of this comprehensive "India's Hydrocarbon Outlook 2020-21" encapsulating the E&P activities in our country.

30/11/21

Rameswar Teli

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Tarun Kapoor
Secretary

तरुण कपूर
सचिव

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India's economic growth is closely related to its energy demand and being the 3rd largest energy consumer, India is poised to drive the global energy demand. Statistics project our energy demand to grow at 3.4% till 2050 as compared to World's 1%. While concerted efforts are being made by the Government to switch to cleaner fuels, Oil and Gas shall prevail in our energy mix for substantial duration. While we endeavor to make a switch to sustainable alternatives, natural gas will serve as the bridge to this transition.

Government has set a target to ensure primary energy percentage for natural gas goes up from the existing 6.7% to 15% by 2030. This would still be lower than the world average of 24 per cent but it would involve huge capacity addition, policy changes and the consumption of natural gas will go up substantially in absolute terms. In order to facilitate easy trading and easy transportation gas, the gas exchange has been made functional. We are also in the process of setting up a Transmission System Operator (TSO) so that transportation of gas is not monopolized. The focus is on exploring more areas to find gas reserves as well as raising output from existing fields.

We are undertaking industry wide consultations to remove roadblocks and create an environment conducive to do E&P business in India. The bouquet of progressive reforms such as Hydrocarbon Exploration and Licensing Policy, Natural Gas reforms, Discovered Small Field Policy, Production Enhancement Contracts and Enhanced Recovery policy have been crucial in attracting investment and interest of E&P players and service providers. Government is committed in bringing further reforms in the sector and augment domestic oil and gas production to secure our growing demands and to realize this, we have set firm production targets for E&P operators to achieve by 2025 and we encourage technology induction and collaboration in field operations to usher efficiencies and enhancing production.

Delivering on the Government's mandate of promoting Ease of Doing Business in the E&P sector, digital initiatives have been introduced for improved coordination and fast-tracking the clearances and approvals through Urja Pragati platform and fostering collaboration in the E&P sector through Upstream India Portal. Backed by the right policy and technology, the E&P sector is now ready for massive investments especially from the private sector. The Government urges new companies to step in and take advantage of the huge business opportunities.

The annual publication of DGH titled "India's Hydrocarbon Outlook 2020-21" is a must-read compendium for any oil and gas investor as it encompasses the present activities in the upstream sector. My heartiest congratulation to team DGH for this informative compilation.

Tarun Kapoor

MESSAGE BY DIRECTOR GENERAL, DGH

Energy remains a high priority sector for our government and the country's reliance on hydrocarbons is crucial for ensuring energy security while keeping pace with the burgeoning economy. On the back of healthy demand and favorable economics, the growth prospects of India's E&P sector are looking bright. As the world tilts towards transition, Oil and Gas will continue to anchor India's energy fundamentals.

For India, its E&P sector must weather these transitional events and focus on technological efficiencies and greening of hydrocarbon operations. India being the 3rd largest energy consumer and with one-third dependency on Oil and Gas for next few decades, India's energy security is critically hinged on oil and gas and for the foreseeable future. India's upstream sector is currently providing energy and shall be funding the future energy transition. Accordingly, this year has been a manifestation of our core agenda to ramp up exploration acreage and domestic production while ensuring a stable fiscal framework and investment ready ecosystem.

Government has set stern targets for oil production of 40 MMT and gas production to 50 BCM by 2024 and even steeper targets for increasing exploration acreage to 5,00,000 sq. km. by 2025 and 10,00,000 sq. km. by 2030. To achieve the exploration targets of 2025 and 2030 in a mission mode, Government is acquiring geoscientific data in less explored sedimentary basins. The Andaman survey shall achieve seismic data acquisition target of 22,500-line kilometer by March 2022.

With huge potential in India's offshore and 51% of sedimentary basin area in offshore, the finest hour of Indian E&P sector is still to come. Current studies indicate significant opportunities in deep water/ultra-deep water; Government is cogitating on special schemes and collaborations for accelerated exploration of India's offshore areas. Meanwhile, offing of acreages has progressed and Government has approved DSF III and OALP VII bid rounds. Launch of special CBM bid round is giving renewed impetus to development of unconventional hydrocarbon resources.

By introducing Production Enhancement Contracts, assets are changing hands from majors to smaller, nimbler, and agile independents who can pick up quality middle aged assets and extend their productive life through cost disciplined technological intervention. Discovered Small Field (DSF) bid round III is a good opportunity for such niche players to monetize discoveries.

To meet cleaner energy goals and to usher India to a 'Gas based economy', Government notified the Natural Gas Reforms in 2019 following which DGH empaneled five agencies for carrying out e-bidding of domestically produced natural gas. E-bidding through empaneled agencies has been carried out successfully for 19.56 MMSCMD of natural gas. [Dec'20- Dec'21]

In a bid to reduce compliance burden on exploration activities in oil and gas blocks, many contractual processes will be complied on self-certification basis online and no further approvals will be required for the same. The online contract management system adopted for E&P contracts has been well received by industry for the convenience and efficiency it has brought to all.

To facilitate E&P operators and monitor the approvals/clearances while bringing e-transparency and e-accountability with real-time presence and information exchange among key stakeholders, URJA PRAGATI (Upstream Response by Joint Action for proactive Governance and Timely Implementation) a web-based interactive portal has been launched recently by DGH to effectively address issues of operators in the E&P sector with Central and State Governments and their regulatory agencies. The *Upstream India* portal on DGH webpage serves as an instrument of collaboration amongst E&P stakeholders in terms of knowledge sharing, resource sharing (rigs/ utilities/tools/infrastructure) and government facilitation (booking of workstations/ VRCs/ usage of licensed software, etc. without any cost implication). Stakeholders shall benefit from presence of all operators, service companies, and new entrants on a single platform.

In a nutshell, I would capture the key E&P activities in 2020-21: in all 170,51.24 LKM of 2D seismic data and 9,361.66 SKM of 3D seismic data were acquired, 115 exploratory wells and 353 development wells were drilled. Production level for oil and gas in FY 2020-21 was: 30.49 MMT crude oil and 28.67 BCM natural gas. As on 31st March 2021, the in-place volume of crude oil is 6,996.29 MMT and 4,213.04 BCM for gas (11,159.33 O+OEG) and there has been a cumulative accretion of in-place volume by 90.46 MMTOE (O+OEG).

India is keen to position itself as the next E&P destination on the world map. Our efforts have garnered support worldwide as we are poised to embark on a transformative journey. The decisions we collectively take at this point shall decide the future trajectory of India's E&P sector. I urge you all to come forward and be part of this amazing journey. Along with the Ministry, DGH is committed to revitalize the country's upstream sector and is assiduously working to promote further reforms to incentivize exploration and facilitate business and investment in the sector.

In 'India's Hydrocarbon Outlook: 2020-21' DGH provides comprehensive review of E&P activities undertaken in India in the fiscal 2020-21. I trust that all stakeholders in the energy sector, including the academia and researchers, will find this report an informative and valuable reference.

With best regards,

S. C. L. Das

महानिदेशक का संदेश

ऊर्जा हमारी सरकार के लिए एक उच्च प्राथमिकता वाला क्षेत्र है और बढ़ती अर्थव्यवस्था के साथ तालमेल बिठाते हुए ऊर्जा सुरक्षा सुनिश्चित करने के लिए हाइड्रोकार्बन पर देश की निर्भरता महत्वपूर्ण है । उचित मांग और अनुकूल अर्थशास्त्र के बल पर, भारत के अन्वेषण एवं उत्पादन क्षेत्र की विकास संभावनाएं उज्ज्वल दिख रही हैं । जैसे-जैसे दुनिया का झुकाव ऊर्जा की ओर बढेगा, भारत भी तेल और गैस क्षेत्र के मूल सिद्धांतों में प्रगति करेगा। भारत के ईएंडपी क्षेत्र को कार्बन रहित भविष्य के लिय अन्वेषण एवं उत्पादन की हरित गतिविधियां और नयी तकनीकी दक्षताओं पर ध्यान केंद्रित करना चाहिए।

भारत तीसरा सबसे बड़ा ऊर्जा उपभोक्ता है और अगले कुछ दशकों के लिए एक तिहाई निर्भरता तेल और गैस पर आधारित है । निकट भविष्य के लिए भारत की ऊर्जा सुरक्षा गंभीर रूप से तेल और गैस पर टिकी हुई है । भारत का अपस्ट्रीम क्षेत्र वर्तमान में ऊर्जा प्रदान कर रहा है और भविष्य के ऊर्जा परिवर्तन के लिए वित्त पोषण करेगा । तदनुसार, यह वर्ष एक स्थिर राजकोषीय ढांचे और निवेश के लिए तैयार पारिस्थितिकी तंत्र को सुनिश्चित करते हुए अन्वेषण क्षेत्र और घरेलू उत्पादन को बढ़ाने के हमारे मुख्य एजेंडे को प्रकट कर रहा है ।

सरकार ने वर्ष 2024 तक 40 एमएमटी के तेल उत्पादन और 50 बीसीएम के लिए गैस उत्पादन और वर्ष 2025 तक अन्वेषण क्षेत्र को 5,00,000 वर्ग किमी तथा वर्ष 2030 तक 10,00,000 वर्ग किमी तक बढ़ाने के लिए बहुत आक्रामक लक्ष्य भी निर्धारित किए हैं । मिशन मोड में 2025 और 2030 के अन्वेषण लक्ष्यों को प्राप्त करने के लिए, सरकार कम खोजे गए अवसादी बेसिनों में भू-वैज्ञानिक डेटा प्राप्त कर रही है । अंडमान सर्वेक्षण से मार्च 2022 तक 22,500-लाइन किलोमीटर के भूकंपीय डेटा अधिग्रहण के लक्ष्य को प्राप्त कर लिया जाएगा ।

अपतटीय क्षेत्र में विशाल क्षमता और अपतट में 51% अवसादी बेसिन क्षेत्र के साथ, भारतीय ईएंडपी क्षेत्र का सबसे अच्छा समय अभी आना बाकी है । वर्तमान अध्ययन गहरे पानी अत्यधिक गहरे पानी के क्षेत्रों में महत्वपूर्ण अवसरों का संकेत देते हैं । भारत सरकार अपतटीय क्षेत्रों की त्वरित खोज के लिए विशेष योजनाओं और सहयोग पर विचार कर रही है । इस बीच, अन्वेषण एवं उत्पादन एक्रेज में वृद्धि हुई है और सरकार ने डीएसएफ III और ओएएलपी VII दौरों के बोली को मंजूरी दे दी है । विशेष सीबीएम बोली दौर का शुभारंभ अपरंपरागत हाइड्रोकार्बन संसाधनों के विकास को नए सिरे से प्रोत्साहन दे रहा है ।

एनओसी द्वारा उत्पादन वृद्धि संविदाओं के शुरू किए जाने से, परिसंपत्तियां (एसेट्स) बड़े से छोटे, कुशल और फुर्तीले स्वतंत्र उद्यमियों के पास आ रही है जो गुणवत्ता वाली मध्यम जीवन काल वाली परिसंपत्तियों को लेकर लागत नियंत्रित तकनीक से उनके उत्पादन जीवन काल में विस्तार ला सकते है । खोजे गए लघु क्षेत्र (डीएसएफ) बोली राउंड III ऐसे विशिष्ट प्रचालकों के लिए खोजों का मुद्रीकरण करने का एक अच्छा अवसर है ।

स्वच्छ ऊर्जा लक्ष्यों को पूरा करने और भारत को 'गैस आधारित अर्थव्यवस्था' की ओर ले जाने के लिए, सरकार ने 2019 में प्राकृतिक गैस सुधारों को अधिसूचित किया, जिसके बाद डीजीएच ने घरेलू उत्पादित प्राकृतिक गैस की ई-बोली लगाने के लिए पांच एजेंसियों को सूचीबद्ध किया । 19.56 एमएमएससीएमडी प्राकृतिक गैस के लिए पैनल में शामिल एजेंसियों के माध्यम से ई-बोली सफलतापूर्वक की गई है [दिसंबर'2020- दिसंबर'2021] ।

तेल और गैस ब्लॉकों में ईएंडपी गतिविधियों पर अनुपालन बोझ को कम करने के लिए, कई संविदात्मक प्रक्रियाओं को स्व-प्रमाणन के आधार पर ऑनलाइन प्रक्रिया अपनाई जाएगी और इसके लिए किसी और अनुमोदन की आवश्यकता नहीं होगी । ईएंडपी संविदाओं के लिए अपनाई गई ऑनलाइन अनुबंध प्रबंधन प्रणाली के माध्यम से सभी के लिए होने वाली सुविधा और दक्षता को देखते हुए उद्योग ने इसका स्वागत किया है ।

ईएंडपी ऑपरेटरों की सुविधा के लिए और प्रमुख हितधारकों के बीच वास्तविक समय उपस्थिति और सूचना विनिमय के साथ ई-पारदर्शिता और ई-जवाबदेही लाने के लिए ऊर्जा प्रगति (प्रोएक्टिव गवर्नेंस और समय पर कार्यान्वयन के लिए संयुक्त कार्रवाई द्वारा अपस्ट्रीम प्रतिक्रिया), एक वेब-केंद्र और राज्य सरकारों के साथ ईएंडपी क्षेत्र में ऑपरेटरों के मुद्दों को प्रभावी ढंग से रखने के लिए डीजीएच द्वारा हाल ही में एक वेब आधारित इंटरैक्टिव पोर्टल लॉन्च किया गया है । डीजीएच (हाइड्रोकार्बन महानिदेशालय) की वेबसाइट पर अपस्ट्रीम इंडिया पोर्टल ज्ञान साझा करने, संसाधन साझा करने (रिग/ यूटिलिटीज/ टूल्स/ इन्फ्रास्ट्रक्चर) और सरकारी तकनाकी सुविधाओं (वर्कस्टेशन/ वीआरसी/ लाइसेंस प्राप्त सॉफ्टवेयर के उपयोग आदि की बुकिंग) के संदर्भ में ईएंडपी हितधारकों के बीच सहयोग के एक साधन के रूप में (बिना किसी लागत निहितार्थ के) कार्य करता है । हितधारकों को सभी ऑपरेटरों, सेवा कंपनियों और नए प्रवेशकों का एक ही इंटरैक्टिव प्लेटफॉर्म पर उपस्थिति होने से लाभ होगा ।

संक्षेप में, 2020-21 में प्रमुख ईएंडपी गतिविधियों में 2डी भूकंपीय डेटा के 17,051 एलकेएम और 3डी भूकंपीय डेटा के 9,362 एसकेएम हासिल किए गए, 115 खोजी कुएं और 353 विकास कुएं ड्रिल किए गए । वित्त वर्ष 2020-21 में तेल और गैस का उत्पादन था: 30.49 एमएमटी कच्चा तेल और 28.67 बीसीएम प्राकृतिक गैस । 31 मार्च 2021 तक, कच्चे तेल की इन-प्लेस वॉल्यूम 6,996 एमएमटी और गैस इन-प्लेस वॉल्यूम 4,213 बीसीएम (11,159.33 एमएमटीओई) हें और वर्ष 2020-21 के दौरान 90.46 एमएमटीओई इन-प्लेस वॉल्यूम की संचयी वृद्धि हुई है ।

भारत दुनिया के नक्शे पर अगले ईएंडपी गंतव्य के रूप में स्वयं को स्थापित करने का इच्छुक है । हमारे प्रयासों को दुनिया भर में समर्थन मिला है क्योंकि हम एक परिवर्तनकारी यात्रा शुरू करने के लिए तैयार हैं । इस बिंदु पर हम सामूहिक रूप से जो निर्णय लेते हैं, वे भारत के ईएंडपी क्षेत्र के भविष्य के प्रक्षेपपथ को तय करेंगे । मैं आप सभी को आगे आने और इस अद्भुत यात्रा का हिस्सा बनने का आग्रह करता हूँ । पेट्रोलियम और प्राकृतिक गैस मंत्रालय के साथ, डीजीएच देश के अपस्ट्रीम क्षेत्र को पुनर्जीवित करने के लिए प्रतिबद्ध है और इस क्षेत्र में अन्वेषण को प्रोत्साहित करने व्यापार और निवेश की सुविधा के लिए और सुधारों को बढ़ावा देने के लिए परिश्रमपूर्वक कार्य कर रहा है ।

डीजीएच का वार्षिक प्रकाशन 'भारत का हाइड्रोकार्बन परिदृश्य: 2020-21' वित्तीय वर्ष 2020-21 में भारत में किए गए ईएंडपी गतिविधियों की व्यापक समीक्षा प्रदान करता है । मुझे विश्वास है कि शिक्षा और शोधकर्ताओं सहित ऊर्जा क्षेत्र के सभी हितधारक इस रिपोर्ट को एक सूचनावर्धक और उपयोगी पाएंगे ।

शुभकामनाएं,

(एस. सी. एल. दास)

1

UPSTREAM OIL AND GAS INDUSTRY IN INDIA

1.1 History and Background

The story of oil exploration in India began in the north-eastern corner of the country, oil seepages were reported from the banks of river Dihing. Mr. C.A Bruce (1828) and Mr. H.B. Medicott (1865) of the Geological Survey of India (GSI) spotted oil seepages while prospecting for coal in Upper Assam.

Mr. Edwin L. Drake drilled the world's first oil well in 1859 at Titusville, Pennsylvania, USA and 7 years later, a hand- dug well of 102 feet was drilled by Stewart & Company, Calcutta at a place near Jeypore area of Upper Assam. The well, however failed to establish satisfactory production. In second attempt a year later, oil was struck at merely 118 feet in Asia's first mechanically drilled well at Makum near Margherita area of Upper Assam.

The Assam Railways and Trading Company Limited (AR&T Co. Ltd.), during Sept. 1889 to Nov. 1890 dug a well at Digboi field to a depth of 662 feet and commercially discovered oil with a rate of 200 gallons per day. AR&T subsequently acquired petroleum-rights concession in the Makum area of Assam. AR&T established Assam Oil Company (AOC) in 1899 to take over the petroleum interests of AR&T, including the Digboi and Makum concessions and set up a small refinery at Margherita (Upper Assam). Thereafter, systematic drilling began in 1899 and two years later in 1901, Asia's first oil refinery was set up at Digboi. It is still functional as the world's oldest operating refinery.

In 1911, UK-based Burma Oil Company (BOC) arrived in Upper Assam and in 1915, it acquired oil business interest from Budderpore Oil Co. Ltd. for exploration in the Surma valley (Upper Assam). Gradually by 1921, in a phase-wise manner, BOC acquired petroleum interests of AOC.

The Indian Co. "TATA Engineering Co." also drilled several wells in Jagatia, Gujarat and produced small amount of gas in 1930s. In 1937, BOC jointly with British Petroleum (then Anglo-Iranian Oil Co.) and Shell proposed to Government of India (GoI) to carry out a geophysical survey of the important plain areas of India. The proposal was accepted, and a new form of grant known as 'Geophysical License' was issued by Assam Government.

In Assam, successful seismic survey was carried out in Naharkatiya during 1937-39, triggering new enthusiasm in oil search and it became forerunner of discoveries in Assam and other basins. The successful outcome at well NHK-1 in 1937 was evidence for geophysical method in oil exploration.

The world knew significance of oil and after Independence, Indian leaders realized its utility for rapid industrialization and security of nation.

The company rule which was earlier framed to satiate the raw material need of British Empire was re-framed. While formulating industrial policy 1948, the development of petroleum industry in the country was given top priority.

By 1948, Geological Survey of India started geophysical survey in Cambay area. The first oil discovery in independent India was made by AOC on 1953 in Naharkatiya and then in Moran in 1956 both in Upper Assam. The oil industry, after independence, remained operated by foreign company for a considerable period. BOC kept its position as largest company in India until it ended its operation.

In 1955-56, a delegation led by Mr. K.D. Malviya, Minister of Natural Resources, visited several European countries to study the oil industries in those countries and train Indian professionals. Foreign experts also visited India to share their know-how. Erstwhile USSR helped draw a detail plan for geological and geophysical survey and drilling plan in second five-year plan (1956 to 1961).

With the intention of intensifying and spreading exploration to various parts of the country, a separate entity, Oil and Natural Gas Directorate was set up in 1955 as a subordinate office under the then Ministry of Natural Resources and Scientific Research.

The department was constituted with a nucleus of geoscientists from Geological Survey of India. But soon after its formation it was realized that the directorate cannot function efficiently with its limited financial and administrative freedom and in early 1956, its status was changed to a commission. In October 1959, Oil & Natural Gas commission was made a statutory body by an act of parliament delegating it more power but it remained under Ministry. The job of ONGC was defined as "to plan, promote, organize and implement programs for development of petroleum resources and the production and sale of petroleum and petroleum products produced by it, and

to perform such other function as the central government may, from time to time, assign to it". ONGC systematically started its geophysical surveys on area considered prospective based on global analogy.

Further, thrust was given for survey in area of Himalayan foothills and adjoining Ganga plains, alluvial tracts of Gujarat, upper Assam and basins of Bengal. The exploratory drilling carried out in Himalayan foothill during 1957, remained unsuccessful. Within a year of being formed, ONGC discovered oil at Cambay. The fields were discovered in Gujarat namely Ankleshwar in 1960, Kalol in 1961 and those in Assam namely Lakwa in 1964, Geleki in 1968 including a gas discovery (Manhar Tibba) in Rajasthan in 1969.

In February 1959, for development and production of Naharkatiya and Moran fields and to increase the pace of exploration in Assam, Oil India Private Limited was incorporated as a rupee company to take over BOC's affairs in Assam. The company was owned two-third by AOC/ BOC and 1/3rd by Government of India and in 1961 they became equal partners by transforming OIL into a Joint-Venture (JV) company.

OIL discovered Kusijan oilfield in 1969 and Jorajan oilfield in 1972. Later, Eocene gas was discovered by OIL in Tengakhat field of Assam in 1973

Offshore exploration was initiated by ONGC in the form of experimental seismic survey in 1962 in Gulf of Cambay and later in western offshore. Detailed seismic surveys in western offshore resulted in a discovery of large structure in Bombay-offshore in 1972-73 and drilling lead to India's biggest commercial oil discovery – Bombay-High.

Encouraged by Bombay-High discovery, exploration was continued in other parts of offshore areas of both west and east coast. This had led to significant discovery of Bassein and Neelam in western offshore and PY-3 and Ravva in Eastern offshore.

In 1978, OIL ventured out of Assam into Orissa offshore and onshore. OIL also ventured into offshore Andamans in 1979-89 and onshore Rajasthan. By the end of 80s, ONGC and OIL have together drilled nearly 3,100 wells.

ONGC's geo scientific survey spread out to Uttar Pradesh, Bihar, Tamil Nadu, Rajasthan, Jammu & Kashmir, Kutch and Andhra Pradesh.

By mid 1980s, ONGC successfully discovered prospects in Cauvery and KG basin. Kharsang oilfield was discovered by OIL in 1976 and in the same year ONGC discovered one of India's biggest gas finds in the Bassein field off Mumbai's coast. Other gas fields discovered by ONGC were Mid-Tapti, South Tapti and B-55.

Till the end of 1970s, Indian E&P industry was dominated by the two National Oil Companies (NOCs)-ONGC and OIL, which were granted PELs on nomination basis. Exploration was primarily confined to onland and shallow offshore. The strategic initiative was taken by government in 1979 to attract foreign investment, technology and capital to deal with future commitment and challenges of Indian oil economy by offering 32 exploration blocks (17 offshore and 15 onshore). Government started offering block systematically through bidding. These bidding rounds are also known as Pre- NELP exploration rounds. The three rounds during 1980-86 were not very successful.

By 1981, Government took over Oil India Private Limited and it became full-fledged PSU. In 1982, ONGC made its biggest gas discovery in Gandhar, Cambay basin, Gujarat and by 1986; KG basin was placed on global map with several significant discoveries made. By the end of 1986, third round of international bidding for exploration block were offered. OIL and ONGC were offered 40% back-in rights in JV for development phase. Few foreign companies participated but there was no committed exploration or breakthrough discovery. However, OIL and ONGC's effort continued in several parts of India and by 1989, OIL discovered gas in Tanot in Rajasthan and ONGC discovered South Heera in Mumbai offshore.

In 1990, fourth Pre- NELP exploration bidding round was launched and for the first time, Indian companies could participate with foreign companies. However, no major discovery was made. A year later, GoI adopted a liberalized economic policy that led to de-licensing of core group including petroleum sector and partial disinvestment of government share including other measures. As a result, in February 1994 ONGC was reorganized as a limited company (under the Company's Act, 1956) from Oil and Natural Gas Commission to Oil and Natural Gas Corporation Limited.

To give momentum to petroleum sector in India, GoI came up with more attractive offers in 1994. However, this also led to general disagreement in Production Sharing Agreement. In couple of years, ONGC ventured into CBM in Damodar valley and explored EOR options in heavy oil belt of North Gujarat. By 1996, GoI conducted 5 rounds of bidding and offered 126 blocks having area in the range of 1 sq. km. to 50,000 sq. km. Besides, NOCs and Indian Private Companies, some important companies like Shell, Enron, Aramco and Occidental participated in exploration and contracts were awarded to them.

The government efforts particularly during 1991-96 gave required thrust for opening up oil and gas sector to international and private entities. After this, the process of opening the sector became more streamlined.

Many private players also joined in development of this industry. Hindustan Oil Exploration Company (HOEC) which started its E&P venture in 1991, was among few such initial domestic private player.

In view of the liberalized policy adopted by GoI, a need for an independent upstream regulatory body called Directorate General of Hydrocarbons (DGH) was envisaged to oversee and review the oilfield development programs to ensure sound reservoir management practices in line with national interests. Thus, DGH was formed vide GoI resolution dated 08.04.1993. After the nomination era till late 1970s, Pre-NELP exploration era (1980-95) and Pre-NELP field rounds (1993-94), GoI formulated a policy, called New Exploration Licensing Policy (NELP) in 1997. The main objective was to attract significant risk capital from Indian and Foreign companies, state of art technologies, enhanced geological perception of Indian sedimentary basins and best management practices to explore oil and gas resources in the country to meet rising demands of oil and gas. NELP policy was approved in 1997 and became effective in February 1999. Since then licenses for exploration were awarded only through a competitive bidding system and NOCs were required to compete on an equal footing with Indian and foreign companies to secure Petroleum Exploration Licenses (PELs). Nine rounds of bidding were conducted under NELP, in which production sharing contracts for 254 exploration blocks were signed. Under the PSC regime, two major basins were opened commercially, namely Rajasthan and Krishna-Godavari Basin.

NELP regime saw Indian E&P sector opened to private and foreign players, however through investors' interaction; a perception was felt for some reformative changes in the existing policy framework. Taking cognizance of the issues arising out of the Production Sharing Contracts, Government made a paradigm shift towards Revenue Sharing Contracts by introducing the Discovered Small Field Policy (DSF, 2015) and Hydrocarbon Exploration and Licensing Policy (HELP, 2016). With recent impetus to the sector through policy interventions and facilitation of projects, Indian Oil and Gas industry is seeing a renewed global interest.

The participation of foreign companies in recent DSF and OALP bidding rounds is a testimony to this fact. With

a huge scope of activities and government's continued thrust on development in oil and gas sector, expectation remains large on some big discoveries in future. With significant findings in recent resource reassessment studies and the fact that experts gave emergent views on new plays and exploration in new areas particularly deepwater, Indian E&P sector is now poised for a definitive push to reveal subsurface insights and to bring out a realistic perception of hydrocarbon prospectivity.

1.2 Formation of Directorate General of Hydrocarbons (DGH)

During early nineties, Ministry of Petroleum and Natural Gas, Government of India had under consideration, the need to have an appropriate agency to regulate and oversee the upstream activities in the petroleum and natural gas sector and advise the Government in these areas. The Dasgupta committee, which had reviewed the management of the Bombay High reservoir, had recommended the creation of an autonomous conservation board to oversee and review that oilfield development which conforms to sound reservoir engineering practices in line with national interests. Subsequently, the Kaul committee, which examined ONGC's organizational structure, also recommended for establishment of an independent regulatory body called the Directorate General of Hydrocarbons. Moreover, the upstream petroleum sector was largely a monopoly of public sector companies till then and sector at that time was being increasingly opened to new operating companies in the private and joint sectors. Thus, a need was felt to establish an agency that could effectively supervise the activities of all these companies in the national interest. Taking all the above into consideration, Government of India, decided to set up a Directorate General of Hydrocarbons (DGH) under the administrative control of the Ministry of Petroleum and Natural Gas. DGH was set up through a Government Resolution No. O-20013/2/92/ ONG-III dated 8th April 1993.

DGH-Objective

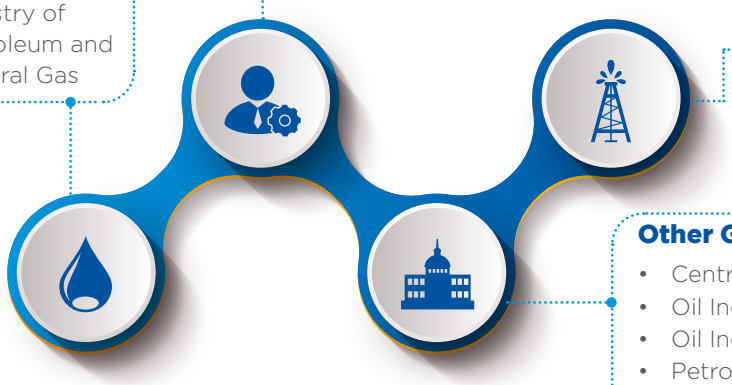
To promote sound management of the Indian Petroleum and Natural Gas resources having a balanced regard for the environment, safety, technological and economic aspects of the petroleum activity.

Petroleum and Natural Gas Sector in India

Technical Advisor/ Regulators
- Directorate General of Hydrocarbons (Upstream)
- Petroleum & Natural Gas Regulatory Board (Downstream)

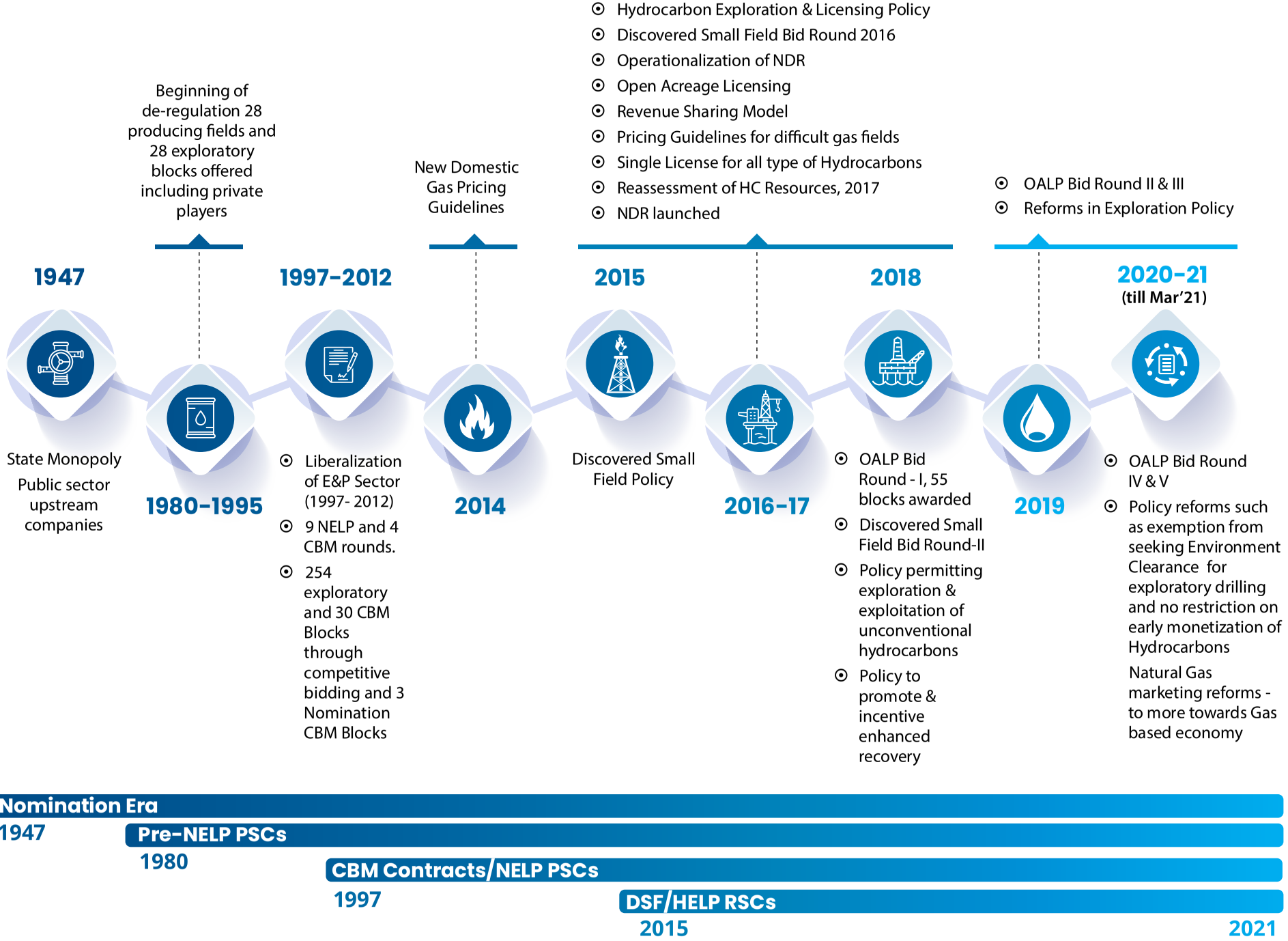
Central Level
- Ministry of Petroleum and Natural Gas

State Level
- Energy Directorates
- Department of Commerce and Industry



Other Government Agencies
- Centre of High Technology
- Oil Industry Development Board
- Oil Industry Safety Directorate
- Petroleum Conservation and Research Association
- Petroleum Planning and Analysis Cell

Figure 1.1: Exploration and Production Regime in India



1.2.1 Role and Functions of DGH

As an important statutory body in Indian E&P sector, DGH has following roles and functions:

I. A nodal agency for implementation of NELP and CBM policy on behalf of Ministry of Petroleum & Natural Gas (MoPNG)

II. To advise MoPNG on Exploration Strategies & Production Policies

III. To provide technical advice to the Ministry of Petroleum and Natural Gas on issues relevant to the exploration and optimal exploitation of hydrocarbons in the country

IV. To review the exploration programs of companies operating under Petroleum Exploration Licenses granted under the Oilfields (Regulation and Development) Act, 1948 and the Petroleum and Natural Gas Rules, 1959 with a view to advising Government on the adequacy of these programs.

V. To evaluate the hydrocarbon reserves discovered and estimated by the operating companies

VI. To advise the Government on the offering of acreages for exploration to companies as well as matters relating to relinquishment of acreage by companies

VII. To review the development plans for commercial discoveries of hydrocarbon reserves proposed by the operating companies

VIII. Advise Government on the adequacy of such plans and the exploitation rates proposed and matters relating thereto

IX. To review and audit concurrently the management of petroleum reservoirs by operating companies and to advise on any mid-course correction required to ensure sound reservoir management practices in line with the optimal exploitation of reserves and the conservation of petroleum resources

X. To regulate the preservation, upkeep and storage of data and samples pertaining to petroleum exploration, drilling, production of reservoirs etc. and to cause the preparation of data packages for acreage on offer to companies

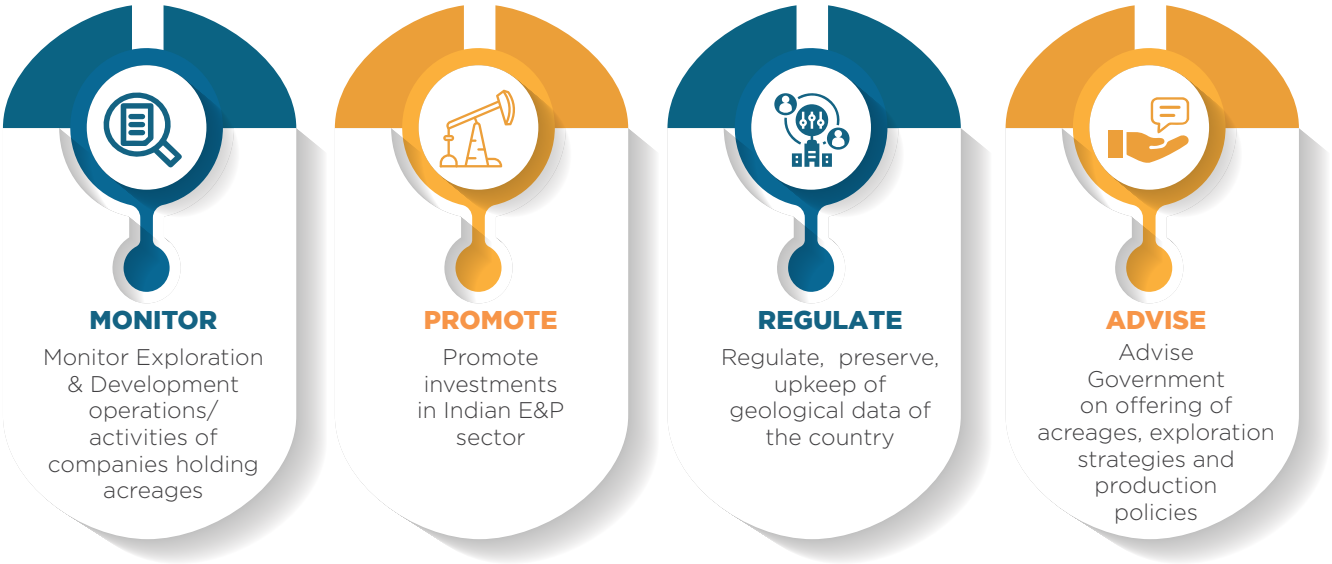
XI. All other matters incidental thereto and such other functions as may be assigned by Government from time to time

XII. Assist Government in contract management functions

XIII. Exploration & Development of unconventional hydrocarbon resources like Gas Hydrate, Shale Gas/Oil and Oil Shale

XIV. Issue Essentiality Certificate for importing goods and services used in E&P sector to avail custom duty concessions

XV. Codification of Good International Petroleum Industry Practices (GIPIP) and timely updation as per international industry best practices



1.2.2 Governance Mechanism

Advisory and Administrative Council of DGH:

Advisory Council

Directorate General of Hydrocarbons has an Advisory Council, which is appointed by the Government comprising of Chairman and members, who are eminent persons in the field of hydrocarbon exploration and production. The Advisory Council is serviced by the Directorate which is headed by a Director General who is also the Member Secretary to the Council.

Administrative Council

Government of India setup an Administrative Council to guide and to take care of all administrative aspects of the functioning of DGH, through Office Memorandum No. O-32012/1/95-ONG-III dated 02.02.2001. The Administrative Council takes decisions on various matters concerning establishment, budget and undertakes periodical review of the functioning of DGH. It is headed by Secretary(MoPNG) and has the following composition:

Table1.1: Composition of Administrative Council of DGH

Name	Designation
Secretary, MoP&NG	Chairman
Additional Secretary, P&NG	Member
AS&FA, MoPNG	Member
Joint Secretary(Expl.), MoPNG	Member
Secretary, OIDB	Member
Director General, DGH	Member- Convener

1.3. Acreages under various Regimes

Petroleum Exploration Licenses (PEL) for domestic exploration & production of crude oil and natural gas were/are being granted under various regimes.

1.3.1 Nomination Basis

Till the end of 1970s, Indian E&P industry was dominated by the two National Oil Companies (NOCs) ONGC and OIL to whom PELs were granted on nomination basis. Exploration was primarily confined to onland and shallow offshore areas.

1.3.2 Pre-NELP Exploration Blocks

28 Exploration blocks were awarded to private companies between 1980 and prior to implementation of NELP where ONGC and OIL had the rights for participation in the blocks after hydrocarbon discoveries.

Table1.2: Pre-NELP Exploration blocks

Year	Exploration Rounds	Contracts signed			
		Description	Offshore	Onshore	Total
1980	First round	PSC signed with Chevron, USA and 3 wells were drilled without success, block area was relinquished in 1985	1	-	1
1982	Second round	No PSC signed	-	-	-
1986	Third round	-	-	-	-
1991	Fourth round	5 PSCs signed	2	3	5
1992		First development round	-	-	-
1993	Fifth round	Second development round	4	2	6
	Sixth round	First speculative survey round	2	3	5
1994	Seventh round	-	2	3	5
	Eighth round	Second speculative survey round	1	3	4
1995	Ninth round	JV Exploration Program	1	1	2
Total			**13**	**15**	**28**

In 1993, GoI offered blocks for geophysical and other surveys to update the information on hydrocarbon potential of India's unexplored sedimentary basins. Once the surveys on these blocks were completed, they were to be offered in subsequent rounds of exploration. The Second speculative survey round was launched in 1994 and the third round in 1995. The third round was called as Joint Venture Speculative Survey Round (JVSSR) with a provision of risk participation/ cost sharing by DGH upto 50%. Government of India has signed 28 contracts for blocks offered under Pre-NELP Exploration regime.

1.3.3 Pre-NELP Discovered Field or Development Rounds:

Government offered Petroleum Mining Lease (PML) of small/ medium sized discovered fields (proven reserves were discovered by ONGC and OIL) to the private sector in August 1992. Production Sharing Contracts (PSCs) awarded during 1991-1993 had the distinctive feature of operators as private companies with ONGC/OIL as having participating interest. These rounds received overwhelming response from various private E&P operators. Government of India has signed 28 contracts (One PSC for Panna Mukta–PM) for 29 discovered fields under Pre-NELP Discovered (Small and Medium size fields) regime.

Table 1.3: Pre-NELP Discovered Field or Development rounds

Month/Year of award	Round	Blocks offered in Medium sized field Round		Blocks offered in Small sized field Round		Contracts signed
		Offshore	Onshore	Offshore	Onshore	
August 1992	1	6	6	10	21	18
October 1993	2	2	6	4	29	10
Total Contracts signed						28

1.3.4 New Exploration Licensing Policy (NELP):

Government introduced healthy competition and public participation by introducing NELP for exploration & production of oil & gas in the country. Under NELP, blocks were awarded to Indian, private and foreign companies through International Competitive Bidding process where NOCs, viz. ONGC and OIL, were competing on equal footing.

NELP not only accelerated the quest for hydrocarbon exploration, but also brought state-of-the-art technology and efficiency of operations/ management to the country.

Government of India signed 254 contracts under NELP with National Oil Companies and private (Both Indian and foreign)/ Joint Venture companies. At present, 73 contracts are operational out of total 310 contracts (254 NELP, 28 Pre-NELP Field round and 28 Pre-NELP Exploration) signed so far under various bidding rounds.

The awarded 254 blocks under NELP regime are in onland (114), offshore shallow water (59) and deepwater (81) areas. As a result of exploratory activities, several unexplored and poorly explored areas, offshore and deepwater areas have been appraised through geophysical surveys and exploratory drilling. Till date, 254 discoveries have been made under PSC regimes and most of the gas discoveries have been made in offshore - shallow (53) and deepwater blocks (45).

NELP bidding rounds have attracted many Private and Foreign Companies in addition to PSUs. Before the NELP, a total of 35 E&P Companies (5 PSUs, 15 Private and 15 Foreign) were working in Nomination and Pre-NELP regime. After the conclusion of nine rounds of NELP bidding, the total number of companies had increased to 117 (11 PSUs, 58 Private and 48 Foreign Companies as Operators and Non- operators/Consortium Partners). Major Private Companies were RIL, Jubilant and Essar. The major foreign companies were British Gas, British Petroleum, the then Cairn Energy (now Cairn India), ENI, Santos and BHP Billiton.

Public Sector Undertakings (PSUs) IOCL, GAIL, BPCL working under MoP&NG and their subsidiaries like Bharat Petro Resources Ltd. (Subsidiary of BPCL), Prize Petroleum Company Limited (Subsidiary of HPCL), have participated in various NELP bidding rounds and have been awarded exploration blocks in various NELP bidding rounds. In addition to central PSU, state PSU like GSPC have participated in various NELP bidding rounds and have been awarded exploration blocks.

The domestic crude oil/gas production in the country consists of oil production from Nomination Blocks/Fields under ONGC and OIL and from the discovered fields and producing Pre-NELP and NELP blocks under the Production Sharing Contract (PSC) regime.

1.3.5 Discovered Small Field Policy

The Government of India brought out a new policy for small fields known as Discovered Small Field (DSF) policy, 2015. This policy offers improved fiscal terms viz. no oil cess applicable on crude oil production, moderate royalty rates, no upfront signature bonus, pricing and marketing freedom for oil and gas and no carried interest by NOCs. DSF provided a unique opportunity for Indian investors/ companies for development of discovered hydrocarbon resources under revenue sharing mechanism wherein the terms are liberalized for providing maximum autonomy to contractor with minimum Government oversight. With two DSF bidding rounds carried out till date, 54 Contract Areas have been awarded, resulting in entry of over 20 new players in Indian E&P sector. DSF fields which are awarded under DSF Bid Rounds are schedule to commence production by 2021-22.

1.3.6 Open Acreage Licensing Programme (OALP) under Hydrocarbon Exploration and Licensing Policy (HELP)

Government of India launched a new policy regime for E&P sector namely Hydrocarbon Exploration and Licensing Policy (HELP) in 2016.

The key facets of the HELP policy are:

- Single license for all forms of Hydrocarbons including conventional and unconventional
- Easy to administer revenue sharing contract model
- Open Acreage Licensing Programme (OALP)
- Marketing and pricing freedom for sale of crude oil and natural gas
- Low and graded royalty rates

The policy intends to open the E&P sector for new entrants and foreign players in a quest to enhance domestic oil and gas production, bring in substantial investment and new technologies in the sector and generate sizable employment. The policy would further enable transparency in the system and reduce regulatory discretion thereby improving the 'Ease of Doing Business" in Indian E&P Sector. Effective implementation of the policy was critical to realize the intended benefits of the policy and exploit huge potential of Indian sedimentary basin which presents a yet-to-find potential of over 230 billion barrels of oil and oil equivalent gas with over 70% of the area yet to be explored.

The HELP is implemented through innovative OAL Programme, where the continuous bidding rounds are conducted on the investor selected blocks. The maiden bidding round under OALP received an overwhelming response with 55 blocks getting awarded covering an area of ~60,000 Sq. Km.

As a further impetus to the sector the policy received a major overhaul in February 2019, wherein government decided to forego the revenue share commitment from the operators at time of bidding in case of Category II and Category III basins in India. Bid round IV & V carried out under invigorated policy regime. A total of 105 blocks have been awarded under five bidding rounds of OALP.

OALP Bid Round - VI

21 blocks covering an approx. area 35,346 Sq. Km have been put on offer under OALP Bid Round-VI and spread over 11 sedimentary basins. These blocks were finalised from the EoI's received in window-VIII (1st Jul. 2020 to 30th Nov. 2020) & window-IX (1st Dec. 2020 to 31st Mar. 2021). Out of 21 blocks 15 blocks are onland, 4 blocks in shallow water & 2 block in ultra deepwater.

Table 1.4: Status of Blocks under various regimes (As on 31-03-2021)

Round	Launch Year	Signing Year	Offered	Awarded				Operational/Active			
				Deep/Ultra-Deepwater	Shallow Water	Onland	Total	Deep/Ultra-Deepwater	Shallow Water	Onland	Total
Pre-NELP Exploration	1980	1985-1995	379	-	13	15	28	-	3	8	11
Pre-NELP Field	1992	1992-1993	84	-	4	24	28	-	2	19	21
NELP I	1999	2000	48	7	16	1	24	2	1	0	3
NELP II	2000	2001	25	8	8	7	23	0	0	1	1
NELP III	2002	2003	27	9	6	8	23	0	1	3	4
NELP IV	2003	2004	24	10	0	10	20	0	0	3	3
NELP V	2005	2005	20	6	2	12	20	0	1	3	4
NELP VI	2006	2007	55	21	6	25	52	0	2	6	8
NELP VII	2007	2008	57	11	7	23	41	0	3	4	7
NELP VIII	2009	2010	70	8	11	13	32	0	2	1	3
NELP IX	2010	2012	34	1	3	15	19	0	1	7	8
DSF-I	2016	2017	46	0	7	23	30	0	3	16	19
OALP I	2018	2018	55	1	8	46	55	1	8	46	55
DSF II	2018	2019	25	0	9	15	24	0	8	11	19
OALP II	2019	2019	14	1	5	8	14	1	5	8	14
OALP III	2019	2019	23	1	3	14	18	1	3	14	18
OALP IV	2019	2020	7	-	-	7	7	-	-	7	7
OALP V	2020	2020	11	1	1	9	11	1	1	9	11
Total			**1004**	**85**	**109**	**275**	**469**	**6**	**44**	**166**	**216**

Table 1.5: Investment made under contract Regime (PSC & RSC) in USD Million (As on 31-03-2021)

Bidding Round	Committed Investment		Actual Investment upto 2020-21*		
	Type	Value	Exploration	Development	Total
Pre-NELP	Exploration	NA	2,338.5	6,955.8	9,424.3
Pre-NELP	Development (Field)	NA	528	5,810	6,338.0
Pre-NELP Total		**NA**	**2,866**	**12,766**	**15,632**
NELP-I	Exploration	1,082	4,964	9,995.4	14,959
NELP-II	Exploration	775	910	34.1	943.9
NELP-III	Exploration	978	3,400	1,967.0	5,366.8
NELP-IV	Exploration	1,135	2,099.1	33.2	2,132.4
NELP-V	Exploration	3,570	1,028.3	48.0	1,076.2
NELP-VI	Exploration	1,505	2,868.1	18.2	2,886.3
NELP-VII	Exploration	1,102	930.5	0.7	931.1
NELP-VIII	Exploration	734	719.3	0.0	719.3
NELP-IX	Exploration	847	255.5	0.6	256.1
NELP Total		**11,728**	**17,174**	**12,097**	**292,71**
DSF-I	Development			23.5	23.5
DSF-II	Development			7.8	7.8
DSF Total				**31.3**	**31.3**
OALP - I	Exploration	815	138.58		138.58
OALP -II	Exploration	452	10.81		10.81
OALP - III	Exploration	709	74.28		74.28
OALP - IV	Exploration	341	11.01		11.01
OALP - V	Exploration	62	12.96		12.96
OALP Total		**2379**	**247.64**		**247.64**
Grand Total			**20,288**	**24,894**	**45,182**

*Rounded-Off

(1) Does not include blocks transferred to ONGC on Nomination

(2) Does not include blocks under termination

Table 1.6: R/P Trend in Oil Production in last 5 decades (From FY 1970-71 to 2020-21) (in MMT)

FY	Production	Balance Recoverable Reserves	R/P
1970-71	6.82	128	19
1980-81	10.51	366	35
1990-91	33.02	739	22
2000-01	32.88	732	22
2010-11	37.66	660	18
2020-21	30.49	475	15.6

Figure 1.2: R/P Trend in Oil Production in last 5 decades (From FY 1970-71 to 2020-21)

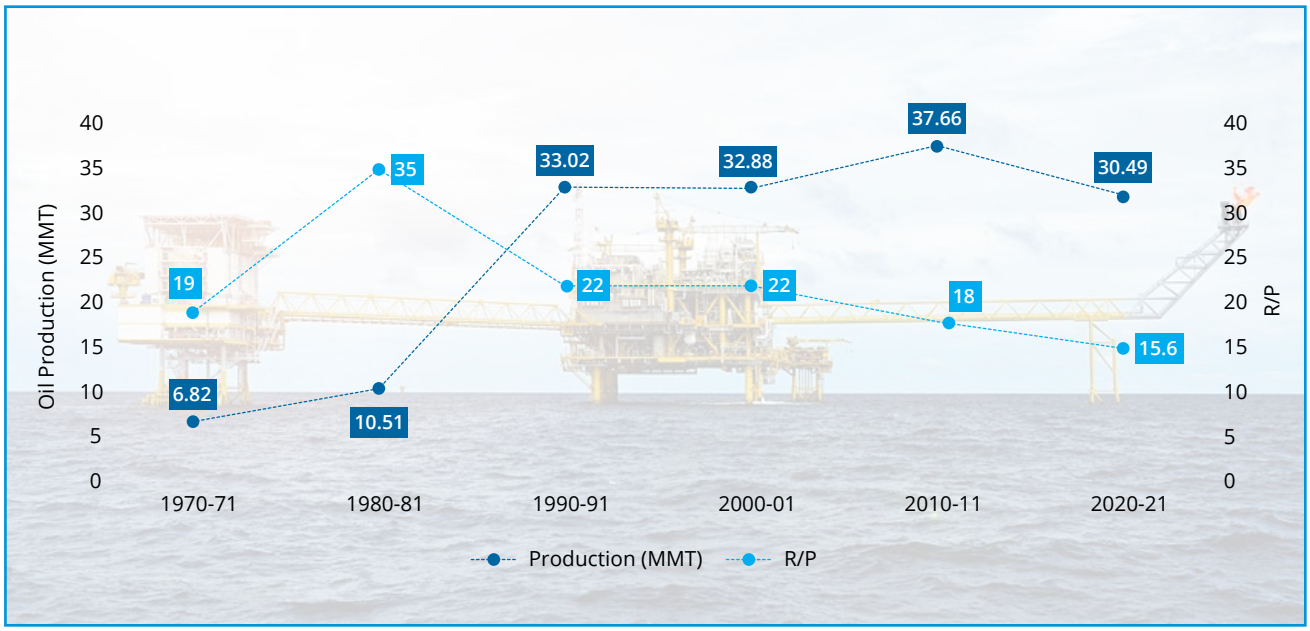
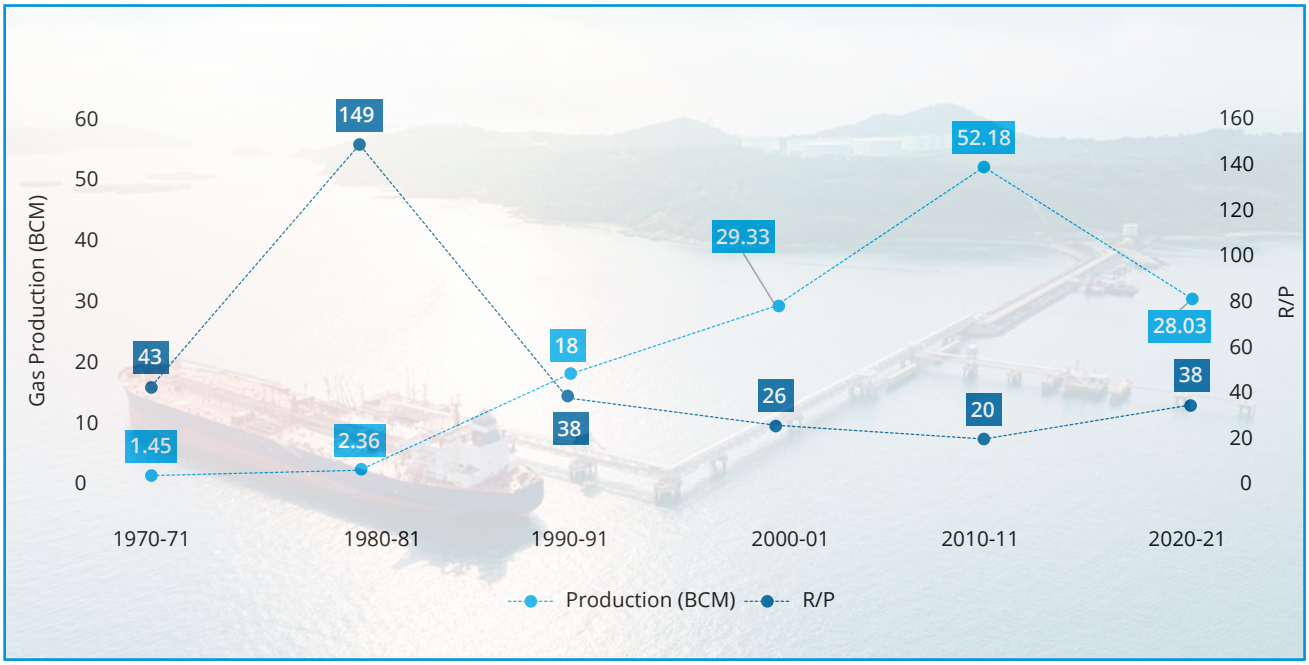


Table 1.7: R/P Trend in Gas Production in last 5 decades (From FY 1970-71 to 2020-21) (in BCM)

FY	Production (BCM)	Balance Recoverable Reserves	R/P
1970-71	1.45	62	43
1980-81	2.36	351	149
1990-91	18	686	38
2000-01	29.33	763	26
2010-11	52.18	1,043	20
2020-21	28.03*	1,070	38

*Excluding CBM

Figure 1.3: R/P Trend in Gas Production in last 5 decades (From FY 1970-71 to 2020-21)



KEY MILESTONES OF **INDIAN E&P SECTOR**

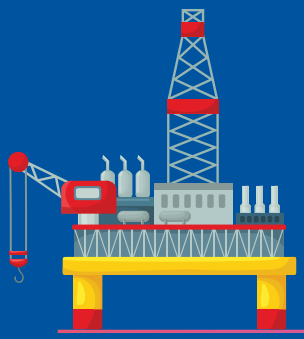
1867
- Struck Oil in Jeypore Assam

1882
- Assam Railway Trading Company set up to explore oil

1890
- First Commercial Discovery at Digboi, Assam

1891
- Assam Oil syndicate set up a refinery at Margherita, Assam

1895
- Assam Oil Company to take over petroleum interest s from Assam Oil Syndicate



1956
- Oil and Natural Gas Commission established
- Discovery of oil in Moran, Assam

1959-1961
- ONGC became statutory body
- Discovery of Ankleshwar oil field, Gujarat
- Oil India Pvt Ltd incorporated as 50% JV between GoI and BOC

1974-1977
- Bombay High discovered
- Discoveries of Bassein Gas Field, Mumbai Offshore, Kharsang oil field, Arunachal Pradesh
- Discovery of Heera oil field, Mumbai Offshore

1981-1983
- Oil India Ltd became wholly owned GoI Enterprise
- Discovery of Gandhar Oil field, Gujarat

1985-1986
- GoI decision for participation of private companies in development of discovered oil and gas fields
- Neelam Oil Field, Mumbai Offshore discovered

1901

- First Oil Refinery Set up at Digboi, Assam

1922

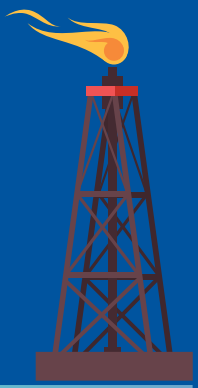
- Burmah Oil Company bought shares from ARTC, and appointed commercial and technical managers from AOC

1930

- Crude Oil Production rose upto 2,50,000 tonnes per annum and exploration activities continued in Assam-Arakan range

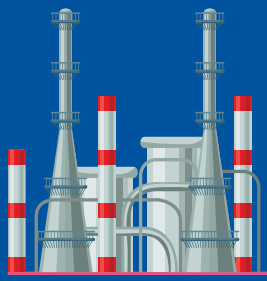
1948

- Industrial Policy Resolution passed
- Oilfields (Regulation and Development) Act, 1948 came into existence



1953

- Discovery of Naharkatia Oil Field, Assam



1987-1993

- Ravva Oil Field discovered in KG Offshore
- DGH Established
- ONGC is re-organised as a corporation

1997-1999

- GoI formulated CBM Policy
- GoI approved NELP
- NELP-I launched offering 48 blocks

2000-2002

- NELP-II launched with 25 blocks on offer
- First round of CBM bidding
- NELP-III launched offering 27 blocks

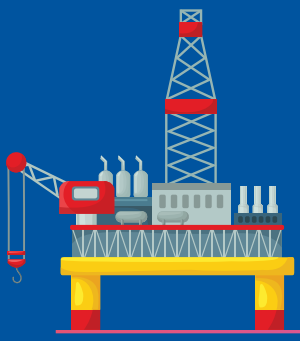
2003

- Second Round of CBM blocks bidding
- NELP-IV launched with 24 blocks on offer

2004-2005

- Mangala Oil Field discovered in Rajasthan
- Third Round of CBM bidding
- NELP-V launched offering 20 blocks

KEY MILESTONES OF **INDIAN E&P SECTOR**



2006

- NELP-VI launched offering 55 blocks
- MA Oil Field, KG Offshore Discovered

2007

- NELP-VIII launched with 57 blocks on offer
- CBM extension policy introduced
- Discovery of D1 & D3 Gas Fields, KG offshore

2008-2010

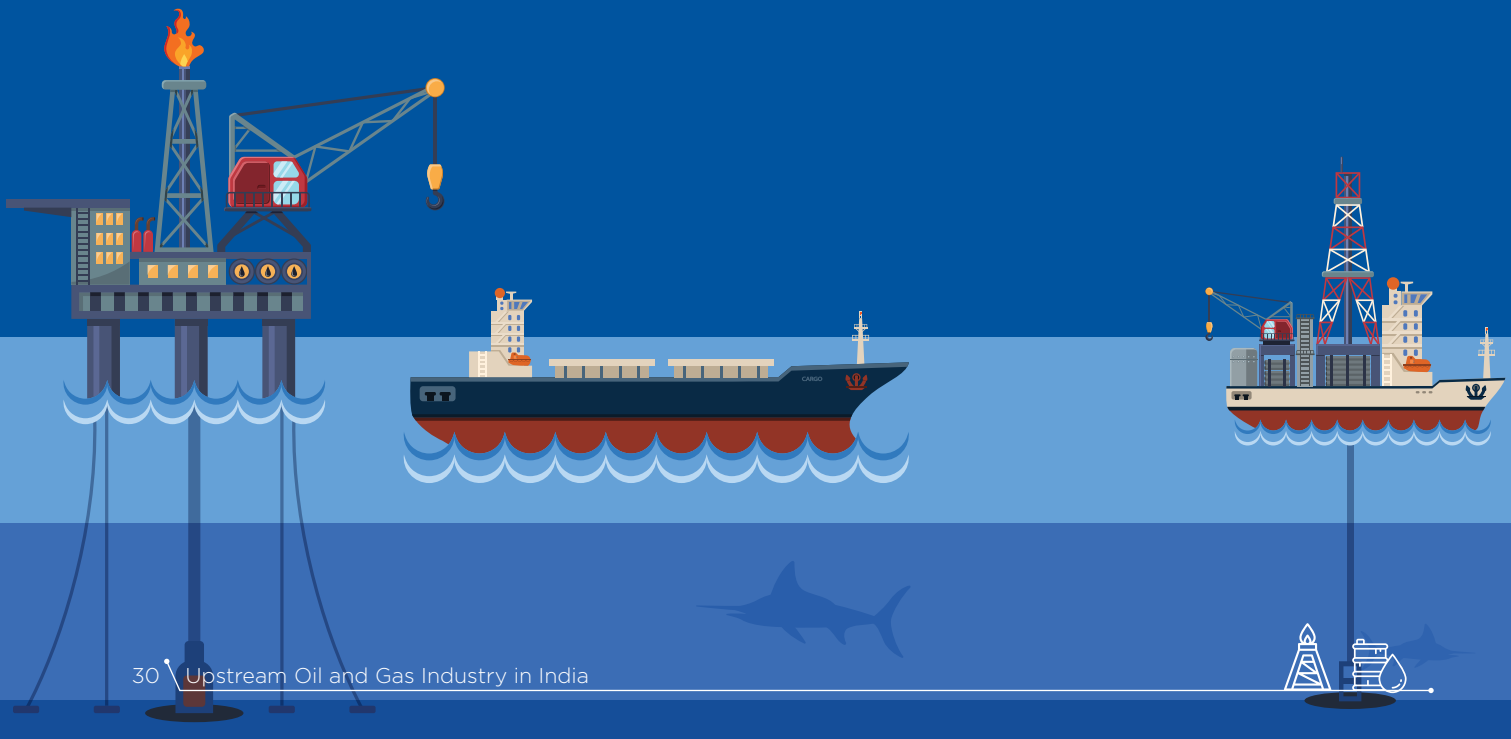
- Fourth round of CBM bidding
- NELP-VIII launched with 70 blocks on offer
- NELP-IX launched with 34 blocks on offer

2014

- Domestic Natural Gas Pricing guidelines
- Approval and launch of Hydrocarbon Resource Reassessment Study

2015

- Discovered Small Field Policy



2016

- Approval of Hydrocarbon Exploration Licensing Policy (HELP)
- Marketing and Pricing freedom for new gas production from Deepwater, Ultra Deepwater and High Pressure-High Temperature Areas
- Launch of Discovered Small Fields Bid Round 2016
- Launch of National Seismic Programme
- GIPIP
- Policy for grant of extension to Production Sharing Contracts for Small and medium sized discovered fields

2017

- Launch of NDR
- Launch of HELP through OALP
- Early monetization of CBM
- Extension policy for Pre-NELP Contracts

2018

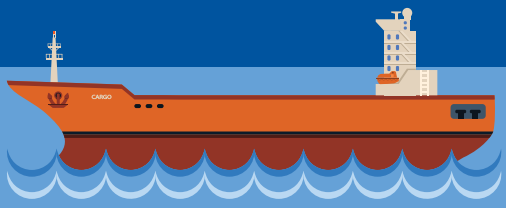
- Launch of OALP Bid Round-I
- Launch of DSF Bid Round-II
- Grant of exploration and exploitation rights to Coal India Limited (CIL) and its subsidiaries from coal bearing areas for which they possess mining lease for coal
- Exploration & exploitation of Unconventional hydrocarbons in existing acreages under PSC, CBM & Nomination Fields
- Enhanced Recovery Policy
- Policy for streamlining of PSCs

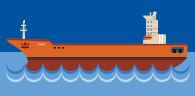
2019

- Launch of OALP Bid Round II & III
- Reforms in Exploration Policy
- Launch of OALP Bid Round IV
- EIA Notification on exemption from seeking Environment Clearance for exploratory drilling for onland and offshore blocks

2020

- Self-certification of PSC processes
- Launch of OALP - V
- Natural Gas Marketing Reforms





2

INVESTORS' PICK

Energy is not only an existential need for mankind but is also, one of the reasons behind human advancement. Among its various sources, Oil and Gas play a significant role in fueling the energy needs of the world and the affordable, reliable supplies of these fuels are integral parts of a vision of the future. Even when cleaner alternatives are being increasingly adopted, a growing global population and an expanding global economy reassures of a continuing demand for Oil and Gas and its noteworthy contribution in the energy basket.

India is the world's third largest energy consumer, behind China and the US. In the coming decades, India's role will become central to global energy demand growth. India will be the leading driver of global energy over the long term. In the preceding two decades as well, the country's primary energy consumption growth has been quite impressive – energy consumption grew by 5.05 CAGR during 2000-2019; during the same period global energy demand growth averaged 2.08 CAGR.

As per International Energy Agency (IEA) forecast. India's oil consumption is expected to rise from 4.8 million barrels per day (mbd) in 2019 to 7.2 mbd in 2030 and 9.2 mbd in 2050 as per the (IEA's key scenario based on stated policies). The projection shows the centrality of oil in the Indian economy over the next three decades. India's oil demand will rise 50% by 2030 as against a global expansion of 7% .

Under the IEA's stated policies scenario, the global oil demand will peak in 2030 at 103 mbd and stay unchanged until 2050. India will remain the third-largest oil consumer in 2030, as it is today, behind the US and China.

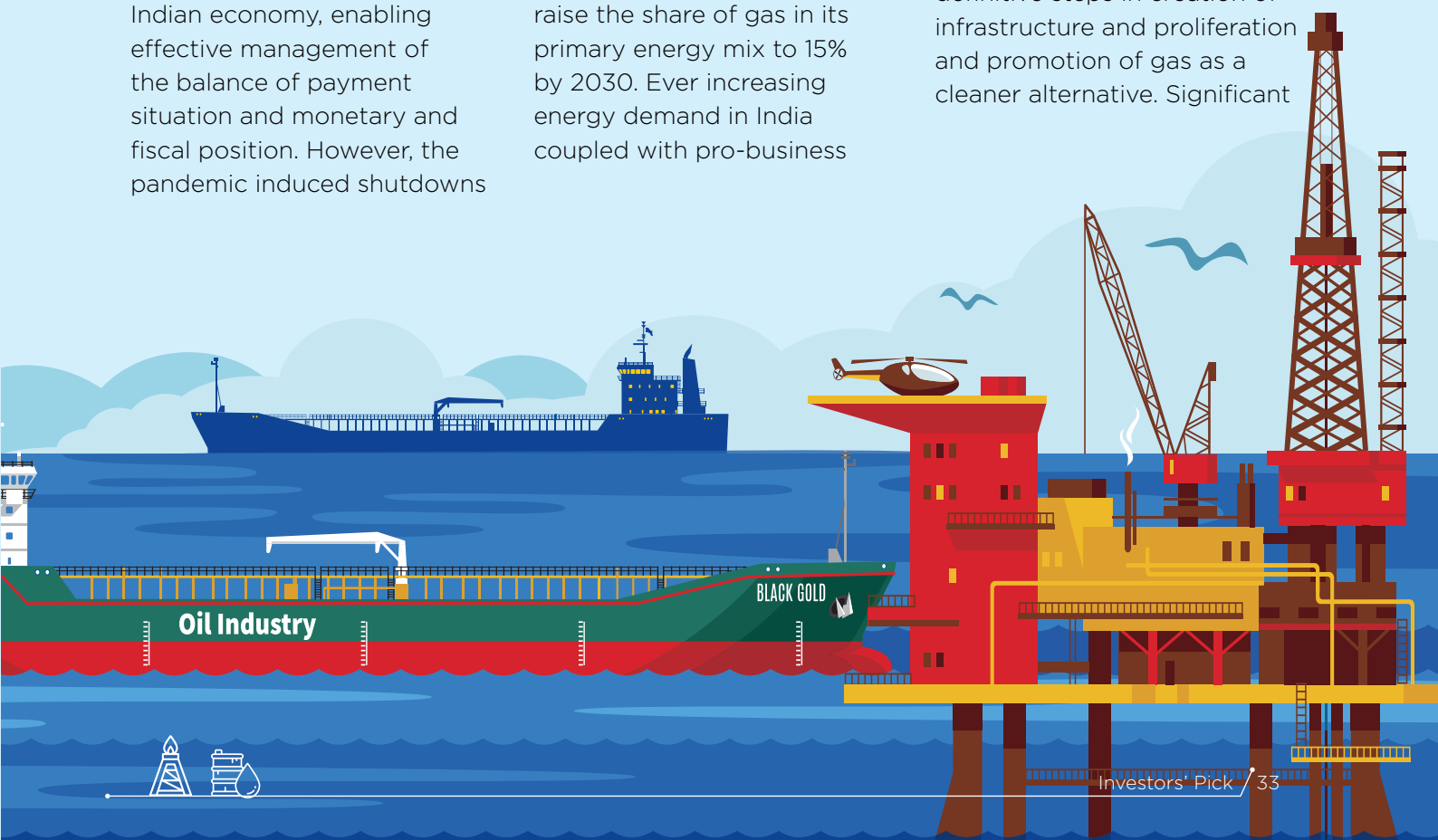
India's natural gas demand is projected to double to 133 billion cubic meters in 2030 from 64 BCM in 2019 as against a 12% rise in global gas demand. Indian refining capacity is projected to expand 30% to 6.9 mbd by 2030 while the global capacity is expected to increase just 3%. India is projected to account for 1/4th of the incremental global energy demand during the period 2019-2040.

India being an import dependent country (around 85% of crude oil requirement is imported), the subdued crude oil price regime during 2020-21 augured well for the Indian economy, enabling effective management of the balance of payment situation and monetary and fiscal position. However, the pandemic induced shutdowns and disruption in economic activity caused a significant decline in the demand of petroleum products with the consumption dropping to 194.6 MMT during the year 2020-21 as against 214.1 MMT in the previous year, a reduction of 9.1%. Likewise, the consumption of natural gas also declined around 5.5% over the previous year.

The country's energy mix is highly dependent on fossil fuels, which cater to over 90 percent of the domestic energy needs. While the composition of the basket is unlikely to see any sudden and marked shifts, over the longer term, renewables will be a valuable contributor, especially in the power sector, and the impressive rise of capacity additions as well as successful recent auctions are a clear indicator of the trend.

India has set a target to raise the share of gas in its primary energy mix to 15% by 2030. Ever increasing energy demand in India coupled with pro-business environment creates huge investment opportunities for investors. Govt. of India has an unwavering commitment towards production maximization for the ever-increasing energy needs of the country. The sector, in the recent years has witnessed major policy and administrative reforms to encourage 'Ease of Doing Business' in the sector. Critical policy support in the form of reforms such as rationalisation of tariffs, taxes, gas trading, transport system operator and viability gap funding for gas pipeline infrastructure development, and a priority focus on city gas distribution (CGD) under gas allocation policy is working to ensure that the sector remains integral to India's decarbonisation strategy.

With its vision set towards becoming a gas-based economy, India has taken definitive steps in creation of infrastructure and proliferation and promotion of gas as a cleaner alternative. Significant



work is being done in the direction of "One Nation, One Gas Grid"; setting up of LNG/CNG stations, pipelines, import and regasification terminals; and rapid expansion of City Gas Distribution network across the country. The increasing adoption of natural gas and increase in its consumption over the years bears testimony to the massive efforts gone in this direction.

The oil production during the year fell by around 5.2% to 30.5 MMT as against 32.2 MMT in the previous year mainly, due to dwindling output from matured fields and operational issues in some of the fields, declined further during the year 2020-21 due to pandemic caused interruptions.

During the year, India's natural gas consumption was 60.6 billion cubic metres (bcm), a fall from the previous year's 64.1 bcm. On the supply side, net natural gas production was 28.7 bcm, 8.2% lower than last year. LNG imports also fell by 3% to 32.9 bcm during the year, from 33.9 bcm in 2019-20.

During the year, ONGC (KG-DWN-98/2) and Reliance (KG-D6) managed to start gas production from deep-water blocks, a significant milestone in India's energy landscape for a cleaner and greener gas-based economy. Gas pricing and marketing reforms also continued during the year. An e-bidding platform was set up to allow price discovery for contracts with pricing freedom, while affiliates for gas sellers could bid for gas available for sale. Gas volumes are expected to rebound, owing to the large-scale rollout of CGD networks, setting up of fertiliser plants, expanding pan-India trunk pipelines network, the proposed launch of a gas trading hub, and the Government's thrust on a gas-based economy

The pandemic caused India's energy demand to fall for the first time in 20 years. The estimated fall was 2.5% year-on-year decline for 2020; however, the impact was not uniform across sectors. India's power demand was down by 1.2% in 2020-21, whereas oil consumption contracted by 19.5 MMT or 9.1%, compared to the previous year – making it the worst year for demand growth in nearly 50 years. Gas demand also fell by 5.5% during the year. For renewables, the total installed capacity increased by 7.4 GW in 2020 - 21 and renewable power generation grew by 6.4%. The share of renewable power increased to 11% in 2020-21 from 10% in 2019-20.

Energy demand is expected to recover stronger and faster, given the scale up of the vaccination drive, pick up in government spending and consumer demand, and increase in investments with impetus on making India self-reliant and a global manufacturing hub. This presents a significant opportunity for the oil and gas sector to partake in the growth and development of the country.

Energy Transition poses both – a threat as well as an opportunity for the Oil and Gas Industry. With the world moving decisively towards a low carbon future, a decline in the demand for oil is imminent, sooner or later, impacting the prospects and profitability of the industry.

Besides, rising incomes in emerging market and developing economies create strong underlying demand for mobility, offsetting reductions in oil use elsewhere. India is likely to experience strong demand for oil longer than the developed world, however, keeping pace with the global trends, India too has set ambitious targets in enhancing the capacity and usage of alternate fuels like gas, biofuels, nuclear energy, electrification of mobility, and renewable sources of energy, particularly solar and wind. The alternate fuels and renewables space present significant diversification opportunities for the domestic oil companies which need to keenly watch these developments and plan their strategies ahead of the curve to become integrated energy players.

(Source IEA Reports, Annual reports of ONGC, OIL, IOCL, BPCL and others etc.)

2.1. Policy

2014-15

1. New Domestic Natural Gas Pricing Guidelines, 2014

Date of Notification: 25.10.2014

The Government of India notified the New Domestic Natural Gas Pricing Guidelines, 2014. effective from 01 Nov'14. Domestic Natural Gas prices are being determined in accordance with the pricing formula dated 25.10.2014 and notified by MoPNG (PPAC) on half-yearly basis. In terms of these guidelines, domestic gas price is determined based on weighted average formula considering (a) annual average prices prevailing at Henry Hub, Alberta Hub, National Balancing Point (NBP) & Russia and (b) annual volume of natural gas consumed in USA & Mexico, Canada, European Union (EU) & Former Soviet Union (FSU) countries excluding Russia and Russia.

Prices notified w.e.f. 01.11.2014 are as under.

Considering above guidelines, new domestic gas price, notified by Government/ PPAC w.e.f. 01.11.2014 till date are as under:

Period	Applicable Domestic Gas Price (US$/MMBtu)	Equivalent Domestic Gas price (US$/MMBtu)
	GCV basis	NCV basis
01.11.14 to 31.03.15	5.05	5.61
01.04.15 to 30.09.15	4.66	5.18
01.10.15 to 31.03.16	3.82	4.24
01.04.16 to 30.09.16	3.06	3.40
01.10.16 to 31.03.17	2.50	2.78
01.04.17 to 30.09.17	2.48	2.76
01.10.17 to 31.03.18	2.89	3.21
01.04.18 to 30.09.18	3.06	3.40
01.10.18 to 31.03.19	3.36	3.73
01.04.19 to 30.09.19	3.69	4.10
01.10.19 to 31.03.20	3.23	3.59
01.04.20 to 30.09.20	2.39	2.66
01.10.20 to 31.03.21	1.79	1.99
01.04.21 to 30.09.21	1.79	1.99
01.10.21 to 31.03.22	2.90	3.22

2. Policy framework for relaxations, extension and clarifications at the development and production stage for early monetization of Hydrocarbon discoveries under PSC regime

Date of Notification: 10.11.2014

The salient features of the policy initiative are as follows: -

I. Extension of Appraisal period for submission of Declaration of Commerciality (DOC) in respect of Hydrocarbon discovery.

II. Extension of time period for submission of Field Development Plan (FDP) after review of DOC by the Management Committee.

III. Reduction in Minimum Work Program (MWP) in case a block or its part is not available for exploration activities consequent to denial of permission by Government Agencies.

IV. Swapping of 2D and 3D Seismic Minimum Work Programme, on the request of the operator.

V. In cases where the committed Minimum Work Programme of any exploration phase is not completed, entry into subsequent exploration phases, would be permitted after paying cost of unfinished MWP of previous phases.

VI. Condoning delays in submission of notice for entering next phase.

VII. Condoning delays in submission of Annual Work Programme and Budget and the Appraisal work programme.

VIII. Permission for drilling of Appraisal Wells after submission of DOC.

IX. Probing additional reservoirs during appraisal programme.

X. Acceptance of discoveries for which notification to the Government has not been made are also notification for testing has not been provided as prescribed.

Status of progress made

- Over 40 cases have been resolved under this policy. Extension of time period for submission of DOC were granted in 8 Blocks, Extension of time period for submission of FDP were granted in 6 Blocks
- Operator allowed to Exit in 14 Blocks whereas in 3 Blocks Minimum Work Programme (MWP) WP Reduction was granted & 2 applications are under consideration.
- Swapping of 2D and 3D seismic MWP were granted in 7 Blocks
- Entry into subsequent exploration phase, after paying cost of unfinished MWP of previous phases was granted in 1 Block
- One application was received for Condoning delays in submission of notice for entering next phase,
- Drilling of Appraisal Wells after submission DOC was granted in 3 Block
- Probing of additional reservoirs during appraisal programme was approved in 3 Block.

3. Policy on Testing requirements for discoveries in NELP Blocks

Date of Approval - 13.05.2015

Government of India approved a clear policy on testing requirements for discoveries made under New Exploration and Licensing Policy (NELP) Blocks. The policy settled the long pending issue about 13 discoveries in five blocks pertaining to ONGC (Seven discoveries) and Reliance Industries (six discoveries). The reform allows the contractors to choose one of the following three options for discoveries which are stuck on account of testing requirement:

1. Relinquish the blocks
2. Develop the discoveries after conducting Drill Stem Test (DST) with 50 percent cost of DST being disallowed as penalty for not conducting the test on time. The cost recovery for carrying out DST would be capped at US $ 15 million.
3. Develop the discoveries without conducting DST in a ring-fenced manner.

If the contractor does not opt for any one of these options suggested above within 60 days of the CCEA approval, then the area encompassing these discoveries shall automatically be relinquished."

Status of progress made

After availing this policy, KG-DWN-98/3 block has been put on Production, One FDP submitted for (Block NEC-OSN-97/2) is on hold due to MoD clearance at DGH, KG-DWN-98/2 Block is under Development & Two Blocks, (MN-DWN-98/3,MN-OSN-2000/2) were relinquished.

4. Discovered Small Field Policy (Earlier called as Marginal Field Policy)

Date of Notification: 14.10.2015

The Govt. approved the Marginal Field Policy (MFP) with the objective to bring marginal fields to production at the earliest and to augment the domestic production of oil and natural gas. For early monetization of these fields, in September 2015, Cabinet approved 69 marginal fields for offer under Discovered Small Fields Policy. These contract areas have been awarded under the new regime of Revenue Sharing Model. Award of contract is expected to provide faster development of fields and facilitate production of oil and gas thereby increasing energy security of the country. It is expected that in-place locked hydrocarbons volume of 40 MMT oil and 22.0 BCM of gas will be monetised over a period of 15 years.

Bid Rounds launched under Discovered Small Field Policy

The objective of the policy is to bring discovered small fields to production at the earliest to augment the domestic production of oil and gas.

Status of progress made

DSF Round – I

- Launched on 25th May 2016
- Offered 46 Contract Areas comprising of 67 fields/discoveries
- 134 bids received for 34 contract areas by 47 companies
- 30 Revenue Sharing Contracts (23 Onshore & 07 Offshore) were signed on 27th March, 2017 with the successful awardee companies for 30 Contract Areas with an area of over 776 sq. km and established hydrocarbon volume of 45 MMTOE

Salient Fiscal and Policy Features of DSF Rounds

- Single License for Conventional and Unconventional Hydrocarbons
- Revenue Sharing Contract
- Exploration allowed during entire contract period
- Royalty in line with HELP and no Cess
- No upfront Signature Bonus
- 100% participation from foreign companies/joint ventures
- Low Geological Risk

DSF Round – II

Discovered Small Field Bid Round-II was launched on 9th August 2018 and was concluded with award of blocks.

- Offered 25 Contract Areas comprising of 59 fields/ discoveries
- 145 bids were received for 24 contract areas
- 24 Revenue Sharing Contracts were signed on 07th March 2019 for 3,000 sq. km. and established hydrocarbon volume of 62 MMTOE
- Under two DSF Bid Rounds, a total of 54 contract areas were awarded of which, 38 contract areas awarded were onland and 16 remaining contract areas were offshore.
- Petroleum Mining Lease (PML) has been granted for 42 contract areas (27 Onland, 15 Offshore)
- PML is pending for 09 contract areas (Andhra Pradesh-05, Tamil Nadu-02, Arunachal Pradesh-01, Gujarat-01)
- 29 Field Development Plans (FDP) are under implementation with total in-place ~100 MMTOE and expected cum production of ~ 37 MMTOE contribution during field life.

Oil		Gas	
Year	Quantity (MMT)	Year	Quantity (BCM)
2021-22	0.28	2021-22	0.07
2022-23	0.89	2022-23	1.61
2022-23	1.27	2022-23	2.70
2023-24	1.32	2023-24	2.91

Details of future DSF Bid Round (DSF-III)

32 contract areas comprising 75 discoveries spread over approximately 13,204 square kilometer acreages across the country is going to be launched soon for extraction of hydrocarbons.

Technical Features of fields on offer:

- 32 Contract Areas are on offer which comprise of 75 oil & gas discoveries
- 11 Contract areas are located in onland, 20 Contract Areas are located in shallow water offshore and 1 Contract Area is located in deepwater offshore.
- Hydrocarbon in-place of over 232 MMTOE and are spread over 13,000 sq. km
- Data available for 24,659 LKM of 2D Seismic, 8,603 SKM of 3D seismic and 314 wells

Type	Contract Area	Discovery	MMToe	Area, Sq km
Onland	**11**	**19**	**24.3**	**3,332.6**
Assam-Arakan Fold Belt	2	3	0.4	590.8
Assam-Shelf	1	1	0.5	21.4
Cambay	1	1	2.2	150.8
Cauvery	1	1	6.1	463.2
KG Onshore	3	8	14.2	540.8
Rajasthan	2	3	0.8	93.9
Vindhyan Basin	1	2	0.1	1471.7
Shallow Water	**20**	**54**	**205.2**	**10,148.3**
Cambay	2	5	6.5	801.1
KG Offshore	6	18	88.5	1,278.5
Kutch	2	9	31.5	2,092.4
Mumbai	10	22	78.7	5,976.2
Deepwater	**1**	**2**	**2.5**	**203.9**
KG Offshore	1	2	2.5	203.9
Grand Total	**32**	**75**	**231.9**	**13,684.8**

2016-17

5. Marketing including pricing freedom for gas to be produced from Discoveries in Deepwater, Ultra Deepwater and High Pressure-High Temperature areas

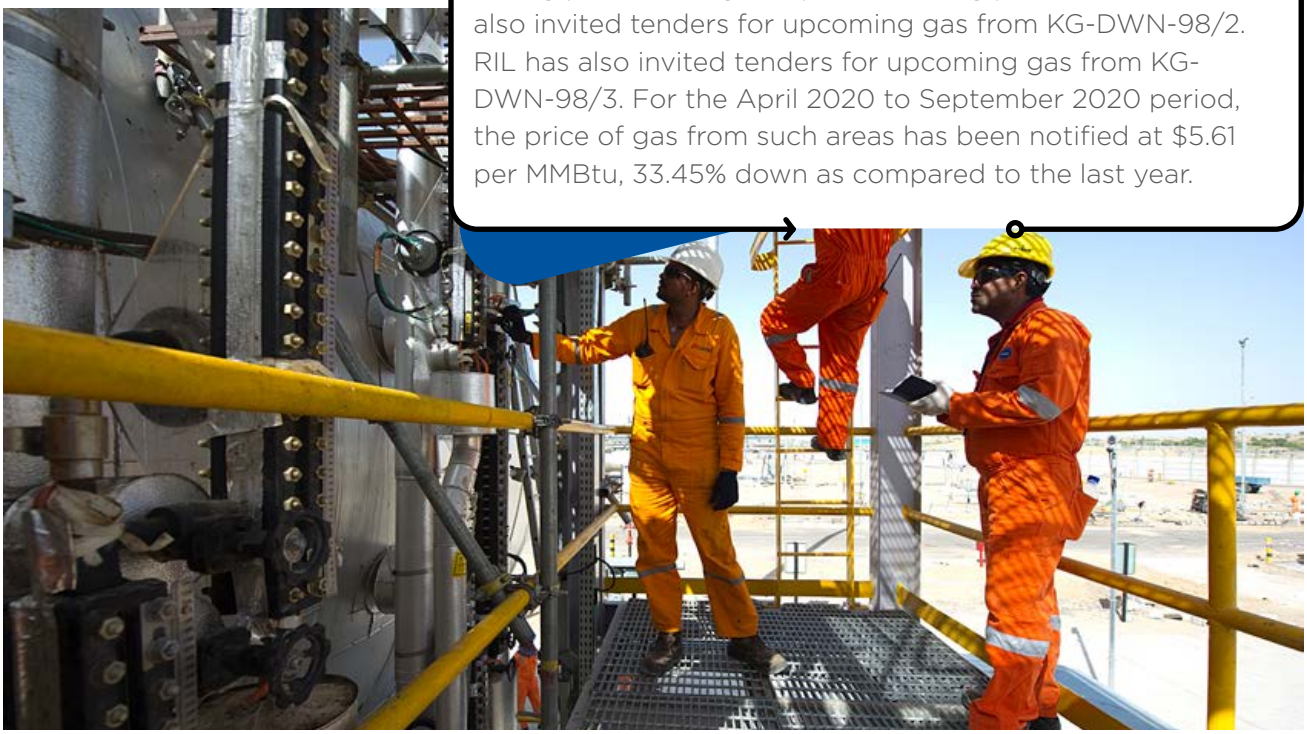
Date of Notification: 21.03.2016

On 10th March 2016, Government approved marketing and pricing freedom for Gas discoveries in High pressure, High Temperature, Deepwater and Ultra deepwater reservoirs. This shall incentivize exploration and production in Deep/ Ultra Deepwater/HPHT areas and will unlock huge Hydrocarbon potential. The ceiling gas price is determined (based on alternative fuels) by Government and notified till date (on GCV basis) are as under:

Period	Applicable Ceiling Price(US$/MMBtu)	Equivalent Ceiling price(US$/MMBtu)
	GCV basis	NCV basis
01.04.16 to 30.09.16	6.61	7.34
01.10.16 to 31.03.17	5.30	5.89
01.04.17 to 30.09.17	5.56	6.18
01.10.17 to 31.03.18	6.30	7.00
01.04.18 to 30.09.18	6.78	7.53
01.10.18 to 31.03.19	7.67	8.52
01.04.19 to 30.09.19	9.32	10.36
01.10.19 to 31.03.20	8.43	9.37
01.04.20 to 30.09.20	5.61	6.23
01.10.20 to 31.03.21	4.06	4.51
01.04.21 to 30.09.21	3.62	4.02
01.10.21 to 31.03.22	6.13	6.81

Status of progress made

ONGC has started producing gas from discoveries in deepwater ultra-deepwater, and High Pressure-High Temperature areas eligible under Notification dated 21.03.2016 from S1-VA field at East Coast from Aug'16. Such gas is presently being supplied to various customers (GAIL, GPPC, and other small customers) at prices finalized through tenders- lowest price being discount of US$ 1.11/MMBtu from ceiling price and highest price is ceiling price. ONGC has also invited tenders for upcoming gas from KG-DWN-98/2. RIL has also invited tenders for upcoming gas from KG-DWN-98/3. For the April 2020 to September 2020 period, the price of gas from such areas has been notified at $5.61 per MMBtu, 33.45% down as compared to the last year.



6. Policy for the Grant of Extension to the Production Sharing Contracts signed by Government awarding small, medium sized and discovered fields to private Joint Ventures

Date of Notification: 28.03.2016

On 10th March 2016, Government approved grant of extension to the Production Sharing Contracts for 28 small, medium sized and discovered fields signed by GoI and Pvt. JVs. Policy allows extension for a period of 10 years for both for Oil and Gas fields.

The Government approved the policy to grant extension for 10 years or economic life of the field, whichever is earlier, to small and medium sized discovered fields in March, 2016. The Government share of Profit Petroleum during the extended period of contract would be 10% higher for these fields. This extension policy is applicable for 28 discovered fields, out of which extension has already been granted for fields.

Status of progress made

Under this policy, 11 PSCs of Pre-NELP Discovered Fields have been extended by 10 years and 1 PSC of 1 no. of Pre-NELP Discovered Field (Hazira) have been extended by 5 years.

7. Hydrocarbon Exploration and Licensing Policy (HELP) along with Open Acreage Licensing Policy (OALP)

Date of Notification: 10.03.2016

Hydrocarbon Exploration and Licensing Policy (HELP) was launched with the clear objective of boosting the production of oil & gas in the Indian sedimentary basin. This policy is based on the new model of Revenue Sharing Contract (RSC) which has replaced the earlier model of Production Sharing Contract (PSC). Under HELP Open Acreage Licensing (OAL) mechanism has been launched which allows the investors to carve out blocks of their choice by assessing E&P data available at NDR & by submitting an Expression of Interest (EoI). EoI can be submitted throughout the year without waiting for a formal bid round from the government. OALP is supported with state of the art National Data Repository. National Data Repository which will provide rapid jumpstart to E&P activities by providing seamless access to the country's entire G&G data for interpretation and analysis.

Salient Features of HELP

- Unified license for all types of hydrocarbon viz. conventional oil and gas, coal-bed methane, shale oil, gas hydrates, etc.
- Revenue Sharing Model: Simple, easy to monitor; only two monitoring parameters for the government-revenue & production of the contractor, no cost recovery; no micro-management by the Government; operational freedom to the operator.
- Freedom to carve out blocks round the year through 3 EoI submission windows.
- Reduced and graded royalty rates. Further to encourage exploration in deepwater and ultra-deep-water areas, the royalty was exempted for first seven years (and subsequently royalty of 5% and 2% applicable in deepwater and ultra-deepwater areas).
- Other fiscal incentives viz. exemption of cess on crude oil and custom duty applicable on equipment/ services for exploration and production activities.
- Full marketing and pricing freedom of gas produced on arm's length basis.
- Extended period for exploration and production i.e. 8 years for onland/ shallow water and 10 years for deep water/ frontier areas.
- Pre-determined Liquidated Damages (LDs) for any shortfall in committed work program.

Status of progress made

Total OALP Rounds conducted till date: 06 Rounds (Blocks under VI round yet to be awarded. Awaiting ECS approval)

Total No. of blocks and area awarded: Till OALP-V, 105 Blocks awarded with total acreage of 1,56,579 sq. km.

Bid Rounds	Number of Blocks	Area Awarded (sq.km)	Cumulative area
OALP-I	55	59,282	59,282
OALP-II	14	29,233	88,515
OALP-III	18	29,765	1,18,280
OALP-IV	7	18,510	1,36,790
OALP-V	11	19,789	1,56,579
OALP-VI	21*	35,346*	1,91,925*

*Blocks to be awarded soon

Type of blocks and area awarded: (till round V)

Type of blocks	Blocks	Area Awarded (sq.km)
Onland	83	1,00,605
Shallow Water	18	41,330
Deepwater	2	9,065
Ultra-Deepwater	2	5,578
Total	**105**	**1,56,578**

Companies operating in OALP Blocks (till round V)

No.	Company	No.	Company
1	VEDANTA	5	IOCL
2	OIL	6	GAIL
3	ONGC	7	BPRL
4	RIL+BP (JV)	8	HOEC

Committed Work Programme and Investment in 6 OALP Bid Rounds (Mn USD)

Round	2D (LKM)	3D (SKM)	Expl. Wells (No.)	Core Analysis (No.)	Investment (mn USD)
I	9,350	19,732	178	172	815
II	11,110	8,842	46	38	452
III	7,410	12,247	84	80	708

Round	2D (LKM)	3D (SKM)	Expl. Wells (No.)	Core Analysis (No.)	Investment (Mn USD)
IV	1,400	2,450	61	0	341
V	495	1,065	11	0	61.9
VI*	520*	11,168.7*	75*	0	600.1*
Total	**30,285**	**55,505**	**455**	**290**	**3,077.28**

Details of OALP Bid Round-VI and VII:

The 21 blocks offered under OALP Bid Round-VI will be awarded in January-February (Tentatively). The next OALP Bid Round-VII launched in 16.12.2021.

2017-18

8. Policy for the Grant of Extension to the Production Sharing Contracts signed by Government of India awarding Pre-New Exploration Licensing Policy (Pre-NELP) Exploration Blocks

Date of Notification: 22.03.2017

This policy enables the contractors to extract not only the remaining reserves but also plan to extract additional reserves by implementing new technologies. The policy will give boost to accelerate and supplement indigenous production of hydrocarbon from existing blocks and act as a progressive step towards achieving the target of 10% reduction in import of crude oil by 2022.

2017-18

Status of progress made

Total 110 PELs (includes multiple PELs for the same Block) for granted out of 105 blocks of OALP Round I to V and the exploration activities are in progress in the blocks where PEL has been granted.

9. Early Monetization of CBM

Date of Notification: 11.04.2017

The policy is expected to boost CBM production to 6 MMSCMD by 2018- 19 and generate new avenues of employment and increased investment in CBM blocks.

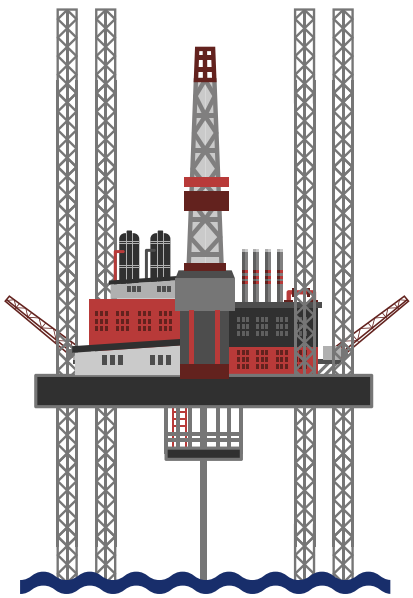
It is also envisaged that 14 CBM blocks which are under relinquishment will be provided an easy exit option under the policy.

Status of progress made

After implementation of policy, one GSA (Gas Sales Agreement) was signed as per clause 1.1 of the policy in Raniganj East CBM Block. Exit from 8 CBM Blocks was approved after notification of the policy. CBM production during 2020-21 was ~1.76 MMSCMD in the country.

Status of progress made

10 blocks are applicable under the policy. Out of which, extension of 10 years has been granted to Pre-Nelp Exploration block RJ-ON-90/1. 6 blocks have more than 2 years for expiry of PSC. One (1) block is terminated. Remaining 2 blocks are exploration blocks under PSC.



10. Survey of Un-Appraised Areas of Sedimentary Basins of India.

Date of Notification: 12.09.2017

The project was sanctioned to acquire 48,243 Line Kilometer (LKM) 2D seismic data for appraisal of Indian sedimentary basins where limited data is available. The project will be implemented by NOCs, i.e. Oil India Limited (OIL) and Oil and Natural Gas Corporation (ONGC). OIL will conduct survey in North - Eastern States while remaining area will be covered by ONGC. Survey work will be carried out in 24 States over a period of 5 years. The timeline to complete the project was till June 2020. Due to the Covid-19 restrictions and lockdown, MoP&NG has been requested to extend the timeline till June 2021. The remaining work with an aim to complete the project by June 2021.

Status of progress made

Till end of March 2021, cumulative data acquisition by ONGC and OIL are 41,137.01 LKM and 4,866.54 LKM respectively. Processing of 39,268.43 LKM and interpretation of 35,047.29 LKM data is completed by ONGC whereas Processing & Interpretation of 4,632.54 LKM data is completed by OIL. So far, total 44,259.44 LKM raw data, 43,900.97 LKM processed data and 39,679.83 LKM interpreted data have been submitted to NDR, DGH by both the implementing agencies. Validation of these data submitted by NOCs is under progress at NDR, DGH.

DGH reviewed the progress of work and construed that reasons for shortfall in completing the project target are inevitable. The ideal time to conduct the survey is from October till June. Some of the areas could not be covered due to hostile environment nationwide lockdowns due to Covid-19 and difficult terrain which considerably hampered the work progress.

2018-19

11. Delegating powers to award of contract areas to Minister of Petroleum & Natural Gas and Minister of Finance on the recommendations of Empowered Committee of Secretaries (ECS)

Date of Notification: 29.06.2018

In line with the Government initiative of ease of doing business, the approval for delegating the powers to Minister of Petroleum and Natural Gas and Finance Minister to award the Blocks/Contract Areas to successful bidders under Hydrocarbon Exploration and Licensing Policy (HELP) after International Competitive Bidding (ICB) based on the recommendations of Empowered Committee of Secretaries (ECS). Under HELP policy, this delegation of powers has expedited the decision-making process on awarding blocks and give a boost to the initiative of ease of doing business. .

12. Exploration and Exploitation of Coal Bed Methane (CBM) from areas under Coal Mining Lease allotted to Coal India Limited (CIL) and its subsidiaries

Date of Notification: 11.04.2018

The decision is in line with the Government's initiatives of 'Ease of Doing Business' and reducing the hydrocarbon import. The amendment will expedite the exploration and exploitation of CBM, enhance the availability of natural gas and reduce the gap in demand and supply of natural gas. The increased development activities for exploration and exploitation of CBM gas reserves in-and-around the block will generate economic activities which in turn has potential to create employment opportunities in CBM operations and in the industries"

Status of progress made

In pursuant to CCEA decision policy has been notified on 08.05.2018. Notification has been sent to Ministry of Coal for taking further action as per notification. Model Agreement for CBM operations by CIL and its subsidiaries was sent to MOPNG for approval 07.05.2019. CIL has understandably come out with a tender for carrying out CBM operations in their Jharia and Raniganj Coal Fields. However, no contract as per clause ix of the policy has been signed between MOPNG and CIL (or its subsidiaries).

13. Policy Framework for Streamlining working of Production Sharing Contracts in respect of Pre-NELP and NELP Blocks

Date of Notification: 14.08.2018

The policy framework includes:

i. Special dispensation for E&P activities in North Eastern Region (NER). Based on recommendations in 'Hydrocarbon Vision 2030 for North East', Government has extended timelines for exploration and appraisal period in operational blocks of North Eastern region of India considering geographical, environmental and logistical challenges. The exploration period has been increased by two years and appraisal period by one year. Further, to stimulate natural gas production in NER, Government has also allowed marketing including pricing freedom for natural gas to be produced from discoveries which are yet to commence production as on 1st July, 2018. PSC blocks in NER will be benefited from this special dispensation.

ii. Sharing of Royalty and Cess in Pre-NELP Exploration Blocks. Government has created an enabling framework for sharing of statutory levies including royalty & cess in proportion to the participating interest of the Contractor in Pre-NELP Exploration Blocks, and same has been made cost recoverable with prospective effect. This will benefit Pre-NELP Exploration Blocks in which fresh investment for additional development & production activities is expected as sharing of royalty and cess, and cost recoverability of same will help in making additional investment commercially viable for licensee company; ONGC/OIL.

iii. Extending tax benefits under Section 42 of Income Tax, 1961 prospectively to operational blocks under Pre-NELP discovered fields for the extended period of contract under PSC extension policy dated 28th March 2016. Section 42 of Income Tax allows the companies to claim 100% of expenditure incurred under a PSC as tax deductible for computing taxable income in the same year. While signing PSC of Pre-NELP discovered fields, 13 contracts out of 28 contracts did not have provision for tax benefit under Section 42 of Income tax Act. Now, this will bring uniformity and consistency in PSCs and provide incentive to contractor to make additional investment during the extended period of PSC.

iv. Relaxing the timeline from 7 days to 15 days for giving written notice to notify the occurrence of a Force Majeure event in the PSCs.

Status of progress made

Using this policy, Excusable Delay was granted in 5 blocks whereas 2 applications are under consideration.

14. Policy Framework for Exploration and Exploitation of Unconventional Hydrocarbons under Existing Production Sharing Contracts (PSCs) Coal Bed Methane (CBM) Contracts and Nomination Fields

Date of Notification: 20.08.2018

This policy will enable the realization of prospective hydrocarbon reserves in the existing Contract Areas which otherwise would remain unexplored and unexploited. With this policy dispensation, new investment in Exploration and Production (E&P) activities and chances of finding new hydrocarbon discoveries and resultant increased domestic production thereof is expected. This will lead to induction of new, innovative and cutting-edge technology and forging new technological collaboration to exploit unconventional hydrocarbons."

Status of progress made

NOC's are carrying out shale Oil/Gas Exploration work in their PEL/PML areas. Operators of blocks Raniganj (South) and RG(East)-CBM-2001/1 have evinced their interest to carry out shale operations in their blocks. In addition, ONGC is carrying out Shale Oil/Gas exploration work in their PML blocks in Cambay and KG Basin

15.Exploration and Exploitation of Coal Bed Methane (CBM) from areas under Coal Mining Lease allotted to Coal India Limited (CIL) and its subsidiaries

Date of Notification: 08.05.2018

Model Agreement for CBM operations by CIL and its subsidiaries was sent to MOPNG for approval 07.05.2019.

CIL has come out with a tender for carrying out CBM operations in their Jharia and Raniganj Coal Fields. However no contract as per clause ix of the policy has been signed between MOPNG and CIL (or its subsidiaries).

16. Policy framework to promote and incentivize enhanced recovery methods for Oil and Gas

Date of Notification: 10.10.2018

The objective of the ER Policy is to encourage and incentivize additional investments towards adoption of enhanced recovery techniques through fiscal waivers to increase domestic hydrocarbon production. The policy aims at building a supportive ecosystem through academic and research institutes, industry-academia collaboration and to support and encourage Exploration and Production (E&P) Contractors to deploy ER/IR/ UHC Methods/ techniques.

Salient Features of policy are as follows:

- ER Policy is a framework to promote and incentivize Enhanced Recovery (ER)/Improved Recovery (IR)/ Unconventional Hydrocarbon (UHC) production methods/techniques to improve recovery factor of existing hydrocarbons reserves for augmenting domestic production of oil and gas.
- The policy includes Enhanced Oil Recovery (EOR) and Enhanced Gas Recovery (EGR), Unconventional Hydrocarbon (UHC) production methods include Shale oil and gas production, tight oil and gas production, production from oil shale, gas hydrates and heavy oil.
- The policy will be applicable to all contractual regimes and Nomination fields.
- The policy, having a sunset clause, will be effective for 10 years from the date of its notification. However, the fiscal incentives will be available for a period of 120 months from the date of commencement of production in ER/ UHC projects.
- In case of IR Projects, the incentives will be available from the date of achievement of the prescribed benchmark.

- The fiscal incentives are extended in form of partial waiver of applicable Cess/Royalty on incremental production resulting from the adoption of ER methods on designated wells.
- An Enhanced Recovery (ER) Committee comprising of representatives of Ministry of Petroleum & Natural Gas, Directorate General of Hydrocarbons (DGH), experts from upstream sector, and academia would monitor and implement the Policy.
- The Policy envisages systemic assessment of every field for its ER potential, appraisal of appropriate ER techniques and fiscal incentives to de-risk the cost involved in ER Projects to make the investment financially viable.
- Mandatory Screening of fields through designated institutions, and conducting Pilot before actual implementation of ER Project on commercial level.

Technological interventions have significant potential in stimulating the recovery of hydrocarbon reserves from the matured/aging fields. An increase by 5% in recovery rate of original in-place volume in oil production is envisaged producing 120 MMT additional oil in next 20 years. In case of gas, an increase of 3% recovery rate on original in- place volume is envisaged, leading to additional production of 52 BCM of gas in next 20 years.

The implementation of the policy broadly involves 3 major stages – screening studies, pilot phase and commercial implementation.

i. **Stage I**: The first stage is the screening of ER methods compatible with the field/reservoir under consideration and selection of the most appropriate ER method accordingly.

ii. **Stage-II**: The second stage is the pilot phase of an ER project which commences after the approval of ER proposals/screening report by DGH.

iii. **Stage III**: The third stage is the commercial implementation of the ER method by the Operator post a successful pilot phase.

After the completion of the pilot phase, which usually takes 2 to 3 years, an assessment based on the pilot performance is carried out by the Operator to formulate a commercial ER implementation plan for the field. Based on this plan for commercial ER implementation, The ER Committee decides upon the quantum of fiscal incentive to be made available to the operator for the project under the ER Policy.

Status of progress made

a) 202 fields preliminarily screened

b) 34 suitable ER fields identified

c) 15 ER proposals approved for commencement of pilot phases

d) Estimated CAPEX > INR 1,950 cr. in ER pilot phases

e) Envisaged ER production > 11.5 million barrels from ER pilot phases

f) Identified commercial potential to recover>250 MMBOE by implementation of ER/IR/UHC methods with potential investment opportunities to the tune of INR 15,000 cr.

17. Reforms in Exploration and Licensing Policy for enhancing domestic exploration and production of oil and gas.

Date of Notification: 28.02.2019

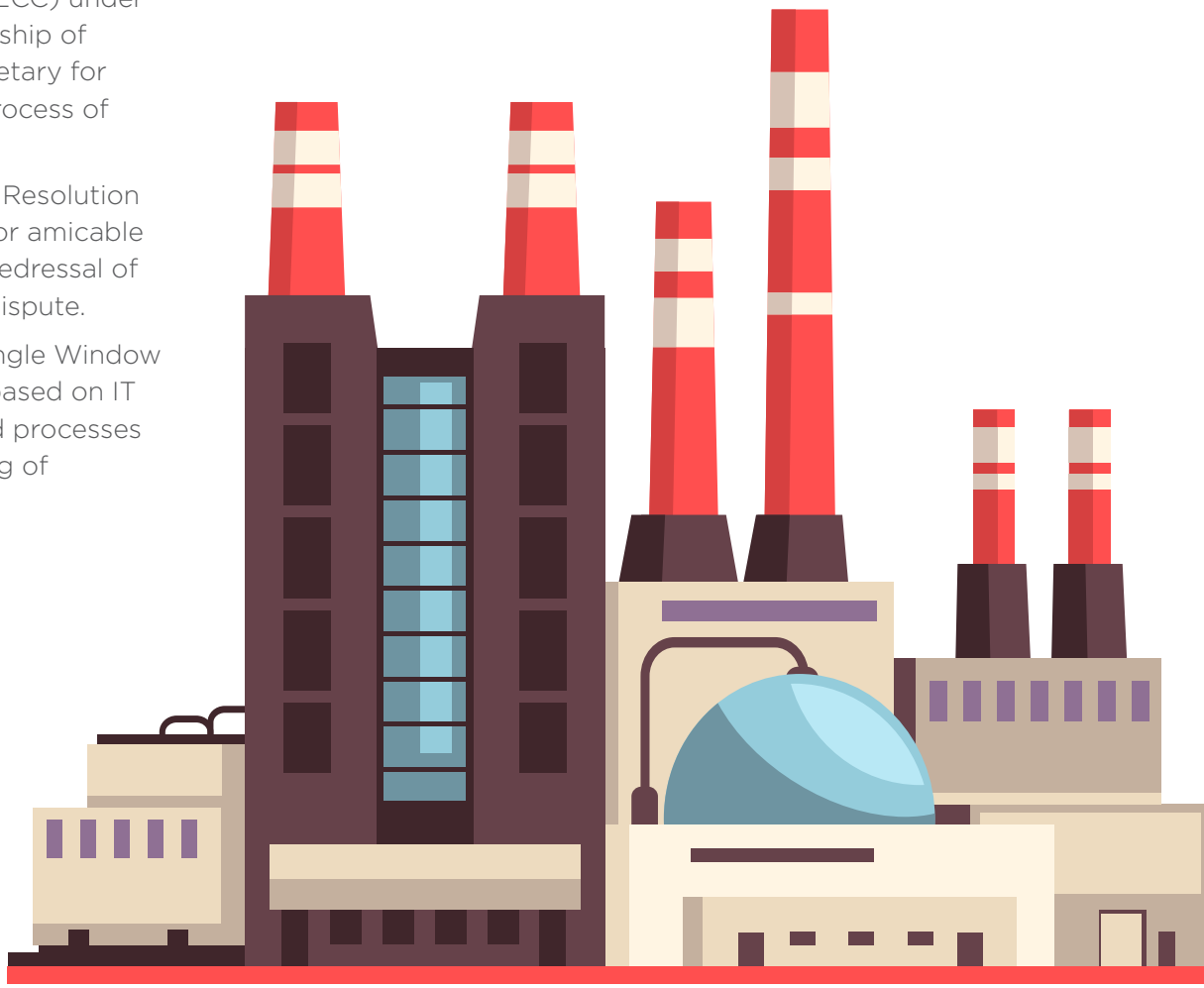
Government notified 'Reforms in Exploration and Licensing Policy' in February 2019, with the objective to intensify exploration activities, attract foreign and domestic investment and enhance domestic production. E&P companies under the Reformed Policy will get

following exclusive benefits during contract period:

1. No Revenue Sharing with Government in Category-II & III sedimentary basins except in case of "Windfall Gain";
2. Royalty concessions for early monetization and commercial production;
3. In Category-I sedimentary basin Revenue share at HRP capped at 50%;
4. Simplified contractual terms with emphasis on cutting down approvals of Government/DGH/ Management Committee and expeditious grant of approvals;
5. Empowered Coordination Committee (ECC) under the chairmanship of Cabinet Secretary for expediting process of approvals;
6. New Dispute Resolution Mechanism for amicable and speedy redressal of contractual dispute.
7. Electronic Single Window mechanism based on IT workflow and processes for processing of approvals.

Summary of initiative

- All discoveries and field development plans approved after 28 Feb 2019 have complete market and pricing freedom.
- In case of the existing contracts, marketing and pricing freedom to sell on arm's length basis through competitive bidding will be permitted to those new gas discoveries whose Field Development Plan (FDP) will be approved for the first time after the date of issuance of this policy.
- In case of nomination fields given to NOCs, marketing and pricing freedom will be provided subject to the condition that FDP for new gas discoveries is approved by DGH. The New Domestic Natural Gas Pricing Guidelines, 2014 and Gas Utilization/ Allocation policy will not be applicable on such new gas discoveries.
- To incentivize additional gas production from Administered Price Mechanism (APM) fields, reduction in royalty by 10% of the applicable royalty will be granted on the additional production over and above BAU scenario. BAU scenario will be approved by DGH on third party evaluation.



- Existing contracts already having marketing and pricing freedom would continue the existing terms

Situation Pre-Intervention

- Complete marketing and pricing freedom not applicable to nomination fields given to NOCs
- Marketing and Pricing Reforms for Natural Gas (Under reforms in Hydrocarbon Exploration and Licensing Policy for enhancing domestic exploration and production of oil and gas introduced in March 2019) Gazette notification No. O-12015(11)/1/2019-ONG-II dated 06.03.2019

Post-intervention data

- Nomination fields given to NOCs, marketing and pricing freedom will be provided subject to the condition that FDP for new gas discoveries is approved by DGH.

The FR for new discoveries for availing marketing and pricing freedom has been approved for GK-28/42 field of ONGC vide DGH's letter dated 29.07.2019. The details of the said approved FR are as given below:

i. GIIP: 15.89 BCM (Recovery factor 58.02%)

ii. EUR: 9.22 BCM

iii. Peak Production rate: 2.97 MMSCMD

iv. Field life: 2021-22 to 2032-33

- All discoveries and field development plans approved after 28 Feb 2019 have complete market and pricing freedom.

No.	DoC/FDP/RFDP of	Block Name	Date of Review/ Approval by MC	GIIP	EUR (Gas)	OIIP	EUR (Oil)	No. of Dev. wells
1	FDP of KHUBAL#4, #7	AA-ONN-2001/1	01.07.2019	3.931 BCM	1.5741 BCM	-	-	6 (2 EX-ISTING +4 NEW)
2	FDP of GSS-041NAA-2	GS-OSN-2004/1	17.06.2019	17.3 BCM	9.63 BCM	NIL	NIL	14
3	FDP of MBS051NAA-1	MB-OSN-2005/1	02.02.2021	11.89 BCM (NAA)	Gas:7.31 BCM, Condensate: 0.90 MMm3	-	-	7

- Gas production from NOCs Administered Price Mechanism (APM) fields are getting benefit of reduction in royalty by 10% of the applicable royalty on the additional production over and above BAU scenario (approved by DGH on third party evaluation)

The third party vetted BAU gas profiles have been approved by DGH for FY 2019-20 and 2020-21 for ONGC and OIL. The details are as given below:

FY 2019-20

i. The third party vetted BAU gas profiles for 51 fields were approved for ONGC vide DGH's letter dated 30.03.2020. As per ONGC's submission, the royalty benefit has been availed for Rupees 10.1 crores against additional production of 1.78 BCM of gas over and above BAU profile.

ii. The third party vetted BAU gas profiles for 11 fields were approved for OIL vide DGH's letter dated 18.04.2020. As per OIL's submission the royalty benefit has been availed for Rupees 92.6 Lakhs against additional production of 136.48 MMSCM of gas over and above BAU profile.

FY 2020-21

i. The third party vetted BAU gas profiles for 81 fields were approved for

ONGC vide DGH's letter dated 17.02.2021.

As per ONGC's submission the royalty benefit has been availed for Rupees 9.52 crores against additional production of 2.32 BCM of gas over and above BAU profile.

ii. The third party vetted BAU gas profiles for 16 fields were approved for OIL vide DGH's letter dated 07.04.2021.

As per OIL 's submission the royalty benefit has been availed for Rupees 96.11 Lakhs against additional production of 184.57 MMSCM of gas over and above BAU profile.

Impact of Intervention

Gas producers are realizing the benefit of new policy in terms of better prices, lesser levies and increase in gas production as per applicable clause of the policy

2020-21

18. Guidelines for Early Monetization of Hydrocarbon discoveries under Production Sharing Contracts (PSCs) and Revenue Sharing Contracts (RSCs)

Date of notification: 25.06.2020

To encourage and facilitate early monetization of discovery (ies), MoPNG has laid down following guidelines to enable early monetization of discovery (ies) in contract areas under Production Sharing Contracts (PSCs) and Revenue Sharing Contracts (RSCs),

- In terms of the contractual provisions the timelines given under the Article on "Discovery, Development and Production" or similar Articles of the PSC/ RSC are the maximum timelines for development and monetization of discoveries. There are no restrictions on monetization of discovery at an early stage within these timelines.
- Accordingly, the Contractor may develop and monetize such early stage discovery/discoveries before completion of Appraisal, Declaration of Commerciality (DoC) and submission of Development Plan (DP)/ Field Development Plan (FDP) etc. in blocks under exploration period, subject to the following:
- Pursuant to a discovery made in the block, the Contractor may submit to DGH its plan to develop (referred to as Early Development Plan), along with relevant details including development plan, estimated cost and production profile, and request for granting Petroleum Mining Lease (PML). Such request for PML may be processed at DGH as per the applicable Petroleum & Natural Gas Rules for recommendation to competent authority for grant of PML.
- At the time of approval of DP/FDP (as defined in PSC/RSC) for development of the total Block/Development Area, all such discoveries for which PMLs would be granted for early monetization shall be subsumed in the total Development Area and PML of the Block/ Development Area, as the case may be.
- The production ensuing from such discoveries shall be considered as 'Commercial Production' and payment of statutory levies, Cost Recovery, sharing of Profit Petroleum, Revenue sharing, etc., as the case shall be as per provisions of respective PSC/RSC and other extant rules/ regulations/guidelines.

Status of progress made

Benefitting from these guidelines, Asokenagar-1 discovery of ONGC is monetized and put on production in December 2020.

19. Self-certification of processes under Production Sharing Contracts (PSC)

Date of Notification: 28.02.2020

A review of the processes for various approvals and submission of documents for the same under Production Sharing Contracts (PSC) under NELP/Pre-NELP has been undertaken. The documents

are submitted to Directorate General of Hydrocarbons (DGH) and/or Ministry of Petroleum and Natural Gas (MoPNG) The government reviewed the processes and segregated 37 processes into three categories A) 22 Processes where documents shall be accepted on self-Certification basis and no approval is required; B) 3 Processes where approval will be deemed on expiry of 30 days of submission of self-certification of documents and C) 12 Processes where approvals shall be required under the Act/Rules or Contracts.

Notwithstanding above, in a bid to enhance ease of doing business the above processes have been further rationalised & linked to 18 process of contract compliance by merging or subsuming in other process or in factsheet

20. Natural Gas Marketing Reforms.

Date of Notification: 15.10.2020

1. GoI Vide its Gazette Notification No. Expl-15022(13)/234/2019-ONG-DV (P-32114) dated 15th October,2020 notified "Natural Gas Marketing Reforms" with an objective of increasing domestic production of Natural Gas, to move towards gas based economy, bring uniformity in process of discovery of market prices of gas and to promote Ease of Doing Business, wherein
   i. Sale to Affiliates allowed
   ii. Marketing freedom is granted for NG produced from FDPs which were approved before 28th Feb,2019 pertains to PSCs, where Contractor has pricing freedom but not market freedom is restricted
   iii. Contractor mandated to get the bids invited through electronic Bidding portal to discover the market price. DGH will empanel the Independent Agencies.
2. Further, GoI its Gazette Notification No. Expl-15022(13)/234/2019-ONG-DV (P-32114) dated 3rd December,2020 notified process to "Discovery of Market price for Domestically Produced Natural Gas through e-bidding" wherein the following Agencies were declared to independently carry the electronic bidding Process.
   i. M/s SBI Capital Markets Ltd.
   ii. M/s Mjunction Services Ltd.
   iii. M/s RITES Ltd.
   iv. M/s MSTC Ltd.
   v. M/s CRISIL Risk and Infrastructure Solutions Ltd (CRIS).
3. Pursuant to empanelment, e-bidding through empanelled agencies carried out successfully for ~20 MMSCMD (19.67 MMSCMD) [Dec,20-Oct,21] and price discovery process happened through e-bidding. Operator wise details are as below: -

S. No	Operator /Contractor Name	Block	Quantity, MMSCMD	E-bidding agency
1	RIL & BPEAL	KG-DWN-98/3	7.50	CRIS
2	RIL& BPEAL	KG-DWN-98/3	5.50	CRIS
3	Vedanta	RJ-ON-90/1	4.30	Mjunction
4	RIL CBM	CBM Block SP(West)-CBM-2001/1	0.82	CRIS
5	HOEC	AAP-ON-94/1 (Dirok)	1.25	MSTC
6	Vedanta	AA/ONDSF/Hazariga-on/2018	0.10	Mjunction
7	Antelopus	AA/ONDSF/Duarma-ra/2016	0.20	CRIS

*ONGC 2.0 MMSCMD e-bidding process stopped due to Delhi High Court stay order

2.2. Ease of Doing Business: A sneak preview of recent initiatives

1. A dedicated 'Hydrocarbon Clearance Cell' has been institutionalized within DGH. The cell liaises with Central/State Government authorities for expeditious grant of clearances/ approvals.
2. To facilitate E&P operators and monitor the approvals/clearances, URJA PRAGATI (Upstream Response by Joint Action for PRoActive Governance And Timely Implementation) web-based interactive portal has been launched recently by DGH to prioritize and flag the long pending issues concerning the upstream hydrocarbon sector involving various stakeholders such as Operators, Central Ministries and State Governments.
3. Creation of North-East Coordination Committee (NECC): NECC under HCC (Hydrocarbon Clearance Cell) of DGH created in September, 2021 and 15 Coordinators are placed with various Departments of State Govts of Assam, Arunachal Pradesh and Tripura for ease of processing Clearance and Approval proposals under various environmental regulations as well as expediting the other issues related to Oil & Gas E&P activities requires administrative/ regulatory supports from the State Govt.
4. Reduction in 'No go' areas: Close to 40% of offshore sedimentary area (1.73 million Sq. Km.) is in 'No Go' zone. DGH in consultation with MoP&NG is working on a mechanism for systemic release and rationalization of 'No Go' areas by MoD. All new exploration and development acreages have pre-marked 'No Go' areas, defense installations, forest/ wildlife/ESZs or EFAs, etc. prior awarding the block. This exercise is further getting mapped exhaustively for facilitating bidders.
5. Upstream India Portal: To extend additional facilitation and bring about effective interaction and seamless coordination among various E&P operators and other stakeholders, an online platform 'Upstream India' portal was launched which provides handholding to E&P operators along with services like sharing of facilities/infrastructure available at DGH, creation of a Knowledge Sharing Platform, organization of regular Workshops/ Seminars/ Conferences/ Training Sessions/ Discussions etc. on latest Government Policies/ Technologies/Usage of Inventories etc. Through the portal, the operators may book a slot in DGH G&G Workstation, Virtual Reality Centre etc. The portal provides easy access to the latest information regarding policies, important government circulars/ notifications, workshops/ conferences, events etc. DGHs existing Single Window System has been envisioned to be integrated with the Upstream India portal thereby creating a single window for all E&P operators for any kind of approval, contract management, clearance, facilitation, etc.
6. Reforms in Essentiality and Project Authority Certificates: DGH issues Essentiality Certificates for enabling duty free import of goods and procurement of indigenous goods at reduced GST rates. Essentiality Certificate (both Import & Indigenous Items) of approx. Rs 16838 Crore issued by EC Section. This translates into approximately 10, 000 of certificates till Nov '2021.

a) As a part of making digital certificates available to the operators for the items imported from Special Economic Zone (SEZ), an online system has been developed and has been integrated with NSDL Portal (under Ministry of Commerce). Now the Operators can download the certificates after logging in to

NSDL portal. With this integration, ECMS system is now connected with e-SANCHIT of customs (for imported goods from port/airport), GSTN (for indigenous items) and NSDL (for items imported from SEZ).

b) New features in ECMS portal such as utilization certificates for issued EC, specific alphanumeric EC series for major Operators have been added for better monitoring of the issued EC.

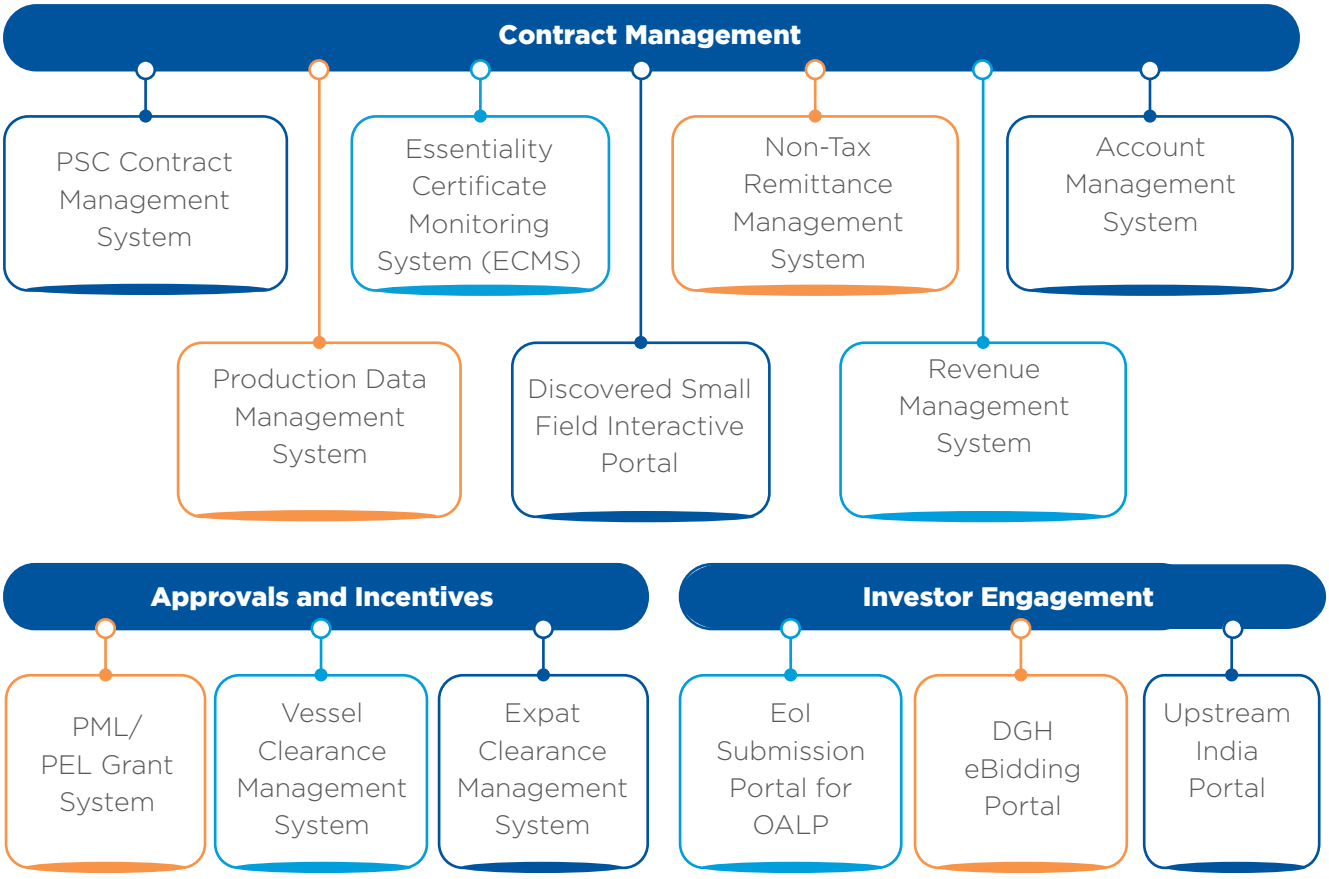
c) Industry concern regarding requirement of Essentiality Certificate at each leg of the movement of the item (requirement of dual EC-one at the time of import and another for subsequent movement) has been resolved. Ministry of Finance has issued detailed notification regarding the same.

d) List of the items based on which EC is issued has been rationalized and has been submitted to Ministry of Finance for issuing amended Notification. This is first such exercise carried out by DGH since issue of the Notification in year 2002 and has potential to reduce imports and promote indigenous goods

2.2.1. Digital Initiatives

Encouraging Ease of Doing Business in the sector, strengthening technological prowess and making governance electronic and automatic are some of the priorities for the government. Aligned to the vision, DGH has introduced host of applications and systems to assist the operators for hassle free operations, transparent contract management, expediting grant of approvals & clearances and engagement with the potential Investors.

An online system for internal work processes and approvals under PSC of Pre-NELP/NELP blocks has been implemented for effective contract management. Considerable progress has been made for similar transition to online systems for CBM and Revenue Sharing Contracts. Further, online systems have been developed for grant of PEL/PML and Issuance of Essentiality Certificate for duty free import of goods. Environment, forest and wildlife clearances are one of the crucial clearances in the E&P operations. DGH in discussion with MoEF&CC has facilitated the links of PARIVESH under its single window clearance portal for viewing the status of online applications submitted by upstream hydrocarbon exploration companies in the country. As a step forward, government is mulling over ways to further enhance the features of single window clearance system for benefit of the operators. A brief about the digital initiatives at DGH is as follows:



1) Production Sharing Contract Management System (PSCMS):

Launched on 1st April 2019, PSCMS is a workflow-based system with 47 PSC processes requests for approval in order to clear proposals and manage contracts contract management for PSC Blocks/ Fields. Ease of doing business is one of the focus areas of the Government in E&P sector with the objective to increase investment and production. Simplification of procedures and processes makes the system transparent and faster which facilitate investments in the sector. The Govt. introduced Production Sharing Contract Management System in a bid to ensure hassle-free contractual submissions by the operator. Introduction of PSCMS aims at reducing the paperwork and expediting approval of processes necessitated under the contract. Further, the Govt. is also mulling over further pruning of processes under PSCs and rationalise them on self-certification basis. The Govt. is confident that simplification of procedures and processes shall reduce the regulatory burden on operators and allow them to focus on exploration and production activities.

2) PSC Self-certification (Simplification of procedures and processes under Production Sharing Contract of Pre-NELP/NELP Blocks)

An extensive review of the processes for various approvals and submission of documents under Production Sharing Contracts (PSC) of NELP/Pre-NELP blocks was undertaken at DGH and the extant processes were divided into three categories:
(A) Processes where documents shall be accepted on self-Certification basis and no approval is required: **22**;
(B) Processes where approval will be deemed on expiry of 30 days of submission of self-certification of documents: **03**;
(C) Processes where approvals shall be required under the Act/Rules or Contracts: **12**.

MoP&NG vide OM dated 28.02.2020 conveyed approval of aforesaid processes.

In order to enhance the ease of doing business, the above processes have been further rationalized and limited to:

(A) Processes where documents shall be accepted on self-certification basis and no approval is required: **09**; (B) Processes where approval will be deemed on expiry of 30 days of submission of self-certification of documents: **03**; (C) Processes where approvals shall be required under the Act/Rules or contracts: **06**. Thus, the 37 erstwhile processes of contract compliance are now covered by 18 processes of contract compliance by merging or subsuming in other process or in the factsheet.

An online PSC Management System (PSCMS) Portal was created wherein all the aforesaid 18 processes were implemented online. Additionally, an online factsheet has been developed wherein all the basic details of the block/field can be updated and was made accessible to both DGH and respective Contractor.

DGH developed the standardized format for each process in consultation with Stakeholders & Stakeholder community. Multiple online workshops were conducted to handhold stakeholders and to seek suggestions for making PSC-MS system more user friendly.

A self-certification helpdesk is created wherein Contractors can raise their queries and may also provide suggestion/advise for improvement of the PSC Management System.

Guidance document for online submission of PSC processes as per DGH notifications dated 25.04.2020 & 12.07.2021 is available to guide the ESP contractors for submission of PSC processes.

3) Petroleum Exploration Lease/Petroleum Mining Lease Data Management System

Launched on 5th November 2019, PEL/PML application is an online application for operators to apply for PEL/PML under various contractual regimes(Nomination/PSC/RSC/CBM). Operators can submit their PEL and PML application for both, onshore blocks for onward submission to states and offshore blocks for onward submission to MoPNG from this portal. The approval by MoPNG for onshore and Grant order by MoPNG for offshore, forwarding approved recommendation to State Nodal by DGH, forwarding application to state technical and state district officers for review, Issue of Grant order by State Nodal officer and view by all stakeholders are incorporated in the online system.

Clearance & Approvals:

a. Total Applications received: 82 (PEL-27, PML-55) / (Offshore - 21, Onshore- 61)

b. Ten states have registered in the system. (I.e. Assam, Tripura, Arunachal Pradesh, Chhattisgarh, Orissa, Himachal Pradesh, Rajasthan, Gujarat, Madhya Pradesh, West Bengal).

c. Few other states i.e. Andhra Pradesh, Tamil Nadu, Pondicherry have not registered in the system.

4) Production Database Management System (PDMS)

An online Production Database Management System (PDMS) has been implemented wherein all oil and gas production data on daily basis is uploaded by operators for Nomination and PSC regime. The portal enables to view, monitor and analyze block, field and asset wise production.

5) Revenue Management System (RMS):

The system is aimed to collate the details of revenue generated in respect of sale of oil, gas and condensate produced in the block. This also facilitates for royalty computation and monitoring. This revenue information is further supplemented by uploading the details of invoices by operator. The web application is in place w.e.f 01/04/2015. Upgradation of RMS Application has been completed and integration with Bharatkosh has gone live from 01.04.2021.

6) Accounts Management System:

The system is aimed to capture electronically and collate the details of audited accounts submitted to DGH. It also captures the contract cost and profit petroleum data for each quarter and annual basis.

The web application is in place w.e.f 01/04/2015 for Accounts Management System,

7) Non-Tax Remittance Management System:

To overcome the reconciliation the system is aimed to collate Details of remittance/payment made (towards Non-Tax Revenue) to Pay & Account office of MOP&NG/State Government under PSC/CBM contracts under the following heads and interest thereon.

Royalty-Oil	Royalty-Gas
Profit Petroleum	Production Level Payment
Government Share of Revenue	Petroleum Exploration License (PEL) Fees
Petroleum Mining Lease (PML) Fees	Liquidated Damages
Unfinished Work Programme	Dead Rent
Cess on Oil	Initial License Fee
Initial Lease Fee	Others

Details of all payments to central/state government w.e.f 1st March 2017 are being uploaded in Non-Tax Remittance Management System.

8) Essentiality Certificates Management System

Essentiality Certificates are issued for import or indigenous procurement of goods required for petroleum operations. In addition to this, Essentiality certificates commonly referred to as NOCs (No Objection Certificates), are also issued for operators for transfer of material from one block to another. DGH has devised an online portal ECMS - Essentiality Certificate Management System wherein operators can apply for EC online without sending any physical copy of documents for all import /indigenous/ transfer cases. Digitally signed Essentiality Certificates for import cases are uploaded directly on the customs portal. For indigenous cases, Essentiality Certificates are issued in physical form till the time GST portal gets ready for integration with ECMS. This entire paperless process has saved considerable time and effort both for operators and DGH and ECs are expeditiously issued. On an average, 90 Essentiality Certificates are being issued every day and mostly ECs are issued the same day. Further, in a bid to encourage Ease of Doing Business in the sector, the govt. is planning to simplify the procedure for ECMS application and make modifications in ECMS wherein the operators would be able to apply for EC for multiple blocks across various regimes

Clearance & Approvals:

EC Monitoring system

a. Online submission of digitally signed EC issuance gone live from 28/02/2019

b. Integration with Customs for online issuance of ECs for Imported items gone live from 28/02/2019

c. Integration with GSTN for issuance of EC for

Indigenous Purchase items gone live 31/01/2020.

d. EC against multiple blocks across multiple regimes had gone live from 17/8/2020.

e. API integration of ECMS system with ICE GATE portal of customs department has gone live from 28/09/2020.

9) Vessel Clearance Portal

Rigs/ships/FPSOs/Vessels entering Indian maritime zone need prior approval from Ministry of Defence. To expedite approvals and facilitate movement of these vessels for E&P related activities in the fair-weather window, an online portal in DGH website has been created. Operators can submit applications for vessel clearance with DGH along with details of vessel, block in which activity is to be undertaken. The vessel clearance is processed and issued online.

Clearance & Approvals:

Vessel Clearance Management System (VCMS):

a. The online processing of vessel clearance applications was facilitated among Operator, DGH and MoD through an online portal developed by DGH which was operational since March 2018.

b. In June 2020, MoD launched its own portal for issuance of NOC for RSEE (Research Survey Exploration & Exploitation) activities. DGH has requested MoD to map DGH internal workflow in this new MoD online NOC clearance portal for end-to-end online processing of applications within DGH.

10) Expat Clearance System

Expat Clearance System(ECS) is required for getting clearance of expats coming on vessel, from Ministry of Home Affairs (MHA). This application enables automation of expat clearance application processing between DGH and Operator. DGH has created an online system for application of expat clearance. The operator can submit the application for seeking expat clearance. The operator can track the status of application online. After successful processing of application by MHA, certificate is issued to operator.

11) EoI Submission portal for OALP

EoI submission portal was launched in 2016 for the operators to submit Expression of Interest (EoI) for the identified blocks under OALP bid rounds.

12) E-bidding portal

DSF Bids were invited on Single Stage, Two envelope system. Bidders were required to submit both the envelopes through online e-bidding portal (https://ebidding.dghindia.gov.in). All bidders were requested to get registered to the portal, which required a valid Digital Signature Certificate (DSC) to enter the system and subsequently the bidders could submit their bids online only, by using their own Digital Signature Certificates thereby ensuring the security of the bids submitted.

This e-bidding portal is developed and maintained by M/s M-junction Services Ltd. The entire system of e-Procurement by M-junction has been certified by Standardization Testing and Quality Certification department under Department of Electronics, Ministry of Information Technology.

13) DSF Operator's Portal: Facilitating contractual process

DGH has created a dedicated DSF Operator's Portal for Contract monitoring of Revenue Sharing Contracts (RSC) awarded through DSF Bid Rounds. Portal is designed keeping in government objective to enhance ease of doing business and smoothen the process of Revenue Sharing Contract monitoring at DGH end. Additionally, portal provides easy access of information to DGH nodal officers as well as to Operator's representatives for contractual monitoring. Further, Govt. is planning to further rationalise the processes to strengthen Ease of Doing Business for the operators. The processes shall be rationalized on self-certification basis and will allow the operator to make contractual submissions in a

pre-defined format through online through DSF operator portal.

14) Site Restoration Fund Management portal

With the objective to encourage 'Ease of Doing Business' by further streamlining the operationalization of Site Restoration Fund (SRF) Scheme 1999, DGH has developed an online portal namely DGH SRF Management Portal. The SRF e-portal includes multiple modules such as Bank Accounts, Submission, Withdrawals etc. These modules will allow the contractors to manage and maintain the information pertaining to their SRF accounts in a more systematic and organized manner both block-wise and financial year-wise. The portal supports the generation of graphical representations, reports etc. based on the database fed in the portal which will help the contractors in visualizing the overall picture w.r.t. SRF submission and utilization over a period of time for their respective blocks/fields. The portal includes features like online approval of Site Restoration and Abandonment Plan by the Management Committee (MC), Annuity Contribution approvals etc. All this together would aid towards making the implementation of the SRF Scheme 1999 - easier and hassle-free.

15) Urja Pragati

Getting regulatory clearances and approvals is critical in achieving production targets and fostering business sentiment of E&P community of the country. Time and again, during various forums and events, E&P operators have raised getting clearances as the number one issue and major bottleneck that they face in conducting their business activities.

The sheer number and multifaceted nature of these clearances needed in the entire E&P lifecycle requires engagement of and coordination among various stakeholders and departments of both Central and State Governments. The scale of task leads to inordinate delays in granting approvals and hampers decision making. Getting clearances in a given timeframe is, therefore, of paramount importance to bolster the E&P sector.

To achieve this objective, a high level Empowered Co-ordination Committee (ECC) was formed under Chairmanship of Cabinet Secretary in May 2019 for streamlining and expediting grant of approvals / clearances.

To further increase the efficacy of the system and for more effective monitoring and interaction at the level of DGH, MoPNG and ECC with various stakeholders e.g. Operators of various regimes, respective Central Ministry / Department, various State Govt Departments, a robust system towards e-transparency and

e-accountability with real-time presence and exchange among the key stakeholders is required to be developed.

In line with these requirements, a URJA PRAGATI portal is envisaged to be developed on the lines of "PRAGATI" web portal of PMO. The portal shall enable a more focused approach and facilitate regular review at the highest level in Petroleum sector. URJA PRAGATI portal shall be an interactive platform having features of data management as well as video conferencing. Geo Spatial feature may also be enabled if required. Here, the various stakeholders will be E&P operators, State Government Departments like Forest, Wildlife, SEIAA, PCB, Mining & the Union Ministries of MoEFCC, MoPNG, MHA, MoD & Dept. of Space; apart from DGH at the coordination level.

The issues which will be dealt through this portal covers clearances related to PEL, PML, FC, WL, CTE/CTO, ESZ and CRZ. These issues may be escalated by the operators on this platform, for which operators will be given access to the platform through User-IDs.

16) Upstream India Portal

Government is intending to work upon building a strong and self-reliant ecosystem to help strengthen the domestic upstream companies for encouraging exploration and boosting hydrocarbon production in the country. In pursuance of the same, Government is trying to provide handholding along with extending multifarious services to E&P players viz. sharing of facilities and infrastructure available at DGH, creation of a Knowledge Sharing Platform, organization of regular Workshops/ Seminars/Conferences/ Training Sessions etc. on latest Government Policies/ Technologies etc.

In pursuance of the above-mentioned objectives, DGH has introduced an online Facilitation Portal named as "Upstream India" wherein the registered users may book a slot for availing the DGH facilities pertaining to G&G Workstation, Virtual Reality Centre etc. Further to this, the Portal also provides easy access to the latest information regarding policies, important government circulars/notifications, workshops/conferences, events etc. Additionally, the Portal includes features like online platform for facilitating discussion amongst contractors w.r.t usage of inventories/ facilities/ knowledge sharing etc.

The portal has multiple modules catering to various requirements of operators. The modules have been broadly divided into following:

i. Facilitation,
ii. Knowledge Sharing
iii. Discussion Forum
iv. Start-Up Forum

The Facilitation module allows operators to book a workstation, use hardware and software and book Virtual Reality Centre (VRC) at DGH office, Noida, free of cost for work requirements in respect of their blocks/fields/acreages or for bidding purpose.

The Knowledge Sharing module is a repository of important documents pertaining to E&P sector. Latest reports, articles, presentations and research papers shall be uploaded here for information dissemination and retrieval. Further, information on upcoming Webinars, Conferences and Seminars will also be uploaded under this module.

The Discussion Forum module allows operators to initiate a discussion on any topic of interest or need. Other operators may provide their comments or views on the topic. The Operators will be able to plan their activities in a better way by sharing information of inventories and resources available with them and work out possibilities to sharing the same among themselves to optimize cost and improving efficiency.

The Start-Up Forum is a platform wherein the startups in the E&P industry may post their details and share information/ideas with other stakeholders in the industry.

Apart from the above functionalities, there are many other features that have been embedded in the portal.

3

E & P ACTIVITIES

Government of India's focus on increasing Ease of Doing Business in the sector is evident in pace from policy reforms introduce in last few years. The impact of these reforms is seen through increased activity in Indian E&P sector. This will help in achieving Government's ambitious target of reducing hydrocarbon import. Increasing Oil & Gas production is one of the measures by which Oil & Gas import dependency can be reduced. Enhancing domestic Oil and Gas production by promoting Exploration and Production activities by providing more exploration and discovered acreages has always been among Government's highest priorities. Substantial E&P activities have been carried out in the country in 2020-21 setting pace for the Indian E&P sector for years to come. This chapter encapsulates all E&P activities executed in FY 2020-21. It also provides the detail of hydrocarbon discoveries made in 2020-21 and statistics of exploration, development & production activities of the country.

3.1 Exploration Activities

In FY 2020-21, about 17,051.24 LKM 2D seismic data was acquired. However, majority of the 2D Data acquisition was carried out under RSC regime (in OALP Blocks) which was approximately 16,806.42LKM.

3D seismic data acquired in FY 2020-21 was 9,361.66 SKM out of which approximately 7,281.69 SKM data was acquired by NOCs/JVs/Pvt. Companies under OALP. This year, 55% of 2D seismic and 68% of 3D Seismic data acquisition has been carried out in the offshore basins.

In addition, 115 exploratory wells (including Onland and Offshore) amounting to a drilling meterage of 3,44,175 m were drilled during the FY 2020-21.

Details of exploratory activities in Nomination, PSC regime & RSC regime in FY 2020-21 compiled in Table 3.1 and Country's company-wise exploratory activities are provided in Table 3.2.

Table 3.1: Exploratory efforts in Nomination & PSC regime in FY 2020-21

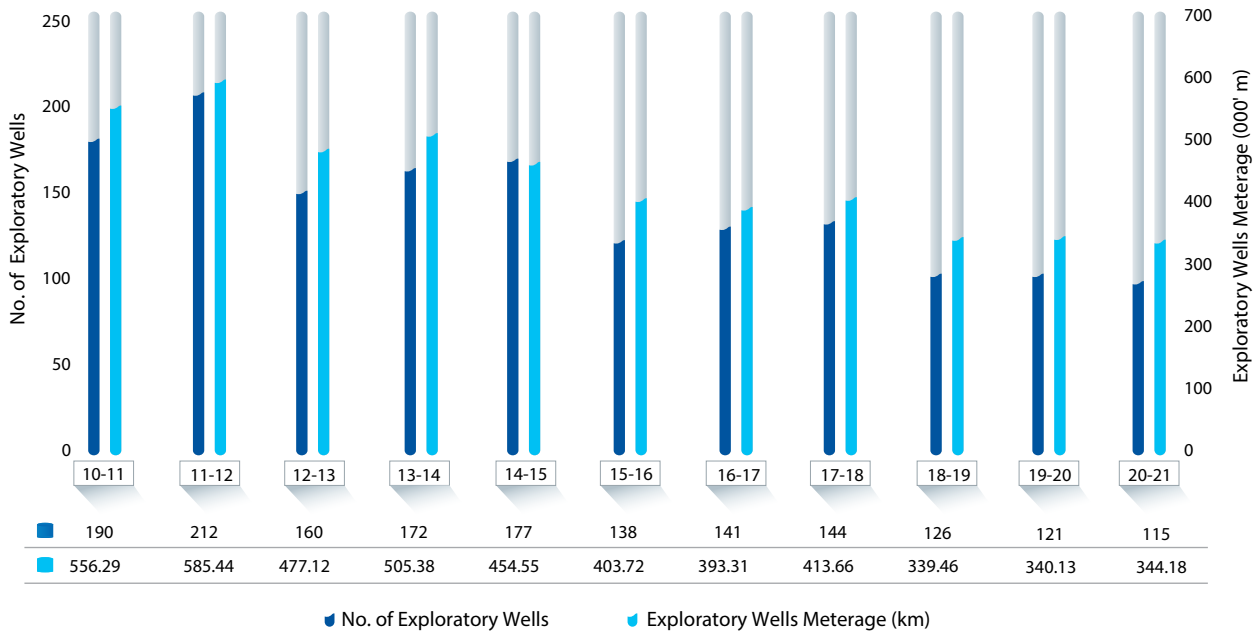
Subject	Parameter	ONGC (Nomination)	OIL (Nomination)	PSC (Pre-NELP & NELP)	RSC (OALP+DSF)	Total
2D Seismic data acquired	Onland (GLKM)	244.82	0	0	7,502.89	7,747.71
	Offshore (GLKM)		0	0	9,303.53	9,303.53
Total 2D Seismic		**244.82**	**0**	**0**	**16,806.415**	**17,051.24**
3D Seismic data acquired	Onland (SKM)	433.05	124.61	250.05	2,321.99	3,129.71
	Offshore (SKM)	1,272.26			4,959.69	6,231.95
Total 3D Seismic		**1,705.31**	**124.61**	**250.05**	**7,281.69**	**9,361.66**
Exploratory wells drilled	Onland	61	10	4	1	76
	Offshore	31		8		39
Total Exploratory wells		**92**	**10**	**12**	**1**	**115**
Exploratory Meterage drilled	Onland (1000 m)	176.266	42.811	13.25	1.4	233.744
	Offshore (1000 m)	83.177		27.25		110.431
Total Exploratory Meterage drilled		**259.443**	**42.811**	**40.5**	**1.4**	**344.175**

Table 3.2: Exploratory efforts by Companies under PSC & RSC regime in F.Y 2020-21

Operator	2D (LKM)	3D (SKM)	Exploratory Wells
PSUs (Nomination + PSC + RSC)			
Oil and Natural Gas Corporation Ltd.	962.42	7,138.18	100
Oil India Limited	13,103.28	2,104.08	12
PSUs Total	**14,065.70**	**9,242.26**	**112**
Indian Private (PSC + RSC)			
Cairn / Vedanta Limited	2,985.54	119.40	2
Adani Welspun Exploration Ltd. (AWEL)	0	0	1
Indian Private Total	**2,985.54**	**119.40**	**3**
Grand Total	**17,051.24**	**9,361.66**	**115**

Table 3.2 showcases the exploratory efforts of PSUs/Pvt. companies/Joint Ventures. The table reflects all the 2D and 3D seismic data acquisition has been carried out by ONGC, OIL, Vedanta & AWEL during the FY 2020-21.

Figure 3.1: Year Wise Exploratory Wells Drilled



3.2 Development Activities

3.2.1. Development wells drilled and meterage in 2020-21

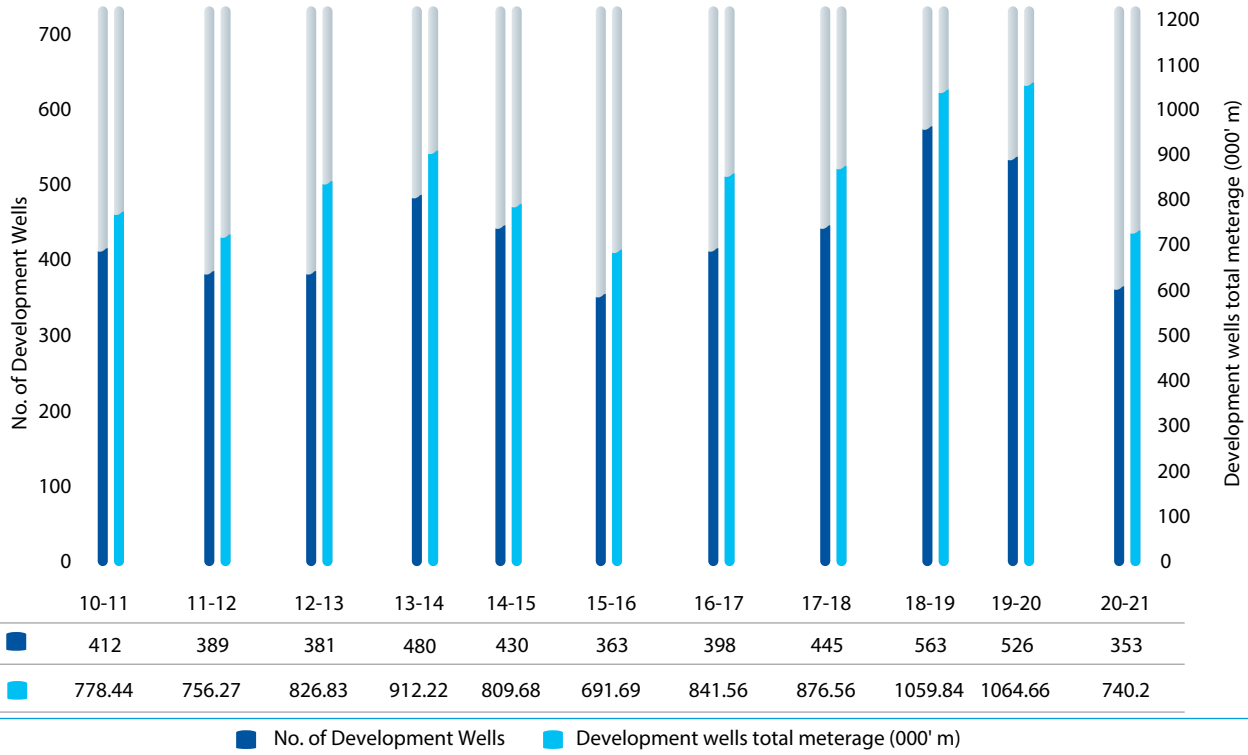
Total 353 development wells were drilled by NOCs and Pvt./JVs in FY 2020-21 (excluding side track and CBM) with a development well meterage to 740202 m. Majority of the wells were drilled by ONGC in its onland nomination areas.

Table 3.3: Development activities in FY 2020-21

No.	Subject	Parameter	ONGC (Nomination)	OIL (Nomination)	PSC (Pre-NELP & NELP)	RSC (OALP+ DSF)	Total
1	Development wells drilled	Onland	252	24	40	0	316
		Offshore	29	0	7	1	37
Total Development wells			**281**	**24**	**47**	**1**	**353**
2	Development Meterage drilled	Onland (1000 m)	466.186	59.49	115.177	0	640.85
		Offshore (1000 m)	73.983	0	22.485	2.881	99.349
Total Development Meterage drilled			**540.169**	**59.49**	**137.662**	**2.881**	**740.202**

** excl. side track & CBM*

Figure 3.2: Year Wise Development Wells Drilled



	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21
No. of Development Wells	412	389	381	480	430	363	398	445	563	526	353
Development wells total meterage (000' m)	778.44	756.27	826.83	912.22	809.68	691.69	841.56	876.56	1059.84	1064.66	740.2

3.2.2. Discoveries in Development Phase

Total of 19 Field Development Plans (FDPs) / EDP/ Revised FDPs (RFDPs) were approved in FY 2020-21. Details of the approved FDPs are provided in table below:

Table 3.4: FDPs and RFDPs approved during the year 2020-21

PSC						
No.	Field/Block	Operator	Round	DoC/FDP/ RFDP	Discovery/Field Name	Type of Discovery (Oil/Gas)
1	N Balol	HOEC	Field	RFDP	RFDP of North Balol Field	Gas
Brief on RFDP: North Balol field is an onland field in Cambay Basin having PSC effective till 20.03.2027. The development plan is pertaining to North Balol comprising of 27.30 sq.km area. The total capital investment is of USD 3.365 MM. The RFDP is approved for three reservoirs viz. Kand, Babaguru & kalol having P-50/GIIP of 36.5 BCM/1033.70 MMSCM. Approval accorded for drilling of 02 development wells as 1st campaign of drilling with required hook up and site requirements. RFDP is effective till the expiry of PSC.						
2	RJ-ON-90/1	Vedanta/ Cairn	Pre-NELP	FDP	FDP for Raag South	Oil
Brief on FDP: Raageshwari south field, situated within the development area-I RJ-ON-90/1 block, was discovered through Raag S-1 well in March-2013. Raag South was put on Early Monetization Plan (EMP) during April-Sept-2014 and produced 0.02 MMSTB of cumulative oil. Later it was discontinued due to unfavourable economics. FDP was submitted under 'Exploration in ML area' policy dated 01.02.2013. FDP has been approved for the total estimated development cost of USD 7.015 MM with envisaged cumulative oil production of 0.048 MMbbls upto 14.05.2020 (Current PSC period) & 0.806 MMbls upto 14.05.2030 from 03 existing producer wells subject to extension of PSC. Raageshwari South FDP is approved for Giral Formation with 2P STOIIP of 7.2 MMBBL.						
3	RJ-ON-90/1	Vedanta/ Cairn	Pre-NELP	FDP	FDP for NL	Oil
Brief on FDP: NL FDP in the block RJ-ON-90/1 is approved under 'Exploration in ML area' policy dated 01.02.2013 with a development cost of USD 10.632 MM. The envisaged cumulative oil production is 0.035 upto 14.05.2020 (Current PSC period) & 1.019 MMbls upto 14.05.2030 from 01 existing & 02 new producer wells subject to extension of PSC. NL FDP is approved for Barmer Hill Formation with 2P STOIIP of 27.16 MMSTB.						
4	RJ-ON-90/1	Vedanta/ Cairn	Pre-NELP	FDP	FDP for Saraswati Basement	Oil
Brief on FDP: Saraswati Basement field, situated in the central part of RJ-ON-90/1 block of Rajasthan India was discovered after discovery well " Saraswati-4" Basement notified in April-2015.The well is under appraisal testing since 28th August-2019 as per directives of DGH. The cumulative oil production is 18493 bbls during 28th Aug-2019 to 30th Mar-2020. Stage-I of FDP has been approved under 'Exploration in ML area' policy dated 01.02.2013 for putting the well Saraswati-4 on production. Initial oil production is envisaged as 100 BOPD and EUR is 0.001 MMSTB upto 14.05.2020 and 0.317 MMSTB upto 14.05.2020 subject to extension of PSC. There is no development cost (Capex) involved and production cost is estimated as USD 6.671 MM till 14th May-2030. Saraswati basement FDP is approved with 2P STOIIP of 4.3 MMBBL.						
5	RJ-ON-90/1	Vedanta/ Cairn	Pre-NELP	RFDP	RFDP for Raageshwari Rev-2	Oil
Brief on RFDP: Raageshwari oil field, situated within the development area-I (DA-I) RJ-ON-90/1 block was discovered in February-2003 with the drilling of RJ-E-1 well. The initial Raag-oil FDP for the development of Upper Thumbli reservoir was approved in 2006 wherein 06 wells in phase-I & 05 wells in phase-II to be drilled. Later due to technical reasons number of drilled wells were reduced and currently 07 wells are producing from 02 fault blocks at a rate of ~ 650 BOPD with GOR of 2500-3000 SCF/BBLS. The previous FDP was proposed for development of 02 fault blocks while the revised FDP plan was approved to enhance the deliverability of Raag-3 & Raag-3ST fault blocks and to develop the remaining fault blocks (Raag-1/-ST & Raag-Central). FDP revision-2 envisages production through 17 wells (7 existing and 10 new) and water injection for pressure maintenance in Raag-3 fault block through 04 new injector wells along with the development of a Central Processing Facility (CPF).The crude will be evacuated through pipeline to AGI-5.The EUR is 2.05 MMBBLS upto 14.05.2020 (Current PSC) and 8.05 MMBBL upto 14.05.2030 subject to extension of PSC. Raageshwari Rev 2 RFDP is approved for Upper Thumbli Formation with 2P STOIIP of 53.64 MMBBL.						

PSC						
No.	Field/Block	Operator	Round	DoC/FDP/ RFDP	Discovery/Field Name	Type of Discovery (Oil/Gas)
6	RJ-ON-90/1	Vedanta/ Cairn	Pre-NELP	RFDP	RFDP for Mangala Rev 3	Oil
Brief on RFDP: In order to sustain and enhance production levels in block RJ-ON-90/1 an adhoc arrangement was made through mutual agreement between representatives of contractor and government for carrying out additional operational activities. Accordingly, permission was granted for drilling and completion activities to achieve production of 4 MMBBL and augmentation of OHL network for power grid supply at an aggregate estimated expenditure of USD 32.43 MM						
7	RJ-ON-90/1	Vedanta/ Cairn	Pre-NELP	RFDP	RFDP for ABH Rev2	Oil
Brief on RFDP: In order to sustain and enhance production levels in block RJ-ON-90/1 an adhoc arrangement was made through mutual agreement between representatives of contractor and government for carrying out additional operational activities. Permission was granted for drilling and completion of 5 infill wells (4 horizontal and 1 vertical) and multi-stage hydraulic fracturing of the wells to achieve incremental oil of 3.14 MBBL at an aggregate estimated expenditure of USD 22.285 MM.						
8	RJ-ON-90/1	Vedanta/ Cairn	Pre-NELP	RFDP	RFDP for Shakti Rev 1	Oil
Brief on RFDP: In order to sustain and enhance production levels in block RJ-ON-90/1 an adhoc arrangement was made through mutual agreement between representatives of contractor and government and permission was granted to revise the expenditure of USD 1.569 MM towards integrated development service cost which was earlier estimated at USD 1.458 MM.						
9	WB-ONN-2005/4	ONGC	NELP	EDP	EDP of Ashokenagar-1	Oil
Brief on EDP: NELP-VII block WB-ONN-2005/4 is located in the Onland part of Bengal Basin covering the districts of North 24 Parganas, Hooghly, Nadia and Burdwan. Oil and gas exploration activities in West Bengal (Bengal Basin) started in 1951-52. After several decades of exploration, a breakthrough has been achieved and exploratory well Asokenagar#1 resulted in an oil & gas discovery from Upper Miocene sandstone. The Early Development Plan for oil discovery has been approved as part of Government of India initiative of early monetization of hydrocarbon discoveries. It will bring the eighth Indian basin (Bengal onland) on production, three and half decades after the last basin i.e. Cauvery onland was put on production in 1985. The oil production started since Nov-2020 in the block. EDP for oil discovery in well Ashoknagar-1 is approved with OIIP (Proved) of 0.718 MMT with development area of 5.88 Sq. Km.						
10	MB-OSN-2005/1	ONGC	NELP	FDP	FDP of MBS051NAA-1	Gas
Brief on FDP: NELP-VII block MB-OSN-2005/1 is located in Saurashtra shallow water and northern side of the block runs approximately parallel to the Saurashtra coast from Diu to Jafrabad Township. The main play in the block is the Daman Formation. Daman sand 30 (DPS-2) and sand 40 (DPS-1) are the most prolific reservoirs established in the field along with the presence of clastic reservoirs charged with gaseous hydrocarbons. The Development Plan envisages gas production from year 2022-23. FDP for gas discovery in well MBS05NAA-1 is approved with GIIP of 11.89 BCM.						

RSC						
No.	Name of Contract Area	Operator	Round	DoC/FDP/ RFDP	Discovery/Field Name	Type of Discovery (Oil/ Gas)
FDPs noted by MC during 2020-21 under RSC (DSF) Regime						
1	MB/OSDSF/ NMT/2020	ONGC Ltd.	DSF	FDP	FDP of MB/OSDSDF/ NMT/2018	Oil & Gas
Brief on FDP: NMT contract area is in the south-western part of Surat Depression and falls in Tapti- Daman block of Western Offshore Basin. The NMT contract area covers an area of around 96.15 Sq.km (Figure-1). Total 3 fields fall under NMT contract area viz., NMT, C-37 & C-43. In the first phase of development (Phase-I) two fields i.e., NMT & C-37 have been considered. The field is at about 230 km from Mumbai city.						
2	MB/OSDSF/ SB15/2018	ONGC Ltd.	DSF	FDP	FDP of MB/OSDSDF/ SB15/2018	Oil & Gas
Brief on FDP: SB-15 contract area is located in the Heera-Panna-Bassein block of Bombay Offshore Basin. The SB-15 contract area covers an area of around 226.16 Sq.km. In the first phase of development (Phase-I) two fields i.e., SB-15 & PER have been considered. The SB-15 area falls in the west of Bassein area within Heera-Panna-Bassein block. It lies on a NNW-SSE trending ridge, west of the Bassein field, across a Low. The ridge forms part of the SB-15/BS-11/B-22-5 paleo high trend with low sediment thickness for Panna. The PER Field is located off the west coast of India in the Arabian Sea, at a distance of about 70 km from Mumbai City. It lies north of Vasai East Field.						
3	MB/OSDSF/ D31/2018	Arch Softwares Private Limited	DSF	FDP	FDP of MB/OSDSDF/ D31/2018	Oil & Gas
Brief on FDP: The contract area, D31 cluster is located in offshore shallow water in Mumbai Offshore basin and has an offered area of 271.8 sq. km. There are seven wells drilled in this contract area with 4 discoveries viz. D-12, D-31, B-192A, BH-67 & BH-70. The D31 cluster is situated in the Mumbai High Platform- Deep Continental Shelf (DCS) zone.						
4	NEC/OSDSF/ D11/2018	Arch Softwares Private Limited	DSF	FDP	FDP of NEC/OSDSF/ D11/2018	Gas
Brief on FDP: The contract area, D11 cluster is located in offshore shallow water within the Bengal- Purnea basin and has an offered area of 541.4 sq. km. under DSF Bid Round II. There are 6 gas discoveries in the contract area, which has been carved out from NELP-relinquished acreage. In D11 cluster, the major reservoir facies are in Pliocene and Miocene sequence and have proved to be hydrocarbon bearing.						
5	MB/OSDSF/ D18/2018	Ganges Geo Resources Pvt. Ltd.	DSF	FDP	FDP of MB/OSDSF/ D18/2018	Oil
Brief on FDP: D-18 structure is located 160 km west of Mumbai at a water depth of 90m. Area of the D-18 field is 90.86 sq. km. In D-18 field, the discovery is within L-VI and Mukta formations of Oligocene age and are oil bearing. No free gas pools are either tested or interpreted to be present in any of the wells of the D-18 field.						
6	AA/ONDSF/ TULAMARA/ 2018	Oil India Limited	DSF	FDP	FDP of AA/ONDSF/ TULAMARA/2018	Oil
Brief on FDP: The Block AA/ONDSF/TULAMARA/2018 is part of the Tripura-Cachar-Mizoram area in the Assam-Arakan Fold Belt of the Assam-Arakan Basin. The area covered by the contract area AA/ONDSF/TULAMARA/2018 was earlier a part of West Tripura PEL operated by ONGC. The Tulamara Anticline is a linear, NNW-SSE trending doubly plunging, asymmetric structure. The discovery well Tulamura-1 in the Block is located in the northern plunge of the anticline in the axial region.						

RSC						
No.	Name of Contract Area	Operator	Round	DoC/FDP/ RFDP	Discovery/Field Name	Type of Discovery (Oil/ Gas)
7	AA/ONDSF/ UMATARA/2018	Indian Oil Corporation Ltd.	DSF	FDP	FDP of AA/ONDSF/ UMATARA/2018	Oil
Brief on FDP: The contract area, UMATARA is located in the Assam Shelf Basin at an approximate distance of 55 Km south-west of Duliajan, in the district of Dibrugarh. The Contract Area covers an area of 51.85 Sq. Km and comprises of two parts namely, South Rajgarh and Umatara. Total three well locations have been identified to be drilled in this contract area targeting both Tipam and Barail Formation.						
8	KG/OSDSF/ GSKW/2018	Oil India Limited	DSF	FDP	FDP of KG/OSDSF/ GSKW/2018	Oil & Gas
Brief on FDP: The KG/OSDSF/GSKW/2018 block is located in shallow waters of Krishna Godavari basin near Kesanapalli town in East Godavari District of Andhra Pradesh, and covers an area of 93.902 Km^2 in two parts separated by a distance of around 1.75 km. This block is in geologically highly complex structural trends. Two main fault systems cut through the block in NE-SW direction. The grabens between the two faults have experienced strike slip movement due to the uneven throw along the strike of the faults. Every structural closure of the block has shown the presence of hydrocarbons						
9	AA/ONDSF/ Disaijan/2018	Invenire Energy Pvt. Ltd.	DSF	FDP	FDP of AA/ONDSF/ DISAIJAN/2018	Oil
Brief on FDP: Disaijan Block is in the North eastern part of Upper Assam Shelf Basin. It is surrounded by producing Eocene oilfields of OIL India Limited. Mechaki Field is situated to the east, Baghjan Field to the west and Hukanguri to the south-west of Disaijan Block and the depth of producing reservoirs varies between 3800-5500 m. Assam Shelf Basin, is a Pericratonic, passive margin basin, with the signature of compressional tectonics during Himalayan orogeny. The basin hosts thick pile of tertiary sediments, ranging from Paleocene to Recent overlying the basement consisting of Granitic and Metamorphic complex.						

3.2.3. New Oil and Gas Discoveries

As per DGH guidelines dated 08. 01. 2021, declaration or announcement of discoverers for nomination fields under NOCs were discontinued. Hydrocarbon discovery reporting has since been done in accordance with PRMS guidelines approved by society of Petroleum Engineers, USA (Revised in June 2018). Accordingly, if and when a

Table 3.5: Discoveries Reviewed by DGH During FY 2020-21

No.	Well Name	Field/Block	Basin	Operator	Regime	Object Interval
1	KGD982NA-CHN-B-1 (KGD982NA-CHN-B-AA) (New Prospect)	KG-DWN-98/2	KG Basin	ONGC	PSC	Obj-I: 2501-2511m, 2521-2535m Obj-II (2282.0-86.0m, 2288-96m & 2301-07m
2	AWEL-A-1	MB-OSN-2005/2	Mumbai Offshore	AWEL	PSC	Object-I (2420.5-2423.5m)
3	KW-2-Updip-1	RJ-ONHP-2017/1	Rajasthan	Vedanta	OALP	1081-1105m in

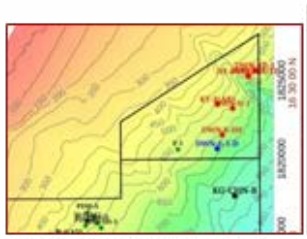
new discovery occurs with in the Contract Area submission of, Format - A & Format - B would not required by the Licensee / Lessee for review or acceptance by DGH. During the year, DGH has received 13 notifications of Oil & Gas discoveries from NOC/PSC/RSC operators. Out of these notified discoveries, 3 discoveries were technically accepted and the details are as under:

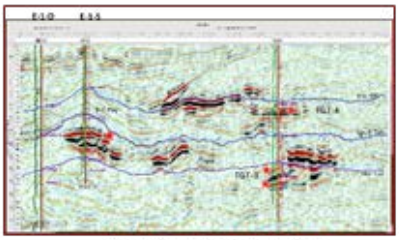
	Formation Name	Formation Age	Oil/ Gas	Format A Date	Testing Results
	Godavari Clay	Pliocene	Gas	11/05/2020	Well Flowed gas @ Qg- 5,69,330 m^3/day, at FTHP-2777psi thru 32/64" choke Well flowed gas @ 5,25,152m^3/day at FTHP-2533Psi thru 32/64" choke
	Daman formation	Late Oligocene	Gas	14.03.2021	Well flowed gas @ 2,74,677 m^3/d and condensate @ 378 bbl/d (59deg API) through 28/64" choke at FTHP: 2659 psi
	Barmer Hill formation	Paleocene	Oil	16.12.2020	Produced oil at an average rate of ~45 stb/d under an approximate drawdown of ~200-250 psi. API of the crude is ~24.8 deg.

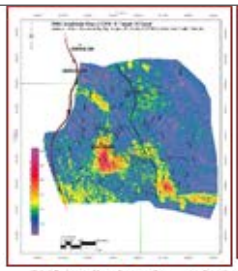
1. KG Offshore/ KG-DWN-98/2- Cl-II PML/ (KGD982NA-CHN-B-AA)

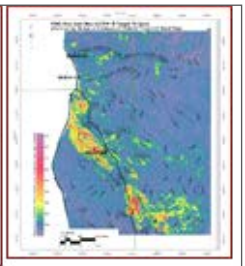
Operator: ONGC

Structure / PML / Well No.	Testing Result	Leads/Exploratory Efficacy
Channel-B/ KGD982NA-CHN-B-1 (KGD982NA-CHN-B-AA)	Obj-I: 2501-2511m, 2521-2535m: Well Flowed gas @ Qg- 5,69,330 m^3/day, at FTHP-2777psi thru 32/64" choke Obj-II (2282.0-86.0m, 2288-96m & 2301-07m: Well flowed gas @ 5,25,152m^3/day at FTHP-2533Psi thru 32/64" choke	This New oil pool discovery within the Pliocene sequences has established additional upsides in the area south of E-1 (S) and F-1 discovery of Cluster-I PML


Map showing location of the well CHN-B


RC line Passing from Well E-1-D, E-1-S and CHN-B FAR Section


RMS Amplitude at the enveloping surface of Target-3 Sand

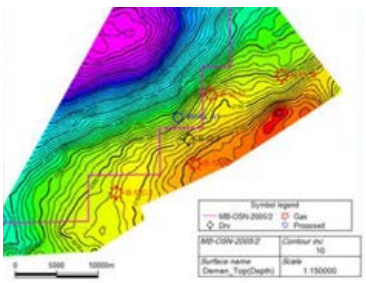

RMS Amplitude of Target-4 Sand

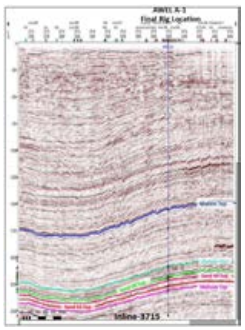
2. Mumbai Basin/(AWEL-A-1)

Operator: AWEL

Structure / Well No./ Location	Testing Result	Leads/Exploratory Efficacy
AWEL-A-1 Block: MB-OSN-2005/2	Object-I (2420.5-2423.5m) in Daman formation flowed gas @ 2,74,677 m^3/d and condensate @ 378 bbl/d (59deg API) through 28/64" choke at FTHP: 2659 psi	Well flowed gas @ 2,74,677 m^3/d and condensate @ 378 bbl/d (59deg API) through 28/64" choke at FTHP: 2659 psi


Location map of well AWEL A-1 with 2D/3D seismic coverage map


Depth Structure Map showing location of offset wells

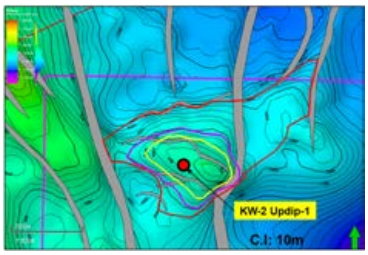

Inline 3713 through well AWEL A-1

3. Rajasthan Basin/ (KW2-Updip-1)

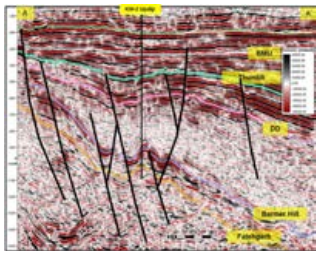
Operator: Vedanta

Structure / Well No./ Location	Testing Result	Leads/Exploratory Efficacy
KW2-Updip-1 Block: RJ-ONHP-2017/1	Perforated interval 1081-1105m in Barmer Hill formation produced oil at an average rate of ~45 stb/d under an approximate drawdown of ~200-250 psi. API of the crude is ~24.8 deg.	Produced oil at an average rate of ~45 stb/d under an approximate drawdown of ~200-250 psi. API of the crude is ~24.8 deg.

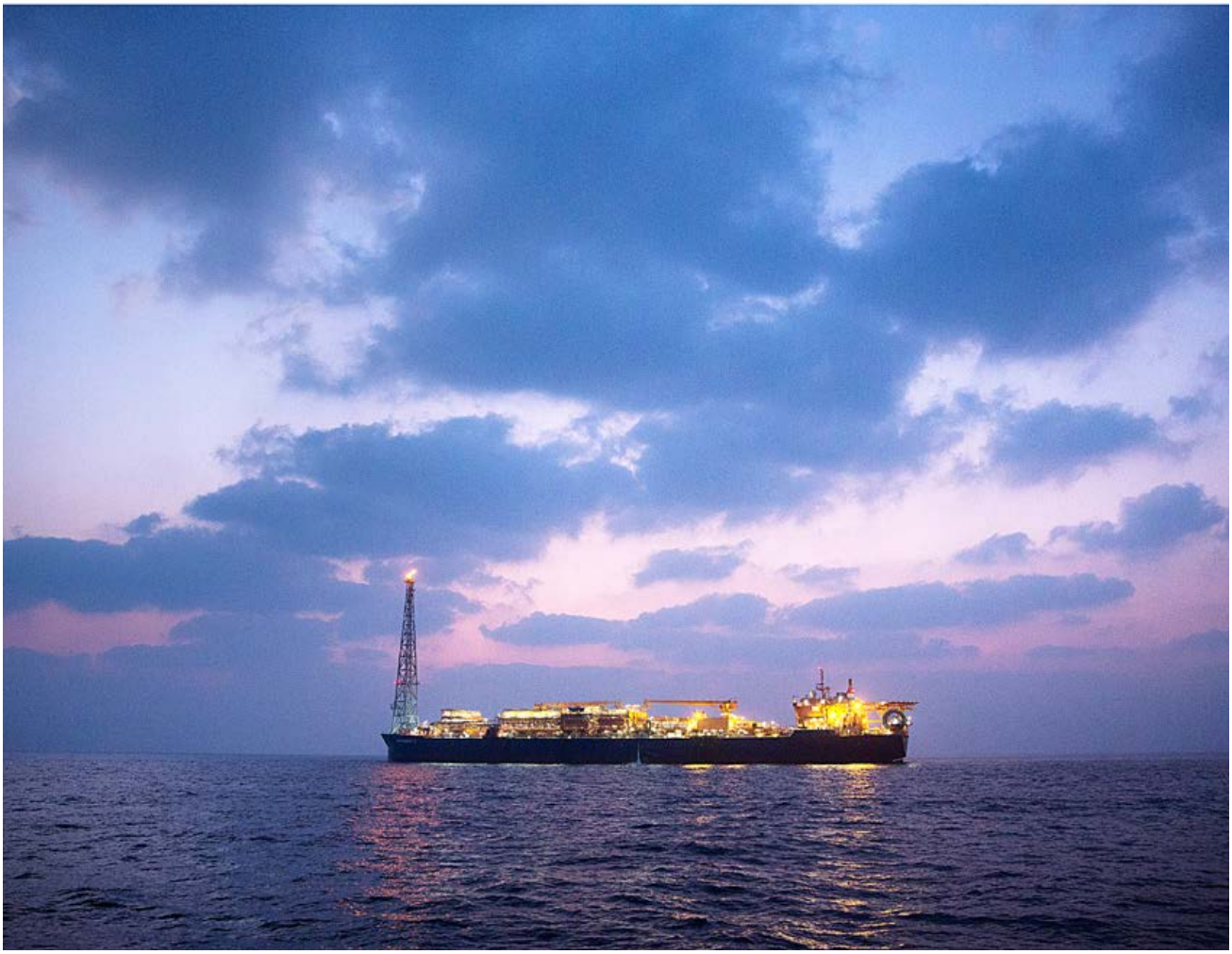
Location map of well KW2-Updip-1



Depth structure map at Top Barmer Hill Reservoir



Seismic Inline line passing through KW-2 Updip Prospect



In addition to 3 DGH reviewed discoveries, 10 more Oil & Gas discoveries were notified by ONGC/OIL as operator, details of these discoveries are listed in the following table.

Table 3.6: Other Notified Discoveries Reviewed by DGH During FY 2020-21

No.	Well Name	Field/Block	Basin	Operator	Regime	Object Interval
1	Kunjaban-13 (KUDD)	Kunjaban/Kunjaban PML	AAFB-Tripura	ONGC	Nomination	3729-3739m
2	Sundulbari-16 (SDAP)	Sundulbari/ West Tripura PML	AAFB-Tripura	ONGC	Nomination	2383-2386m & 2356-2365m
3	WO-5-13	WO-5/ BOFF PML	WOFF	ONGC	Nomination	2434.5m-2433.5m,2430.5-2429.5m & 2428-2418m
4	B-126N-1	B-126N/ MUKTA ML	WOFF	ONGC	Nomination	Panna (2454-2456.5m, 2465-2468.5m, 2470-2476m, 2478-2480m) Lr Bassein (2376-2391m) Upper Bassein:(2185-2194m)
5	BS-17-1	WEST OFF BASSEIN/BS-17	WOFF	ONGC	Nomination	Bassein (1850-38m & Ib-1835m-1830m) Mukta: (1772-53m, 1750-48m) Heera: (1722-18, 1712-10m, 1708-07m)
6	GK-28-14	GK-28/ GK-28PML	WOFF	ONGC	Nomination	Intrusive (3999-3968m) Jhuran sandstone (3942.5 -3921.5m)

	Formation Name	Formation Age	Oil/ Gas	Format A Date	Testing Results
	Middle Bhuban	Early Miocene	Gas	08.06.2020	Obj-III (3729-3739): Well flowed gas @ 1,56,000 m^3/d, condensate @ 0.23m^3/d with THP-193 Kg/cm^2 (FBHP-257.73 Kg/cm^2) through 8.0 mm bean.
	Upper Bhuban	Middle Miocene	Gas	07.07.2020	Obj-II (2383-2386m): Well flowed gas @ 1,56,378m^3/d; Qc-0.53 m^3/d with FTHP-2147 psi, through 8.0 mm bean. Obj-III (2356-2365m): Well flowed gas @ 1,58,975 m^3/d, Ql- 0.853 m^3/d with FTHP - 2320psi, through 8.0 mm bean.
	Lower Bassein	Middle Eocene	Oil & Gas	31/03/2021	½" Qo:1019bpd Qg:1,18,598m^3/d, FTHP:1325psi
	Panna Lower Bassein, Upper Bassein	Panna: Early Eocene, Lower Bassein/ Upper Bassein: Middle Eocene	Oil & Gas	31/12/2021	Obj I (Panna): Qg-2,92,300m^3/day, Qo-794bpd FTHP-2300psi Obj II (Lr Bassein): Qg-35,078m^3/day, Qo-1289 bpd FTHP-660psi. Obj III (Upper Bassein): Qg-61,547 m^3/day, Qo-89bpd, FTHP 1177-1162 psi
	Bassein, Mukta, Heera	Bassein: Middle Eocene, Mukta/ Heera :Early Oligoce	Oil & Gas	27/10/2020	Obj-Ia(Bassein): Qg-1,56,688.7m^3/d, Qcond.-326bpd FTHP-1250psi Obj-III (Mukta): Qg-1,98,514 m^3/day, Qoil-272 bpd, FTHP-1450psi. Obj-IV (Heera): Qg-1,98,023m^3/day, Qcond-279 BPD FTHP-1525psi
	Intrusive, Jhuran	Intrusive: Cretaceous Jhuran sandstone: Jurassic	Gas	19/03/2021	Obj III (Intrusive): observed bottom sample-14.26bbls of Light oil with traces of gas, API: 43.1° - 47.6° & BS & W:50%). Obj IV (Jhuran): Qg-80,206m^3/day, Qcond-6bbl/day, Qcondensed water-14bbl/day at FTHP-460psi

No.	Well Name	Field/Block	Basin	Operator	Regime	Object Interval
7	KGD982NA-R1-E-1 (KGD982NA-R1-E-AA)	KG-DWN-98/2	KG Basin	ONGC	PSC	Obj-I (1883-1891m & 1877-1879m,
8	KGD982NA-PDM-SH-1 (KGD982NA-PDM-SH-AA)	KG-DWN-98/2	KG Basin	ONGC	PSC	Obj-I (2225-27.5m, 2253-59m,
9	Kavitam South-1 (KTAC)	PML-Kavitam Onland	KG-Onland	ONGC	Nomination	Obj-I (3358.5-62m, 3354-57.5m, 3319-25m)
10	Dinjan-1	Tinsukia PML	Assam Shelf	OIL	Nomination	3614.6-3617.2

	Formation Name	Formation Age	Oil/ Gas	Format A Date	Testing Results
	Godavari Clay	Pliocene	Gas	24/06/2020	Well Flowed gas @ 4,64,141 m^3/day at FTHP- 2079 psi thru 32/64" choke
	Godavari Clay	Pliocene	Oil and Gas	30/07/2020	Well Flowed gas @, Qo-3496 BOPD, Qg-61,926m^3/day (oil API- 34) at FTHP-1432psi thru 32/64" choke
	Golappali Formation	Pliocene	Gas	04/07/2020	Well Flowed gas Qg- 4,98,560m^3/d at FTHP-7600psi. SBHP-9275.47psi at 3276.8m thru 20/64" choke
	Lakadong+Therria	Eocene	Gas	20.05.2020	Qg 1,01,424 SCMD through 4.5 mm bean, FTHP 3500 psi

In 2020-21, Three discoveries were made in PSC/RSC regime taking total discoveries to 254 as on 31st March 2021

Till date 254 discoveries have been made in PSC/RSC regime, out of which 30% (75 discoveries) have been put on production, 50 discoveries are under development or on the way to production. The detailed status of discoveries is shared in table below:

Table 3.7: Status of discoveries under PSC regime

Status of Discovery	Oil	Gas	Total
Discoveries which have been put on Production	54	21	75
Discoveries which are under Development or on way to production	24	26	50
Commerciality established (DoC Reviewed)	3	14	17
Discoveries in Early Stage , DoC to be submitted	4	9	13
Discoveries that may be monetised under policy for "Exploration in ML area"	18		18
Discoveries not pursued by Operator/relinquished/proposed for relinquishment	27	54	81
Total	**130**	**124**	**254**

Table 3.8: Basin wise discoveries under PSC/RSC regime as on 31.03.2021

Basin Name	Oil	Gas	Total
Andaman-Nicobar		1	1
Assam Arakan		7	7
Bengal		1	1
Cambay	70	14	84
Cauvery	3	6	9
Gujarat Kutch		4	4
Gujarat Saurashtra		3	3
Krishna Godavari	20	59	79
Mahanadi-NEC		13	13
Mumbai Offshore	1	5	6
Rajasthan	36	7	43
Vindhyan		1	1
Total	**130**	**124**	**254**

Table 3.9: Region wise discoveries under PSC/RSC Regime as on 31.03.2021

Location/Bid Round	Oil				Gas			Grand Total
	NELP	OALP	Pre-NELP	Pre-NELP Field Round	NELP	Pre-NELP	Pre-NELP Field Round	
Deepwater	9				44			53
On Land	51	1	52	2	17	10		133
Shallow water	6		3	6	47	5	1	68
Grand Total	**66**	**1**	**55**	**8**	**108**	**15**	**1**	**254**

Table 3.10: Details of Oil and Gas Discoveries under Pre-NELP/Pre-NELP Field Round as on 31.03.2021

Operator	Block	NELP/Pre NELP	Oil	Gas	Total
Cairn/Vedanta	CB-OS/2	Pre-NELP	2	3	5
	Ravva	PSC-Field Round	5	1	6
	RJ-ON-90/1	Pre-NELP	34	4	38
ESSAR	CB-ON/3	Pre-NELP	5		5
Focus	GK-ON/4	Pre-NELP		1	1
	RJ-ON/6	Pre-NELP		3	3
GSPC	CB-ON/2	Pre-NELP	11	1	12
HARDY	CY-OS/2	Pre-NELP		1	1
HOEC	AAP-ON-94/1	Pre-NELP		1	1
	CB-ON/7	Pre-NELP	2		2
ONGC	CB-OS/1	Pre-NELP	1		1
RIL	SR-OS-94/1	Pre-NELP		1	1
Selan Exploration Technology Lim-ited	Karjisan	PSC-Field Round	1		1
Shell	PANNA-MUKTA	PSC-Field Round	1		1
Sun Petrochemicals Pvt Ltd	Baola	PSC-Field Round	1		1
Total			**63**	**16**	**79**

Table 3.11: Details of Oil and Gas Discoveries under NELP as on 31.03.2021

Operator	Block	PSC Round	Oil	Gas	Total
AWEL	MB-OSN-2005/2	NELP-VII		1	1
BPRL	CB-ONN-2010/8	NELP-IX	2		2
Cairn/Vedanta	KG-OSN-2009/3	NELP-VIII	1	1	2
Focus	CB-OSN-2004/1	NELP-VI	2	3	5
GAIL	CB-ONN-2010/11	NELP-IX	2		2
GSPC	CB-ONN-2000/1	NELP-II	4		4
	CB-ONN-2002/3	NELP-IV	8		8
	CB-ONN-2003/2	NELP-V	2	1	3
Jay polychem (India) Pvt. Ltd.	CB-ONN-2009/8	NELP-VIII	1		1
JOGPL	AA-ONN-2002/1	NELP-IV		3	3
	CB-ONN-2002/2	NELP-IV	2		2
	CY-ONN-2002/1	NELP-IV		1	1
MPL	CB-ONN-2005/9	NELP-VII	2		2
NAFTOGAS	CB-ONN-2004/5	NELP-VI	1		1
NIKO	CB-ONN-2000/2	NELP-II		2	2
NTPC	CB-ONN-2009/5	NELP-VIII	1		1
OIL	KG-ONN-2004/1	NELP-VI		3	3
	RJ-ONN-2004/2	NELP-VI	1		1
ONGC	AA-ONN-2001/1	NELP-III		2	2
	AA-ONN-2001/2	NELP-III		1	1
	AN-DWN-2002/1	NELP-IV		1	1
	CB-ONN-2001/1	NELP-III	2		2
	CB-ONN-2002/1	NELP-IV	1		1
	CB-ONN-2004/1	NELP-VI	1		1
	CB-ONN-2004/2	NELP-VI	5		5
	CB-ONN-2004/3	NELP-VI		1	1

Operator	Block	PSC Round	Oil	Gas	Total
ONGC	CB-ONN-2005/10	NELP-VII	1		1
	CB-ONN-2005/4	NELP-VII	1		1
	CB-OSN-2003/1	NELP-V		3	3
	CY-ONN-2002/2	NELP-IV	2	1	3
	CY-ONN-2004/2	NELP-VI	1		1
	GK-OSN-2009/1	NELP-VIII		2	2
	GK-OSN-2009/2	NELP-VIII		1	1
	GK-OSN-2010/1	NELP-IX		2	2
	GS-OSN-2004/1	NELP-VI		2	2
	KG-DWN-2005/1	NELP-VII		1	1
	KG-DWN-98/2	NELP-I	7	10	17
	KG-ONN-2003/1	NELP-V	2		2
	KG-OSN-2001/3	NELP-III		9	9
	KG-OSN-2004/1	NELP-VI		7	7
	KG-OSN-2009/2	NELP-VIII	1		1
	MB-OSN-2005/1	NELP-VII		3	3
	MB-OSN-2005/3	NELP-VII		1	1
	MN-DWN-98/3	NELP-I		2	2
	MN-OSN-2000/2	NELP-II		2	2
	NEC-DWN-2002/2	NELP-IV		1	1
	VN-ONN-2009/3	NELP-VIII		1	1
	WB-ONN-2005/4	NELP-VII		1	1
Pan India Consultants Pvt. Ltd	CB-ONN-2010/5	NELP-IX	1		1
RIL	CB-ONN-2003/1	NELP-V	1		1
	CY-DWN-2001/2	NELP-III		2	2
	CY-PR-DWN-2001/3	NELP-III		1	1
	GS-OSN-2000/1	NELP-II		1	1
	KG-DWN-2001/1	NELP-III		1	1
	KG-DWN-2003/1	NELP-V		4	4

Operator	Block	PSC Round	Oil	Gas	Total
RIL	KG-DWN-98/1	NELP-I	1		1
	KG-DWN-98/3	NELP-I	1	19	20
	KG-OSN-2001/1	NELP-III		3	3
	KG-OSN-2001/2	NELP-III	2		2
	NEC-OSN-97/2	NELP-I		8	8
Sun Petrochemicals Pvt Ltd	CB-ONN-2003/1	NELP-V	7		7
Total			**66**	**108**	**174**

Table 3.12 : Details of OALP discovery as on 31.03.2021

Operator	Block	Oil
Vedanta	RJ-ONHP-2017/1	1

3.3 Oil and Gas Production

In FY 2020-21 country has achieved 94.4% of its crude oil production target by producing 30.49 MMT against crude production target of 32.32 MMT, while the domestic gas production stands at 28.67 BCM against target of 33.57 BCM.

There was a decline in crude oil production by 5.2% and the gas production by 8% compared to previous year.

Table 3.13: Oil and Gas production in the country in 2020-21

Operator (Regimes)	Oil TMT					Gas (MMSCM)				
	2019-20	2020-21		%, Ach w.r.t		2019-20	2020-21		%, Ach w.r.t	
	Actual	Target	Actual	Target	19-20	Actual	Target	Actual	Target	19-20
ONGC (N)	20,627	20,932	201,83	96.4%	97.8%	23,746	23,983	21,872	91.2%	92.1%
OIL (N)	3,107	3,121	2,937	94.1%	94.6%	2,668	2,762	2,480	89.8%	92.9%
PSC + CBM	8,436	8,265	7,374	89.2%	87.4%	4,770	6,827	4,321	63.3%	90.6%
Country	**32,170**	**32,318**	**30,494**	**94.4%**	**94.8%**	**31,184**	**33,572**	**28,672**	**85.4%**	**91.9%**

Figure 3.3: Oil Production of Country in 2020-21

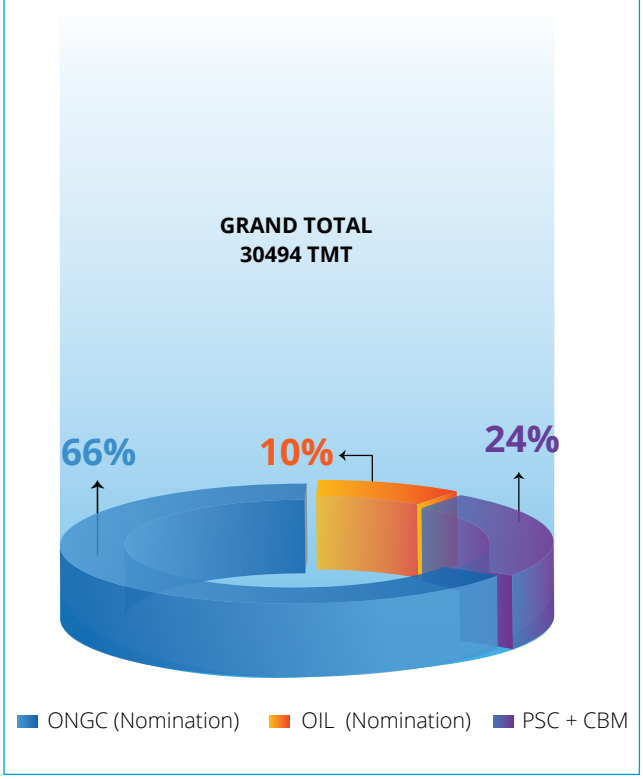


Figure 3.4: Gas Production of Country in 2020-21

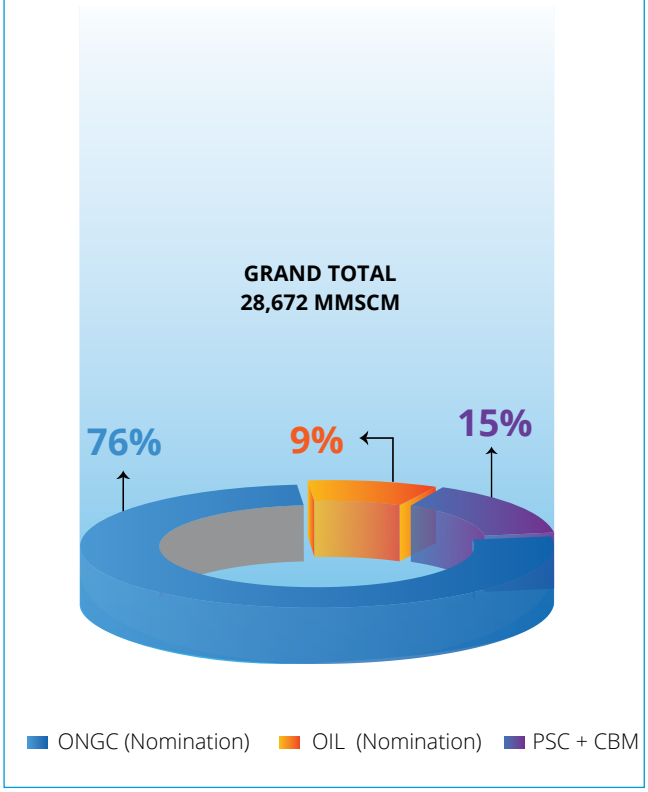


Table 3.14: Basin and Operator-wise production of country in FY 2020-21

Regime	Operator	Basin	Oil (MMT)	Gas (BCM)	O+OEG (MMT)
OIL Nomination	OIL Nomination	Assam-Arakan Shelf	2.93	2.29	5.22
		Rajasthan	0.01	0.19	0.20
OIL Nomination Total			**2.94**	**2.48**	**5.42**
ONGC Nomination	ONGC Nomination	Assam-Arakan Fold Belt	0.003	1.63	1.64
		Assam-Arakan Shelf	0.96	0.39	1.35
		Cambay	4.48	1.07	5.56
		Cauvery	0.33	0.876	1.21
		Krishna Godavari	0.17	1.24	1.41
		Mumbai	14.24	16.66	30.90
ONGC Nomination Total			**20.18**	**21.87**	**42.05**
Total NOCs			**23.12**	**24.35**	**47.47**

Regime	Operator	Basin	Oil (MMT)	Gas (BCM)	O+OEG (MMT)
PSC/RSC	CEIL	Cambay	0.40	0.1034	0.5080
		Krishna Godavari	0.73	0.3381	1.0656
		Rajasthan	5.88	1.7649	7.6459
	ESSAR	Cambay	0.00116	0.0000	0.0012
	FOCUS	Rajasthan	0.00	0.0867	0.0881
	GEOENPRO	Assam-Arakan Shelf	0.03	0.0049	0.0347
	GNRL	Cambay	0.00	0.0068	0.0090
	GSPC	Cambay	0.02	0.0116	0.0338
	HOEC	Assam-Arakan Shelf	0.03	0.3674	0.4007
		Cambay	0.00	0.0037	0.0080
		Cauvery	0.00	0.0126	0.0127
	JTI	Cambay	0.03	0.0133	0.0481
	OILEX	Cambay	0.00	0.0000034	0.0000034
	ONGC	Bengal-Purnea	0.00013	0.0000	0.0001
		Cambay	0.03	0.0461	0.0768
		Cauvery	0.08	0.0340	0.1133
		Krishna Godavari	0.04	0.1767	0.2182
	Pan India Consultants	Cambay	0.00041	0.0000	0.0004
	RIL	Krishna Godavari	0.00	0.6808	0.6831
	SELAN	Cambay	0.02	0.0113	0.0283
	SUNPETRO	Cambay	0.06	0.0160	0.0764
PSC/RSC Regime Total			**7.37**	**3.68**	**11.05**
CBM Regime	ESSAR	CBM	0.00	0.1971	0.1971
	GEECL	CBM	0.00	0.1099	0.1099
	ONGC	CBM	0.00	0.0017	0.0017
	RIL	CBM	0.00	0.3337	0.3337
CBM Regime Total			**0.00**	**0.64**	**0.64**
Grand Total			**30.49**	**28.67**	**59.17**

Overall, there has been decline of ~5% in oil production and ~8% in gas production in country. Rajasthan continued to dominate the production with around 80% contribution to Oil production and 40% Gas production under PSC regime. Under Nomination regime Mumbai offshore contributes significantly to both Oil and Gas production.

Table 3.15: Contribution by ONGC, OIL and NOCs/Pvt./JVs in country's Oil and Gas production in last 10 years

	Oil production (MMT)				Gas production (BCM)				
Year	ONGC (Nomination)	OIL (Nomination)	PSC	Total Oil (MMT)	ONGC (Nomination)	OIL (Nomination)	PSC	CBM	Total Gas (BCM)
2010-11	24.42	3.59	9.68	37.69	23.09	2.35	26.73	0.04	52.22
2011-12	23.71	3.85	10.53	38.09	23.32	2.63	21.52	0.08	47.56
2012-13	22.56	3.66	11.64	37.86	23.55	2.64	14.38	0.11	40.68
2013-14	22.24	3.47	12.08	37.79	23.28	2.63	9.33	0.17	35.41
2014-15	22.26	3.41	11.78	37.45	22.02	2.72	8.68	0.23	33.65
2015-16	22.37	3.23	11.36	36.96	21.18	2.84	7.84	0.39	32.25
2016-17	22.21	3.26	10.53	36.00	22.09	2.94	6.31	0.56	31.90
2017-18	22.25	3.38	10.06	35.68	23.43	2.88	5.60	0.73	32.65
2018-19	21.04	3.29	9.87	34.20	24.67	2.73	4.77	0.71	32.88
2019-20	20.63	3.11	8.44	32.17	23.75	2.67	4.12	0.66	31.19
2020-21	20.18	2.94	7.37	30.49	21.87	2.48	3.68	0.64	28.67

Figure 3.5: Trends in Oil Production in Country (in MMT)

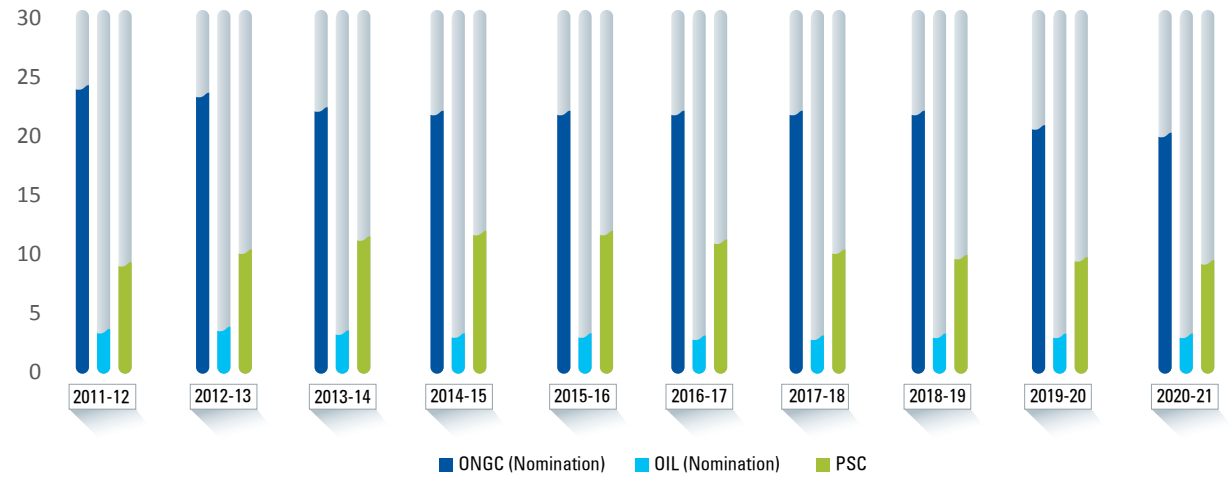


Figure 3.6: Trends in Gas production in country (in BCM)

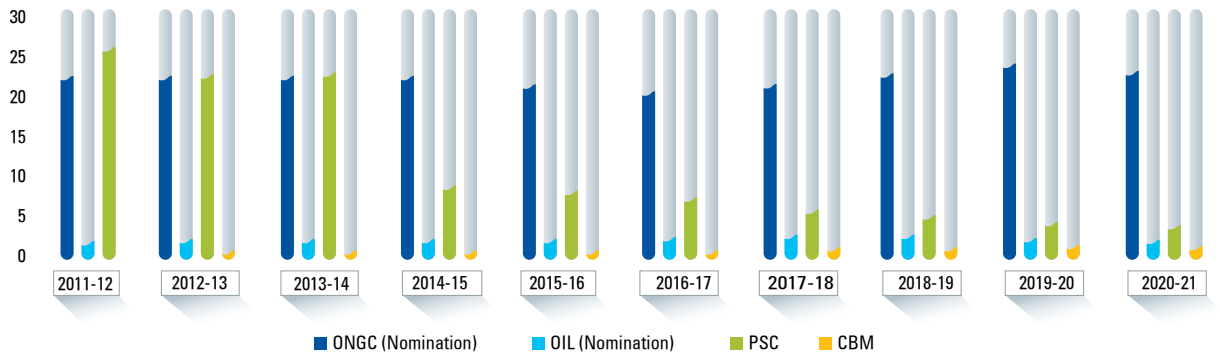


Figure 3.7: Country's Basin-Wise Oil production in 2020-21 (MMT)

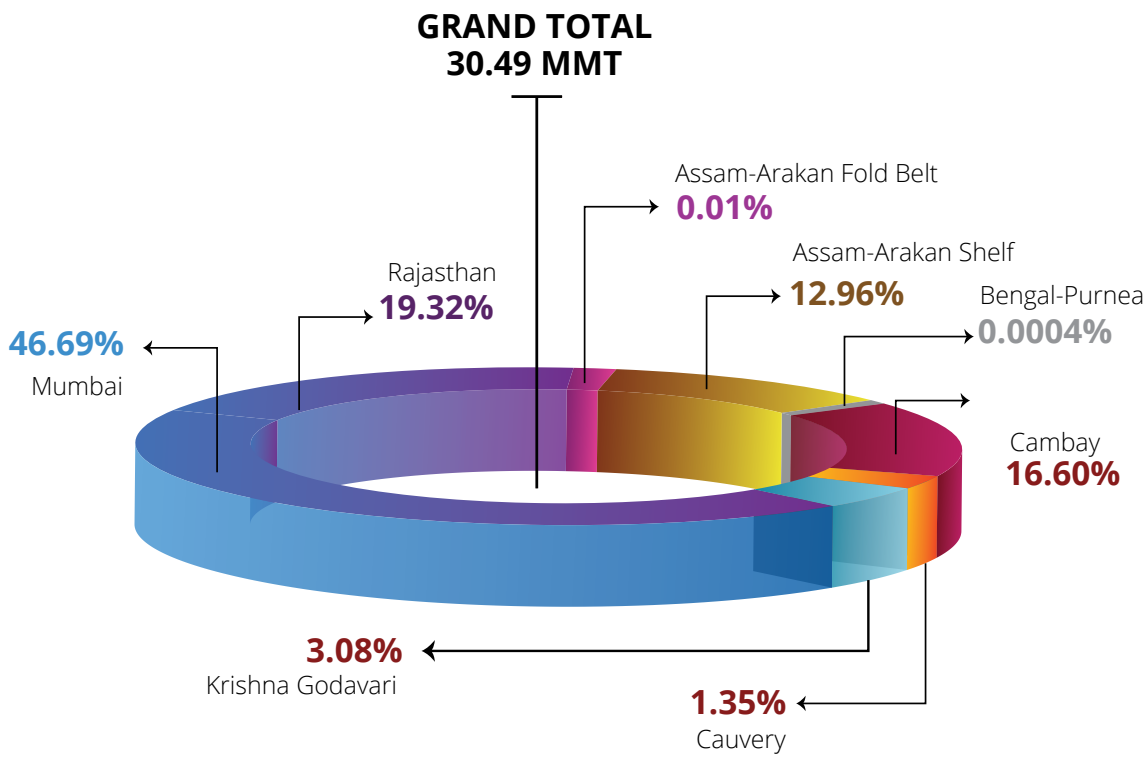


Figure 3.8: Country's Basin-Wise Gas production in 2020-21 (BCM)

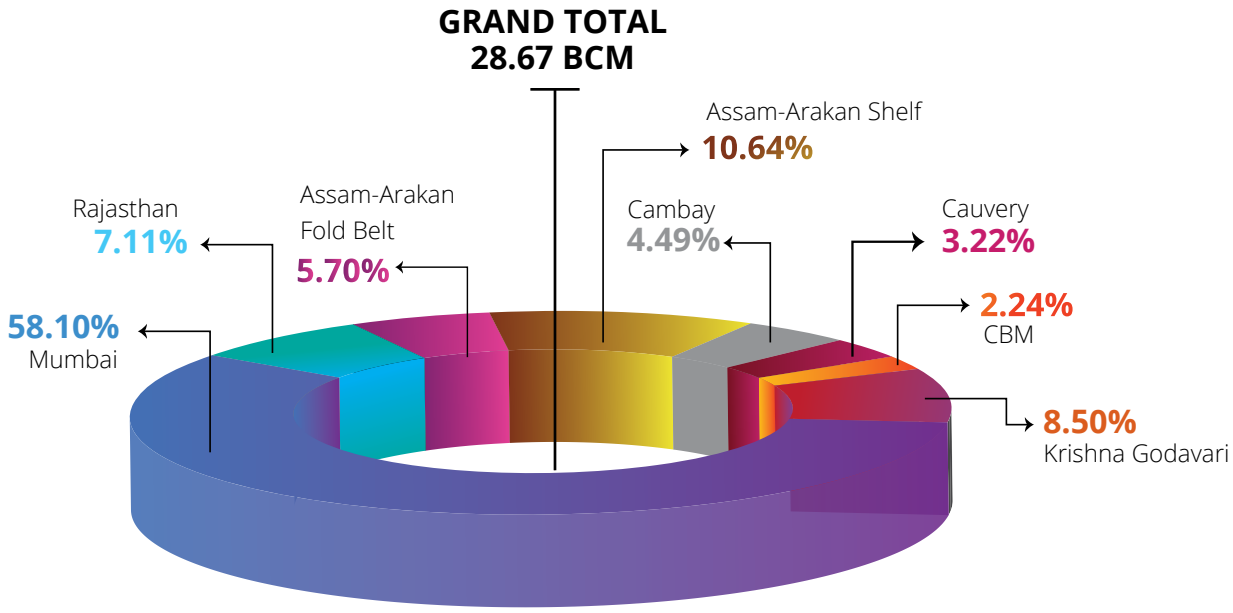


Figure 3.9: Country's Location-Wise Oil production in 2020-21 (MMT)

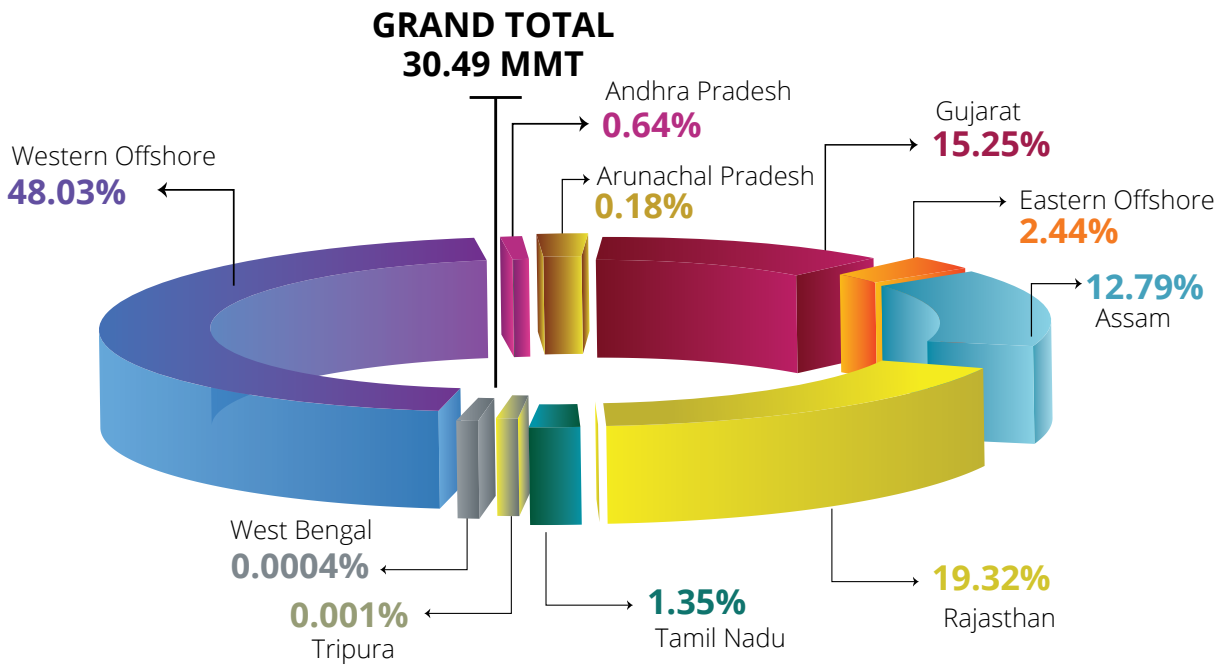
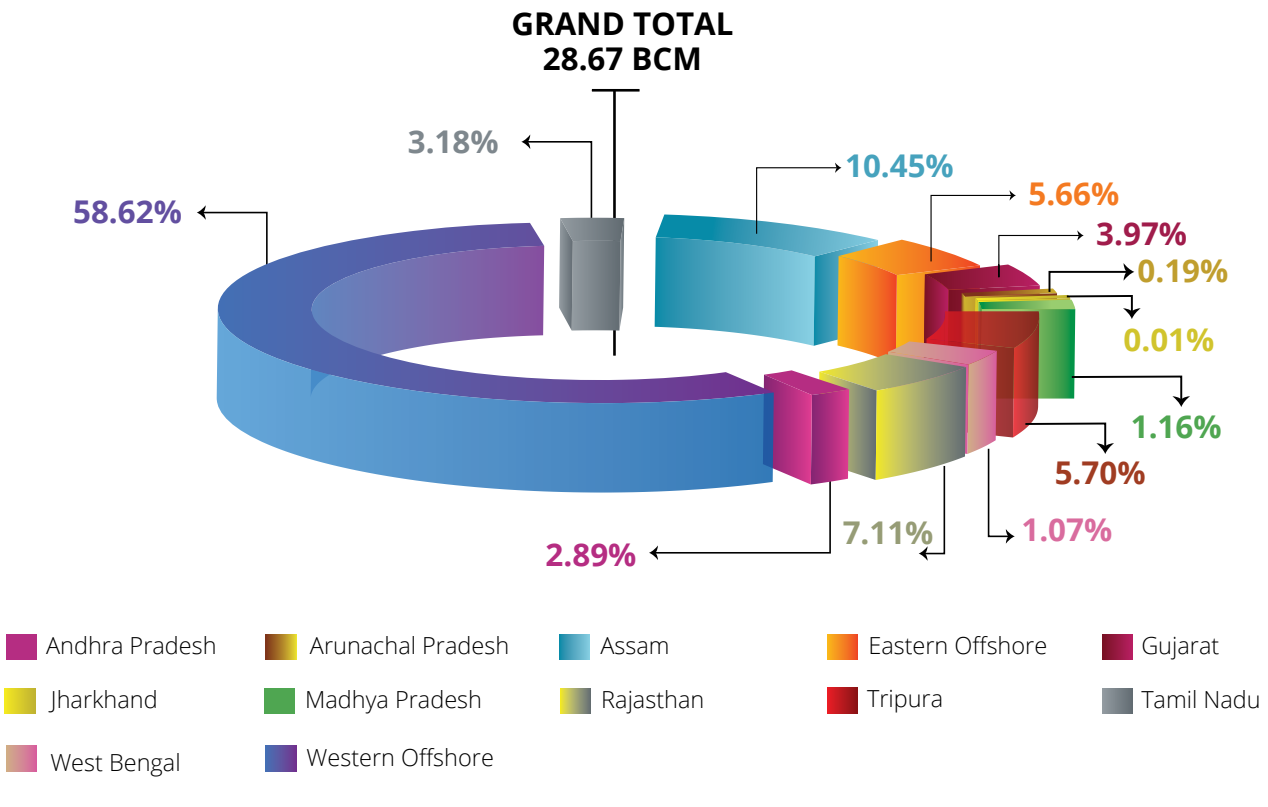


Figure 3.10: Country's Location-Wise Gas production in 2020-21 (BCM)



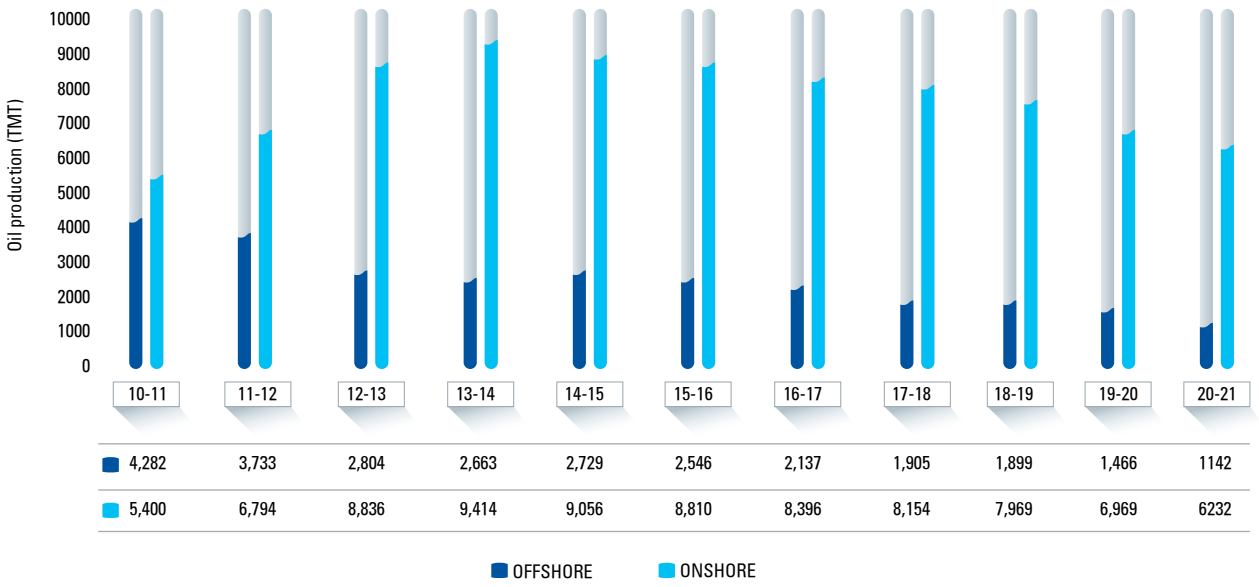
The Country's Oil and Gas production has risen consistently under PSC regime starting from year 1994-95 with gas production hitting a peak level during 2010-11 at level of 26.77 BCM and oil production hitting a peak of 12.08 MM in 2013-14. The Oil and Gas production level from PSC fields this year was at lowest in last 10 years, however with a renewed impetus to the sector through HELP, DSF bidding round and upcoming policies supporting enhance recovery from existing fields, the production figures are likely to hit peak again in near future.

The country oil production under PSC regime has declined moderately over past 5 years. There is slight variation in proportion from onshore and offshore areas for oil production, while gas production has seen shift from offshore to onshore area with CBM as one of the major contributors over past 3-4 years.

Table 3.16: Location-wise Crude Oil and Natural Gas production under PSC+CBM regime from FY 1994-95 to 2020-21

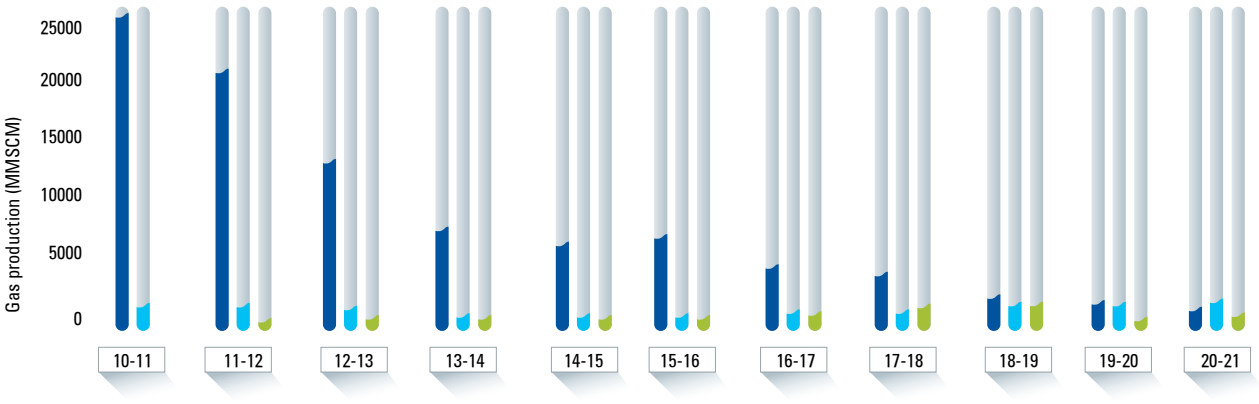
Year	OIL (TMT)					GAS (MMSCM)						
	Off-shore	On-shore	Total	%age of off-shore with Total	%age of on-shore with Total	Off-shore	On-shore	CBM	Total	%age of off-shore with Total	%age of on-shore with Total	%age CBM of Total
1994-95	250	4	254	98%	2%	88	-	-	88	100%	0%	0%
1995-96	617	25	642	96%	4%	324	10	-	334	97%	3%	0%
1996-97	1,305	38	1,343	97%	3%	479	31	-	510	94%	6%	0%
1997-98	2,472	43	2,514	98%	2%	1,615	66	-	1,681	96%	4%	0%
1998-99	2,965	76	3,042	97%	3%	2,747	128	-	2,874	96%	4%	0%
1999-00	3,924	94	4,018	98%	2%	3,268	197	-	3,465	94%	6%	0%
2000-01	4,006	77	4,083	98%	2%	3,286	310	`	3,596	91%	9%	0%
2001-02	4,070	71	4,140	98%	2%	3,430	624	-	4,054	85%	15%	0%
2002-03	4,013	75	4,088	98%	2%	4,295	1,112	-	5,407	79%	21%	0%
2003-04	4,240	75	4,314	98%	2%	5,184	1,307	-	6,491	80%	20%	0%
2004-05	4,226	74	4,300	98%	2%	5,357	1,427	-	6,784	79%	21%	0%
2005-06	4,451	101	4,552	98%	2%	5,801	1,557	-	7,358	79%	21%	0%
2006-07	4,669	161	4,830	97%	3%	5,908	1,131	-	7,040	84%	16%	0%
2007-08	4,895	192	5,087	96%	4%	6,861	867		7,727	89%	11%	0%
2008-09	4,431	243	4,674	95%	5%	7,348	722	20	8,090	91%	9%	0%
2009-10	4,529	734	5,263	86%	14%	21,350	597	38	21,985	97%	3%	0%
2010-11	4,282	5,400	9,682	44%	56%	26,054	679	41	26,774	97%	3%	0%
2011-12	3,733	6,794	10,527	35%	65%	20,910	615	84	21,609	97%	3%	0%
2012-13	2,804	8,836	11,640	24%	76%	13,700	684	107	14,491	95%	5%	1%
2013-14	2,663	9,414	12,076	22%	78%	8,428	904	166	9,497	89%	10%	2%
2014-15	2,729	9,056	11,785	23%	77%	7,589	1,095	228	8,912	85%	12%	3%
2015-16	2,546	8,810	11,356	22%	78%	6,605	1,236	393	8,235	80%	15%	5%
2016-17	2,137	8,396	10,532	20%	80%	5,155	1,152	565	6,872	75%	17%	8%
2017-18	1,905	8,154	10,059	19%	81%	4,219	1,384	735	6,338	67%	22%	12%
2018-19	1,899	7,969	9,868	19%	81%	3,075	1,691	710	5,477	56%	31%	13%
2019-20	1,466	6,969	8,436	17%	83%	2,059	2,055	655	4,770	43%	43%	14%
2020-21	1,142	6,232	7,374	15%	85%	1,343	2,336	642	4,321	31%	54%	15%

Figure 3.11: Location-wise Oil production in PSC Regime from 2010-11 to 2020-21 (TMT)



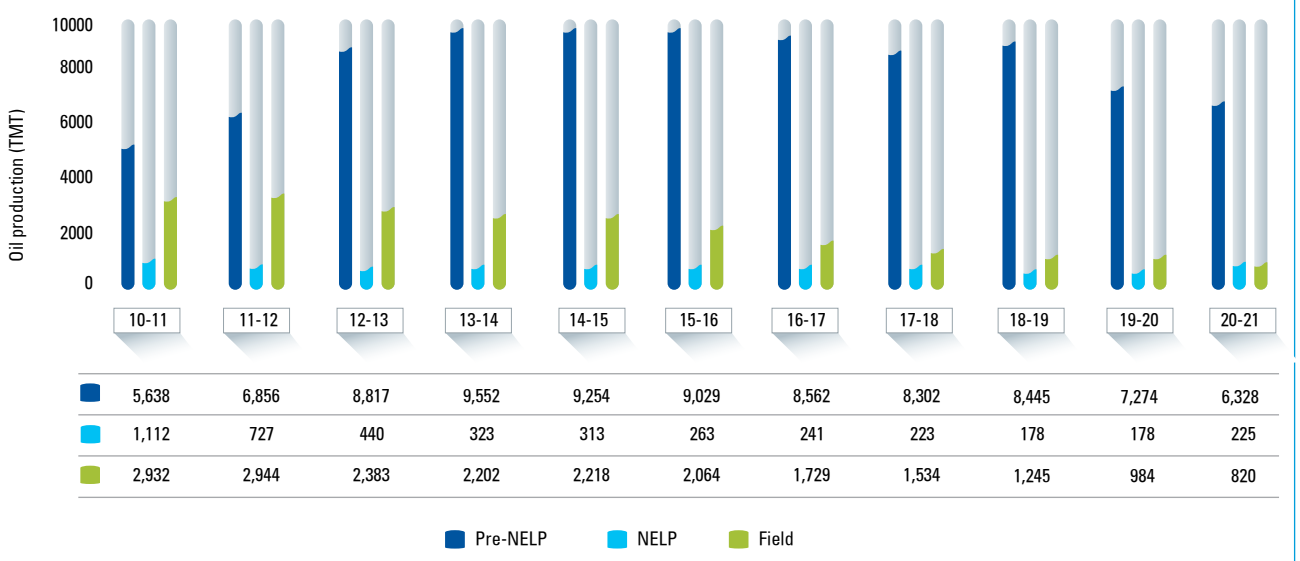
	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21
OFFSHORE	4,282	3,733	2,804	2,663	2,729	2,546	2,137	1,905	1,899	1,466	1142
ONSHORE	5,400	6,794	8,836	9,414	9,056	8,810	8,396	8,154	7,969	6,969	6232

Figure 3.12: Location-wise Gas production in PSC+CBM Regime from 2010-11 to 2020-21 (MMSCM)



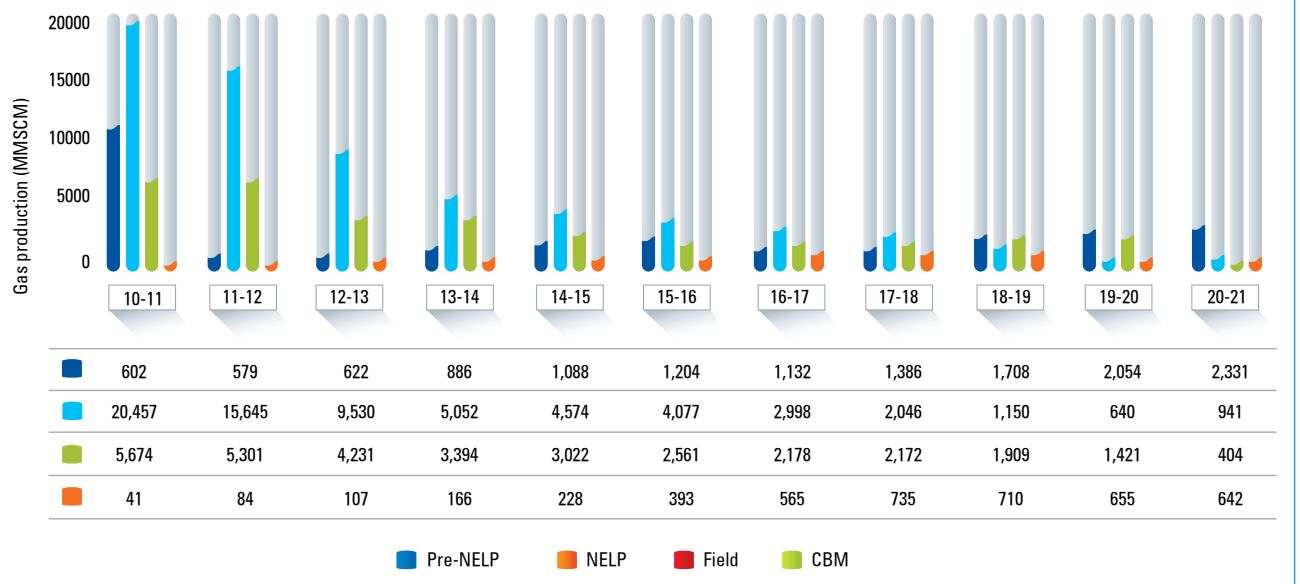
	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21
OFFSHORE	26,054	20,910	13,700	8,428	7,589	6,605	5,155	4,219	3,075	2,059	1343
ONSHORE	679	615	684	904	1,095	1,236	1,152	1,384	1,691	2,055	2336
CBM	41	84	107	166	228	393	565	735	710	655	642

Figure 3.13: Crude oil production in PSC regimes in last 10 years (in TMT)



	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21
Pre-NELP	5,638	6,856	8,817	9,552	9,254	9,029	8,562	8,302	8,445	7,274	6,328
NELP	1,112	727	440	323	313	263	241	223	178	178	225
Field	2,932	2,944	2,383	2,202	2,218	2,064	1,729	1,534	1,245	984	820

Figure 3.14: Natural Gas production in PSC regimes in last 10 years (in MMSCM)



	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21
Pre-NELP	602	579	622	886	1,088	1,204	1,132	1,386	1,708	2,054	2,331
NELP	20,457	15,645	9,530	5,052	4,574	4,077	2,998	2,046	1,150	640	941
Field	5,674	5,301	4,231	3,394	3,022	2,561	2,178	2,172	1,909	1,421	404
CBM	41	84	107	166	228	393	565	735	710	655	642

Figure 3.15: Trend in Oil production in PSC Regime from 2010-11 to 2020-21

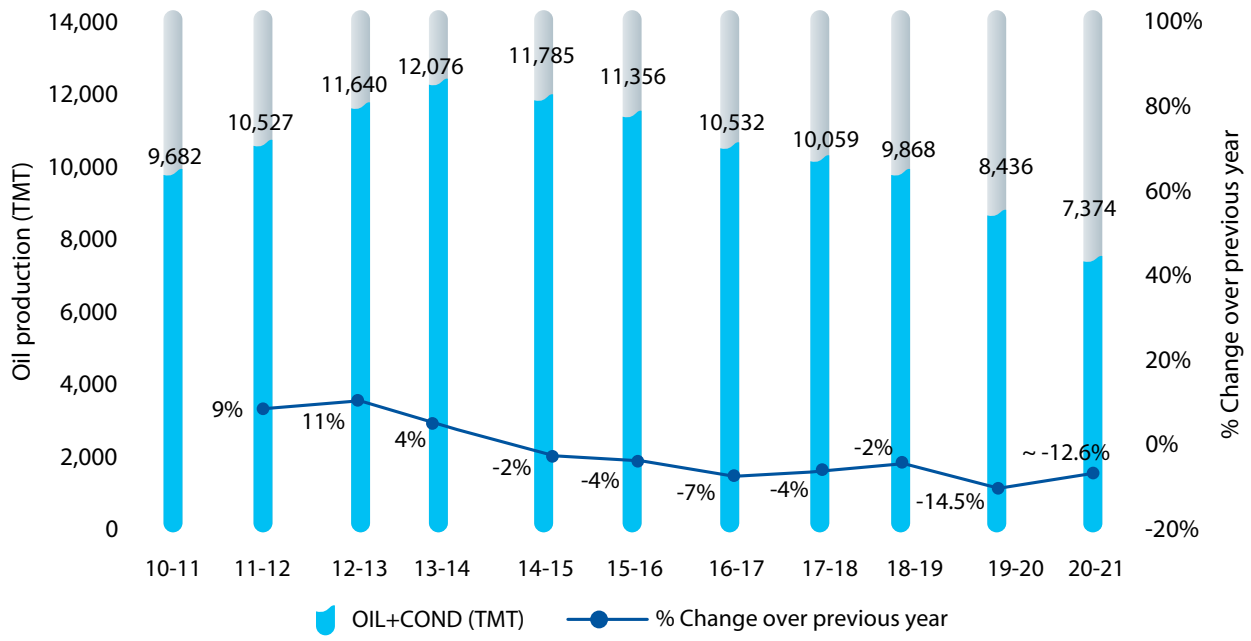
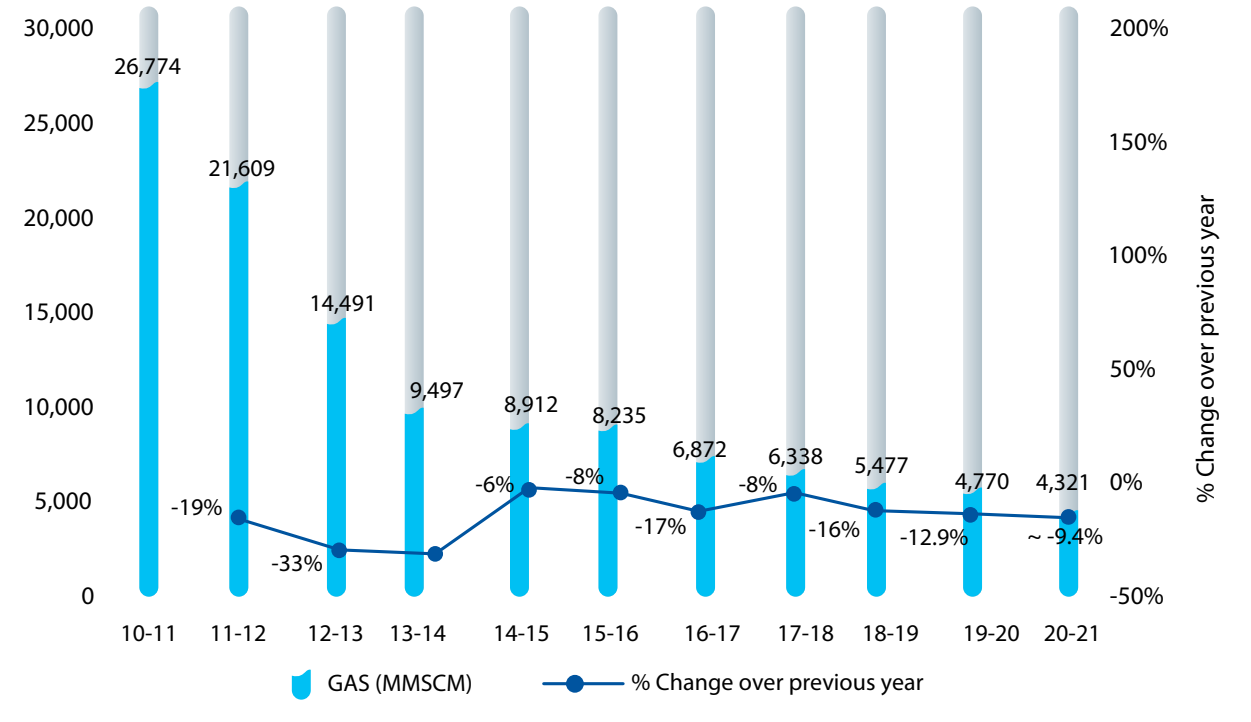


Figure 3.16: Trend in Gas production in PSC Regime from 2010-11 to 2020-21



4

GEOSCIENTIFIC STUDIES

In order to achieve self-sufficiency in E&P sector and accelerate exploration activities in India, accessible viable & good quality of E&P data is required. Sufficient knowledge of hydrocarbon potential of a basin is necessary for any meaningful attempt towards exploration of oil and gas which is a key aspect that attract investments into exploration and production activities. Government of India has recognized how crucial quality E&P data is for making a project techno-economically viable, which led to data driven reforms in the sector to enable investors to view, analyse E&P data and make sound investment decisions at any given point of time. In consideration of the same, Government of India (GoI) has unveiled a series of initiatives for enhancing exploration activities in the country, "Hydrocarbon Resource Assessment of Indian Sedimentary Basins" and "National Seismic Programme" are two major initiatives of GoI in this direction. These initiatives are a testament to the Government's vision to make quality data available, accessible and implementable.

During the last two decades, geo-scientific data grew in volume due to activities pertaining to exploration, development and production. Use of new technologies furthered opening up of new hydrocarbon plays (petroleum habitat with favorable geological conditions, occupying specific stratigraphic levels) and improved assessment tools for estimating hydrocarbon potential. Driven by the philosophy of realizing the potentials of Indian sedimentary basins for bidding out oil and gas acreage, an idea was mooted for a comprehensive evaluation of all 26 sedimentary basins with a re-assessed estimate.

The reassessment study & National Seismic Programme focused on a fact that future bidding should be strengthened with more realistic assessment of Indian Sedimentary Basins and the results could be readily available to the bidders. With HELP ("Hydrocarbon Exploration and Licensing Policy") and OALP ("Open Acreage Licensing Programme") already launched and operational along with NDR ("National Data Repository"), the project outcome of hydrocarbon play information would significantly expand and enrich the geo-scientific database, essentially required for any meaningful and wiser foray into exploration business.

4.1 Play-based Exploration (PBE):

It is well-documented that "Play is defined as area in which several geological factors are present so that the producible petroleum could be proven" (Norwegian Petroleum Directorate, 2016). PBE is a widely used term, representing a structured exploration approach. "Initial focus is always on the basics like the determination and description of the regional context and the basin framework, leading to an understanding of the working Petroleum Systems" (Shell, Play Based Exploration Guidelines). Understanding of petroleum systems, analysis of play chance and assessment of plays provide the foundation on which Yet-to-Find (YTF) hydrocarbon resources (risked recoverable undiscovered hydrocarbons) are assessed.

During 2015-17, the government-sponsored study on resource re-assessment on conventional hydrocarbons was conducted. The study was technically assured by international domain specialists and Indian basin experts with assessment procedures benchmarked to international industry practices. In that study, the resources were estimated for the first time at play level and in process, a significant geo-scientific data were assimilated.

All 26 basins were studied for conventional resources that worked out to be 42 BTOE as un-risked in-place, which is nearly 50% higher than what was assessed two decades back. With geological risks factored, the estimate gave a realistic figure of 25 BTOE, out of which 12 BTOE have already been established through discoveries. In terms of plays, Tertiary plays (87 nos.) have 76% of total un-risked in-place and it is 20% for Mesozoic plays (53 nos.). There are 37 nos. of plays in older sequences (Pre-Mesozoic) constituting 4% of total in-place.

Plays were segregated into as 'Proven' and 'Known' category based on play chances. Proven plays are those, where geological risk elements of petroleum source, reservoir and entrapment are adequately mitigated through hard data like discoveries. Known plays are those which are not yet proven through any discovery. Out of total 177 nos. of plays identified, 86 nos. of plays are "Proven" and 91 are "Known" plays.

The fact that plays were identified during the 2017 Resource Study, Operators were advised to adopt the PBE approach for a comprehensive assessment of acreage, held by them. As a part of holistic exploration strategy, Proven plays are required to be developed, consolidated, and adequately appraised while Known plays are to be chased for discovery. DGH has chalked out the following key exploration initiatives in its E&P Action Plan:

- Continuous review of exploration stage gates: Continuous assessment of exploration risks through subsurface data acquisition being critical in analysis of play chance and future success rate, E&P players should leverage the latest state-or-the-art acquisition, processing and interpretation tools, along with data analytics to continuously engage and review exploration stage gates focusing on hydrocarbon prospectivity for a comprehensive PBE.
- Aggressive exploration strategy: Nearly 80% of undiscovered conventional potential are present in Category I basins, which constitute 65% of total active area. Exploration in such basins are still rewarding due to proven play system with reduced

geological risks. 77 OALP blocks were awarded in Category I basins during last 5 rounds. Generation of drillable prospects in established play systems through fast-track assessment of existing and acquired subsurface data will open new prospects in stratigraphic subtle traps and basin margin wedge-outs.

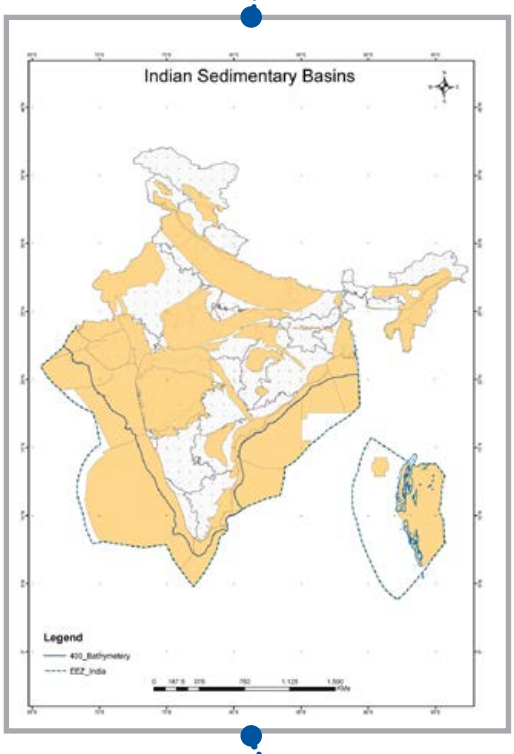
- Thrust for big discoveries: Current exploration trend in proven plays shows that most of the discoveries are small and discrete, if not marginal. As India's offshore area constitutes 51% of total basin area and appraised through survey/drilling to the extent of 78%, increased focus on offshore acreage may be a meaningful approach. Given these facts and quicker statutory clearances without the necessary compliance from State Government, Operators may aggressively embark on exploration in offshore area. This is more significant as new plays, including those in deepwater channels and biogenic plays for possible big discoveries.
- Exploration in Category-II & III basins: As a part of frontier exploration strategy, Operator should keep continuous emphasis on mitigating geological complexities, seismic imaging issues and operational challenges of drilling hard formations in these basins. Following discoveries in Vindhyan and Bengal onland areas, equivalent geological plays can be further studied with new data including those from National Seismic Programme. These basins constitute 15% of total conventional hydrocarbons which are largely risk weighted.

The fact that plays have different risk elements laterally and stratigraphically and further, realistic assessment of plays is driven by availability and strength of data, it's true that adequate time is necessary for a comprehensive evaluation. Even within Category I basins, which have 85% of total un-risked hydrocarbons assessed, significant volumes are undiscovered in proven plays. There are plays, which are geologically difficult to explore and challenging like plays at deeper depth, HP-HT, tight reservoirs, heavy oils etc., which require both technology induction and significant risk capital. View this, DGH has drawn up necessary policy leveraging to target technical resources to be recoverable commercially.

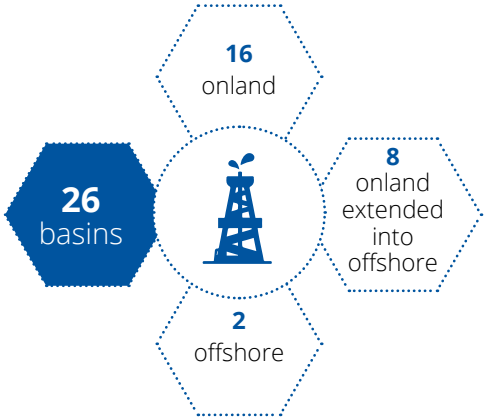
In order to provide clarity to increased use of PBE approach and generate awareness among E&P stakeholders, a one-day webinar was proposed to be hosted by DGH covering all aspects of PBE namely, (i) Play concepts & Industry best practices, (ii) Resource mapping, volumetric & risking, (iii) Indian contexts – Opportunities & Challenges and (iv) Exploration strategy & policy framework. DGH technical heads, industry experts from Operators and service providers along with international domain specialists would participate in the proposed conference as speakers and moderators. The subtle concepts, tangible benefits, standard approach, and policy framework would be part of proposed deliberation in the event.

4.2. Sedimentary Basins in India

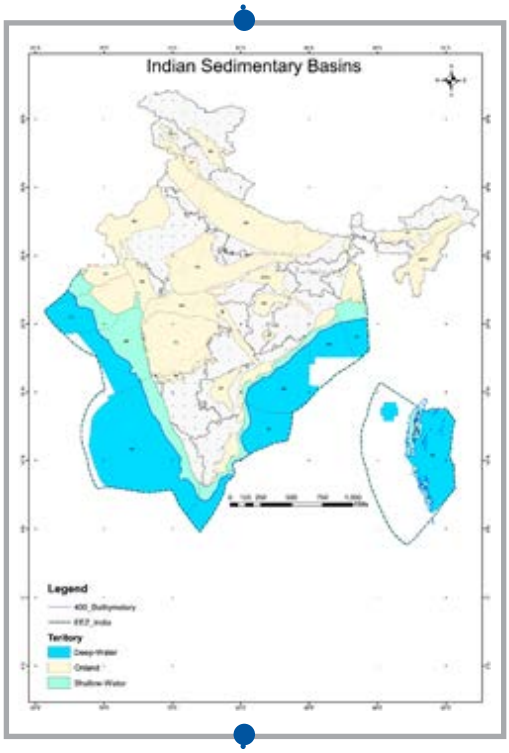
a) Sedimentary Basins: Geographical Area



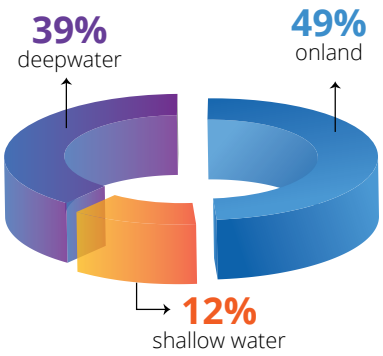
Geographical Area (approx.) (million square kilometer)	
Mainland	**3.29**
Exclusive Economic Zone (EEZ)	**2.37**
Sedimentary Basin	**3.36**



b) Sedimentary Basins -Territories

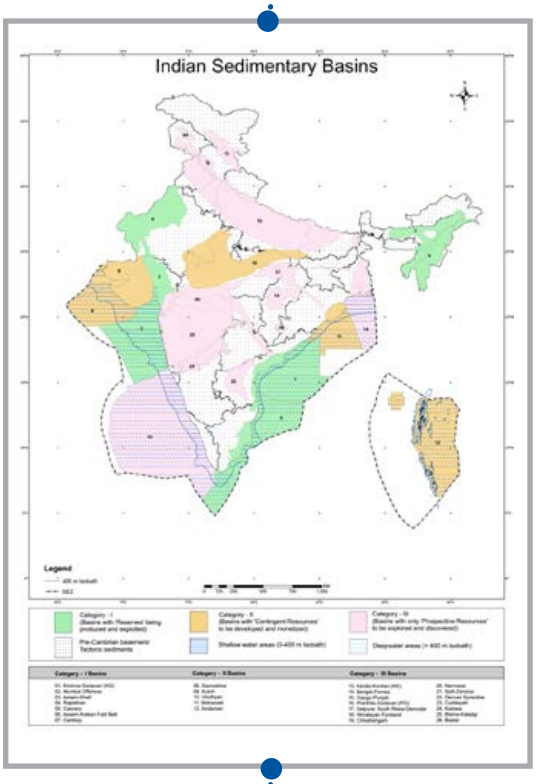


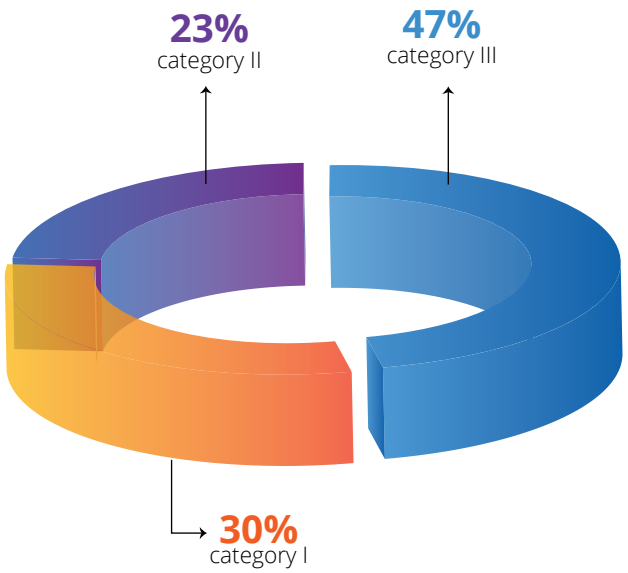
Geographical Area (approx.) (million square kilometer)	
Onland part	**1.63**
Offshore part	**1.73**
Shallow water (Up to 400m water depth)	**0.41**
Deepwater (Beyond 400m water depth)	**1.32**



51% area offshore with major part in deepwater

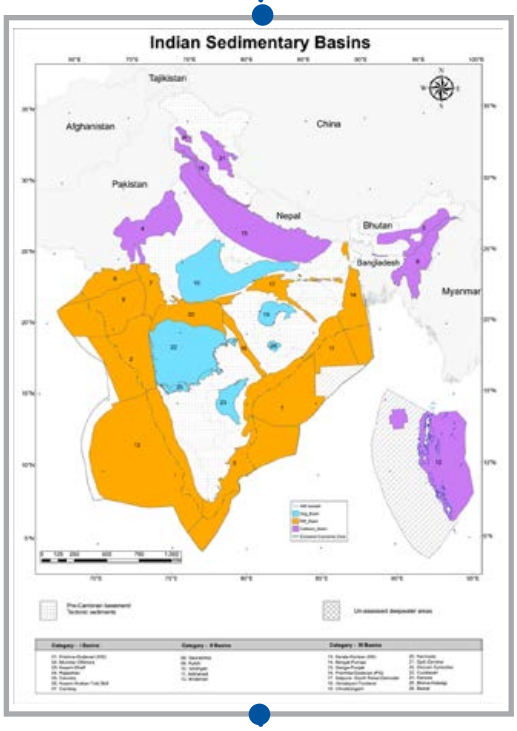
c) Basin Category based on maturity of hydrocarbon resources





Category Description		
	Category I	**Basins are commercially producing hydrocarbons** • 7 basins producing conventional hydrocarbons • 1 basin also producing coal-bed methane
	Category II	**Basins have discoveries, not yet commercially developed** • 5 basins have established conventional hydrocarbons
	Category III	**Basins have no discoveries yet, less explored** • 1 basin has a discovery, started producing oil, poised for category upgrade

d) Sedimentary Basins – tectonic framework



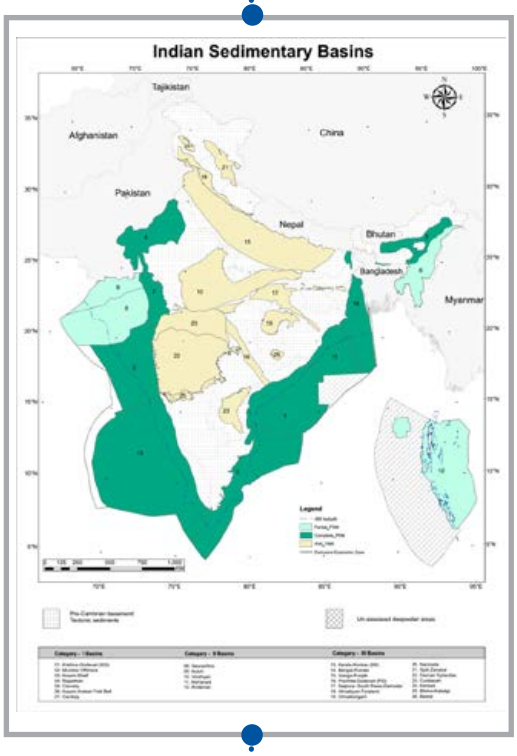
Rift basins producing with substantial resources

Inter-orogenic and foreland basins also producing

Sag basin has a significant discovery in Proterozoic clastic

- FOLD, FORELAND, INTER-OROGENIC, ARC
- CRUSTAL SAG
- RIFT (PERI-CRATONIC, INTRA-CRATONIC)

e) Sedimentary Basins – data coverage



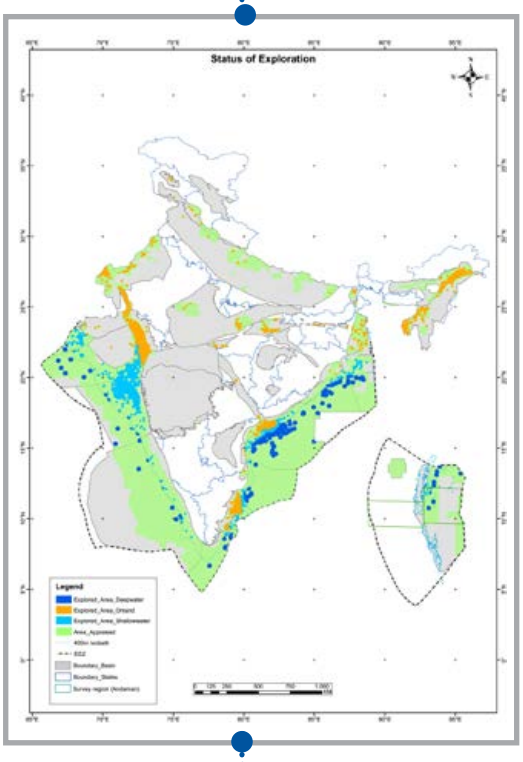
Good geoscientific data coverage in Rift Basins

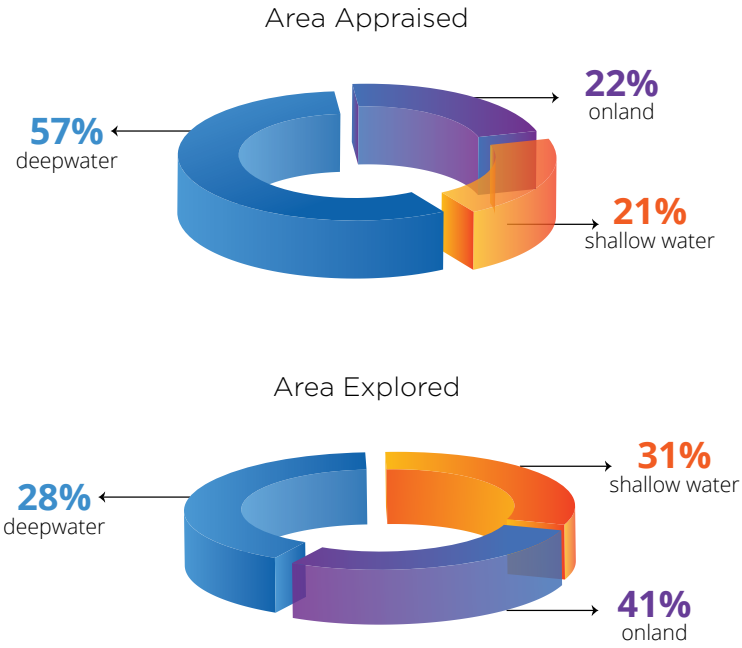
13 basins assessed through advanced petroleum system modeling

Data gap filled up through national data acquisition programme

- GOOD
- FAIR
- LIMITED

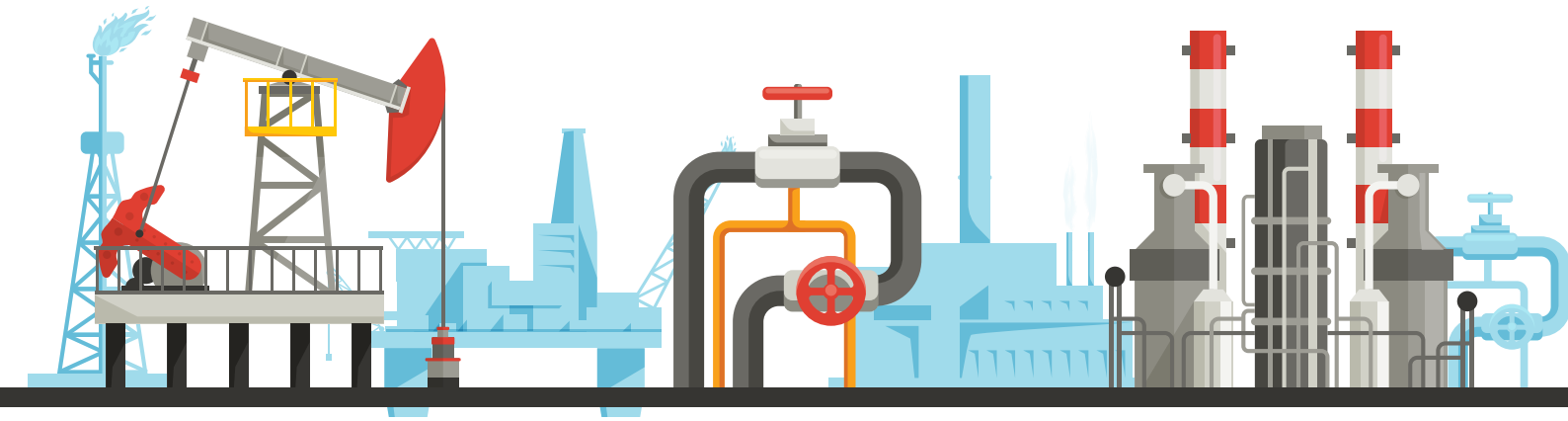
f) Sedimentary Basins – extent of exploration



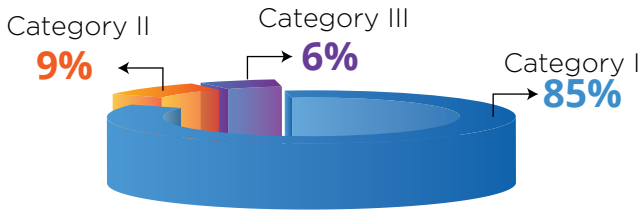


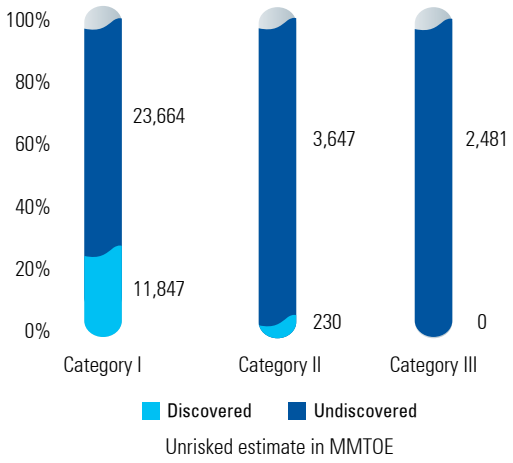
49% basin area appraised through survey and drilling

10% basin area explored through drilling

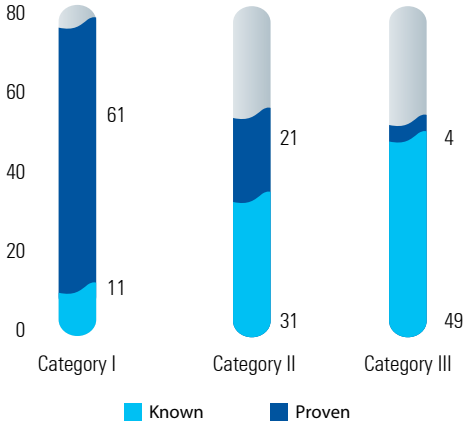


g) Sedimentary Basins : Resource Potential and Exploration Opportunity

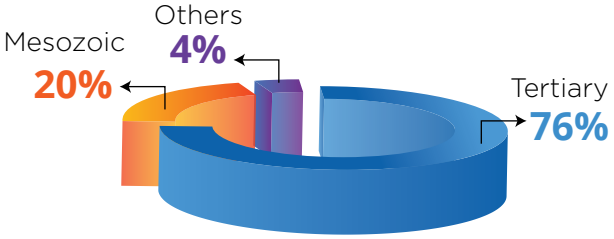


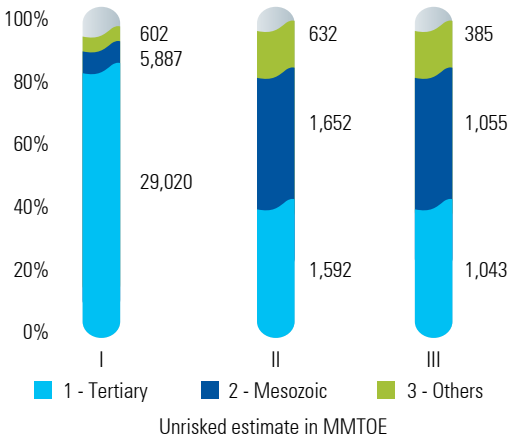


Hydrocarbon Plays: Proven and Known



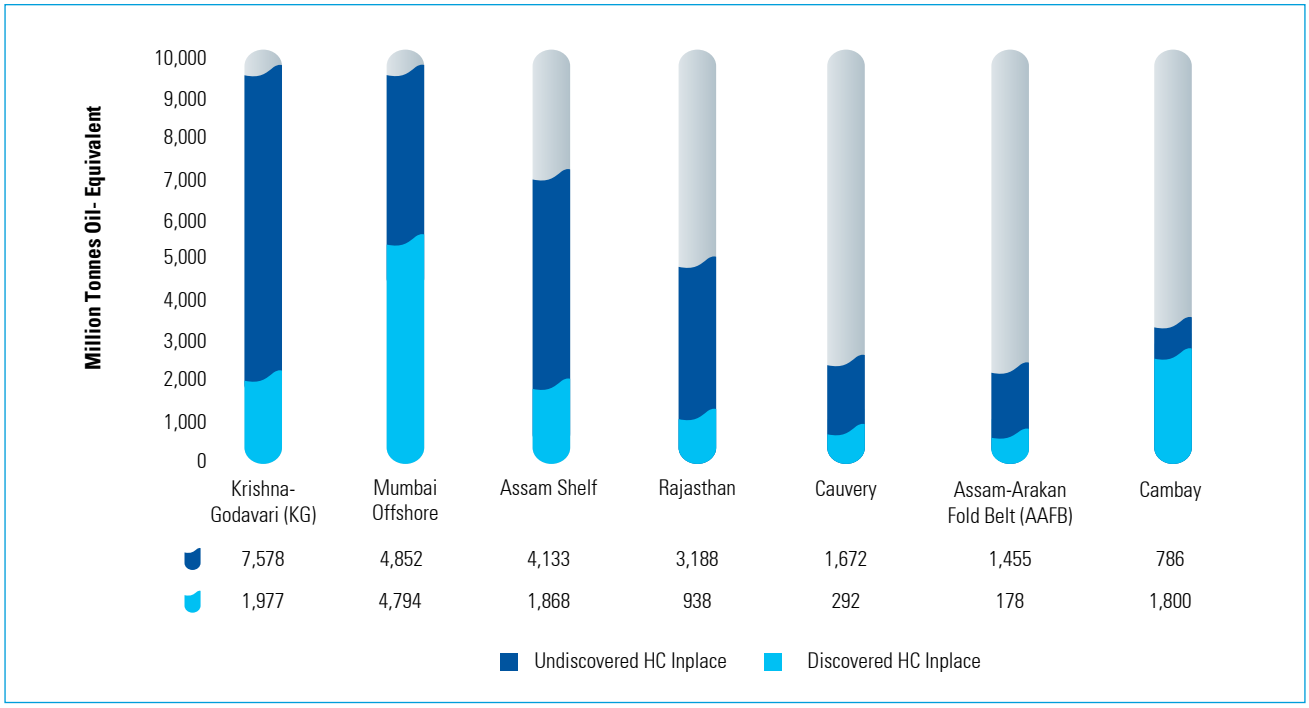
Hydrocarbon Plays: Resource across Geological Age





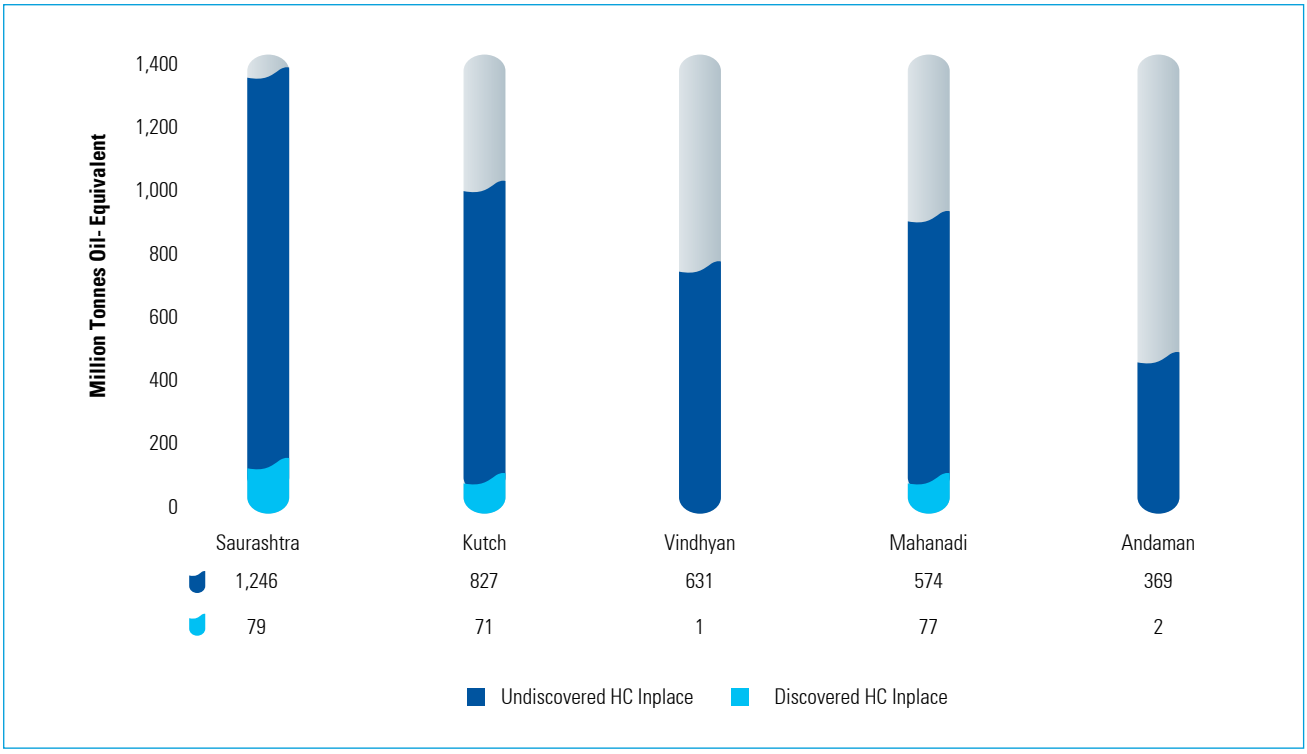
Category I has most Undiscovered Resources, mostly Proven and Tertiary | Mesozoic Potential too substantial

h) Conventional resources across Basins – Category I



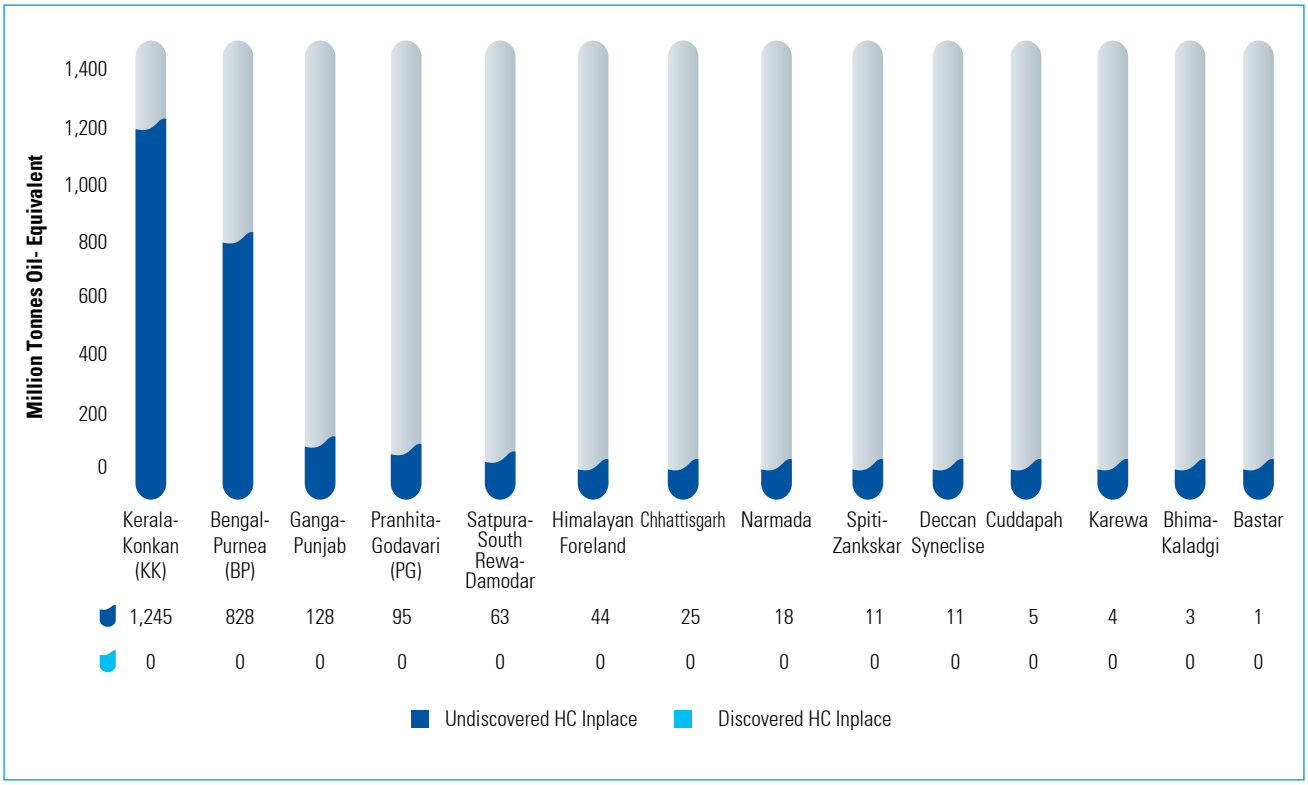
- Cambay has 70% resource discovered, Mumbai 50%
- KG and Rajasthan are relatively newer basins

i) Conventional resources across Basins – Category II



- Kutch and Saurashtra have development plans approved
- Vindhyan under appraisal survey and drilling

j) Conventional resources across Basins – Category III



- Bengal sub-basin recently made a significant discovery, currently under appraisal and production
- Kerala-Konkan has excellent sub-surface data with Mesozoic potential.
- Most basins have sparse data, which are now covered under National Seismic Programme (NSP)

Technical Webinar

DGH, on 22.03.2021 conducted one International webinar, titled **"Hydrocarbons Reserves and Resources: Conformance to PRMS 2018"** and also advanced to host a couple of webinars, titled "Digital Transformation in Indian E&P Sector: The Road Ahead" and **"Increased focus on Play-based Exploration: The Road towards a holistic perception of Indian Hydrocarbon Industry".** These international webinars are being scheduled early next fiscal (FY 2021-22).

The key actionable points from PRMS webinar are as under:

No.	Title	Date	Key way-forward
1.	Hydrocarbons Reserves and Resources: Conformance to PRMS 2018	March 22, 2021 Workshop platform: www.airmeet.com	1. Develop increased understanding of technical terms and their use 2. Create an updatable database of resources and reserves (conventional and unconventional), company-wise separately for both oil and gas for all active acreages under PEL and PML 3. Segregate the reserves/resources that are audited by Third-party reserves auditors 4. Develop monitoring matrix to periodically scrutinize time-bound maturation of resources and exploitation of reserves and to framework suitable strategy in this direction 5. Keep track of key field performance indicators like RRR (Reserve Replacement Ratio), R/P (Reserve-to-Production) and Discovery/Exploitation Indices

4.3. National Seismic Programme (NSP)

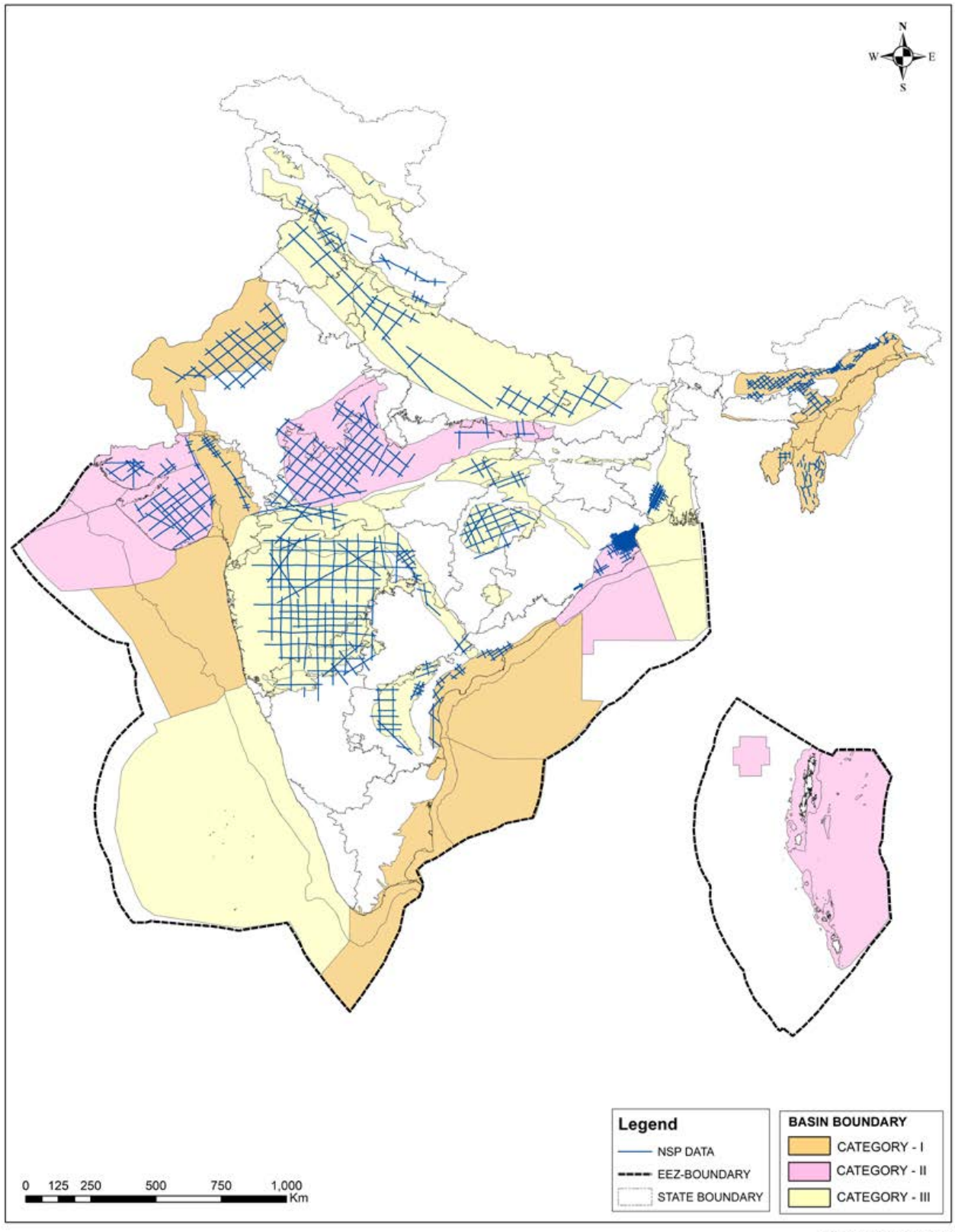
Quality geophysical data of acquisition, processing & interpretation (API) is one of the most important aspects in considering a field to be technologically & commercially viable. It assists in giving the initial insight into the prospectivity assessment and also assist in inducing confidence in drilling plans which is a capital-intensive project. In order to assist the operators in making sound decision regarding bidding for the new contractual regime of revenue sharing contract appraisal of unapprised areas was considered an important task which led to the introduction of NSP.

To achieve this, MoP&NG formulated a plan to conduct 2D seismic surveys within timeframe of five years at an estimated cost of INR 2,932.99 Crores in all sedimentary basins of India where no/scanty data is available. Directorate General of Hydrocarbons (DGH) identified the need of about 48,243 Line Kilo Meter (LKM) 2D seismic data for appraisal of these areas. The project was introduced under the broad policy framework of Geo-Scientific Data generation for Hydrocarbons in Indian Sedimentary Basins to appraise the un-appraised onland areas in 26 sedimentary basins and was notified on 20th May 2014.

The project is being implemented through National Oil Companies (NOCs) OIL and ONGC through service providers in North-Eastern states and rest of India respectively. OIL is undertaking seismic data API in Assam Shelf & Assam Arakan Basin whereas ONGC carried out survey work in other basins.

As on 31st March 2021, approx. 46,004 LKM of data has been acquired which is ~95% of the total target of 48,243 LKM under NSP campaign.

Map Showing NSP Data Loaded in NDR



as on 31st Mar 2021

Table 4.1: Sector-wise Progress of Data Acquisition, Processing, Interpretation as on 31.03.2021:

Sector	Area	Target (LKM)	Cumulative Field data acquired (LKM)	Total data submitted to NDR (LKM)			Remarks (API completed)
				Raw	Processed	Interpreted	
1	Cambay	1,487	1,468.80	1,034.88	1,034.88	0	
	Saurashtra	2,280	2,305.95	2,305.95	2,305.95	2,305.95	Completed
2	Kutch	1,760	1,660.93	1,174.98	868.62	0	
	Rajasthan	2,793	2,752.44	2,752.44	2,752.44	2,752.44	Completed
3	Krishna-Godavari	1,065	980.80	980.80	980.80	980.80	Completed
	Pranhita-Godavari	877	735.18	735.18	735.12	735.12	
	Cudappah	1,158	1,386.90	1,386.90	1,386.90	1,386.90	
	Cauvery	-	-	-	-	-	Dropped
4	Andaman	255	210.84	78.64	0	0	
5	Mahanadi-NEC	3,029	2,480.62	2,480.62	2,480.62	2,480.62	Completed
	Bengal	358	911.40	911.40	911.34	911.34	Completed
6	Ganga	2,642	2,671.50	2,671.50	2,671.50	2,671.50	Completed
6A	Ganga-Punjab	1,200	1,186.14	1,186.14	1,181.64	1,181.64	Completed
7	Deccan _North	5,318	5,471.09	5,471.09	5,471.09	5,471.09	Completed
8	Deccan_South	4,833	4,964.50	4,964.50	4,982.50	4,982.50	Completed
	Bhima	663	611.64	611.64	611.64	611.64	Completed
	Kaladgi	310	257.22	257.22	275.22	275.22	Completed
9	Narmada	1,844	1,617.96	1,617.96	1,617.96	1,617.96	
	Vindhyan-A	4,413	4,904.46	4,904.46	4,904.41	4,904.41	Completed
	Satpura	245	-	-	-	-	Dropped
10	Vindhyan-B	774	477.90	393.36	393.30	0	
	South Rewa-Damodar	1,595	756.80	684.32	684.32	0	
	Chhattisgarh	1,742	1,778.16	1,778.16	1,778.16	1,778.16	Completed
	Bastar	-	-	-	-	-	Dropped
11	Himalayan Foreland	993	1,167.96	862.20	862.20	0	
	Spiti-Zanskar	197	7.74	7.74	7.74	0	Dropped
	Karewa	-	-	-	-	-	Dropped
11A	Himalayan Foreland (New)	380	370.08	370.08	370.08	0	
Total (ONGC)		**42,211**	**41,137.01**	**39,622.16**	**39,268.43**	**35,047.29**	

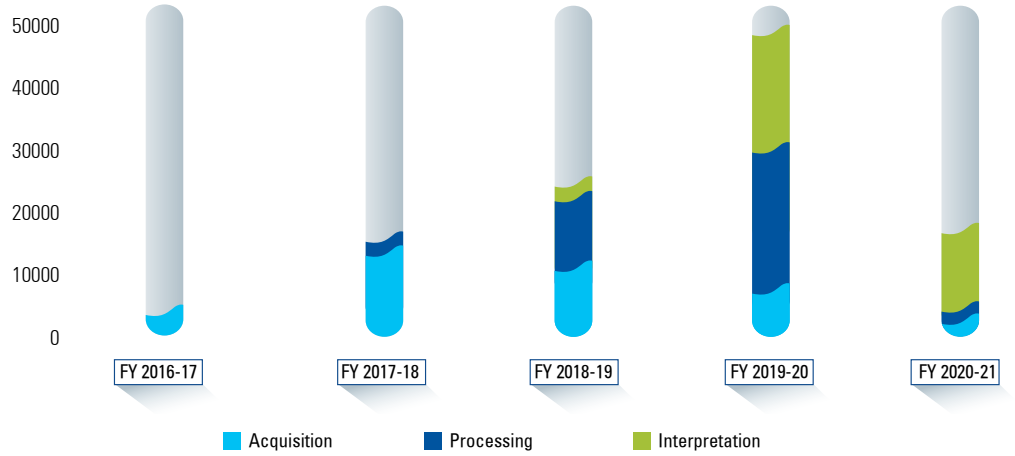
Sector	Area	Target (LKM)	Cumulative Field data acquired (LKM)	Total data submitted to NDR (LKM)			Remarks (API completed)
				Raw	Processed	Interpreted	
A1S1	Assam-Arunachal	2,414	2,416.20	2,416.20	2,416.20	2,416.20	Completed
A1S2	Arunachal -Assam	738	743.70	743.70	743.70	743.70	Completed
A2S1	Nagaland	-	-	-	-	-	Dropped
A2S2	Manipur	870	4.74	4.74	0	0	
A2S3	North Cachar Hills	885	136.98	329.16	329.16	329.16	
A2S4	Mizoram-Tripura	1,125	1,143.48	1,143.48	1,143.48	1,143.48	Completed
Total (OIL)		**6,032**	**4,866.54**	**4,637.28**	**4,632.54**	**4,632.54**	
GRAND TOTAL (ONGC+OIL)		**48,243**	**46,003.55**	**44,259.44**	**43,900.97**	**39,679.83**	

Plan for comprehensive appraisal of Indian Sedimentary Basins

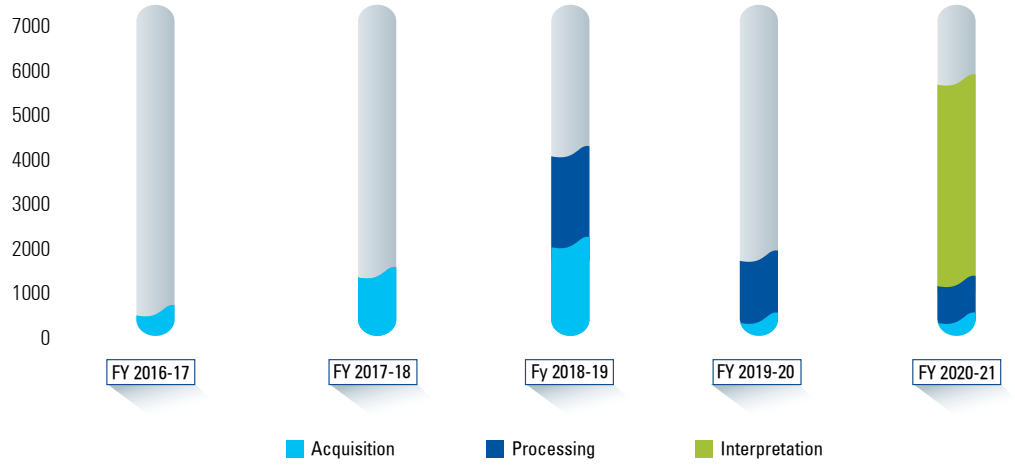
To build a reliable and robust geoscientific database covering all sedimentary basins of India, comprehensive appraisal of onland and offshore Indian Sedimentary Basins are being taken up. Drilling of parametric wells at least in each of the basins have also been planned. 2D broadband seismic data acquisition in Andaman deepwater is underway.

Year Wise trend of data Acquired, Processed & Interpreted *(All data are in LKM)*

2D Seismic API carried out by ONGC



2D Seismic API carried out by OIL



Approximately 95% of the target data has been acquired

4.4. National Data Repository:

A huge volume of data collected by Public & Private E&P companies and other agencies over more than six decades of activities was hitherto lying scattered at different work centers of ONGC, OIL and DGH or held by the operating companies. This necessitated establishment of a set up at national level that could assimilate, preserve and disseminate the vast amount of data that could be organized and regulated for use in future exploration & development activities, besides use by R&D and other educational Institutes. With this objective, Govt. of India by an order dated 28.02.2014 initiated the establishment of National Data Repository (NDR), which has been set up under the aegis of Directorate General of Hydrocarbons (DGH) in Noida. National Data Repository (NDR) is an E&P databank with state-of-the-art facilities. It has been operational since 28th June 2017.

NDR being a national E&P database is one stop solution for all the E&P data requirements. NDR is entrusted with the responsibility of Data assimilation, Disclosure, Sharing, Accessibility & Dissemination for commercial exploitation, research & development through its policy. The broad objectives of NDR are as follows:

- To validate, store, maintain and reproduce high quality and reliable geoscientific data
- To facilitate efficient data reporting, data exchange, and data trading with existing players including all geoscientific agencies and academia
- To improve DGH's ability to monitor and control the E&P activities and reporting
- To encourage new E & P activities by providing high quality and reliable data
- To strengthen overall geoscientific activities in India

NDR is key enabler of Open Acreage Licensing Programme (OALP) & Discovered Small Fields (DSF) rounds under the Hydrocarbon Exploration and Licensing Policy (HELP) regime and it is for this reason, NDR was launched on 28th June 2017 alongwith OALP Round-I. The freedom of E&P operators to carve out blocks of their interest and size is facilitated by National Data Repository (NDR) under new OALP/HELP policy regime.

Key features

- State of the art Primary Data Centre (PDC) equipped for data storage capacity of 236TB of hard disk to store processed data & 720TB robotic tape library
- Secondary Data Centre (SDC) with a facility of 140TB Capacity for Disaster Recovery and Business Continuity.
- Real time data replication between PDC & SDC
- Online portal (Team Work Space-TWS) showcasing E&P data of 26 sedimentary Basins along-with the Capability for online data viewing, selecting and ordering.

4.4.1. Secondary Data Centre:

DGH established its Secondary Data Centre (SDC) in high-tech Software Technology Parks of India (STPI) Building, at Bhubaneswar. SDC is located in a different seismic zone than PDC, NOIDA. STPI is a Tier-III data center built under the Ministry of Electronics and Information Technology. SDC would work as Business Continuity/Disaster Recovery Centre of Primary Data Centre (PDC) of National Data Repository of DGH, Noida. The Secondary Data Centre (SDC) is fully operational since 4th August 2018. SDC will be able to resume business operations in case of a disaster at PDC.

Data Available in NDR as of 31st March 2021

1.	2D Seismic Data	: 2.728 Million LKM
2.	3D Seismic Data	: 0.895 Million SKM
3.	Well and Log Data	: 19,869 No. of Wells
4.	Well Reports	: 40,815 Nos. of reports

Key Achievements in FY 2020-21

1. Prepared Data Package for 10 blocks offered under OALP Bid Round-VI
2. Carved-out 32 contract areas (75 Discovery) for upcoming DSF Bid Round-III
3. Contract awarded for archival of 9,650 nos. of tape cartridges (3590 & 3592)
4. Processed of 240 nos. of PML regrant applications
5. **Delivered 58** numbers of data orders to **12 Indian, 3 Foreign** & **3 Academic** users.

4.4.2 Future ready National Data Repository 2.0 (NDR 2.0)

Next generation National Data Repository 2.0 **(NDR 2.0)** is planned with the aim to further improve the data accessibility (downloading), data reporting, submission (uploading) and enhance storage (for all E&P data types including seismic field data) and to create a cloud enabled database platform.
It is envisaged to use AI and Machine Learning to extract knowledge and insights from various structured/unstructured E&P data.

Target for NDR 2.0

a) **Cloud based solution with the following key features:**

i. Online data uploading by E&P operators

ii. Online data downloading by entitled users

iii. Virtual Data Rooms - Online/anywhere/anytime data visualization and interpretation facility

iv. Enhanced industry-academia collaboration

v. Safeguarding E&P data as a strategic national asset

b) **Data Analytics:**

i. To create a database platform to be able to apply data science methods using AI and Machine Learning

ii. To leverage existing E&P data of NDR to gain understanding of potential occurrence of or delineation and development of oil and gas in the subsurface of a basin

iii. **Automation of NDR system and processes** - will enhance end user experience and automate most of the repetitive work processes

iv. **Improving upon key areas of NDR processes** - reduced data order processing time, while eliminating manual intervention at each step, efficient QC of data, faster user query resolution using cognitive technologies etc.

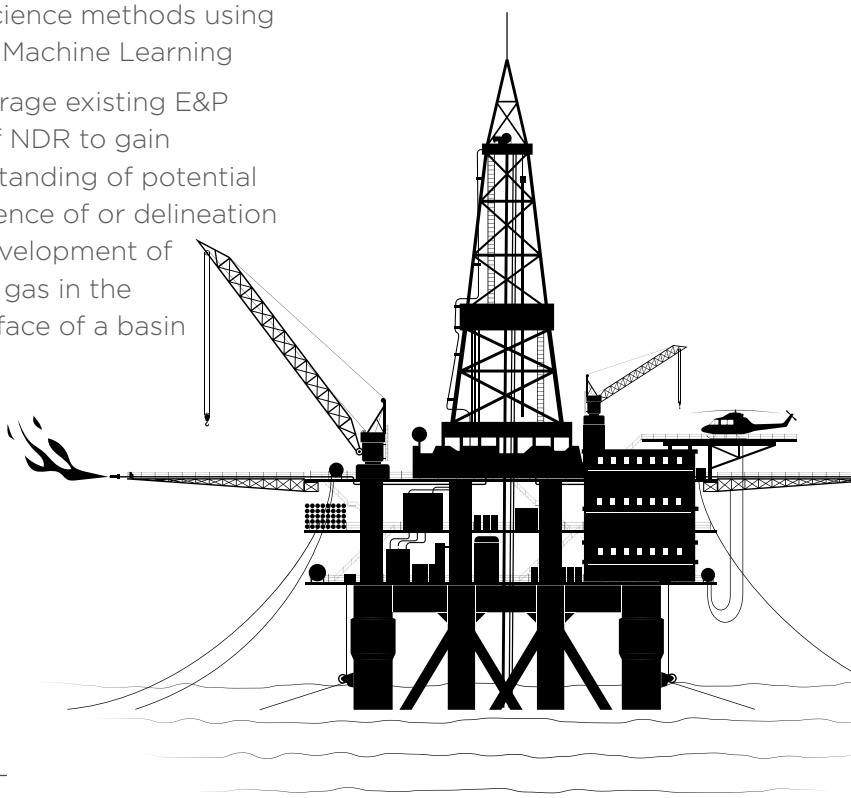
c) **Expansion of storage:**

i. Provision for storing all E&P data types including seismic field data

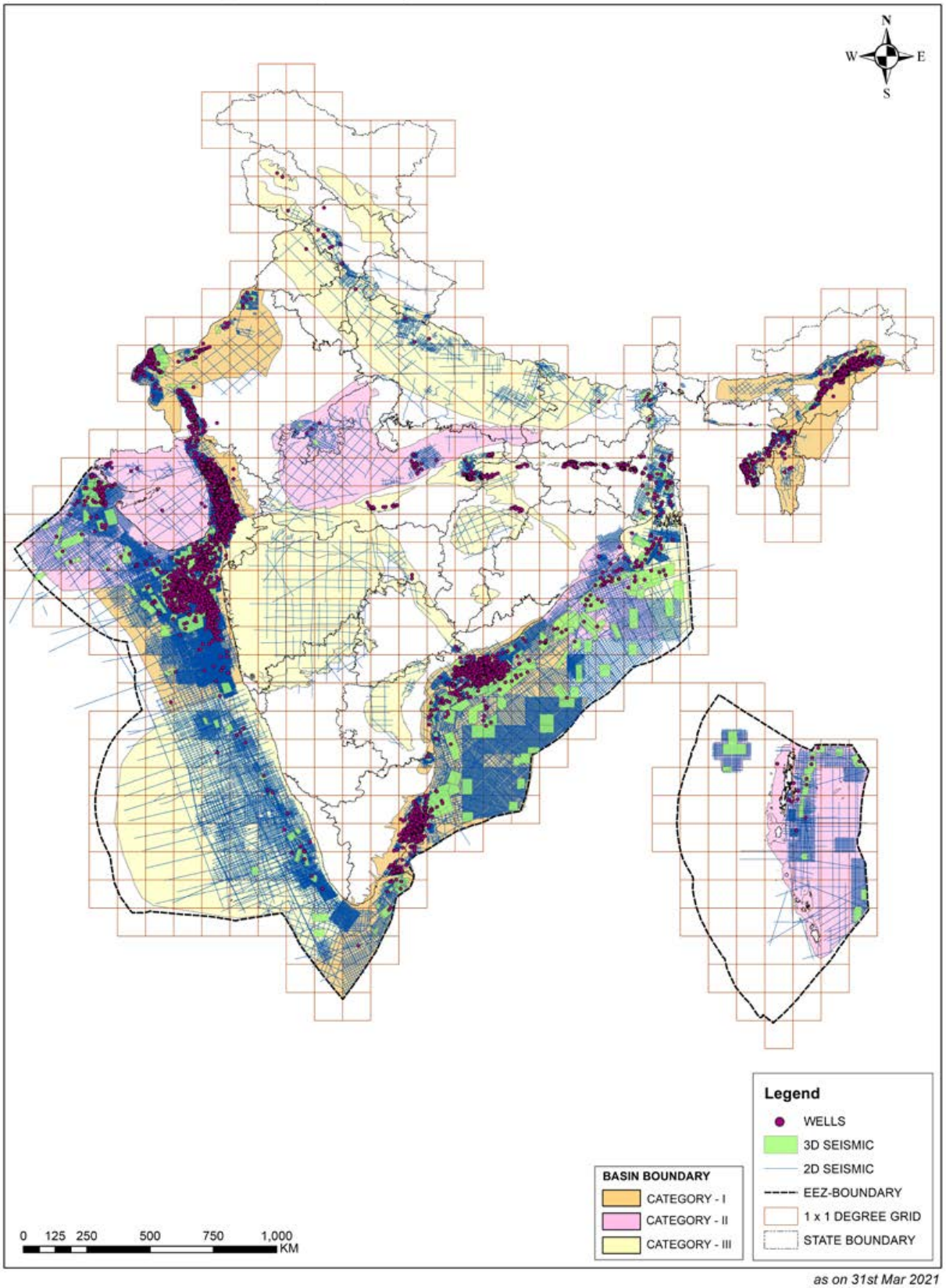
ii. 100% redundancy from disaster recovery point of view

iii. Improved efficiency in access of such data with low latency

d) **Timeline:** Planned for implementing NDR 2.0 solution by end of FY 2021-22.



Map of India showing coverage of 2D/3D Seismic and Well data in NDR as on 31st March 2021:



as on 31st Mar 2021

5 PETROLEUM RESOURCES & RESERVES

5.1 Conventional Hydrocarbons

The conventional hydrocarbon resources in India are currently estimated at approx. 42 billion metric tonnes of Oil & Oil Equivalent of Gas (O+OEG). This is a significant increase of 49% over previous estimate of 28.09 billion metric tonnes of O+OEG. However, India's hydrocarbon resources still remain highly underdeveloped and the Governments new liberal approach is nudging companies to invest in tapping them.

The resource potential revealed with the recent re-assessment study presents true potential of the Indian sedimentary basins, and proved to be useful in ongoing projects, including OALP, DSF rounds, and NSP (National Seismic Programme).

In accordance with the best practices of Oil & Gas industry globally, the basin categories are simplified into three categories in line with PRMS (Petroleum Resources Management System) as Reserves, to be produced (Category I, 7 basins), Contingent Resources to be monetized (Category II, 5 basins) and Prospective Resources, to be explored (Category III, 14 basins).

Table 5.1: Assessment Result Comparison 1995-96 VS 2017 (Excluding unconventional hydrocarbons)

No.	Basin	Un-risked Conventional Hydrocarbon In-place (1995-96)	Un-risked Conventional Hydrocarbon In-place (2017 Study)			Discovered Conventional Hydrocarbon In-place	Un-risked Undiscovered Hydrocarbon In-place
			3D PSM	Areal Yield	Total		
1	Krishna-Godavari (KG)	1,130	9,555	.....	9,555	1,977	7,578
2	Mumbai Offshore	9,190	9,646	.....	9,646	4,794	4,852
3	Assam-Shelf	3,180	6,001	.....	6,001	1,868	4,133
4	Rajasthan	380	4,126	.....	4,126	938	3,188
5	Cauvery	700	1,964	.....	1,964	292	1,672
6	Assam-Arakan Fold Belt	1,860	1,233	400	1,633	178	1,455
7	Cambay	2,050	2,586	.....	2,586	1,800	786
8	Saurashtra	280	1,294	31	1,325	79	1,246
9	Kutch	760	862	36	898	71	827
10	Vindhyan	Not Studied	.....	633	633	1	632
11	Mahanadi	145	651	.....	651	77	574
12	Andaman	180	359	12	371	2	370
13	Kerala-Konkan (KK)	660	1,245	.....	1,245	0	1,245
14	Bengal-Purnea	190	828	.....	828	0	828
15	Ganga-Punjab	230	.....	128	128	0	128
16	Pranhita-Godavari (PG)	Not Studied	.....	95	95	0	95
17	Satpura-South Rewa-Damodar	Not Studied	.....	63	63	0	63
18	Himalayan Foreland	150	.....	44	44	0	44
19	Chhattisgarh	Not Studied	.....	25	25	0	25
20	Narmada	Not Studied	.....	18	18	0	19
21	Spiti-Zanskar	Not Studied	.....	11	11	0	11
22	Deccan Syneclise	Not Studied	.....	11	11	0	11
23	Cuddapah	Not Studied	.....	5	5	0	5
24	Karewa	Not Studied	.....	4	4	0	4
25	Bhima-Kaladgi	Not Studied	.....	3	3	0	3
26	Bastar	Not Studied	.....	1	1	0	1
-	Deepwater Areas	7,000	Deepwater area estimated basin-wise & resources added to respective basins				
Total (MMTOE)		**28,085**	**40,350**	**1,522**	**41,872**	**12,076**	**29,796**

All figures in MMTOE

5.2 Hydrocarbon reserves of India

In-place hydrocarbon volume of 11159.33 MMT of Oil and Oil Equivalent Gas (O+OEG) have been established by ONGC, OIL and Pvt./JVs under Nomination, PSC and CBM regime. Ultimate reserves are 4374.70 MMT O+OEG and accretion in ultimate reserves in the year 2020-21 is 41.61 MMT O+OEG. Balance recoverable reserves are 1599.69 MMT O+OEG. Details are as below:

Table 5.2: 2P Reserves status as on 01.04.2021

No.	Subject	Parameter	ONGC (Nomination)*	OIL (Nomination)*	PSC/RSC	Total with out CBM	CBM	Total with CBM
1	Initial In-place volume	Oil + Cond. (MMT)	5,327.85	800.30	868.14	6,996.29		6,996.29
		Gas (BCM)	2,346.35	391.24	1,178.55	3,916.14	296.90	4,213.04
		O+OEG (MMTOE)	7,674.20	1,141.54	2,046.69	10,862.43	296.90	11,159.33
2	Accretion of In-place volume(during 2020-21)	Oil + Cond. (MMT)	17.53	1.49	25.77	44.79		44.79
		Gas (BCM)	37.19	6.08	3.09	46.36	0.00	46.36
		O+OEG (MMTOE)	54.72	6.88	28.86	90.46	0.00	90.46
3	Ultimate Reserves	Oil + Cond. (MMT)	1,508.46	256.24	242.12	2,006.82		2,006.82
		Gas (BCM)	1,350.53	230.36	742.20	2,323.09	75.28	2,398.37
		O+OEG (MMTOE)	2,858.99	456.12	984.32	4,299.43	75.28	4,374.70
4	Accretion of Ultimate Reserves (during 2020-21)	Oil + Cond. (MMT)	4.27	1.39	6.32	11.98		11.98
		Gas (BCM)	22.76	4.05	3.44	30.25	0.00	30.25
		O+OEG (MMTOE)	27.03	4.82	9.76	41.61	0.00	41.61
5	Balance Recoverable Reserves	Oil + Cond. (MMT)	301.02	73.05	101.23	475.30		475.30
		Gas (BCM)	324.64	130.75	615.03	1,070.41	70.89	1,141.31
		O+OEG (MMTOE)	625.66	186.88	716.26	1,528.80	70.89	1,599.69

** As Provided by ONGC & OIL*

5.3 Reserves established under PSC+RSC regime

The government has taken several steps in the recent past to enhance E&P activities under PSC+RSC regime and In-place reserves have steadily increased over the years. The trend of In-place volume and Ultimate reserves of crude oil and natural gas under the PSC+RSC regime, excluding CBM, during the period 2008-09 to 2020-21 along with the growth with base year as 2008-09 is provided. In-place has recorded growth of 39% and Ultimate reserves have recorded growth of 44%. Details are as below:

Table 5.3: In-Place Volume Trend (PSC+RSC regime, excluding CBM)

As on	OIL+COND (MMT)	Gas (BCM)	O + OEG (MMTOE)	% Growth Rate with Base year 2008
01.04.2008	638.82	837.97	1,476.79	-
01.04.2009	658.36	839.27	1,497.62	1%
01.04.2010	814.19	918.42	1,732.61	17%
01.04.2011	820.67	944.66	1,765.34	20%
01.04.2012	816.56	991.26	1,807.82	22%
01.04.2013	829.92	1,010.69	1,840.62	25%
01.04.2014	972.36	1,036.82	2,009.18	36%
01.04.2015	975.35	1,179.19	2,154.54	46%
01.04.2016	995.45	1,077.75	2,073.20	40%
01.04.2017	1,008.34	1,187.26	2,195.59	49%
01.04.2018	1,080.89	1,245.97	2,326.87	58%
01.04.2019	1,129.39	1,364.50	2,493.89	69%
01.04.2020	846.05	1,257.41	2,103.46	42%
01.04.2021	868.14	1,178.553	2,046.6942	39%

Figure 5.1 - In-Place Volume Trend (PSC+RSC Regime)

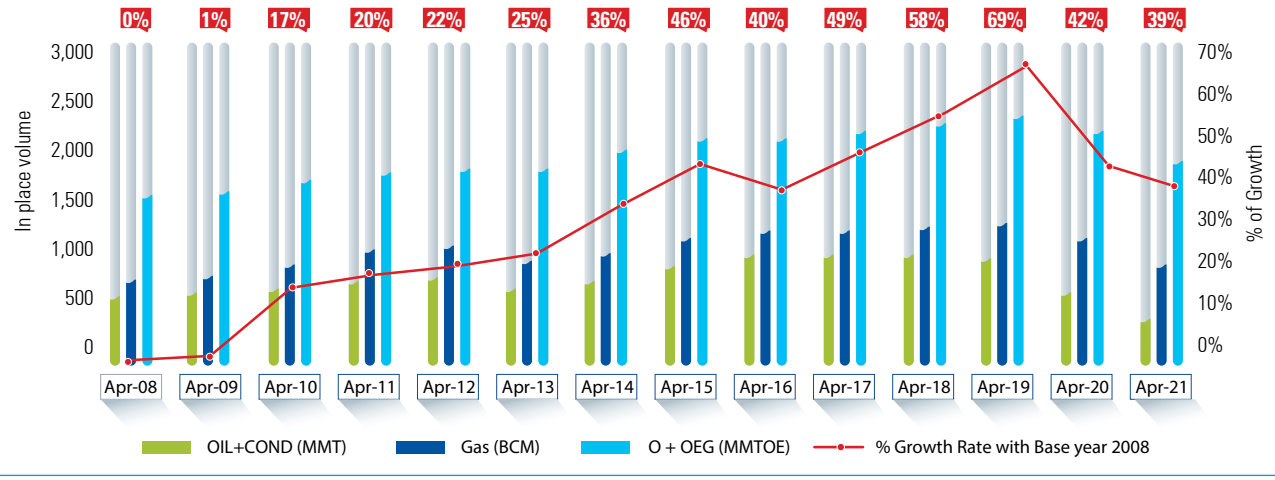
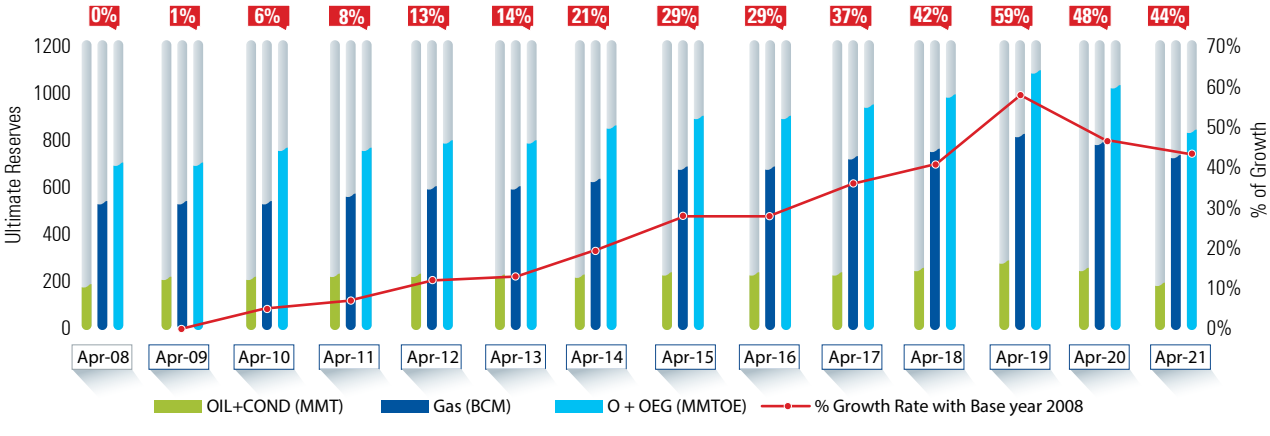


Table 5.4: Ultimate Reserves Trend (PSC+RSC regime, excluding CBM)

As on	OIL+COND (MMT)	Gas (BCM)	O + OEG (MMTOE)	% Growth Rate with Base year 2008
01.04.2008	172.36	511.15	683.50	-
01.04.2009	178.12	510.44	688.55	1%
01.04.2010	194.31	526.88	721.20	6%
01.04.2011	194.89	542.93	737.82	8%
01.04.2012	194.89	578.85	773.74	13%
01.04.2013	197.21	579.00	776.21	14%
01.04.2014	214.58	614.50	829.08	21%
01.04.2015	215.38	666.22	881.60	29%
01.04.2016	225.20	658.38	883.58	29%
01.04.2017	227.63	710.36	938.00	37%
01.04.2018	234.04	738.38	972.42	42%
01.04.2019	270.85	815.39	1,086.24	59%
01.04.2020	237.80	776.52	1,014.32	48%
01.04.2021	242.117	742.2	984.317	44%

Figure 5.2 - Ultimate reserves trend (PSC+RSC Regime)



Basin wise In-place volume and Ultimate reserves (PSC+RSC regime):

India has 26 sedimentary basins covering an area of 3.36 million square kilometres. The sedimentary basins of India, onland have an aerial extent of about 1.63 million sq. km. and offshore up to the 400-m isobath, have an aerial extent of about 0.41 million sq. km. In the deepwater beyond the 400-m isobath, the sedimentary area has been estimated to be about 1.32 million sq. km. Major basins where hydrocarbon potential has been established under the PSC regime are Assam- Arakan, Bengal-Purnea ,Cambay, Cauvery, Krishna Godavari, Mahanadi, Mumbai, Rajasthan and Saurashtra . In-place volume and ultimate reserves, as on 01.04.2021, in the prospective sedimentary basins of India established through various bidding rounds under PSC & RSC regime are provided below.

Table 5.5: Distribution of In-place volume and Ultimate reserves in sedimentary basin of India Under PSC + RSC Regime (as on 1.4.2021)

Basin	In-Place (O+OEG) in MMTOE	Ultimate (O+OEG) in MMTOE
Assam Shelf & AAFB	104.034	21.202
Bengal-Purnea	6.674	4.441
Cambay	166.9172	45.658
Cauvery	88.862	26.155
Krishna Godavari	1,041.386	635.295
Mahanadi-NEC	37.067	26.221
Mumbai	71.812	33.223
Rajasthan	512.642	182.492
Saurashtra	17.3	9.63
Grand Total	**2,046.6942**	**984.317**

Figure. 5.3 Basin-wise In-place volume (O + OEG (MMTOE) Distribution under PSC & RSC Regime as on 01.04.2021

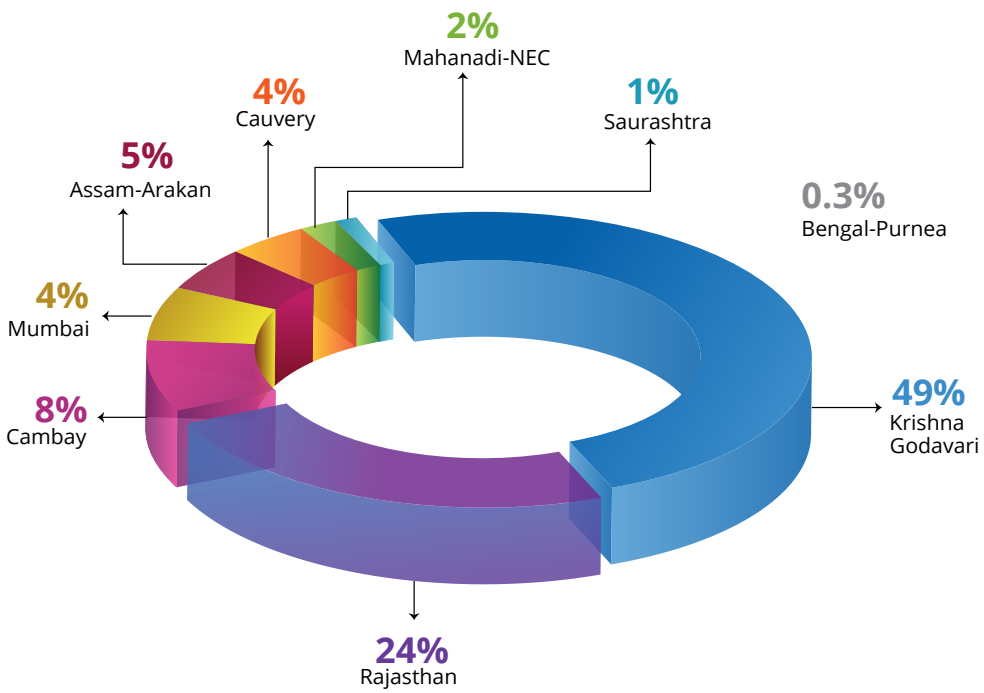


Figure 5.4 Basin-wise Ultimate Reserves (O + OEG (MMTOE) Distribution under PSC& RSC Regime as on 01.04.2021

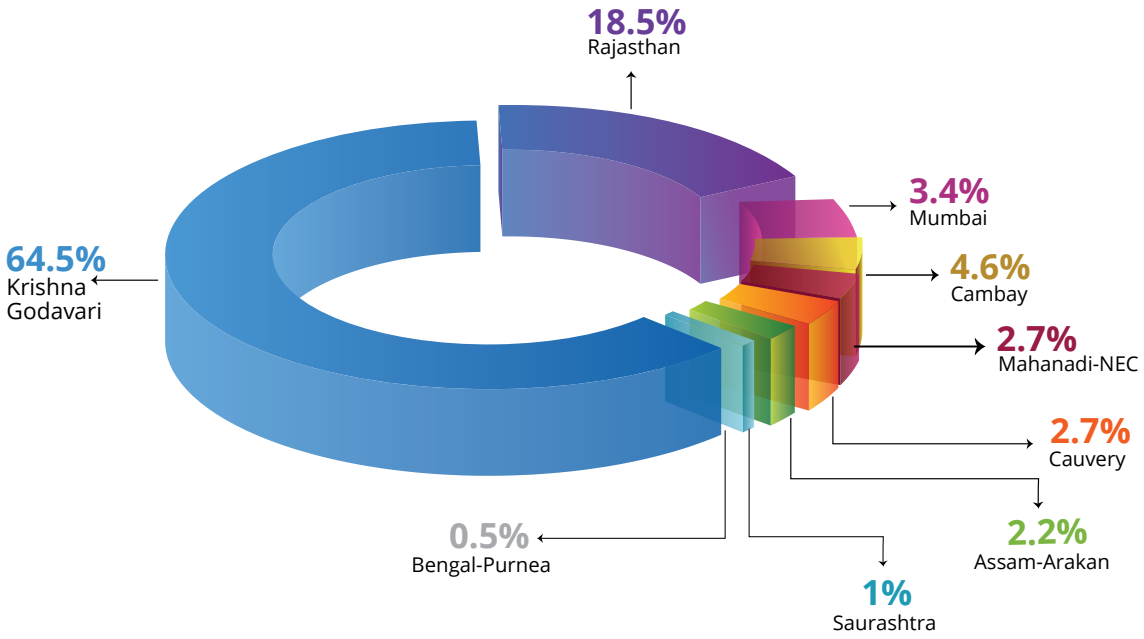


Figure 5.5: Reserves established in Assam Shelf and Assam Arakan Fold Belt (O+OEG) under PSC+RSC Regime

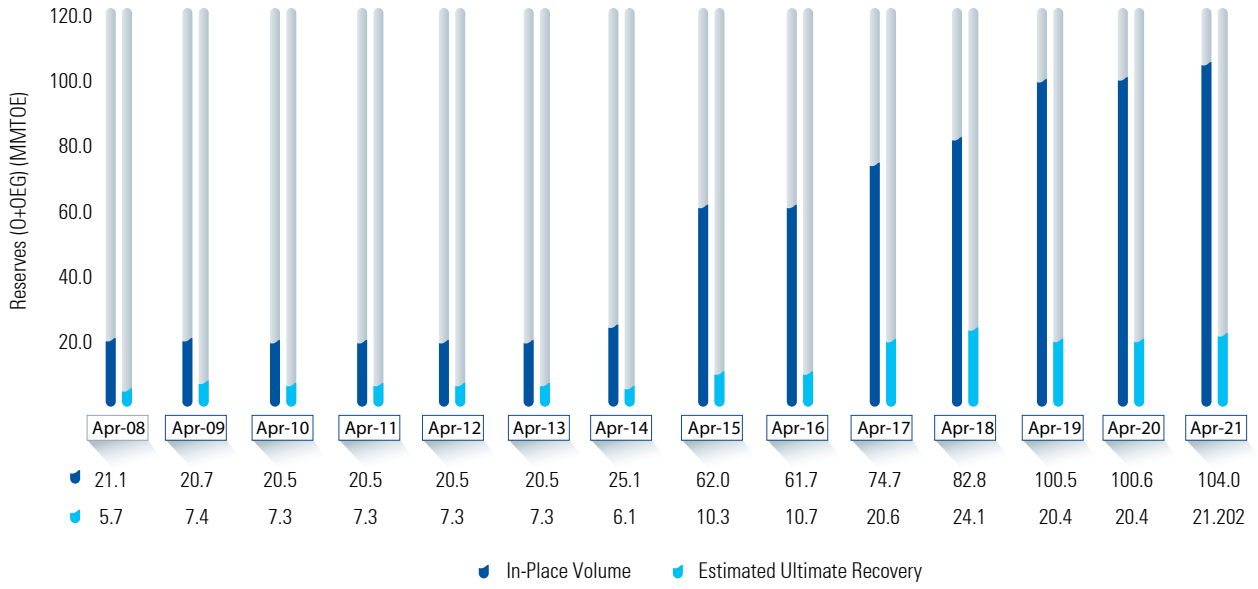


Figure 5.6: Reserves established in Cambay (O+OEG) under PSC+RSC Regime

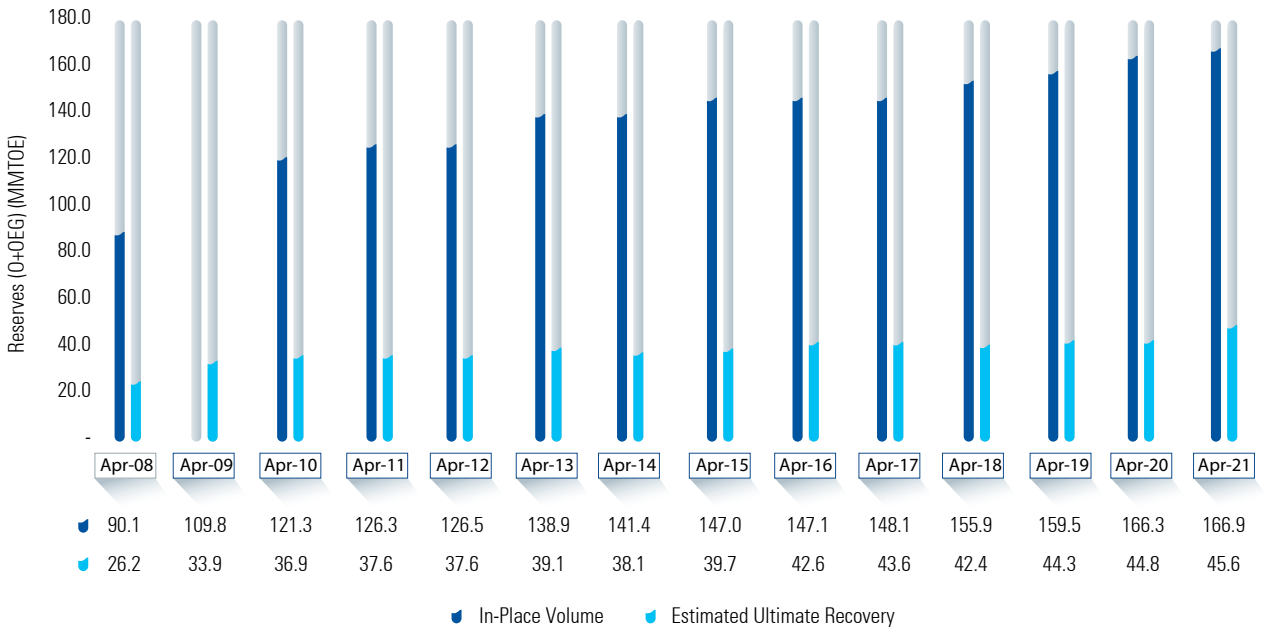


Figure 5.7 Reserves established in Cauvery (O+OEG) under PSC+RSC Regime

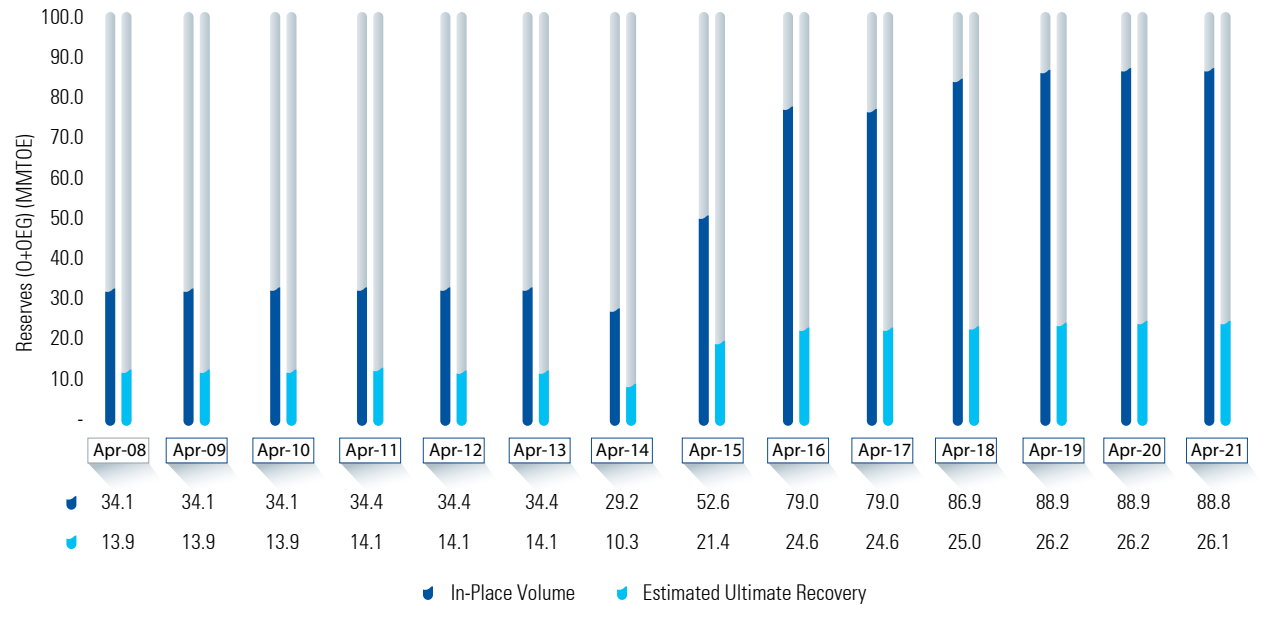


Figure 5.8: Reserves established in Krishna Godavari (O+OEG) under PSC+RSC Regime

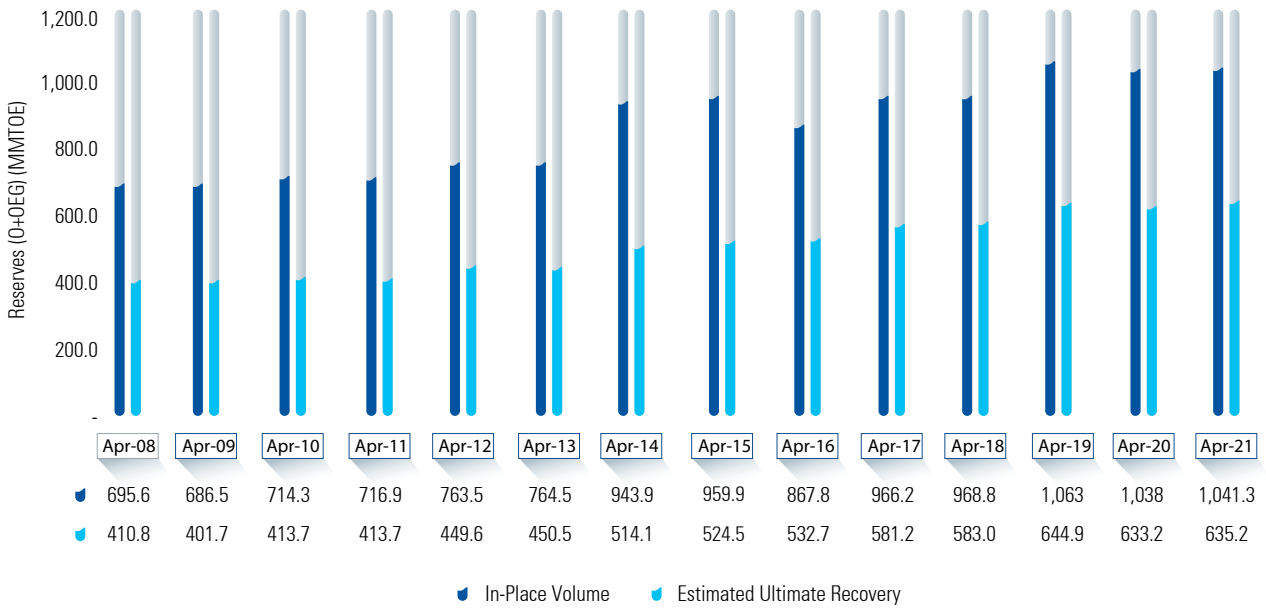


Figure 5.9 : Reserves established in Mahanadi-NEC (O+OEG) under PSC+RSC Regime

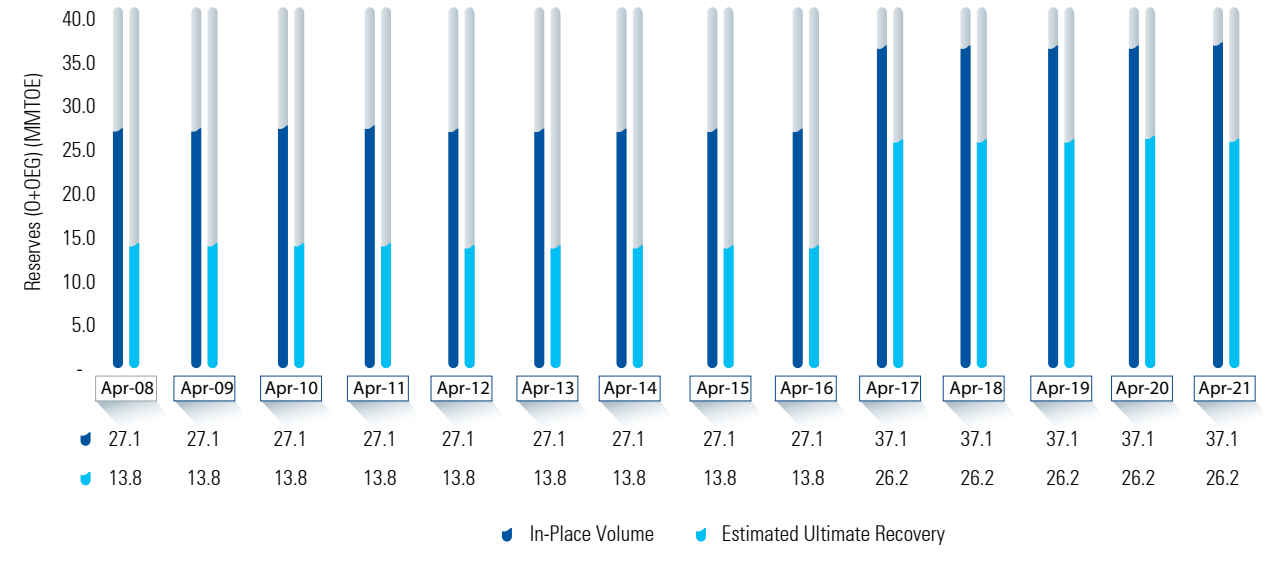


Figure 5.10: Reserves established in Mumbai (O+OEG) under PSC+RSC Regime

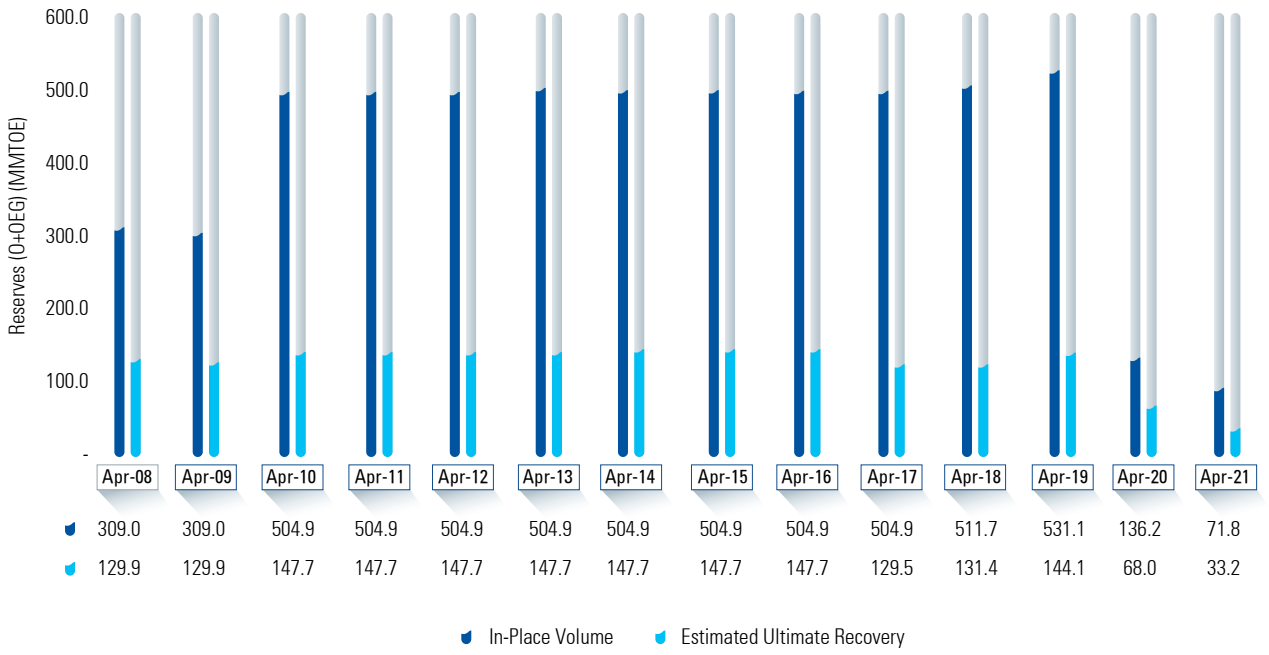


Figure 5.11: Reserves established in Rajasthan (O+OEG) under PSC+RSC Regime

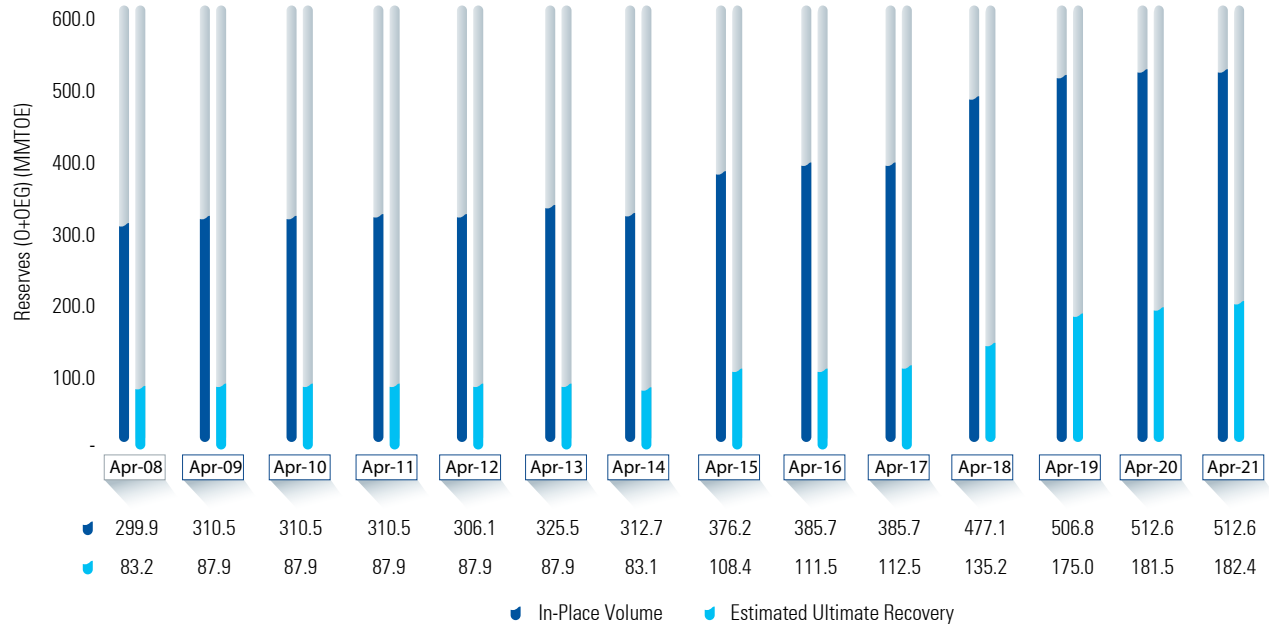


Figure 5.12: Reserves established in Saurashtra (O+OEG) under PSC+RSC Regime

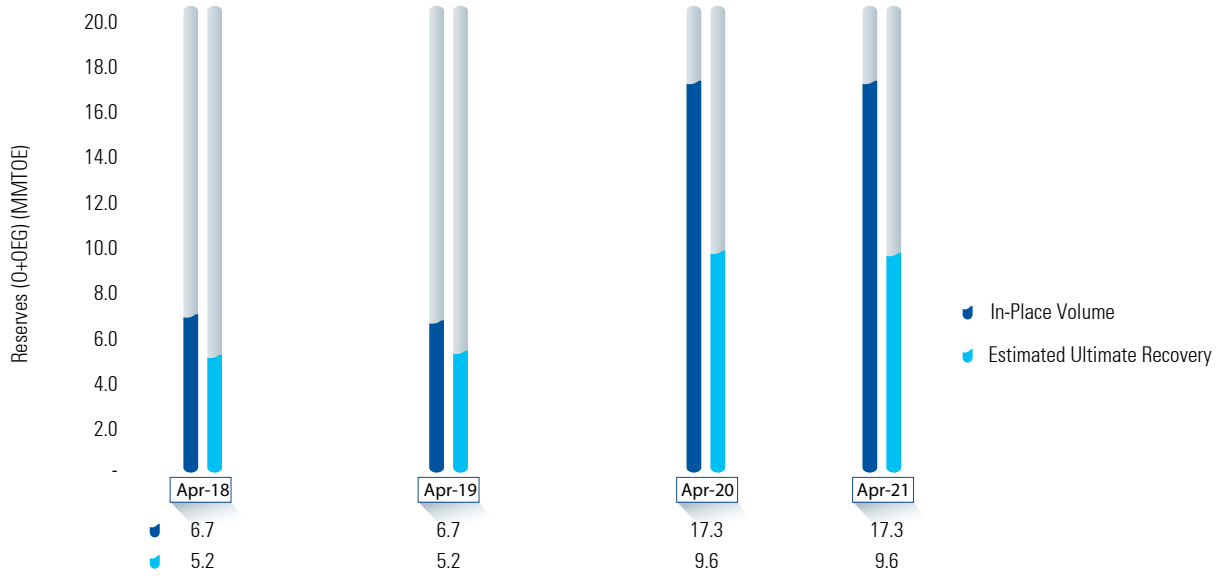


Figure 5.13: Reserves established in Bengal-Purnea (O+OEG) under PSC+RSC Regime

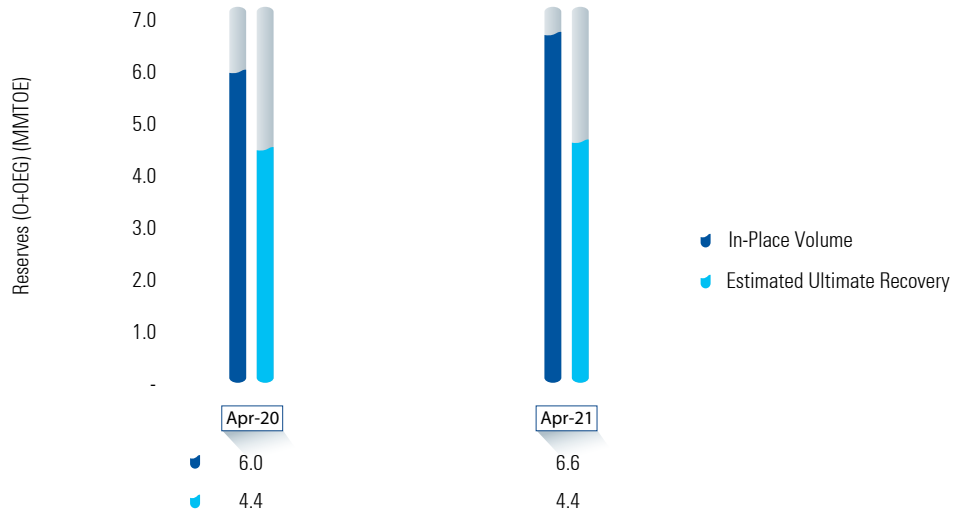


Table 5.6: Distribution of In-place volume and Ultimate reserves in various regime (O+OEG in MMT) excluding CBM as on 01.04.2021

Bidding Round	In-Place (O+OEG) in MMTOE	Ultimate (O+OEG) in MMTOE
Field	215.7072	83.636
NELP	1,155.371	655.152
Pre-NELP	590.012	210.281
RSC-DSF-1	26.66	8.761
RSC-DSF-2	58.944	26.487
Grand Total	**2,046.6942**	**984.317**

Figure 5.14: In-place volume Distribution under PSC & RSC Regime As on 01.04.2021

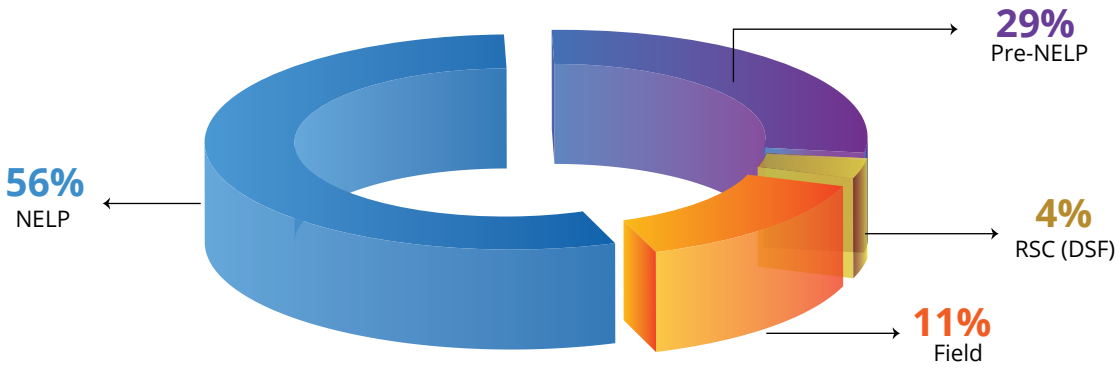
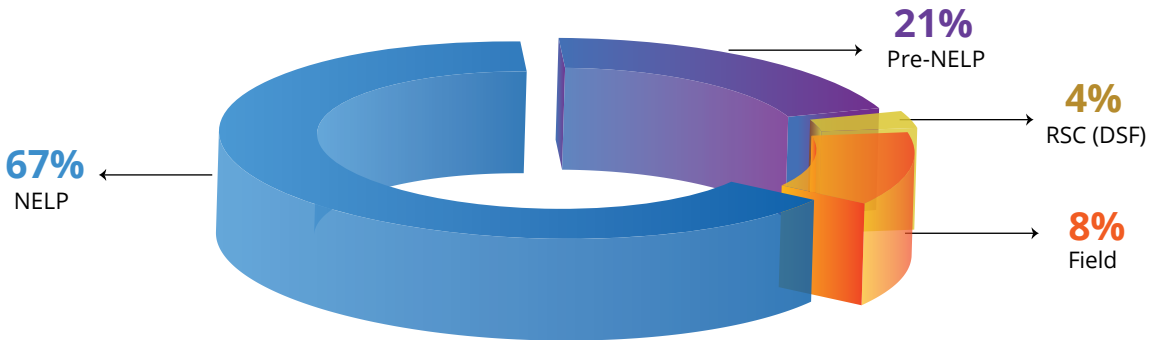


Figure 5.15: Ultimate Reserves Distribution under PSC & RSC Regime As on 01.04.2021



5.4. Reserve Replacement Ratio (RRR)

The RRR (Reserve Replacement Ratio) is a metric to assess the operating performance of an oil and gas exploration and production company. It is the amount added to its reserves divided by the amount extracted. As discoveries are made and reserve estimates are revised every year it is a practice to calculate RRR over several years.

A reserve replacement ratio if greater than 1 indicates stable demand condition environments and suggest that reserves are added up along with simultaneous draining out of reserves through continued production.

The trend of Reserve Replacement Ratio (RRR) of overall country's producing fields under all the regimes during the period as on 01.04.2011 to 31.03.2021 is provided in Table below

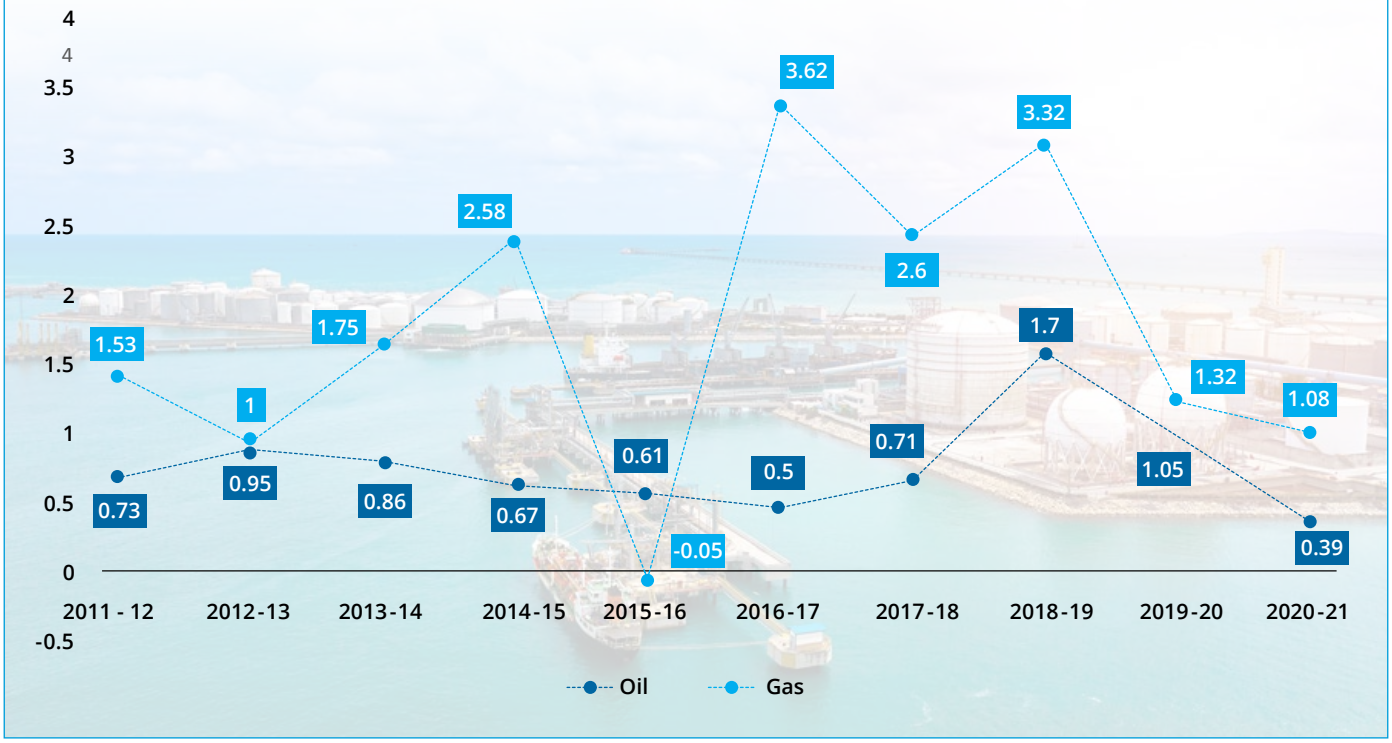
Table 5.7: Oil R/P and RRR Ratios in the Last 10 years

	ONGC Nomination		OIL Nomination		PSC/RSC		Country	
FY	R/P	RRR	R/P	RRR	R/P	RRR	R/P	RRR
2011-12	19.15	0.91	21.85	1.57	10.83	0.00	17.12	0.73
2012-13	20.54	1.37	22.95	0.94	8.94	0.15	17.21	0.95
2013-14	20.32	0.44	24.82	1.55	9.06	1.44	17.13	0.86
2014-15	20.39	1.05	24.39	0.21	8.35	0.07	16.97	0.67
2015-16	19.89	0.55	24.98	0.10	8.44	0.86	16.81	0.61
2016-17	19.68	0.63	24.16	0.38	8.37	0.26	16.78	0.50
2017-18	19.39	0.71	23.28	0.97	8.40	0.64	16.66	0.71
2018-19	15.09	0.97	23.09	0.27	11.29	3.73	14.76	1.70
2019-20	15.42	1.13	24.00	0.63	11.92	1.00	15.33	1.05
2020-21	14.91	0.21	24.87	0.47	13.73	0.86	15.59	0.39

Table 5.8: Gas (Except CBM) R/P and RRR Ratios in the Last 10 years

	ONGC Nomination		OIL Nomination		PSC/RSC		Country	
FY	R/P	RRR	R/P	RRR	R/P	RRR	R/P	RRR
2011-12	22.42	1.46	38.39	1.02	20.49	1.67	22.43	1.53
2012-13	23.09	1.50	39.42	2.04	29.65	-0.01	26.48	1.00
2013-14	23.02	1.03	41.58	0.85	48.59	3.80	31.17	1.75
2014-15	24.55	1.20	42.07	2.96	57.17	5.96	34.45	2.58
2015-16	24.46	-0.08	42.09	2.74	59.07	-1.00	34.55	-0.05
2016-17	24.15	1.68	42.11	2.43	83.38	10.93	37.76	3.62
2017-18	23.92	2.20	43.37	1.23	97.85	5.00	38.65	2.60
2018-19	13.48	0.99	46.68	2.01	130.20	16.08	33.59	3.32
2019-20	14.17	1.10	48.41	1.82	149.57	2.28	35.40	1.32
2020-21	14.84	1.04	52.73	1.63	167.20	0.93	38.19	1.08

Figure 5.16: Country's Trend of Reserve Replacement Ratio (RRR) - Oil & Gas



6 REVENUE SHARING CONTRACTS

Earlier policy regime for exploration and production of oil and gas, known as New Exploration Licensing Policy (NELP), had been operational since 1999. The Production Sharing Contracts (PSCs) under NELP were based on the principle of "profit sharing", thus it warranted micro-management by the Government to control the cost and maximize government take. In addition, numerous other operational issues emerged while administering the contracts under NELP leading to disputes and arbitrations with the awardee contractors, which inter-alia involve - cost recovery limit, procurement issues, methodology adopted for calculation of investment multiple, lack of incentives for the operator to keep costs low thereby adversely affecting profit petroleum. Further, separate policies and fiscal terms were formulated to administer Exploration and Production of different types of Hydrocarbons such as CBM, shale oil and gas and conventional Hydrocarbons. The fragmented policy framework led to inefficiencies in exploiting natural resources. Under NELP, exploration was confined to blocks which have been put on offer by the Government, which restricted access to lucrative opportunities in other untapped areas. To overcome these structural and functional issues, the government introduced Revenue Sharing Contact Regime with several revolutionary changes at policy front.

6.1 Discovered Small Field Policy

The Government of India brought out a new policy for small fields known as Discovered Small Field (DSF) Policy, 2015. This policy offers improved fiscal terms viz. no oil cess applicable on crude oil production, moderate royalty rates same as in NELP regime, no upfront signature bonus, pricing and marketing freedom for oil and gas and no carried interest by NOCs. This round has substantially removed regulatory burden on the operators.

Salient features of DSF Small Field Policy

- **Revenue Sharing Contract (RSC)**: In line with the vision of "ease of doing business" a simple and easy way to administer contractual model of revenue sharing is introduced wherein the government's take is based on bid revenue share.
- **Single license for Conventional & Non-conventional hydrocarbon**: Single license to explore and extract all hydrocarbon resources, including CBM, Shale gas/oil, tight gas, gas hydrates and other resources to be identified in future.
- **No restriction on exploration activity during contract period**: Contractor will be allowed to carry out exploration during entire contract duration.
- **Eligibility for Bidding**: Up to 100% participation by foreign companies, Joint ventures will be allowed. No mandatory state participation and no carried interest by ONGC and OIL are envisaged.
- **Marketing and Pricing freedom**: Contractor will be free to sell the crude oil and Natural Gas exclusively in domestic market through a transparent bidding process at arm's length.
- **Oil Cess & Royalty**: No Oil Cess will be applicable on crude oil production, Royalty rates as under NELP regime.
- **Custom duty**: Customs duty exemptions for specified goods and services will be available for contract areas.

a. Launch of Bid Rounds under Discovered Small Field Policy under Revenue Sharing Contract Regime

i. Discovered Small Field Bid Round-I (2016)

The DSF bid round was launched in May 2016 under the overarching vision of Hon'ble Prime Minister's call for reducing import dependency on Oil and Gas. Launched on 25th May 2016, the bid round offered 46 Contract Areas consisting of 67 fields across 9 sedimentary basins for extraction and exploration of oil and gas, with estimated in-place Oil and Oil equivalent reserves of 86 Million Metric Tonnes.

Government of India signed the Revenue Sharing Contracts (RSC) of the fields awarded under the DSF Bid Round 2016 with the successful awardees at New Delhi on 27th March 2017 for 30 Contract Areas (23 Onland and 07 Shallow Offshore) comprising of 43 discoveries having cumulative area of 776.8 SKM and having in-place of 44.66 MMT (O+OEG).

Key Highlights of DSF Bid Round-I are as follows:

- Bid round concluded in record time of 10 months, contracts were awarded in March'2017
- Transparent bidding process through online bidding portal with strong handholding support to bidders/ investors
- Prior technical experience not a pre-qualification criteria
- Total of 134 bids were received for 34 contract areas
- 22 companies (singly or in consortium) were shortlisted for 31 Contract Areas
- 30 Contracts (23 Onshore and 07 Offshore) were successfully awarded
- 20 Companies (singly or in consortium) signed contracts
- 13 companies were new entrant to Indian E&P industry

ii. Discovered Small Field Bid Round-II (2018)

Following the success of DSF Bid Round-I (2016), Government extended the DSF Policy of 2015 for future DSF Bid Rounds in April'2018. Extended policy offers all the benefits of original DSF Policy and additionally applicable Royalty rates were further reduced and aligned to Hydrocarbon Exploration & Licensing Policy (HELP).

DSF Bid Round-II was launched on 9th August 2018 offering 25 Contract Areas for International Competitive Bidding covering 59 discovered oil and gas fields with an area of 3,042 Sq.kms and prospective resource base of 190 MMT (O+OEG).

Out of the total 145 e-bids received, 103 e-bids were received for onland contract areas and 42 e-bids were received for offshore contract areas. As many as 40 companies (Individually or as member of the bidding consortium) have participated in the bid round. 6 foreign companies also participated in the bidding round. This bid round saw more than anticipated participation from new entrants from India and foreign countries like USA, UK, Australia, Singapore and UAE.

Through detailed process of evaluation, 14 Companies (singly or in consortium) were shortlisted for award in 23 Contract Areas. Out of there 14 Companies, 8 are new entrants in the E&P Sector. DSF Round II provided an opportunity for industry professional to invest in larger areas on offer in already discovered basins, thereby providing investment opportunity at minimal risk. The DSF round-II process was made entirely digital which offered a transparent, secure and easy bidding process through state of art e-bidding portal.

Key highlights of DSF Bid Round-II are as follows

- 145 bids were received for 24 Contract Areas; no bid was received for 01 contract area
- 40 companies (Individually or as member of the bidding consortium) have participated
- 6 foreign companies participated in the bidding round
- 14 Companies (singly or in Consortium) were shortlisted for award in 23 Contract Areas. Out of there 14 Companies, 8 are new entrants in the E&P Sector.
- Total 23 Revenue Sharing Contracts (comprising of 57 discoveries) were signed on 7th March 2019
- Subsequently, 01 Revenue Sharing Contract was signed in Jan'2021 with successful awardee company.

Figure 6.1: Blocks awarded under DSF I and II

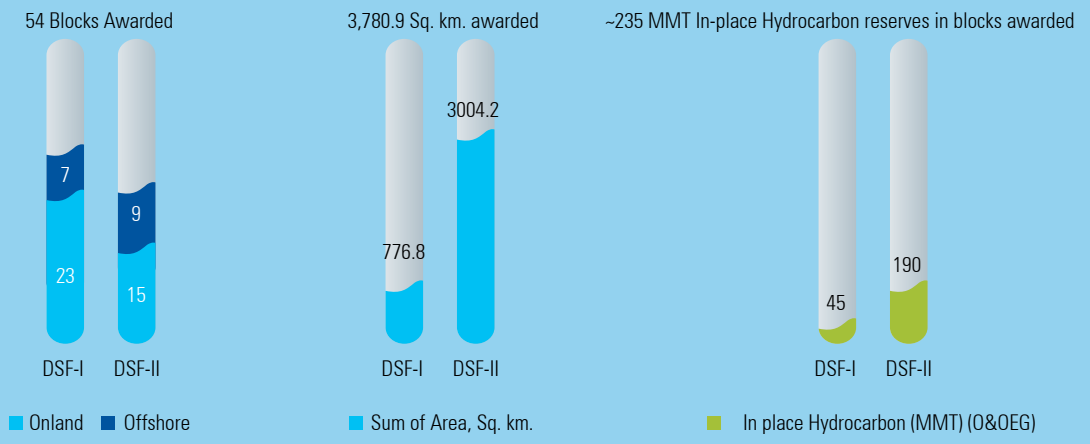
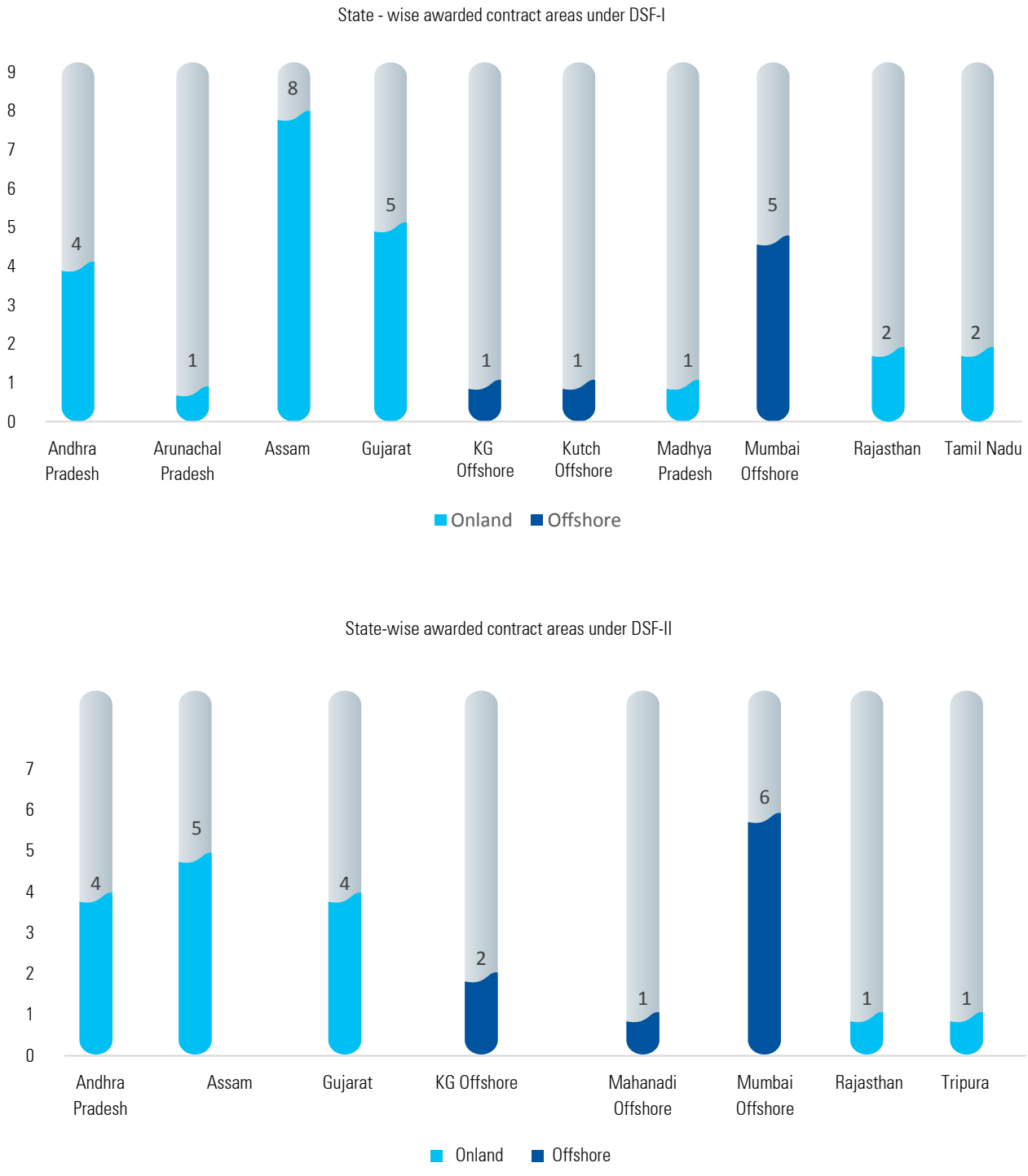


Figure 6.2: State-wise segregation of awarded blocks under DSF Round I & II

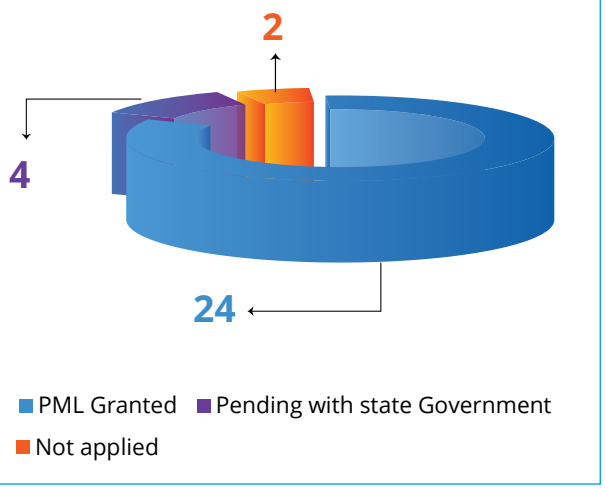


a Overview of Petroleum Operations of Contract Areas awarded under DSF Bid Rounds

i. Status of awarded Contract Areas under DSF-I

No.	Description	Status
1	CAs with PML Granted	24
2	CAs where PML not obtained	06
2.1	PML application submitted but pending with State Govt	04
2.2	PML application not submitted by Operator	02
3	FDP Submitted	23
3.1	FDP approved in MC	15
3.2	Unviable FDP	08
4	Committed Investment under FDP	USD 268 Million

Figure 6.3: Status of PML in awarded Contract Areas under DSF Bid Round I

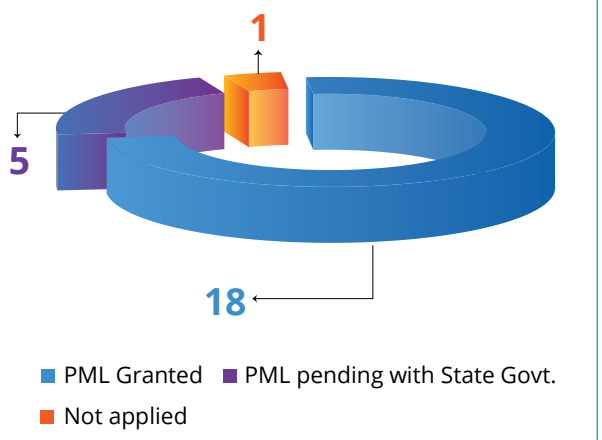


PML of ~711 Sq. Km out of total awarded area of 777 Sq. Km, has been approved

ii. Status of awarded Contract Areas under DSF Bid Round II

No.	Description	Status
1	CAs with PML Granted	18
2	CAs where PML not obtained	06
2.1	PML application submitted but pending with State Govt	05
2.2	PML application not submitted by Operator	01
3	FDP Submitted	13
3.1	FDP approved in MC	13
3.2	Unviable FDP	-
4	Committed Investment under FDP	USD 1,490 Million

Figure 6.4: Status of PML in awarded Contract Areas under DSF Round II



PML of ~2,573 Sq. Km out of total awarded area of 3,004 Sq. Km, has been approved

6.2 Hydrocarbon Exploration and Licensing Policy (HELP)

In March 2016, Government launched Hydrocarbon Exploration Licensing Policy (HELP). HELP is a paradigm shift from Cost Recovery to Revenue Sharing Mechanism wherein contractor shares revenue with the Government from the start of the production. Contractor quotes Revenue Share percentage at LRP and HRP at the time of bid submission. It was a giant step towards improving the 'Ease of Doing Business' in the Indian Exploration and Production (E&P) sector as Government does not require to interfere in day-to-day business activities of Contractor. The Government of India introduced the Open Acreage Licensing (OAL) mechanism as a part of the HELP which gives exploration companies the option to select the exploration blocks on their own, without having to wait for the formal bid round from the Government.

HELP comes with attractive and liberal terms like reduced royalty rates, no oil cess, marketing and pricing freedom, round the year bidding, freedom to investors for carving out blocks of their interest, a single license to cover both conventional and unconventional hydrocarbon resources, exploration permission during the entire contract period, and an easy, transparent and swift bidding and awarding process. HELP also encourages round the year submission of Expression of Interest (EoI) in 3 windows (April 1 to July 31, August 1 to November 30 and December 1 to March 31) by the interested bidders.

Salient features of HELP

- Opportunity to carve out blocks using National Data Repository (NDR)
- Unified License for both conventional and unconventional Hydrocarbons
- Simple and easy to administer Revenue Sharing Model
- Low regulatory burden
- Easy entry and exit barriers
- Complete transparency and time bound process
- Level playing field for global private companies as well as National Oil Companies
- Market pricing and free market access
- Concessional royalty regime for Ultra-Deepwater and Shallow water areas
- Exploration rights for full contract life

Government further notified policy reforms in upstream sector on 28th February 2019 under HELP to increase exploration activities, attract domestic and foreign investment in unexplored/unallocated areas of sedimentary basins and promote ease of doing business by streamlining and expediting the approval processes. These reforms were made applicable from OALP Round IV onwards. Category specific Bid Evaluation Criteria with more weightage to exploratory work programme in Category-I basins (70% vis-à-vis 50% earlier), Category-II and III type blocks bidding based on exploratory work programme only, shorter exploration period, concessional royalty rates to expedite oil and gas production, introduction of

alternate dispute resolution mechanism and Empowered Coordination Committee (ECC) for expediting statutory clearances/approvals.

Launch of OALP (Open Acreage Licensing Programme) Bid Rounds under HELP

The first OALP Bid Round under revolutionary HELP was launched by the Government in January 2018. The Govt. launched state-of-art National Data Repository, a database of all the geo-scientific data of hydrocarbon resources in the country, in 2017 to enable potential investors to take informed decisions.

With the successful roll out of the HELP/OALP regime, based on the world-class National Data Repository (NDR), the Government has achieved massive enhancement of exploration acreage in India. The exploration acreage which stood at approximately 80,000 sq. km. in 2019 from earlier regimes has now been enhanced to approx. 2,40,000 sq. km. after 5 rounds of OALP and is expected to rise to approx. 2,70,000 with the award of twenty-one (21) blocks under OALP-VI.

a. Summary of Participation

In five rounds of bid under OALP, 110 blocks were on offer and 105 exploration blocks covering an area of 1, 56,580 sq. Km. were awarded to successful bidders. Five (5) un-awarded blocks were offered under OALP-Round-III and in all of them CBM was focus; however, no bids were received for those CBM blocks. 205 bids were received for remaining 105 blocks that are spread over 16 Sedimentary Basins.

Table 6.1: Summary of participation in OALP rounds is as under

OALP Bid Round	Blocks on offer	Number of participants	No. of bids	Area on offer (sq.km.)	Area awarded (sq.km.)
OALP-I	55	9	110	59,282	59,282
OALP-II	14	8	33	29,233	29,233
OALP-III	23*	5	42	31,722	29,765
OALP-IV	7	2	8	18,510	18,510
OALP-V	11	3	12	19,789	19,789
Total	**110**	**-**	**205**	**158,536**	**1,56,579**

** No bid received for five CBM Blocks.*

Overall awarded area of 1,56,579 sq. km is split in to three categories of sedimentary basins as follows:

Table 6.2: Basin-wise area awarded under OALP rounds

Category of Basin	Number of Blocks	Area (Sq. km.)	% of area
Category-I	77	85,897	54.86%
Category-II	22	55,911	35.71%
Category-III	6	14,771	9.43%
Total	**105**	**156,579**	**100%**

Figure 6.5: Basin-wise blocks awarded under OALP Bid Rounds

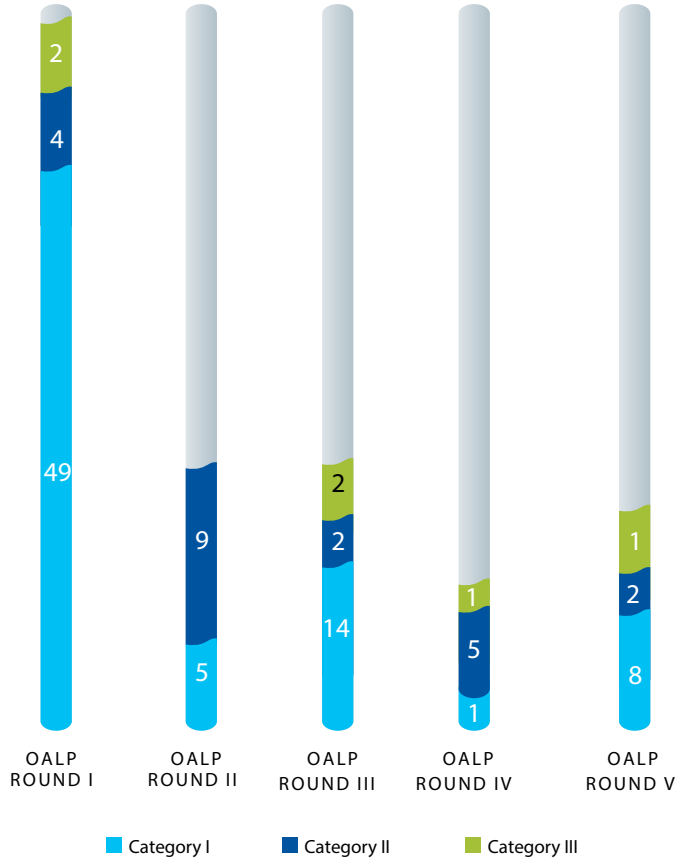


Figure 6.6: Basin-wise % area of blocks awarded under OALP Bid Rounds

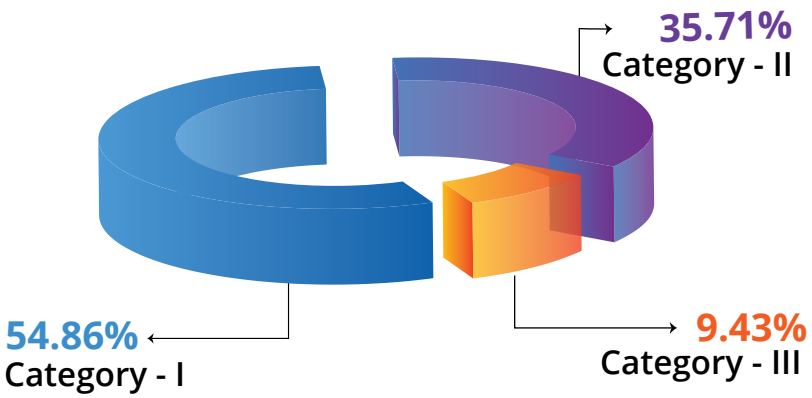


Figure 6.7: Segregation of blocks awarded under OALP Bid Rounds

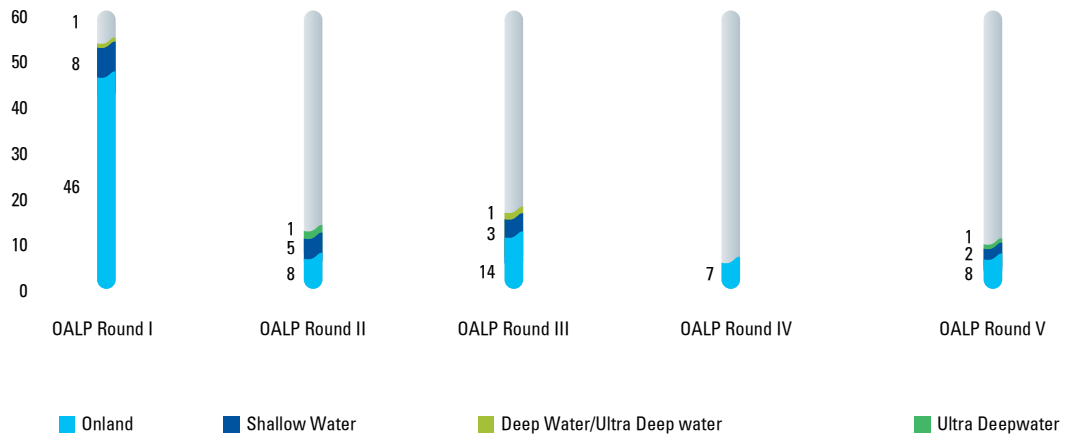
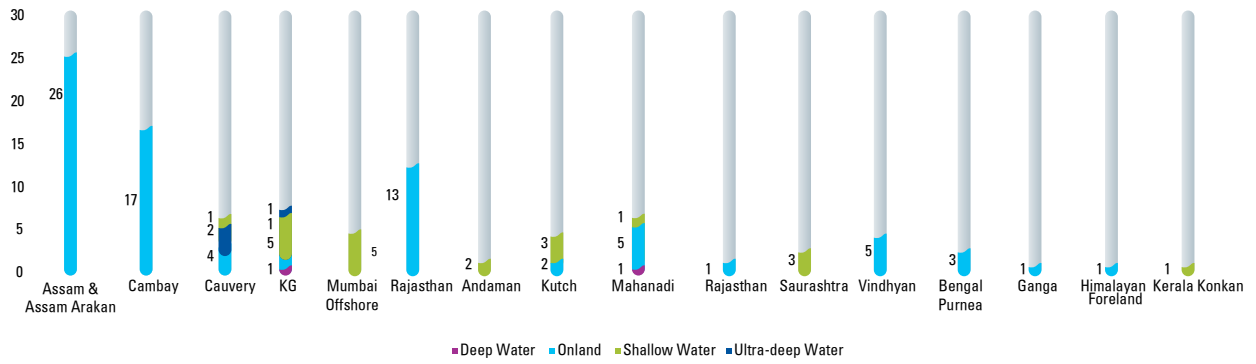


Figure 6.8: Basin wise segregation of Awarded blocks



b. Committed Exploration Work Programme and Committed Investment

Investors of the 105 blocks in five rounds of OALP have committed 38,570 LKM of 2D Seismic Survey and 42,433 sq. km of 3D Seismic survey, 380 number of Exploratory wells, and 290 core analysis to establish shale resources. This will generate investment of approximately US$ 2.379 billion over next 3-4 years. Summary of Committed Work Programme and Investment is as under-

Table 6.3: Summary of Committed Work Programme and Investments

OALP I-V CWP & INVESTMENTS (Operator-Wise)

Operator	2D Seismic CWP (LKM)	3D Seismic CWP (SKM)	Exploratory Wells (No.)	Core Analysis (No.)	Committed Investment (Mn USD)
ONGC Limited	5,870	13,051	101	35	789
Vedanta Limited	10,620	22,972	192	190	786
Oil India Limited	17,070	3,963	73	53	725

Operator	2D Seismic CWP (LKM)	3D Seismic CWP (SKM)	Exploratory Wells (No.)	Core Analysis (No.)	Committed Investment (Mn USD)
RIL-BP	5,000	1,514	2	3	32
IOCL	10	469	6	5	24
BPRL	-	174	3	1	15
GAIL	-	212	1	1	5
HOEC	-	79	2	2	3
Total	**38,570**	**42,433**	**380**	**290**	**2,379**

c. Monitoring of OALP Blocks

Coordinators have been designated for each Block to monitor the Petroleum Operations in the Blocks. Management Committee Meetings are being conducted regularly in every six (6) months. Management Committee comprising representatives from the Government and the Contractor closely review and monitor the Exploration activities in the Blocks. Grievances of the Contractors are also resolved during the MC Meetings. Furthermore, other tools to monitor Petroleum Operations are Quarterly Progress Report (QPR), Quarterly Gantt Chart and Annual Investment Report.

Quarterly Progress Report comprises the actual number of Exploration Work Programme completed during the relevant quarter against Committed Work Programme. Operators also provide planned work programme for upcoming quarter and for current Financial Year.

Contractors submit Gantt chart for monitoring overall activities carried out during the relevant quarter to accomplish Exploratory Work Programme. It comprises comprehensive list of activities mandatory to complete Exploration Work in the Blocks.

Government reviews the Investment made in the awarded blocks from the annual Investment statement submitted by the Contractors. All three statements are being submitted by the Contractors for each block separately.

d. Overview of Petroleum Operations in Blocks awarded under OALP

i. Status of grant of Petroleum Exploration License (PELs)

Total 135* Petroleum Exploration License (PEL) were involved in 105 blocks awarded in five rounds of bid, out of which 110 PELs for an area of 1,34,802.70 sq.km have been granted till 31st March 2021. Two numbers of PEL have been denied by Union Territory of Puducherry for an area of 40.53 sq. km. This area has been surrendered. Remaining 23 PELs for an area of 21,736.71 sq. km. are pending from various State Governments. Summary of status of PELs is as under:

Table 6.4: Bid Round wise status of PEL under OALP (As on 31-03-2021)

OALP Bid Round	PEL Granted	PEL Pending	PEL Denied
OALP I	65	9	2
OALP II	17	1	-
OALP III	15	6	-
OALP IV	7	0	-
OALP V	6	7	-
Total	**110**	**23**	**2**

**Some of the awarded blocks falls under the jurisdiction of multiple states hence the number of PELs are more than the number of awarded blocks.*

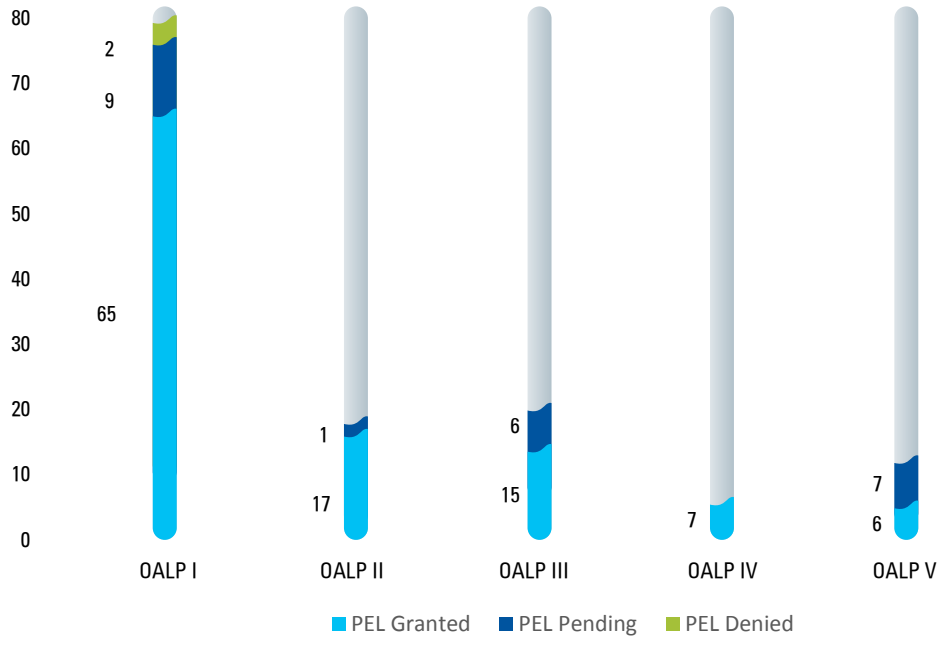
ii. FTG Survey

As on 31st March 2021, 58,112 LKM of Full Tensor Gradiometry (FTG) data has been acquired in Assam and Kutch Blocks.

iii. Actual Exploration Work Programme

As on 31st March 2021, contractors of the blocks have acquired 16,806.42 LKM of 2D Seismic data and 7,281.7 Sq. km. of 3D Seismic data.

Figure 6.9: Status of PEL in OALP Bid Rounds



7

UNCONVENTIONAL HYDROCARBONS

Unconventional resources exist in petroleum accumulations that are pervasive throughout a large area and are not significantly affected by hydrodynamic influences (also called "continuous-type deposit"). Usually there is not an obvious structural or stratigraphic trap.

These include deposits like the Coal Bed Methane (CBM), Shale gas/oil, Gas Hydrates etc. that lack the porosity and permeability of conventional reservoirs required to flow without stimulation at economic rates. Such accumulations require specialized extraction technology (e.g., dewatering of CBM, hydraulic fracturing, horizontal drilling etc.). The target volumes are larger.

The Government of India had mooted an array of policies since 1997 for effective extraction and utilization of these resources. A background of the activities carried out in CBM, Shale Gas/Oil and Gas Hydrates in India shall be discussed in the subsequent sections.

7.1 Coal Bed Methane

Coal Bed Methane (CBM) is a form of natural gas generated during the process of coalification and adsorbed into the solid matrix of the coal. It is classified as unconventional source of natural gas owing to its nature of occurrence.

India, having the fifth largest proven coal reserves in the world, presents a significant opportunity for considering CBM as an alternative source for augmenting India's energy resource, in line with the vision of reducing hydrocarbon import and moving towards gas-based economy.

CBM Policy Reforms

In order to harness CBM potential in the country, the Government of India formulated CBM Policy in 1997, wherein CBM being Natural Gas is explored and exploited under the provisions of Oil Fields (Regulation and Development) Act 1948 (ORD Act 1948) and Petroleum & Natural Gas Rules 1959 (P&NG Rules 1959) administered by Ministry of Petroleum & Natural Gas (MoP&NG).

2020

In October-2020, GoI notified "Natural Gas Marketing Reforms" with an objective of increasing domestic production of Natural Gas, to move towards gas based economy, bring uniformity in process of discovery of market prices of gas and to promote Ease of Doing Business, Further, GoI in December,2020 notified process to "Discovery of Market price for Domestically Produced Natural Gas through e-bidding" wherein the following agencies were declared to independently carry the electronic bidding Process.

- M/s SBI Capital Markets Ltd.
- M/s Mjunction Services Ltd.
- M/s RITES Ltd.
- M/s MSTC Ltd.
- M/s CRISIL Risk and Infrastructure Solutions Ltd (CRIS).

2018

In 2018, the Government of India notified a Policy framework for Exploration and Exploitation of Unconventional hydrocarbons in existing acreages under existing Production Sharing Contracts (PSC), Coal Bed Methane (CBM) Contracts and Nomination fields.

2017

In 2017, a policy framework for Early Monetization of CBM was introduced to develop alternate sources of natural gas including CBM and promote gas economy. This policy was formulated to provide marketing and pricing freedom for Coal Bed Methane (CBM) and streamline the operational issues in the existing blocks.

2016

In 2016, Unified Licensing Policy under Hydrocarbon Exploration and Licensing Policy (HELP) was introduced wherein all types of hydrocarbon resources, both conventional and unconventional were allowed to be explored and exploited. The Open Acreage Licensing Policy (OALP) to carry out exploration and production from areas which are either, free or relinquished and Discovered Small Field (DSF) Policy to exploit resources from already discovered fields are two such policies within the HELP regime.

2015

In 2015 (re-notified in 2018), the Government of India, granted permission to Coal India Limited (CIL) and its subsidiaries to explore and produce CBM from its areas under Coal Mining Lease allotted to them, thereby, dispensing the requirement of having additional license from Ministry of Petroleum and Natural Gas. This was formulated to increase the area under CBM exploration and to enhance and accelerate the CBM production in the country from Coal mining areas.

2007

In 2007, CBM Phases & Extensions Policy was framed to provide a transparent and consistent framework for granting extension in exploration phases, under CBM Contracts.

Summary of CBM Bid Rounds

The Government of India formulated a CBM policy in 1997 and a Memorandum of Understanding (MoU) was signed between the Ministry of Coal and the Ministry of Petroleum and Natural Gas, to act in a co-operative manner for development of CBM. As per the policy, Ministry of Petroleum & Natural Gas (MoP&NG) became the administrative Ministry and Directorate General of Hydrocarbons (DGH) was made the nodal agency for development of CBM in the country.

About 26,000 sq. km. was identified for CBM exploration in the country. The first bidding round commenced in 2001. Subsequently, there were 3 other bidding rounds in the years 2003, 2005 and 2008, respectively. 29 CBM blocks were awarded under these rounds (out of which 1 block was awarded in 2 bidding rounds), 2 blocks were awarded on nomination basis and 1 under Foreign Investment Promotion Board Route. Around 16,598 sq. km. of the total prospective area has been awarded till date. These CBM blocks are in the states of Andhra Pradesh, Assam, Chhattisgarh, Gujarat, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu and West Bengal.

The total prognosticated CBM resource for the awarded 33 CBM blocks, is about 62 TCF (1767 BCM), of which, 10.5 TCF (296.9 BCM) has been established as Gas-in-Place (GIP).

Status of the awarded CBM blocks

At present, out of the 32 CBM blocks, 8 are active, 4 of which are in production phase, 4 in development phase.

The first commercial production from the CBM blocks commenced in the year 2007 from Raniganj (South) block operated by M/s. Great Eastern Energy Corp. Ltd. (GEECL). Raniganj (East) Block Operated by M/s. Essar Oil & Gas Exploration & Production Ltd (EOGEPL) started its commercial production from July 2016, Sohagpur (West) operated by M/s. Reliance Industries ltd. (RIL) started producing from March 2017 and Bokaro operated by M/s. Oil and Natural Gas Ltd. (ONGC) from August 2019. In addition to this incidental CBM gas is being produced during testing of CBM wells in Jharia block operated by ONGC and Sohagpur (East), operated by RIL.

The cumulative CBM production from these blocks as of FY 2020-21 is 4.4 BCM. The average gas production rate in the FY 2020-21 was 1.76 MMSCMD. It is envisaged that a cumulative of approximately 8 BCM of gas shall be produced from 8 CBM Blocks till FY 24-25.

To date, most of the CBM exploration and production activities in India are pursued by domestic Indian companies.

CBM Resources and Block Performances

The Gondwana sediments of eastern India host the bulk of India's coal reserves and all the current CBM producing blocks. Majority of the best prospective areas for CBM development are found to be in eastern India, situated in the belt of Damodar-Koel valley and Son valley.

A drastic increase in the production of Sohagpur west block can be attributed to the commissioning of Shahdol – Phulpur Gas Pipeline (SHPPL), operating from Shahdol in Madhya Pradesh to Phulpur in Uttar Pradesh where it hooks up with Gas Authority of India (GAIL)'s existing Hazira-Vijaipur-Jagdishpur (HVJ) pipeline network, laid by Reliance Gas Pipelines (RGPL), a subsidiary of RIL.

CBM's initial reserve & ultimate reserve has increased drastically since last 10 years. Taking 2008 as base year the initial reserve has increased approximately by 108% and ultimate reserve has increased approximately by 90%.

Table 7.1: Snapshot of CBM resources in India

Total CBM rounds conducted	4
No. of CBM Blocks awarded in 4 rounds	33
Coal bearing Area identified for CBM	26,000 Sq. Km.
Area covered under 33 blocks	16,598 Sq. Km. (64%)
CBM Resources in the 26,000 sq. km area	2600 BCM (91.8 TCF)
CBM Resources (from 33 Blocks)	1767.06 BCM (62.4 TCF)
Established CBM Reserves (GIP)	296.9 BCM (10.48 TCF)
Commercial Production commenced	Jul-07
Total No. of Wells drilled	999
Avg. Gas Production (FY 2020-21)	1.76 MMSCMD from 4 CBM blocks
No. of CBM Blocks in Development/Production Phase	8
No. of CBM Blocks Under Relinquishment	13
No. of CBM Blocks Relinquished	11
No. of blocks under Termination	1
Annual CBM Production in FY 2020-21	642 MMSCM
Cumulative Production till Mar-2021	4385 MMSCM
Expected cumulative production in next 5 years (FY 21-22 till FY 24-25)	8 BCM

Table 7.2: State-wise distribution of CBM Resources in India

No.	State	Estimated CBM resources (IN BCM)	Estimated CBM resources (IN TCF)	GIIP (in TCF)
1	Jharkhand	722.08	25.5	1.99
2	Rajasthan	359.62	12.7	0
3	Gujarat	351.13	12.4	0
4	Odisha	243.52	8.6	0
5	Chhattisgarh	240.69	8.5	0
6	Madhya Pradesh	218.04	7.7	3.64
7	West Bengal	218.04	7.7	4.85
8	Tamil Nadu	104.77	3.7	0
9	Telangana & Andhra Pradesh	99.11	3.5	0
10	Maharashtra	33.98	1.2	0
11	North east	8.50	0.3	0
Total CBM Resource		**2,599.48**	**91.8**	**10.48**

*Conversion factor: 1 cubic metre = 35.3147 cubic feet

Table 7.3: Status of CBM Blocks

No.	Block	State	Present Area (SKM)	Contractor (PI%)	Contract signed on	Status
CBM BLOCKS OFFERED ON NOMINATION/FIPB ROUTE						
1	Raniganj (South)	West Bengal	210	GEECL (100)	31.05.2001	Production
2	Raniganj (North)	West Bengal	311.8	ONGC (74)-CIL (26)	06.02.2003	Development
3	Jharia	Jharkhand	67.1	ONGC (74)-CIL (26)	06.02.2003	Development/ incidental production
CBM ROUND-I						
4	RG(East)-CBM-2001/I	West Bengal	500	EOGEPL (100)	26.07.2002	Production
5	SP(East)-CBM-2001/I	Madhya Pradesh	495	RIL (100)	26.07.2002	Development
6	SP(West)-CBM-2001/I	Madhya Pradesh	500	RIL (100)	26.07.2002	Production
7	BK-CBM-2001/I	Jharkhand	75	ONGC (80)-IOC (20)	26.07.2002	Production
8	NK-CBM-2001/I	Jharkhand	271.5	ONGC (55)-IOC (20)-PEPL (25)	26.07.2002	Development
CBM ROUND-II						
9	SH(N)-CBM-2003/II	Chhattisgarh	825	RIL (100)	06.02.2004	Relinquished
10	BS (1)-CBM-2003/II	Rajasthan	1,045	RIL (100)	06.02.2004	Under relinquishment
11	BS (2)-CBM-2003/II	Rajasthan	1,020	RIL (100)	06.02.2004	Under Relinquishement
12	SK-CBM-2003/II	Jharkhand	70	ONGC (100)	06.02.2004	Under Relinquishement
13	NK(W)-CBM-2003/II	Jharkhand	267	ONGC (100)	06.02.2004	Relinquished
14	ST-CBM-2003/II	Madhya Pradesh	714	ONGC (100)	06.02.2004	Relinquished
15	WD-CBM-2003/II	Maharashtra	503	ONGC (100)	06.02.2004	Relinquished
16	BS (3)-CBM-2003/II	Rajasthan	790	ONGC (70)-GSPC (30)	06.02.2004	Relinquished
CBM ROUND-III						
17	SP(N)-CBM-2005/III	Madhya Pradesh	609	R-Infra (55)-RNRL (45)	07.11.2006	Under Relinquishment
18	SR-CBM-2005/III	Madhya Pradesh	330	DIL (90)-Coal Gas (10)	07.11.2006	Under Relinquishment
19	RM-CBM-2005/III	Jharkhand	469	Dart Energy (35)-GAIL (35)-EIG (15)-TATA Power (15)	07.11.2006	Under Relinquishment
20	GV(N)-CBM-2005/III	Telangana	386	Coal Gas (10)-DIL (40)-Adinath (50)	07.11.2006	Relinquished
21	BB-CBM-2005/III	West Bengal	248	British Petroleum (100)	16.11.2006	Relinquished
22	MR-CBM-2005/III	Chhattisgarh	634	Dart Energy (35)-GAIL (35)-EIG (15)-TATA Power (15)	07.11.2006	Under relinquishment

No.	Block	State	Present Area (SKM)	Contractor (PI%)	Contract signed on	Status
23	TR-CBM-2005/III	Chhattisgarh	458	Dart Energy (35)-GAIL (35)-EIG (15)-TATA Power (15)	07.11.2006	Under relinquishment
24	BS (4)-CBM-2005/III	Rajasthan	1,168	REL (45)-RNRL (45)-Geopetrol (10)	07.11.2006	Under Relinquishment
25	BS (5)-CBM-2005/III	Rajasthan	739	REL (45)-RNRL (45)-Geopetrol (10)	07.11.2006	Under Relinquishment
26	KG (E)-CBM-2005/III	Andhra Pradesh	735	REL (45) – RNRL(45) – Geopetrol (10)	07.11.2006	Relinquished
CBM ROUND-IV						
27	AS-CBM-2008/IV	Assam	113	Dart Energy (10)-OIL (90)	29.07.2010	Under Relinquishment
28	MG-CBM-2008/IV	Tamil Nadu	667	GEECL (100)	29.07.2010	Under Arbitration
29	RM(E)-CBM-2008/IV	Jharkhand	1,128	EOGEPL (100)	29.07.2010	Under Relinquishment
30	TL-CBM-2008/IV	Odisha	557	EOGEPL (100)	29.07.2010	Relinquished
31	IB-CBM-2008/IV	Odisha	209	EOGEPL (100)	29.07.2010	Relinquished
32	SP(NE)-CBM-2008/IV	Madhya Pradesh & Chhattisgarh	339	EOGEPL (100)	29.07.2010	Under Relinquishment
33	ST-CBM-2008/IV	Madhya Pradesh	714	Dart Energy (80)-TATA Power (20)	29.07.2010	Relinquished

Table 7.4: Gas Initially in Place (GIIP) and CBM Reserves of the Active Blocks

No.	Block Name	Put on Production	GIIP (BCM)	GIIP (TCF)	Rec. Reserves (BCM)	Rec. Reserves (TCF)	Cum. Production (MMSCM)	Cum. Production (BCF)	Total wells drilled
1	RG(E)-CBM-2001/I	Jul-2016	60.77	2.15	28.12	0.99	1660.703	58.68	348
2	SP(W)-CBM-2001/I	Mar-2017	55.5	1.96	15.44	0.55	1247.713	44.08	305
3	BK-CBM-2001/I	Aug-2019	30.18	1.07	3.68	0.13	0.803	0.028	84
4	RANIGANJ (SOUTH)	Jul-2007	69.09	2.44	5.29	0.19	1437.663	50.800	156
5	SP(E)-CBM-2001/I	-	47.70	1.68	16.70	0.59	-	-	37
6	JHARIA*	Jan-2012	16.7	0.59	2.73	0.10	30.556	1.079	17
7	RANIGANJ (NORTH)	-	7.43	0.26	1.86	0.07	-	-	3
8	NK-CBM-2001/I	-	9.53	0.34	1.46	0.05	-	-	49
Total			**296.9**	**10.48**	**75.28**	**2.66**	**4377.438**	**154.68**	**999**

*On incidental production; In-place and recoverable based on the RFDP (approved on 09.09.2019)

Figure 7.1: CBM Production trend (in MMSCM)

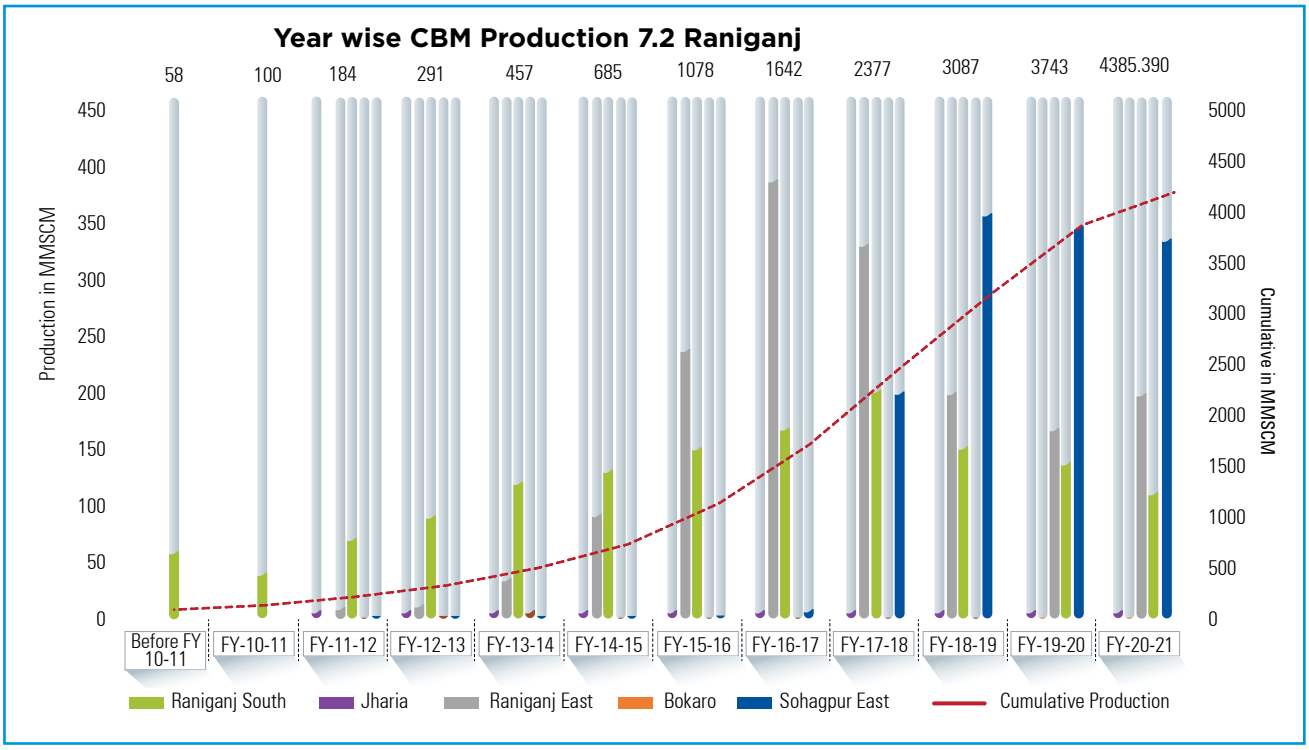
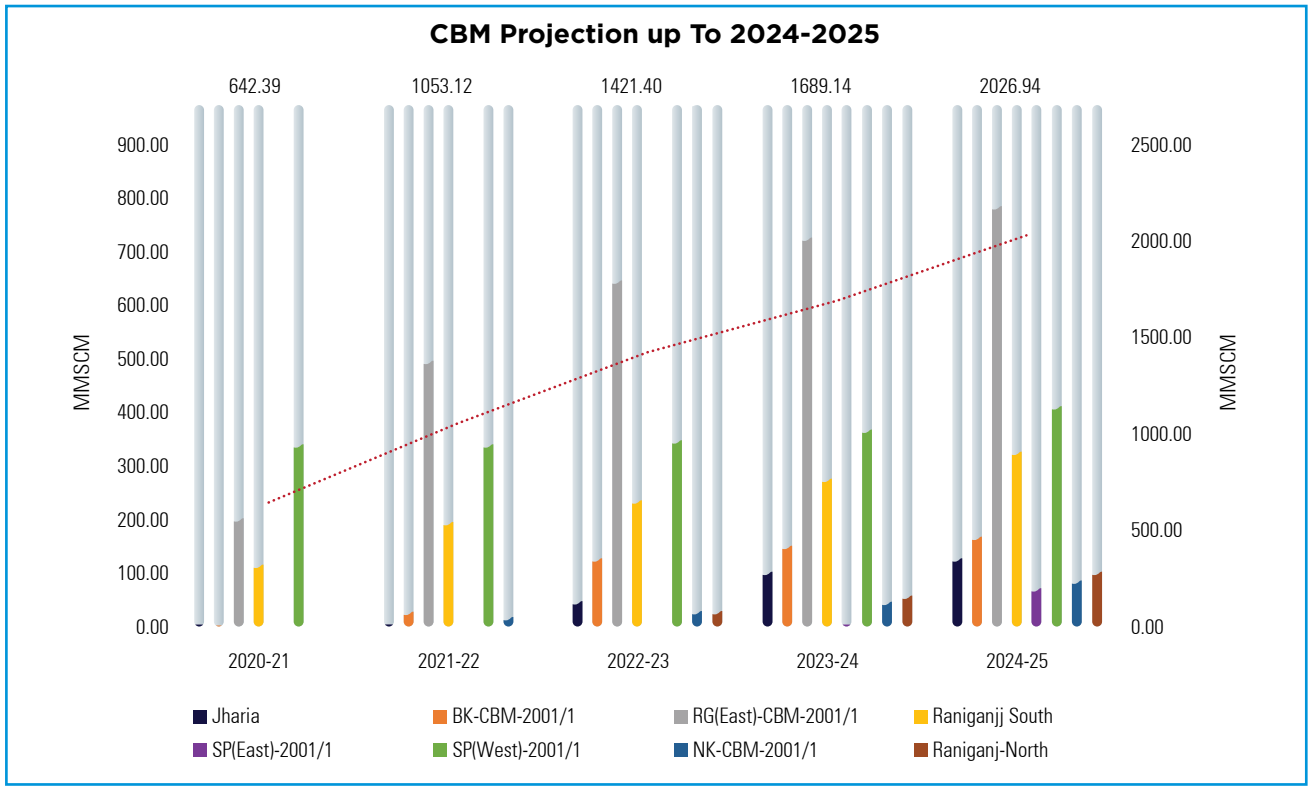
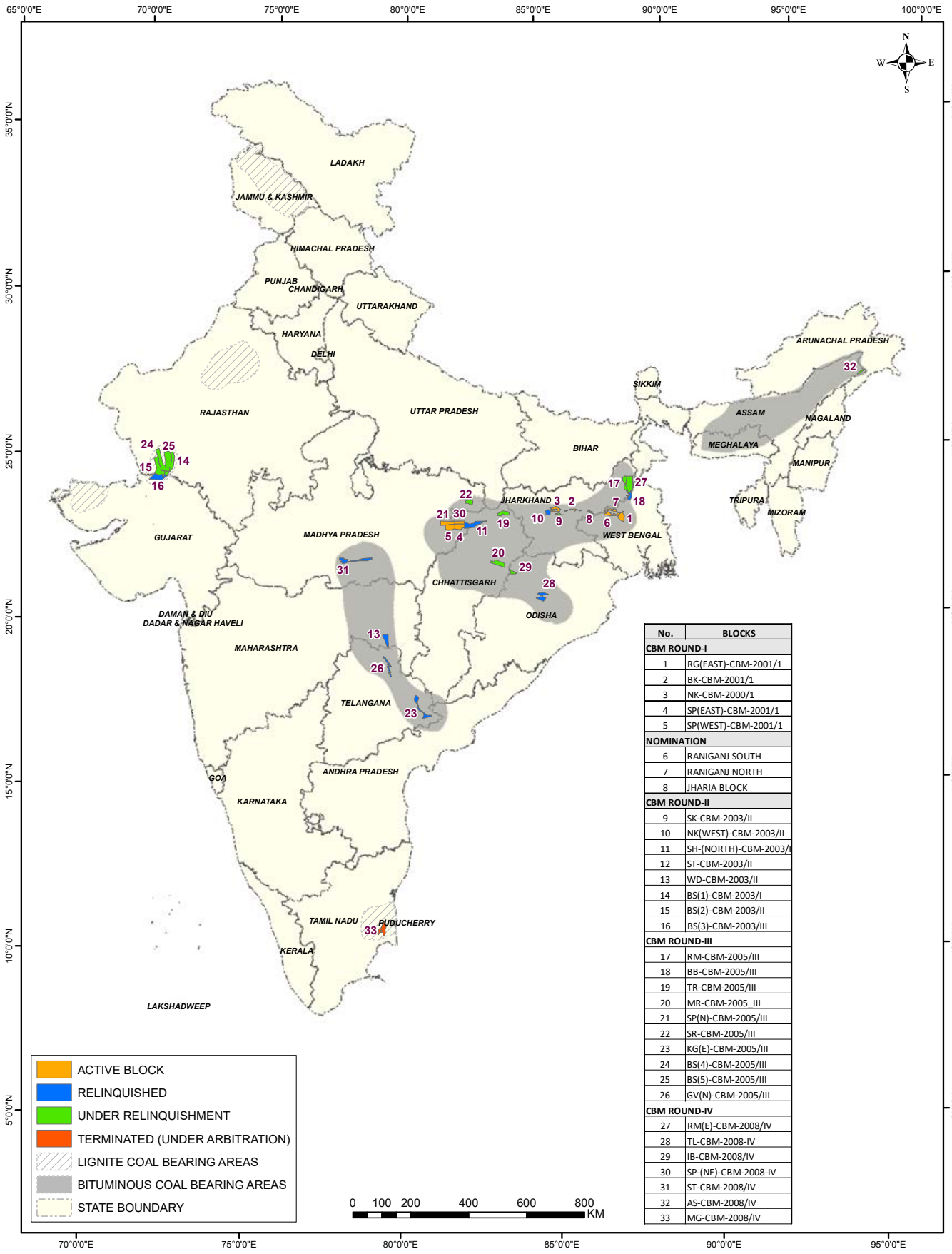


Figure 7.2: CBM future production trend (in MMSCM)



Map showing CBM Blocks along with Coal Bearing Areas



No.	BLOCKS
CBM ROUND-I	
1	RG(EAST)-CBM-2001/1
2	BK-CBM-2001/1
3	NK-CBM-2000/1
4	SP(EAST)-CBM-2001/1
5	SP(WEST)-CBM-2001/1
NOMINATION	
6	RANIGANJ SOUTH
7	RANIGANJ NORTH
8	JHARIA BLOCK
CBM ROUND-II	
9	SK-CBM-2003/II
10	NK(WEST)-CBM-2003/II
11	SH-(NORTH)-CBM-2003/I
12	ST-CBM-2003/II
13	WD-CBM-2003/II
14	BS(1)-CBM-2003/I
15	BS(2)-CBM-2003/II
16	BS(3)-CBM-2003/III
CBM ROUND-III	
17	RM-CBM-2005/III
18	BB-CBM-2005/III
19	TR-CBM-2005/III
20	MR-CBM-2005_III
21	SP(N)-CBM-2005/III
22	SR-CBM-2005/III
23	KG(E)-CBM-2005/III
24	BS(4)-CBM-2005/III
25	BS(5)-CBM-2005/III
26	GV(N)-CBM-2005/III
CBM ROUND-IV	
27	RM(E)-CBM-2008/IV
28	TL-CBM-2008-IV
29	IB-CBM-2008/IV
30	SP-(NE)-CBM-2008-IV
31	ST-CBM-2008/IV
32	AS-CBM-2008/IV
33	MG-CBM-2008/IV

7.2 Shale Gas/Oil

Shale gas/oil is a form of natural gas/oil that remain unexpelled, unmigrated and entrapped within the pore space and fractures of a source rock (commonly, shale). They are categorized as unconventional resource due to their nature of occurrence and method of extraction. In general, shales have insufficient permeability (usually in Nano Darcy i.e. 10-9 D) for fluid flow to a well bore.

The shale gas/oil is produced commercially when sufficient fracture conductivity is induced by hydraulic fracturing.

In contrast to the conventional play exploration where the risk profile is governed by the presence and effectiveness of source, reservoir, trap, timing and migration of hydrocarbon, shale gas/oil exploration has a much different and usually more predictable risk profile. The gas shale itself contains all of the elements of petroleum risk as mentioned.

The producibility of shale gas is not just limited to a single prospect but to a larger geographic region. Thus, in a proven shale play, the challenge is to develop the proper drilling and completion techniques to optimize the gas production rate versus capital employed and operating costs.

In India, a preliminary resource assessment of Shale gas/ oil was carried out by three different organisations.

In 2011, the United States Geological Survey (USGS) estimated the technically recoverable Shale gas/ oil as 6.1 TCF for 3 basins: Cambay, Krishna-Godavari (KG) and Cauvery. Again in 2014, it estimated a technical recoverable volume of 62 million barrels of shale oil in Cambay Basin alone.

In 2013, the National Oil Company, ONGC estimated Shale Gas resources of 187.5 TCF from 5 sedimentary basins; Cambay, KG, Cauvery, Ganga and Assam.

CMPDI in July 2013 had estimated around 45.8 TCF in the Gondwana basin.

In order to understand the prospectivity and untap the Shale gas and oil resource potential in India, GoI announced a Shale gas and oil exploration policy on 14th October, 2013 for the National Oil Companies (NOCs), ONGC and OIL. The companies were required to carry out exploration in their PEL and ML areas in three phases.

Shale Gas/Oil Policy Reforms

In addition to the policies notified in 2016 (HELP) and 2018 (Unconventional), in Oct 2018, a policy framework to promote and incentivize Enhanced Recovery Methods for Oil and Gas was notified by the Ministry of Petroleum and Natural Gas, Government of India.

Under this policy, fiscal incentives are provided from the first day of the entire production from future discoveries of unconventional hydrocarbons (Shale Gas/Oil and Gas Hydrate). Many CBM operators have shown interests for exploiting the Shale gas resources in their region.

Summary of Shale Gas/Oil Activities in India

Under the Shale Gas Policy - 2013, 50 blocks in 4 basins; Assam, Krishna Godavari, Cauvery & Cambay were identified by ONGC and 6 blocks in 2 basins; Jaisalmer and Assam were identified by OIL in the Phase-I of exploration which ended in April-2017.

Till FY 2020-21, ONGC had drilled a total of 30 wells in 4 basins and OIL has drilled 4 shale wells in 2 basins.

Activities carried, till March-2021

ONGC

WGSGA well (KG Basin) was prepared for HF in BTU by perforating the interval 2985-2980m. HF was carried out on 20.05.2018, by placing 78 MT of HSP with 310 m^3 of frac fluid.

During activation influx of oil, gas and water was observed. This has established presence of shale oil petroleum system in BTU of Gudivada Graben in KG Basin. Total knocked out liquid during activations after HF so far is about 203 m^3, of which oil is 2.3 m^3.

Final activation carried out in March 2020 indicated poor rate of influx with high percentage of water. Post HF testing of shale objective in WGSGA concluded. Objective of assessment of shale in BTU sequence within Raghavapuram Shale Formation has been fulfilled. The well is proposed for abandonment.

Out of the 30 wells completed so far, across four basins viz. Cambay, KG, Cauvery and A&AA Basins, 11 are exclusive wells and 19 are dual objective wells. Indications of presence of shale oil have been recorded in some wells namely JMSGA, NSGB and NJSGA in Cambay Basin and WGSGA in KG Basin during activation after hydro-fracturing. In the shale well, NGSGA (Cambay Basin), a zone encountered within the Nawagam Middle Pay (Tight Reservoir) was hydro-fractured and on activation, produced oil.

OIL

Prospectivity evaluation study of Barail shales recovered from well Balimara-6 (Loc DIG) of Dumduma PML, Assam-Arakan Basin has been completed. Around 17.23 m of conventional core has been acquired from the well Balimara-6 from the target shale section of Barails for this study.

The results of the study indicate Barail shales penetrated in the Balimara-06 lacks the organic richness, hydrocarbon generative potential or thermal maturity necessary to be considered as a potential source rock reservoir for unconventional hydrocarbon.

7.3 Gas Hydrates

National Gas Hydrate Programme (NGHP):

National Gas Hydrate Programme in the country is steered by the Ministry of Petroleum and Natural Gas and technically coordinated by Directorate General of Hydrocarbons (DGH). Two expeditions 01 & 02 have been completed under NGHP. Under Expedition-01 carried out on 2006, 39 holes at 21 sites were drilled and established physical presence of Gas Hydrates in Krishna Godavari, Mahanadi and Andaman but were non exploitable with available technologies. Expedition-02 was conducted in 2015 drilled 42 holes in 25 sites. Two distinct Gas hydrate bearing sand reservoir areas B & C were identified in KG basin and Area A sand-rich reservoir systems having limited formation of concentrated gas hydrate accumulations. Area-E drilled wells indicated the presence of gas hydrate, with a combination of fracture/ displacement and pore-filling type gas hydrate.

NGHP Expedition-02 results are encouraging and further extensive studies are planned to assess the gas hydrate resource potential, reservoir characterization, reservoir delineation and geo-mechanical modelling for seafloor and wellbore stability and identification of sites for pilot production for testing. KG deep offshore Area B' & C' contain gas hydrate accumulations may be suitable sites for gas hydrate production testing under NGHP Expedition-03.

Technology for production of gas from gas hydrate is not yet matured and is at R & D stage world over. Based on collation and interpretation of data acquired from NGHP-02, five sites have been found suitable for acquiring additional data those can be suitable for pilot production testing. A tentative action plan is firmed up with help of NGHP member organisations based on the Advisory committee recommendations.

Way Forward

NGHP member organizations are working on projects for the development of feasible production technology. The various jobs being carried out by member organisation will envisage the potential resource and firm up strategy for the execution of Gas Hydrate pilot production testing in Indian offshore. Action plan will be implemented after approval the area/sites of interest and development of production technology for pilot production tests.

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