HYDROCARBON VISION 2030 FOR NORTHEAST INDIA

Develop North East Region as a dominant hydrocarbon hub at the forefront of India's energy economy

- Double the production of Oil and Natural Gas (O + OEG in MMTOE) by 2030
- Access to clean fuel for 100% households at affordable price in the region (LPG/PNG)
- Bolster development through creation of service provider hubs
- Ensure availability to support growth in per capita petroleum product consumption
- Provide pipeline connectivity by installing new POL and LPG Pipeline
- Develop natural gas grid, CGD networks and CNG Highways
- Generate employment opportunities through Industrial and skill development
- Promote manufacturing industry related to oil and gas in the region
- Incentivize production of bio fuel in the region for providing access to clean fuels and to boost rural economy
- Promote trade between North East Region of India and neighbouring SAARC countries

Contents

Message from Hon'ble Minister

Shri Dharmendra Pradhan, MoS (I/C),
Ministry of Petroleum and Natural Gas, Government of India

The North East, endowed with abundant natural resources and an industrious talent pool, has several distinctions to its credit – captivating landscape, copious rainfall, high literacy rates, gateway to South and Southeast Asia, to name some. It is also the region where oil & gas reserves were first discovered in India.

Victor Hugo once said, "Nothing is stronger than an idea whose time has come." I firmly believe that a paradigm shift in production and utilisation of hydrocarbons is due and can catalyse growth in the region. During my four days tour to Assam in April 2014, I realised that a lot more can be done to ensure that North East region emerges as a dominant hydrocarbon hub on India's energy map. Despite being 'Gangotri' of India's hydrocarbon sector, the reach of the petroleum product in this region has been sub-optimal. Time has come to give returns to this region by engaging reforms in upstream-midstream and downstream sectors of the hydrocarbon chain.

With this conviction my Ministry team led by Shri K D Tripathi, Secretary, Shri Ajay Sawhney, Additional Secretary and Shri U P Singh, Additional Secretary set out to draft Vision 2030 for Hydrocarbons in the North East.

A vision statement is incomplete without people-planning and involvement of local stakeholders, besides strategic, economic and financial considerations. Hence, apart from production, projects and policy, people and partnership have been crucial pivots in the development of this statement. The vision statement lays out a detailed roadmap for the entire hydrocarbons value chain, covering upstream, midstream and downstream segments. It also provides a framework for planning supporting infrastructure, skill development and health facilities, and touches upon allied industrial and manufacturing facilities as well.

To realise the full potential of the North East Region, concerted efforts are needed to address the specific issues that can catalyse the development of the region's hydrocarbon potential. Such efforts need to be aimed at a range of areas, such as better utilisation of resources available in the region, investments in the hydrocarbon sector and development of concomitant infrastructure as well as towards creating new avenues of growth through skill development and cross-border trade. As multiple avenues for growth and development emerge in the 21st century, it is of paramount importance that the region, as a collective identity, embarks on a vibrant journey to realise the dreams of a prosperous future.

This vision document is definitely not a mere academic exercise. A lot of consultations have been carried out with the stakeholders including each of the state governments. The participation of field level functionaries, inputs from state governments and central government Ministries has added immense value to the document.

I am confident this Hydrocarbon Vision 2030 for North East India will set the direction and a platform for us to act upon and implement the identified action plan. I take this opportunity to compliment the team for helping us take this first step and welcome the participation of stakeholders, state governments and local people in achieving the goals and objectives.

(Dharmendra Pradhan)

Foreword

Shri K D Tripathi, IAS, (Secretary)
Ministry of Petroleum and Natural Gas
Government of India

The quest for an improved quality of life necessitates all aspects of energy security: exploration of resources, effective exploitation of available resources, intelligent balancing of imports, and ensuring a sustainable energy strategy. For India to succeed in our unrelenting pursuit towards steady, high growth as well as a strong desire for poverty eradication, proper exploitation and utilisation of hydrocarbon sources remains a key area. This warrants thinking towards better planning not only for the highest possible domestic production of oil and gas, but also integrating India's hydrocarbon sector with the Asian and, to a large extent, the global energy economy.

Oil & gas together constitute over 45% of primary energy consumption in India. Given this, hydrocarbon resources become an important lever to sustainably plan for the energy needs of the country. In this regard, the North East Region remains a belt with high potential. The states comprising the region are unique but have similar developmental needs. Literacy rate in the region is higher than the national average but per capita energy consumption is lower.

The key to unlocking the region's potential lies in the development of its vast energy and hydrocarbon resources. This apart, availability of fuels for homes, transport and businesses is crucial. This Hydrocarbon Vision 2030 report dwells on both of these (development of resources and availability of fuels) as levers to uncover the latent potential of the region. This report presents a roadmap – of immediate, medium-term and long-term initiatives – to help achieve the objectives. It has been drafted specifically in the context of issues and challenges specific to the North East region topography, weather and ecological sanctity.

The report charts out a plan to increase oil and gas production, make fuels accessible and supplement industrial development. Also, corresponding projects and investments have been detailed. It is now upon all of us to set out to make the Vision a reality. This calls for concentrated and coordinated efforts of the central and state governments and various entities in the segment. I look forward to expeditious and synchronised implementation of the planned initiatives.

(K.D. Tripathi)

Preface & Acknowledgments

Shri Ajay Sawhney, IAS, (Additional Secretary)
Ministry of Petroleum and Natural Gas
Government of India

This document – Hydrocarbon Vision 2030 for North East India – is the result of a meticulous exercise of a steering committee of key stakeholders in the segment. A steering committee with participation of representatives from Oil and Natural Gas Corporation, Oil India Ltd, Directorate General of Hydrocarbons, GAIL India Ltd, Indian Oil Corporation Ltd, Numaligarh Refinery Ltd, Petroleum Planning & Analysis Cell, Oil Industry Development Board and Engineers India Ltd was constituted in May 2015 with the objective of preparing the vision document for hydrocarbons in the North East. This was in pursuance of the decision taken by the Hon'ble Minister of State (I/C), Petroleum and Natural Gas after his four days extensive tour to various oil and gas installations in Assam.

As part of the consultation process, focussed discussions were conducted with various stakeholders including private /public sector exploration and production companies, industry bodies, service providers, and domain experts representing different segments of the hydrocarbon value chain. The committee members, from time to time, provided inputs and perspectives on operations, production and plans for the region. Also, a team visited the North East Region and held interactions with stakeholders and players in the oil and gas value chain.

Based on the review and analysis of respective segments, the committee members worked to identify solutions and a roadmap for the region. Thereafter, the recommendations drafted were discussed with state government representatives and sector entities operating in the region. The recommendations were also shared with other concerned ministries for their inputs. This report is a result of rigorous deliberations by committee members and incisive review of solutions to achieve the identified objectives, and duly considers the specific local aspects of the region.

The Vision document not only sets out an aspiring outlook for the region but also lays down state-wise and segment-wise plans to achieve the objectives. Based on the deliberations by the committee, I am convinced this document will serve as a guidebook to implement the action plans and bring meaningful results for the oil and gas industry and people at large in the region.

I take this opportunity to thank the committee members for their many contributions; without their coordinated and focussed efforts this report wouldn't have been possible. I also thank the state representatives and local governments for their many invaluable inputs and suggestions and help in refining the recommendations to improve their effectiveness. I acknowledge the inputs and efforts of CRISIL Infrastructure Advisory team as a Knowledge Partner to the committee in preparing the report. Also, this document wouldn't have been as comprehensive without the inputs and support we received from various stakeholders across the industry including private operators, service providers and equipment suppliers who added value from their experiences. I would like to make a special mention of the tireless

efforts of Shri Prashant Lokhande, IAS (Director, Exploration, MoPNG) in ensuring coordinated work by the committee and providing all required support in making this report a reality. I am grateful to the Hon'ble Minister of State (IC) and Secretary, Ministry of Petroleum and Natural Gas for their continuous guidance.

The Hydrocarbon Vision 2030 for North East India document aspires to catalyse growth in the region by developing its hydrocarbon potential. I firmly believe that under the guidance for development set forth in this document, the North East Region would embark on a journey to growth and prosperity. The Vision can be realised only through the combined effort of all stakeholders and people of the North East.

I am hopeful that Vision 2030 will act as a change agent for the region and the people of the North East and I welcome the participation of stakeholders, state governments and people of the region in achieving it.

(Ajay Sawhney)

Prologue

Shri U P Singh, IAS, (Additional Secretary)
Ministry of Petroleum and Natural Gas
Government of India

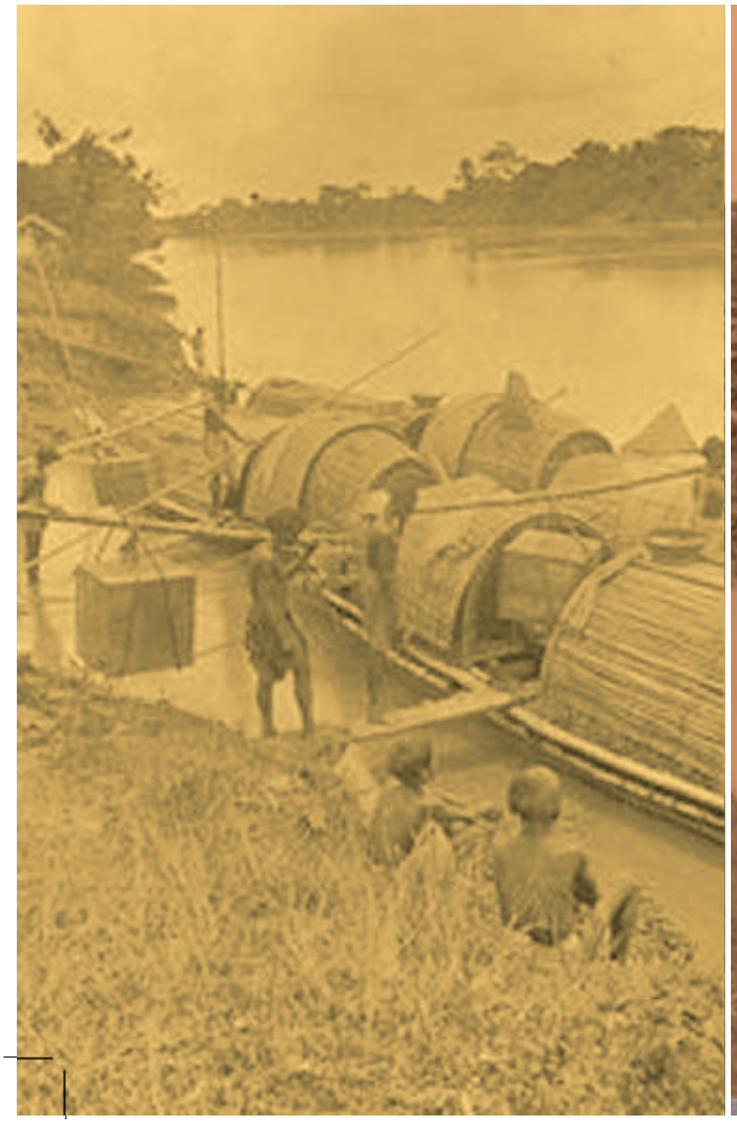
The aim of a vision document is to establish the high-level purpose supported by a clear statement of the issues and to identify possible solutions with implementation plan. I am glad the Hydrocarbon Vision 2030 for North East India covers all of these and sets a clear roadmap. Apart from encapsulating the aspirations for the region, the document touches upon all aspects of the hydrocarbon value chain to leverage the potential in the region and at the same time redirect efforts to generate economic and social development.

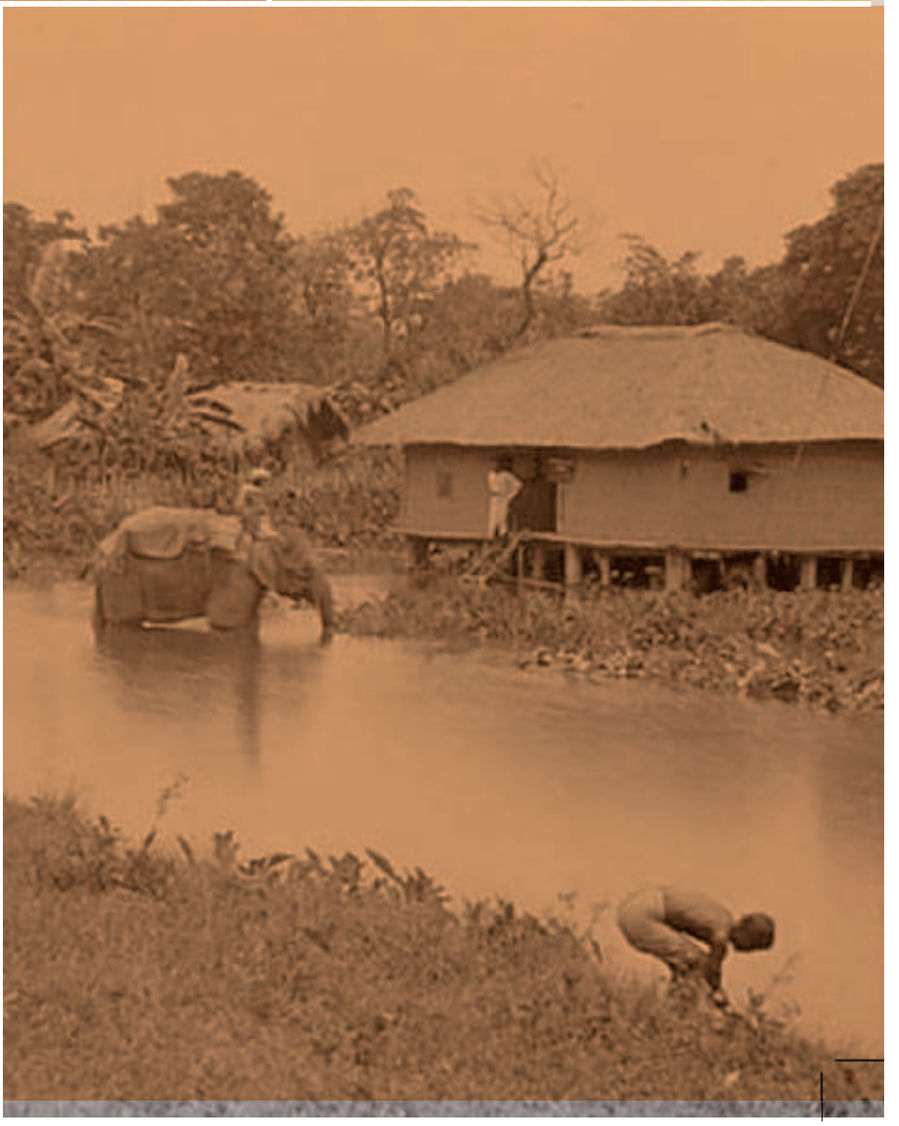
Also, while stating action plan of the hydrocarbon segment in NER, the intention has been to identify the specific workable measures across the value chain which could be addressed in a systematic manner preferably over the short term and in some cases over the medium to long term. The solutions proposed in the document have also been deliberated in detail to assess the achievability on the ground so that we can set out with a well-defined roadmap that allows us to take stock of the progress made along the way.

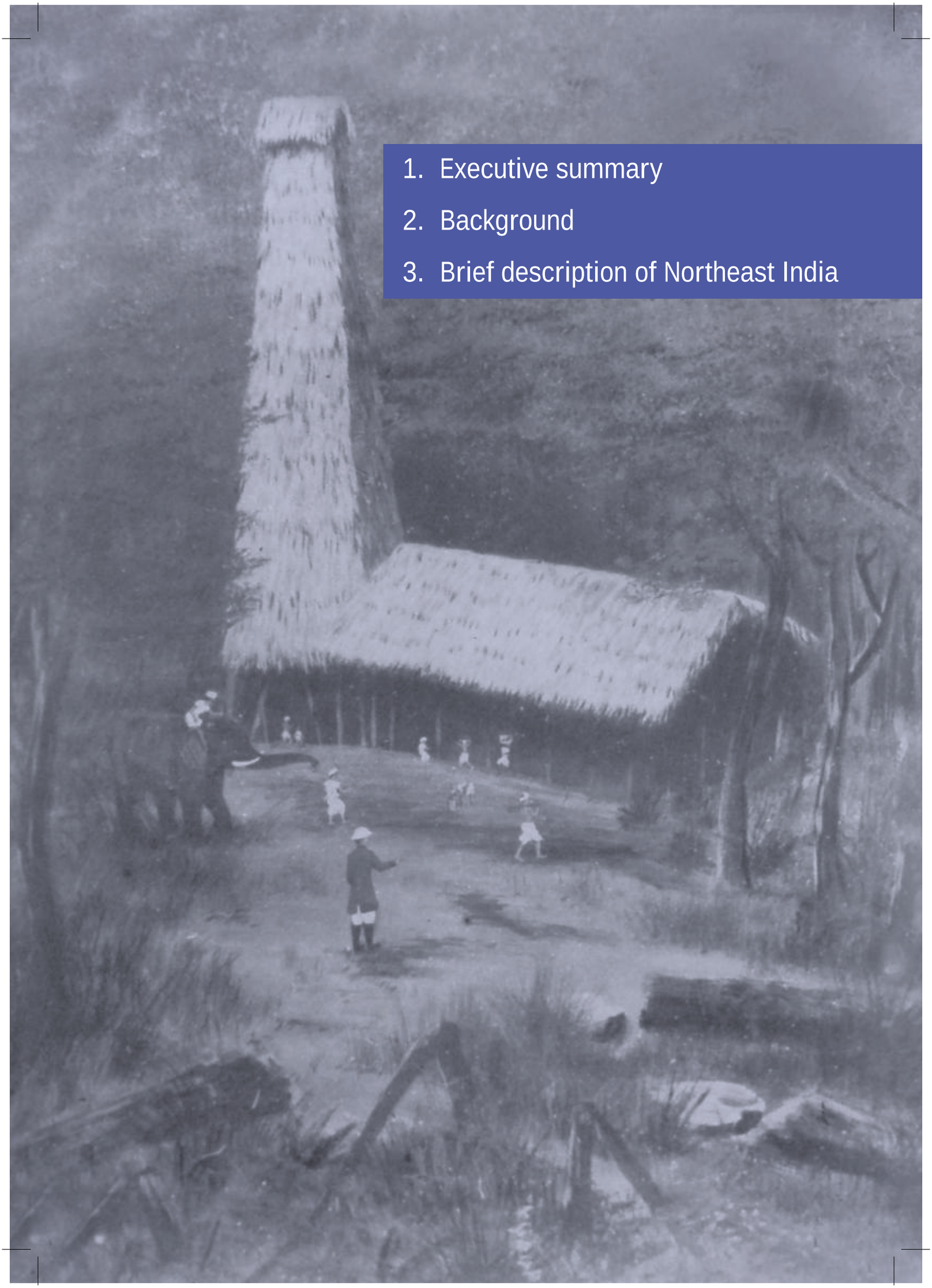
As the famous Chinese proverb says "A journey of a thousand miles begins with a single step"; I firmly believe that this Vision 2030 document is a step that would set in motion the journey of developing the hydrocarbon sector in NER towards realization of the potential of this region. I am also hopeful that this development effort for NER would go a long way towards making a contribution towards the overall growth and development objective of our country. And I must admit that the journey has only begun. Now it will call for concentrated efforts on all accounts and prompt action to bring about the change we all wish to see.

I am hopeful the results of this Vision formulation will generate benefits on all accounts – fuel access, attracting investments & industries, generating employment, improving trade with SAARC and most importantly welfare of local people. I look forward to wholehearted support of all stakeholders to achieve these.

(U P Singh)







1. Executive summary

The North East Region (NER) of India is strategically located as it is surrounded by Bhutan, China, Nepal, Myanmar and Bangladesh. Captivatingly scenic, endowed with abundant natural resources, vast expanses of farmland and an industrious talent pool, the region has the potential to emerge as an important gear in India's development in the 21st century. However, challenges related to terrain and extreme weather have hindered realisation of that potential.

The states comprising NER are unique, but have similar developmental needs that merit special public and private sector intervention. Literacy rate in the region is above the national average, but per capita income lags the national average. Consequently, per capita energy consumption is lower. The key to unlocking the region's potential, therefore, lies in its vast energy and hydrocarbon resources and their development.

India's economic progress is closely linked to energy demand. As the economy expands, the need for oil and gas is expected to grow considerably. The Government of India (GoI) has taken several steps in recent months to drive investments and growth across the country. A number of nation-wide initiatives have been announced including Make in India, Swachh Bharat, Smart Cities, and RuUrban to name a few. All of these will spur economic activity in the country and help attract investments in the respective sectors. GoI has also embraced several policies towards energy security, including allowing 100% foreign direct investment (FDI) in segments such as natural gas, petroleum products and refineries. A series of reforms have been initiated to boost development activity in the country, including adoption of a new methodology for calculation of domestic gas price, marginal field policy, 'give it up' scheme for domestic cooking gas, Pratyaksh Hanstantrit Labh (PaHaL) and liquefied petroleum gas (LPG) connection to rural areas under Rajiv Gandhi Gramin Vitaran Yojana. Moreover, the 'give it up' campaign, whose aim is to make well-off citizens voluntarily give up the LPG subsidy, is expected to bring down the government's subsidy burden.

On the consumption front, there have been sustained efforts to manage the demand for petroleum products and ensure availability of affordable fuel to the common man. The Ministry of Petroleum and Natural Gas (MoPNG) has rolled out an elaborate plan to reassess hydrocarbon resources in India's sedimentary basins by March 2016, even as it aggressively pursues assets and supplies overseas. It aims to construct strategic crude oil reserves of 5.33 million metric tonnes (MMT), pursue transnational oil and gas pipeline projects, and enhance oil and gas production with the assistance of exploration and production (E&P) companies, among others.

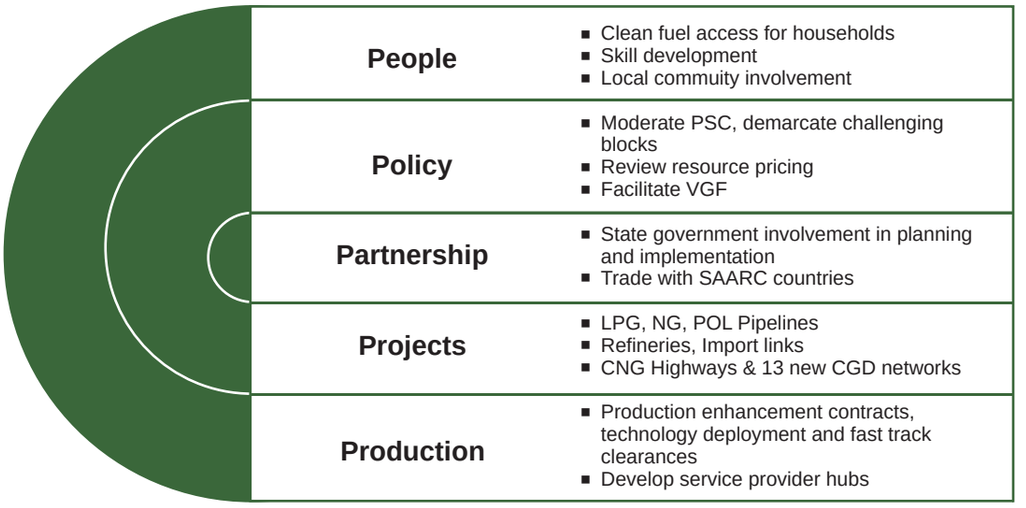
Oil and gas exploration in India dates back to the 19th century, when production commenced at Digboi in Assam. Even today, Assam contributes about 10% of the country's total crude oil and natural gas production. Since then, both the national oil companies – Oil India Ltd (OIL) and Oil and Natural Gas Corporation (ONGC) – have added substantial hydrocarbon reserves, acquired production technical knowhow and made large investments to manage complex reservoirs (with contribution of around 8.5 MMT of oil plus oil-equivalent of gas (O+OEG) from their producing assets 2014-15) in the northeastern region.

The region under coverage in this report consists of eight states that together make up about 8% of the country's total geographical area and nearly 3% of the population (46 million). The region contributed around 2.65% to national GDP during 2014-15. The North East is predominantly rural, with over 84% of the population living in the countryside; agriculture provides livelihood to 70% of the region's population. A significant part of the region is covered in forest, and bestowed with abundant natural resources.

Driven by expanding global trade and investment, NER was in the forefront of development almost 150 years ago. Global trade was carried out through the sea, a network of inland waterways, and through roads and railways. However, today, the region lags the rest of the country on several development indicators. It accounts for less than 8% of the nation's power generation requirement and per capita power consumption, at 258 kWh, is less than one-third of the national average (883

kWh). Literacy rate in the region is high; however, the slow pace of industrialisation has led to high unemployment rates. Further, a shortage of adequate skill development infrastructure in the region has adversely impacted the employability of the labour force, especially for technical jobs. This is an alarming situation for a region that holds large reserves of petroleum and natural gas, constituting one-fifth of the country's total potential.

This vision document aims to prepare a roadmap for the next 15 years to increase the production of oil and gas in northeast India and outline the necessary investment in the hydrocarbon sector to increase exploration activities, expand the piped natural gas (PNG) network and ensure availability of petroleum products, including LPG, in the remotest corners of the region. Northeast India will have to play an important role in achieving this target as it is endowed with huge untapped natural resources and is acknowledged as the eastern gateway of India's 'Act East' policy. The vision rests on the following five pillars:



The two sedimentary basins – Upper Assam Shelf and Assam-Arakan Basin – cover an area of 116,000 sq km and contain prognosticated hydrocarbon resources estimated around 5,040 MMT, out of which 2,224 MMT (44%) has been established so far, leaving considerable opportunity to establish and develop the remaining 56%. Around 90% of the Upper Assam Shelf has been explored and current production of oil and gas is mainly from this basin, whereas only 10% of the Assam-Arakan fold belt, mainly covering Tripura and some parts of Mizoram, Manipur and Nagaland, has been explored. The region is characterised by large forest cover and tough terrain, which hinders geo-scientific surveys and drilling activities. Seismic data acquisition and processing problems inherent to fold belts result in poor imaging while high formation pressure poses problems during deep well drilling. It is worth mentioning that all structures in west Tripura probed so far have proved to be gas bearing, and the success ratio of exploratory prospects is quite encouraging. A snapshot of the status of exploration activities in NER as on March 31, 2015, is given below.

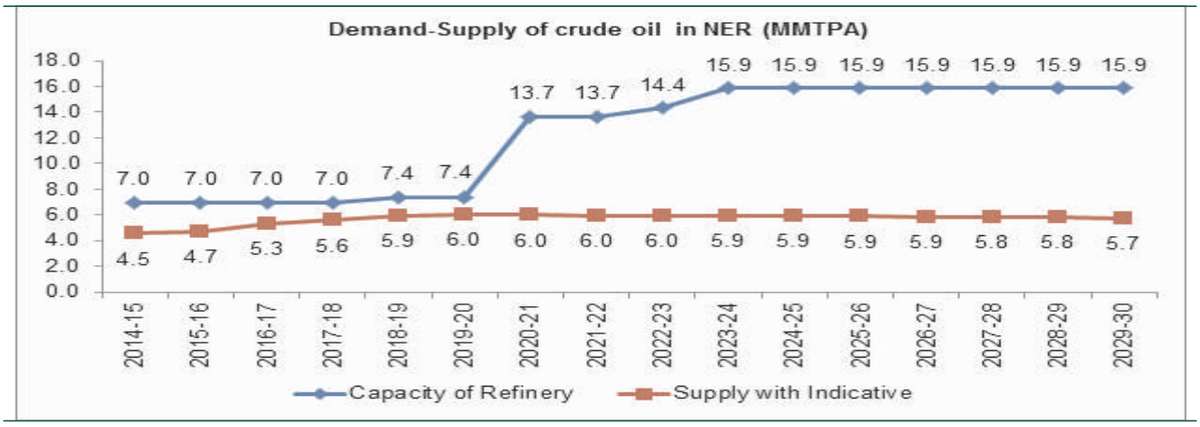
Area category	Area in sq km (%)
Total sedimentary basin area	116,000 (100%)
Area awarded before NELP and under NELP rounds	43,722 (38%)
Currently active nomination petroleum exploration licence (PEL)	4,905 (4%)
Currently active petroleum mining lease (PML) (nomination + PSC)	9,665 (8%)
Total area under exploration and exploitation	58,355 (50%)
Coal bed methane (CBM) area under exploration	113
Shale gas area under exploration	1,262

Policymakers and economists have recognised that the main stumbling block for economic progress of the region is the harsh terrain and weather conditions. It is recognised that globalisation propagates de-territorialisation and a borderless world, which is often associated with economic integration. Thus, with 98% of its borders with China, Myanmar, Bhutan, Bangladesh and Nepal, northeast India appears to have a better scope for development in the era of globalisation. Against this backdrop, the region must look at economic integration with rest of Asia, particularly East Asia and Southeast Asia.

Hydrocarbon demand-supply snapshot

Crude oil

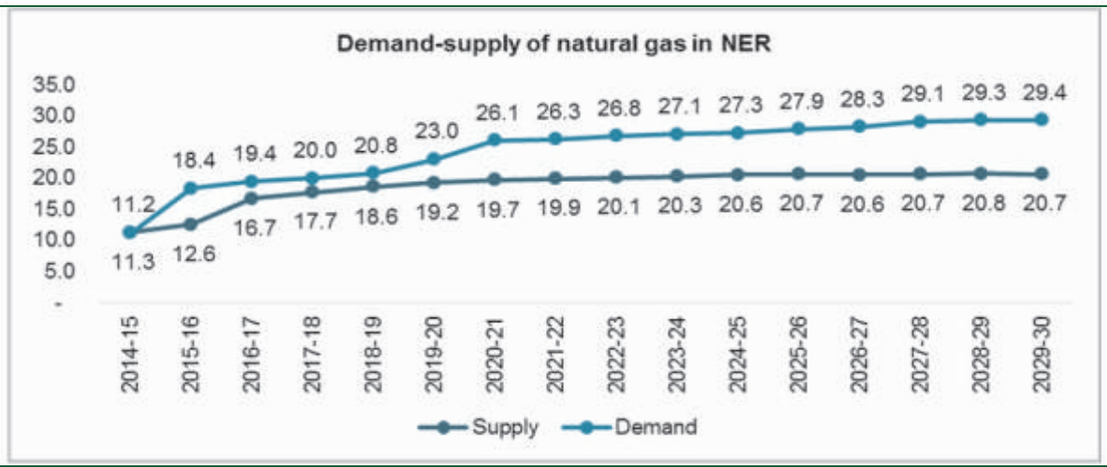
The current demand for crude oil from refineries in northeast India is around 7 million tonne per annum (MMTPA) and this is expected to increase to 16 MMTPA by 2023-24 after the expansion of IOCL Guwahati, IOCL Bongaigaon and Numaligarh Refinery (NRL). The current supply of crude oil is 4.54 MMTPA from OIL, ONGC and other fields (2014-15) and is expected to remain at a similar level (~4.6 MMTPA) without including indicative production. However, production, including indicative production, is expected to be around 5.7 MMTPA by 2030.



Source: ONGC, OIL

Natural gas

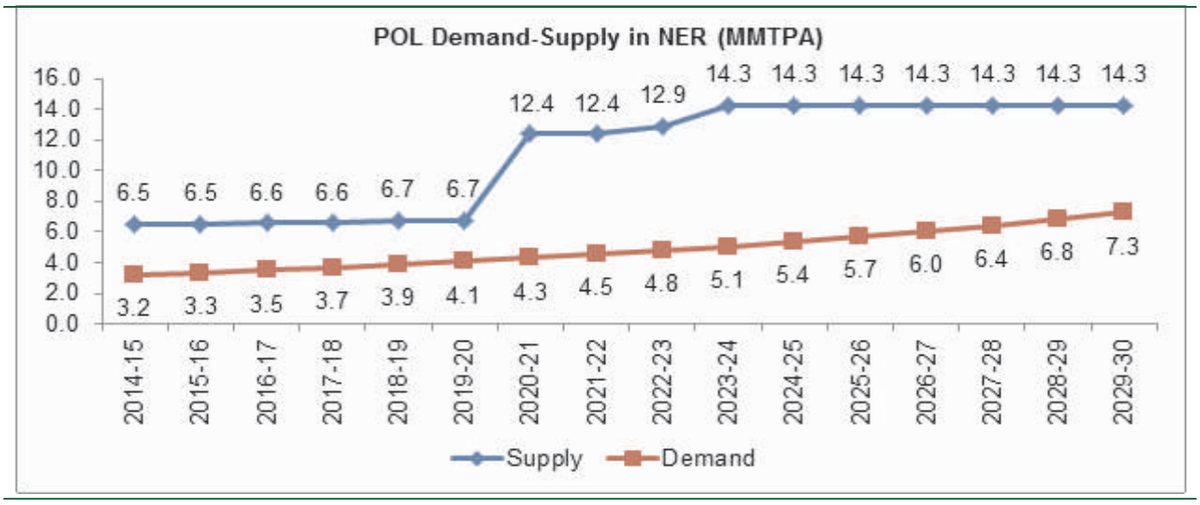
The current supply of natural gas from the region (OIL, ONGC and others) is around 11.3 MMSCMD (2014-15) and it is expected to increase to 15.3 MMSCMD by 2029-30; however, if indicative production figures are also considered, then overall production can increase to 20.7 MMSCMD. The demand for natural gas in the region is expected to increase over two fold during the same period. Potential for CGD network and industrial development (consists of proposed power projects, cracker plants, fertiliser plants, cement industries and other industrial projects) could drive demand for natural gas in northeast India to around 29 MMSCMD by 2029-30.



Figures in MMSCMD, Source: CRISIL Infrastructure Advisory Analysis

Petroleum, oil and lubricant (POL) products

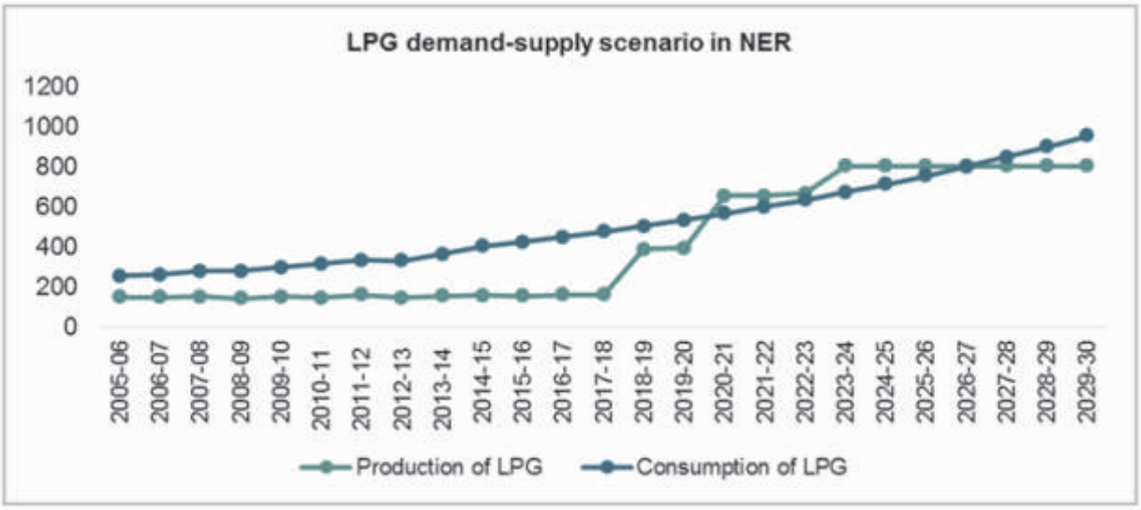
Overall production of POL products in the region is in surplus as consumption in 2014-15 was around 3.2 MMTPA as against a production of 6.5 MMTPA. Production is expected to increase to 14.3 MMTPA by 2029-30 after the expansion of NRL and IOCL Guwahati/Bongaigaon refineries and remain in surplus with consumption forecast around 7.3 MMTPA. However, an exception to this is LPG, of which currently there is a shortage, a trend that is expected to continue even in 2029-30.



Source: PPAC, CRISIL Infrastructure Advisory Analysis

Liquefied petroleum gas

Production of LPG in the region was 157 thousand metric tonnes (TMT) in 2014-15 as compared to consumption of 402 TMT. Consumption is expected to increase as LPG penetration rates improve. By 2029-30, LPG consumption in NER is expected to be around 957 TMT for achieving 80% penetration, as compared with production of around 806 TMT, which will result in a shortfall of around 150 TMTPA. Assuming 100% LPG penetration, there will be a shortage of around 800 TMTPA.



Figures in TMT, Source: PPAC, CRIS

Challenges in northeastern region

Key constraints in the region, as well as the rest of the country, to the growth of oil and gas industry, especially the exploration and production sector, have been poor infrastructure and limited connectivity. Today, exploration activities in the northeast region are being carried out in hilly and mountainous areas, which pose logistical as well as environmental challenges. Moreover, the region, connected to rest of India by a narrow stretch of land called 'Chicken's Neck', needs infrastructure to support and ensure significant investments and developmental aid. The creation of connectivity infrastructure to support exploration and development activities will have a far-reaching impact on the overall development of the region as it will help unlock the larger economic potential by removing accessibility constraints that have held back the economic development of the region.

However, development of any kind, particularly infrastructure, in this part of India will be challenging to say the least as infrastructure development encompasses socio-political issues such as land acquisition and displacement of people. Therefore, to address these problems, both central and state government aid will be vital from time-to-time to accelerate the completion of developmental projects. Though a lot of improvement has taken place over the years, challenges still remain. Some of the challenges encountered while carrying out exploration activities, particularly in the 'new exploration licensing policy' (NELP) blocks, include law and order issues, infrastructure gaps, unavailability of service providers, unavailability of adequate evacuation infrastructure and lower local demand from industry. All such issues need to be resolved at the earliest to make the investment climate of the region more attractive for E&P companies.

Exploration and production

Crude oil production in NER declined from 4.84 MMT in 2010-11 to 4.54 MMT in 2014-15 on account of maturing fields and limitations on exploring and producing oil from yet-to-find (YTF) areas, coupled with the absence of major oil and gas discoveries over the past few years. If the current situation prevails, crude oil production is likely to remain at the same level even in 2029-30. To improve oil production from matured fields, national oil companies (NOCs) need to involve technology partners through production enhancement contracts. New discoveries of oil and gas in the North East are critical for increasing production. This will need pursuing new petroleum plays, leads and field-growth possibilities in logistically difficult and geologically complex areas; targeting the Frontal Belt Corridor; pursuing exploration for structural and strati-structural prospects; and improving sub-surface imaging and G&G understanding through technology induction and reprocessing.

By contrast, the natural gas production scenario in the region has been positive over the last few years. Production is expected to reach 20.6[1] MMSCMD by 2030 (includes gas production upside from Tripura), growing at a compounded annual growth rate (CAGR) of 4 % from 11.3 MMSCMD in 2014-15. Moreover, there can be a significant increase in natural gas production in future, particularly through exploration in Manipur, Tripura and Mizoram, as these states are yet to be fully explored.

Service providers are the backbone of any industry; especially E&P industry, as spends on work outsourced to service providers are more than 60% of total E&P costs. This reliance is expected to continue in future too, if the country aims to explore and produce hydrocarbon resources from its vast sedimentary areas of 3.14 million sq km. Service providers in the northeastern region provide limited service offerings compared to the complete service portfolio offered elsewhere in India primarily due to lower business potential, inadequate connectivity infrastructure and lack of incentives when compared with the high risks involved in the region.

[1] *This is inclusive of indicative production. However, if we consider only firm and upside production, the expected production will reach 15.3 MMSCMD by 2029-30.*

The key action points identified for improving the state of upstream infrastructure are listed below.

Action plan	Rationale	Responsible authority	Timeline
Production related issues			
Increasing production from mature fields by : ▪ Production enhancement contract (PEC) ▪ Deployment of new technology by NOCs.	Arrest declining production. Using new technology by reputed service providers may increase production.	NOCs/service providers/MoP&NG	<2 years
Enhancing exploration activities ▪ Conversion of 2P to 1P reserves. ▪ Development of yet-to-find areas	▪ Faster clearances to open new fronts for work ▪ Incentive to service providers will enable more drilling and work over rigs.	NOCs/private players DGH/MoPNG/MoEF	2-5 years
Resolution of disputes			
Nagaland Area A review of existing royalty structure could be considered.	Unlock exploration potential in disputed areas	MoPNG/Ministry of Home Affairs/Government of Nagaland	<2 years
DAB Area A committee formed by authorities nominated by Secretary-MHA/MoPNG and chief secretaries of Assam & Nagaland need to be formed for resolution on these blocks.	Unlock exploration potential in Nagaland	MoPNG/Ministry of Home Affairs/Government of Nagaland & Assam	<2 years
Offering premium on natural gas production in NER			
Provide premium on gas price for gas produced from NER areas (challenging blocks) considering high capital & operational costs. (Detailed analysis in section 5.1.4.4)	Incentivise gas production and reduce dependence on LPG	MoPNG/DGH	<2 years
Availability of service providers			
NOCs to extend services to third parties on chargeable basis	Compensate for unavailability of service providers	ONGC & OIL	<2 years
Development of service provider hubs in NER (Jorhat/Dibrugarh & Agartala)	Achieve sustainable increase in exploration activity	MoPNG/Ministry of Finance/Ministry of Commerce	2-5 years
State policy support			
Development of free industrial zones (FIZ) or special economic zones (SEZ)	Develop and promote presence of service providers	Ministry of Commerce & Industry/state govt.	2-5 years
Introduction of fiscal incentives that may include income tax holidays for 10 years for service providers having base in the northeastern region	Develop and promote presence of service providers	MoPNG/Ministry of Finance	<2 years
Sector policy framework			
Challenging blocks in NER to be considered for increased timelines.	Incentivise exploration and avoid relinquishment	MoPNG/DGH	<2 years

Action plan	Rationale	Responsible authority	Timeline
Timeline needs to be extended as 8 + 4 years (for challenging blocks) instead of existing 4 + 3 years (for onshore) and 5 + 3 years (for frontier blocks) due to limited working cycle	Incentivise exploration and avoid relinquishment	MoPNG/DGH	<2 years
Tax holiday to be increased to 12 years from the current 7 years for challenging blocks in future contracts	Incentivise exploration and avoid relinquishment	MoPNG/DGH	<2 years
Clearance and approvals			
Single-window clearance for environment and forest	Avoid environmental clearance delays and increase investor confidence	MoEF/state government/ MoPNG/DGH	<2 years
Exemption from environment and forest clearances for exploratory drilling	Avoid environmental clearance delays and increase investor confidence	MoEF/ state government MoPNG/DGH	<2 years
Batch clearances for exploratory wells	Avoid environmental clearance delays and increase investor confidence	MoEF/state government MoPNG/DGH	<2 years
Inclusion of policy on giving flexibilities to operator on carrying out outstanding MWP on similar blocks where operator holds an exploratory licence, in PSC	Avoid efforts in areas with lower or no potential for E&P	DGH/MoP&NG	<2 years
Availability of data - topography/revenue maps			
Boundary demarcation of forest and non-forest area in land records	Avoid environmental clearance delays and increase investor confidence	MoEF State government MoPNG/DGH	<2 years
Relinquished area			
Offering of relinquished areas to NOCs on a nomination basis for exploration and production with first right of refusal to NOC operating near that area		MoPNG/DGH	<2 years
Zero phase of exploration			
Concept of zero phase exploration period to be included in the PSC	Increasing confidence in the local community before start of E&P activity in the area	DGH/MoPNG	<2 years

Midstream

Limited pipeline connectivity in the region has adversely impacted the development of the local market as well as transport of oil and gas in NER. The Digboi-Guwahati segment of OIL's trunk pipeline transports crude from ONGC and OIL to refineries. Apart from the OIL pipeline, ONGC also owns three short-distance pipelines that are used to transport crude oil from its oilfields to Moran and Jorhat. The crude oil is then either pumped into the OIL trunk pipeline or stored and transported to the refineries through other modes of transportation.

The current capacity of crude pipelines in the region suffices to meet the production forecast from existing oilfields and recent discoveries. However, capacity augmentation planned by Numaligarh, Guwahati, and Bongaigaon refineries will warrant capacity addition/new pipelines from Paradip to Numaligarh. The unavailability of pipelines has discouraged gas production in the region. Gas produced from ONGC fields in Tripura is transported through pipeline only to the power plants of

ONGC Tripura Power Company Ltd (OTPC), North Eastern Electric Power Corporation Ltd (NEEPCO) and Tripura State Electricity Corporation Ltd (TSEB). However, going forward, gas demand from the local market is expected to surpass local supply. DNP Ltd's (a joint venture of Assam Gas Company Ltd (AGCL), NRL and OIL) 192 km pipeline for gas from Duliajan to Numaligarh is a step in this direction. The government should consider extension of Duliajan-Numaligarh gas pipeline to Guwahati and Bongaigaon, link Agartala to Bongaigaon via Silchar and Guwahati and connect Bongaigaon to the national gas grid in Barauni.

However, these proposed projects are likely to face challenges such as right of way, land acquisition and high capital costs. Therefore, both the central and state governments will have to extend the necessary support to ensure their timely implementation. The limited capacity of product pipelines, transporting only about 61% of the products from the refineries, has forced them to use alternate transportation mechanisms such as road and rail networks, which are costlier than pipeline transportation. Moreover, the region does not have any LPG pipeline network, which has adversely affected its penetration in most states of the region.

Another important issue that needs to be addressed is the effective utilisation of oil and gas resources available. An energy corridor needs to be developed in NER for utilising the resources available, producing POL products and exporting to the rest of India as well as Bangladesh, Myanmar and Nepal. This will fuel overall growth in the region. A corridor is envisaged to connect Paradip to the northeastern region for imported crude oil in Phase I and to Chittagong for export of products in Phase II. This will facilitate uninterrupted and economic transportation of hydrocarbons.

The key action points identified for improving the state of midstream infrastructure are listed below.

Action plan	Rationale	Responsible authority	Timeline
Increase crude oil pipeline capacity			
Paradip-Siliguri-Numaligarh	Imported crude oil refinery in NER	NRL	<2 years
Barauni-Bongaigaon pipeline: OIL to maintain the same capacity of pipeline as per requirement of NER refineries. OIL to consider capacity enhancement of pipeline for expansion of NER refineries	Need to enhance capacity of this pipeline in future according to expansion plans of NER refineries	OIL/IOCL/NRL	2-5 years
Increase gas pipeline capacity			
Phase I Extend Duliajan-Numaligarh pipeline to Guwahati and Bongaigaon	Connectivity of upper Assam to the national gas grid at Guwahati for potential production of gas from Kharsang	MoPNG/ PNGRB/JV–GAIL/DNP L/AGCL/state govt./NRL/OIL (GAIL will coordinate)	<2 years
Phase II New gas pipeline from Agartala to Bongaigaon (Via Guwahati, Silchar)	Connectivity of gas produced from Agartala to the national gas grid	MoPNG/PNGRB/JV–GAIL, AGCL/TNGCL/other state entity (GAIL will coordinate)	<2 years
Phase III Bongaigaon to Barauni	Connectivity to the national gas grid	MoPNG/PNGRB/JV-GAIL/AGCL/state govt. (GAIL will coordinate)	2-5 years
Myanmar- Silchar (Via Sitwe, Aizawl)	Import of gas from Myanmar to India	MoPNG/MEA (GAIL will coordinate)	>5 years
Increase POL product pipeline			
Siliguri-Parbatipur (under planning by NRL)	Increase the availability of POL products	NRL/MoPNG/Govt. of Bangladesh	<2 years

Action plan	Rationale	Responsible authority	Timeline
Numaligarh-Siliguri (capacity enhancement)	Increase the availability of POL products after NRL expansion	NRL/MoPNG	2-5 years
Guwahati-Lumding -Silchar-Imphal (further extension to Aizawl/Agartala)	Increase the availability of POL products for Manipur and Mizoram	IOCL	5 years with VGF / Govt support funding made available within the first year of project execution
Numaligarh-Dimapur-Imphal-Moreh (post NRL expansion)	Increase POL availability in Manipur, Tripura	NRL/MoPNG/MEA	2-5 years
Numaligarh-Itanagar (future plan)	Easy transport of POL in north bank of Brahmaputra river	NRL	>5 years
LPG product pipeline			
Numaligarh-Dimapur-Imphal LPG pipeline	LPG can be supplied to Dimapur BP, Sekmai BP and, through further nodal movement, to Mualkhang BP (in Mizoram), for which, Sekmai BP can be used as nodal point for loading tankers	IOCL/MoPNG/MoF	2-5 years
Chittagong-Sabrum-Agartala (with further extension to Silchar & Aizawl)	Saving on transportation cost	IOCL/MoPNG/MoF	2-5 years
Durgapur-Siliguri-Guwahati (extension to Imphal if NRL expansion does not happen) (alternative to Chittagong – Agartala pipeline)	As alternative to Chittagong-Sabrum-Agartala LPG Pipeline	MoPNG/IOCL	
Policy			
Uniform pipeline tariff			
Develop uniform pipeline tariff structure for gas pipelines in the north-eastern region	Incentivise demand for natural gas	PNGRB	<2 years
Right of way issues			
Develop provisions for special permission for laying of pipelines in NER	Incentivise investment in pipeline laying	MoPNG/state govt	<2 years
Increase VGF limit from 20% to 50%	Projects in NER have funding gap of more than 50%	MoPNG/MoF	<2 years
Flare gas: Contract terms should be equitable for both supplier and off taker of gas, with liability being equally shared for the contract period	No takers of gas available through bidding due to tough terms & conditions	MoPNG	<2 years

Downstream

As the region's refineries are primarily dependent on crude oil supplies from local oilfields, declining production of crude has left the refineries with suboptimal capacity utilisation. Refineries in NER have so far been processing crude oil from oilfields in the region, and their crude procurement prices are linked to the international market. In case of a duty reduction, as in the past, the region's refineries are left in a disadvantageous position vis-à-vis refineries processing imported crude elsewhere in the country. Northeast refineries have to pay VAT at 5% and entry tax at 2%, while refineries elsewhere in the country are not liable to pay such duties even though they process imported crude. Therefore, the advantage of having excise duty concession, in view of the sub-economic size and geographically disadvantageous location, is also lost because of imposition of VAT and entry tax. NRL, with existing refining capacity of 3 MMTPA, has mooted a plan to expand its refinery capacity to 9 MMTPA to achieve economic viability. Considering crude availability scenario in Northeast India, the additional crude oil requirement of NRL is expected to be met through imported crude. Therefore, along with refinery expansion, NRL plans to build a crude pipeline of around 6 MMTPA from Paradip to Numaligarh.

Except for LPG, production exceeds demand for all other key POL products produced by the refineries in the region. So, expansion of refinery capacity will increase surplus capacity. Therefore, finding a market for the surplus productions will be critical. However, NER refineries have not been able to produce enough LPG to meet local demand. Moreover, LPG storage capacity in the region is not very encouraging. Arunachal Pradesh, Nagaland, Meghalaya, Tripura and Mizoram have 0-2 days' storage capacity. Owing to such challenges, LPG coverage in the region is less than 60% at present.

In terms of demand for natural gas, most of the towns/cities in Northeast India have individual houses. Also, there are very few small and medium scale industries in Tripura. So, there is very low business opportunity for any city gas distribution (CGD) entity. In addition, there are no utility corridors to lay pipelines in most of the areas.

The key action points identified for improving the state of downstream demand centres and access are listed below.

Action plan	Rationale	Responsible authority	Timeline
Refinery capacity augmentation			
Undertake expansion of NRL/IOCL Guwahati/IOCL Bongaigaon (under planning by NRL/IOCL)	Cater to POL demands of NER as well as other regions of India	NRL/IOCL	2-5 years
Enhance LPG production using INDMAX technology	Increase LPG production	IOCL	<2 years
Export of POL to SAARC countries (subject to pricing considerations)			
MoPNG to form a committee to evaluate possibility of export of POL products subject to pricing considerations, to neighbouring countries Bangladesh, Myanmar, Nepal, Bhutan, and Sri Lanka as they are net importers of crude oil & POL	Excess capacity of POL from the northeastern region can cater to demand of SAARC countries	NRL/IOCL/MoPNG/MEA	<2 years
Increase availability of Natural Gas and POL products			
Natural Gas grid development (Phase I, II, III) [Phase I-Guwahati-Duliajan, Phase II-Agartala-Bongaigaon, Phase III-Bongaigaon-Barauni)	GAIL/PNGRB/AGCL/TNGCL/State governments		Phase I & II <2 years Phase III 2-5 years

Action plan	Rationale	Responsible authority	Timeline
Incentives for CGD development	Cities in NER may not be financially viable for CGD development	MoPNG/MoF/PNGRB	2-5 years
Increase availability by laying product pipeline network and LPG pipeline, e.g., Numaligarh-Imphal and Guwahati-Silchar Imphal pipelines, and imported LPG pipeline Chittagong-Sabrum-Agartala	Will improve availability of POL at remote locations	MoPNG/IOCL/NRL	<2 years
Re-instate North East Industrial and Investment Promotion Policy (NEIIPP)	Will lead to industrialisation and hence increase consumption	Department of Industrial Policy & Promotion (DIPP)	<2 years
Development of small scale industries such as wax, bamboo-based industries, candle manufacturing, tyre, rubber-based industry etc	Will lead to industrialisation and, hence, increased consumption	DIPP/MoPNG	<2 years
Connectivity ▪ 4-laning of NH 37 and 2-laning of NH 150 ▪ Connectivity to Agartala via NH-44 needs to be upgraded to 2-lane. ▪ Upgrade Silchar, Shillong, Dimapur, Jorhat civilian airports to improve connectivity and promote tourism	Improve connectivity to increase industrial development and, hence, more consumption of POL products	Ministry of Road Transport and Highways/MoPNG/AAI	<2 years
Evaluate use of National Waterway-2 for transportation of POL and other goods	Capitalise on existing and proposed refinery capacity	Inland Waterways Authority of India (IWAI) /MEA/MoPNG	2-5 years
Development of common user facilities (CUF)	Development of common marketing facilities in NER, which can be shared by all of OMCs.	MoPNG, IOCL, NRL, BPCL	2-5 years
Ancillary industries	Setting up of ancillary industries such as fertiliser and petrochemical plants around refineries in NER, which can utilise naphtha produced from the refineries as feedstock	DIPP, MOCI, MSME	2-5 years
Increase natural gas demand			
Identified key target cities in the region along with Phases I, II, III of gas pipelines for CGD bidding and evaluate incentive schemes such as tax benefit and subsidy for initial years, to make CGDs viable	Increase natural gas demand	MoPNG/PNGRB	2-5 years
Silchar needs to be considered for CGD on immediate basis as gas from ONGC is available	ONGC Barrack Valley Block has gas available	ONGC/AGCL	<2 years
Evaluate utilisation of flared gas by using cascades of gas and LNG skid-mounted trucks	Use flared gas	GAIL	<2 years

Action plan	Rationale	Responsible authority	Timeline
Develop small power plants (modular)	Use of flared gas	OIL/ONGC/APGCL	<2 years
Develop end-consumer segments such as power and fertiliser plants	Develop end-consumer segments such as Chambal Fertilisers plant and expansion of OTPC power plant to ensure adequate natural gas demand	ONGC/ Chambal Fertilisers Ltd /MoPNG/MEA	<2 years
Industrial development			
Re-instate NEIIPP Policy with increased budget allocation and include medium-scale industries in the policy as well. Promote local manufacturing of ancillary parts related to the hydrocarbon industry in Tripura/Guwahati/Dibrugarh	Promote industries to ensure overall economic growth of the region and capitalise on the hydrocarbon potential in the region	DIPP/MoF/state govt.	<2 years
The government should incentivise production of bamboo in NER, through National Bamboo Mission, and fund the intermediary bamboo processing industry through National Bank for Agriculture and Rural Development (NABARD) for incentivising farmers and entrepreneurs	Will reduce dependence on crude oil to some extent. Will increase income of farmers.	MoPNG/Department of Agriculture and co-operation(DAC)/ NABARD	<2 years

Connectivity and infrastructure

The infrastructure gap is a major concern in the region, and acceleration in economic growth and development is dependent on how quickly this deficit is addressed. Lack of connectivity has virtually isolated the region not only from the rest of the country and the world, but also within itself. Poor density of road and rail transportation has not only hampered mobility but also hindered the development of markets. Although air connectivity in the region has improved in the last few years, the frequency of flights remains a key concern. At present, air inter-connectivity between different states in the region is limited. Although inland water transport is operationally cheaper, high in fuel efficiency and environment friendly, the development of inland water transport has remained dormant for a long time. Connectivity concerns, thus, are a barrier for industrial development. Lack of connectivity has remained one of the key impediments in the development of E&P sector in the region.

Action plan	Rationale	Responsible authority	Timeline
Road connectivity and infrastructure			
Upgrade to 2- and 4-lane roads on identified stretches of highways (NH 37 and NH 44)	Improving logistics movement for E&P activity	National Highway Authority of India (NHAI)/State Public Works Department (PWD)	<2 years
Build black-top surface on NH 53, NH 150 and NH 102B in Manipur and NH 44 in Tripura	Suitable for E&P equipment movement	NHAI/PWD/ Border Road Organisation (BRO)	2-5 years
Replace steel bailey bridge infrastructure with modern bridge infrastructure across all national highways in the region	Suitable for E&P equipment movement	NHAI/PWD/BRO	2-5 years

Action plan	Rationale	Responsible authority	Timeline
Build intra-region connectivity infrastructure along identified routes	Enhance movement of product and trade	NHAI/PWD	2-5 years
Develop proposed Asian highways through Manipur	Capitalise on opportunities in international trade	NHAI/BRO/ MEA/ MHA	>5 years
Rail connectivity and infrastructure			
Strengthen existing infrastructure and increase coverage in the region	Enhance trade by connectivity to markets	Ministry of Railways	2- 5 years
Develop rail connectivity to Bangladesh	Enhance trade by connectivity to markets	Ministry of Railways	>5 years
Air connectivity and infrastructure			
Develop civilian airports in Jorhat, Aizawl, Dimapur and Silchar	Create a business conducive environment	Ministry of Aviation/Airport Authority of India (AAI)	2-5 years

Law and order

Over the years, both the state and central governments have undertaken efforts to enhance stability in the region. The key action points identified for improving the law and order scenario and support the development of oil and gas industry in northeast India are listed below.

Action plan	Rationale	Responsible authority	Timeline
Appoint central coordination committee to resolve the boundary issues between Assam-Nagaland, Manipur-Nagaland and Assam-Arunachal Pradesh	Revival of exploration activity in the affected regions and increased drive for states to participate in a mutually rewarding manner	Central and state governments	<2 years

Trade opportunity with neighbouring nations

Total demand for all petroleum products in the northeast region is around 3.2 MMTPA. Taking into consideration the expansion proposed along with existing refinery capacity, the region will have more capacity than demand. Already a net exporter of petroleum products, India can utilise this excess capacity to service demand in neighbouring nations such as Bangladesh, Myanmar, Sri Lanka and Bhutan. Bhutan and Nepal present export opportunities to replace firewood by cleaner sources of energy, i.e., natural gas and LPG. Myanmar is an exception with excess capacity in natural gas production. Therefore, the option to import gas from Myanmar through the northeast region may be considered once the gas pipeline network in the region is developed and linked to the national gas grid. Development of a gas grid in the region will provide opportunities for setting up industries such as power and petrochemical plants in the region, which, in turn, will bring in investment and provide employment opportunities to the local population.

Make in India

Make in India, launched in September 2014, by the prime minister of India is an initiative of the government of India to encourage investment in the manufacturing sector to facilitate best-in-class manufacturing infrastructure in the country. Prior to the launch of the programme, GoI announced relaxation in foreign equity caps in various sectors to infuse confidence among foreign investors. Moreover, not only have the applications for licences been made available online but the validity of the licences has also been increased (to 3 years). Barring space, defence, news & media sectors, 100% FDI has been permitted in all 22 sectors.

The oil and gas sector, which requires a major investment boost, has been included under the 100% FDI bracket. There are ample investment opportunities in India, especially in manufacturing of equipment for the oil & gas sector. Equipment such as drilling rigs can be produced in India for local use. Further, such equipment can be exported to neighbouring countries such as Myanmar, and Bangladesh as these countries do not have manufacturing facilities and depend completely on imported equipment.

A proposal to lay pipelines of around 7,500 km and other spur lines for the CGD network in the next 4-5 years have been suggested for the northeast region under the Hydrocarbon Vision Plan. On the same lines, setting up a refinery in NER to export petroleum products subject to pricing considerations, to neighbouring countries such as Nepal, Bhutan, Bangladesh and Myanmar can be a profitable proposition. This will also offer a lift to local manufacturing. Taking into consideration the abundance of raw materials in the region, other industrial units such as tyre manufacturing, manufacturing related to plastic etc. could be considered of to promote industrialisation in the region.

Action plan	Rationale	Responsible authority	Timeline
Manufacturing equipment such as drilling rigs, drill pipes, nuts and bolts, casing and tubing, well head equipment, to be manufactured in NER and exported to Bangladesh, Myanmar & Malaysia	Develop the region as a manufacturing hub of oil and gas equipment	DIPP/MoPNG	2-5 years
Service provider hub for extension of services	Services will be available to small and private players	MoPNG/Ministry of Finance/Ministry of Commerce	< 2 years
To promote industries related to pipe manufacturing/steel in NER as there is potential for development of pipelines	Developing the region as a manufacturing hub would cater to midstream oil and gas sector	DIPP/MoPNG	2-5 years
Expansion of refineries in NER	Cater to the increasing demand in the country and export of surplus products	NRL/IOCL	>5 years
Development of concomitant infrastructure to facilitate production and evacuation of finished products from hydrocarbon-related industries	Promotion of ancillary industries around oil and gas sector	MoPNG/Ministry of Finance/Ministry of Commerce/Ministry of power	2-5 years
To promote industries related to decorative items based on wax.	Will promote small scale industries such as candle manufacturing in the region	DIPP	<2 years
To promote bio-ethanol production in NER as large quantity of raw material (bamboo, rice husk/ straw etc.) is available.	Will promote usage of clean fuels in the region	MNRE/MoPNG	2-5 years

Health/Medical services

National Health Mission has been set up with a vision of 'attainment of universal access to equitable, affordable and quality health care services, accountable and responsive to people's needs, with effective inter-sectoral convergent action to address the wider social determinants of health.' The National Rural Health Mission (NRHM) is a national effort at ensuring effective healthcare through a range of interventions at individual, household, community, and most critically at the health system level. A number of states in the northeastern parts of the country have stagnant health indicators and continue to grapple with significant morbidity and mortality.

To address the premature deaths caused by air pollution each year, effective strategies could be considered to scale up the dissemination of cleaner burning fuels and efficient stoves for household cooking. Further propagation of cleaner fuels such as LPG and natural gas in the northeast region can help reduce pollution-related deaths, thereby aiding the objectives of the National Health Mission.

Financing

Opportunities exist across all segments of the oil and gas sector to both increase its availability and reduce its cost. However, compared with other infrastructure-intensive sectors such as power and utilities, project finance has been less widely used by the oil and gas industry. The industry requirement is inherently long term in nature, which can be a challenge when trying to arrange project financing on acceptable terms. The exploration and production sector could benefit from lower cost of capital, especially debt capital and long-term financing.

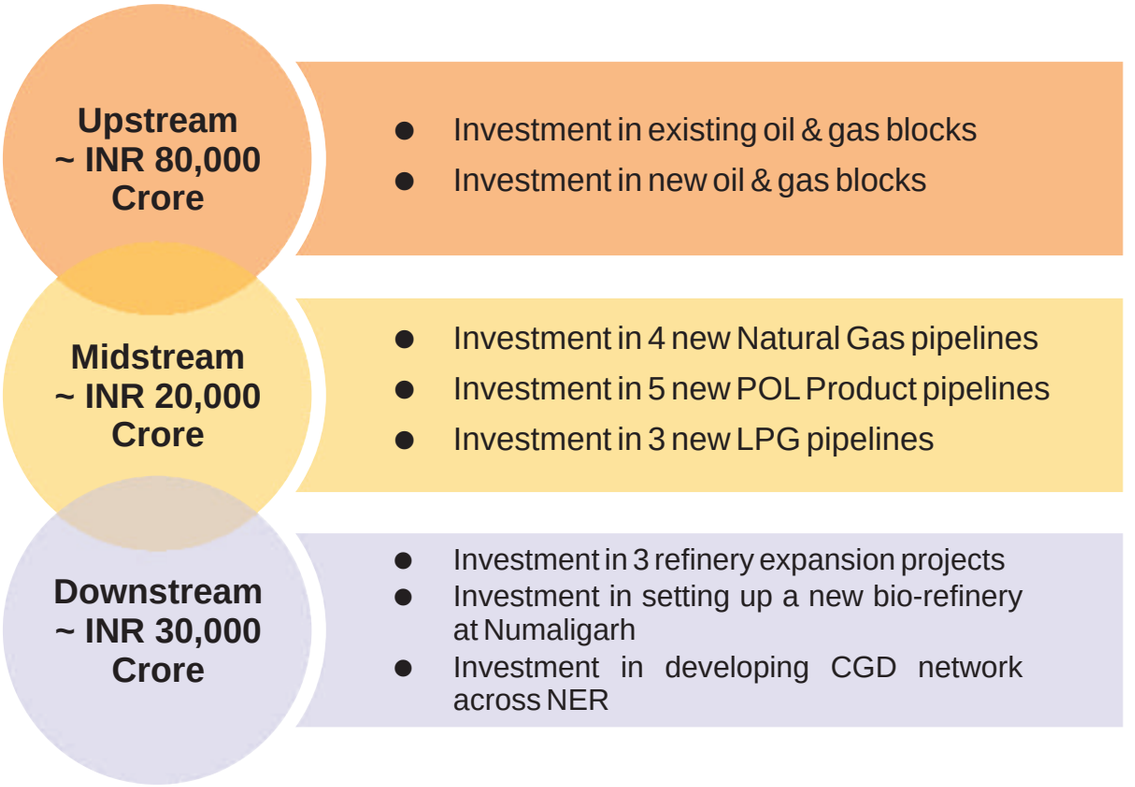
Viability gap funding (VGF) is a grant, one-time or deferred, provided to support infrastructure projects that are economically justified but fall short of financial viability. VGF is designed to make projects that are economically unviable over the long term commercially viable for investors. It helps mobilise private sector investment for development projects while ensuring that the private sector still shares in the risks of infrastructure delivery and operation. The VGF mechanism for pipeline connectivity should be considered as a development mechanism to establish evacuation systems for the oil and gas sector. Other options that can be considered for effective development of the oil and gas industry in the region include:

- Provision of soft loans
- Issue of tax-free infrastructure bonds from public sector undertakings – GAIL, IOCL, ONGC
- Development cess on petrol/diesel or aviation turbine fuel (ATF) at national level for projects related to the northeastern region for a limited period
- Increasing budget allocation from Non Lapsable Central Pool of Resources (NLCPR) of MoDONER and North Eastern Council (NEC)
- Increasing the minimum limit for VGF eligibility of projects
- Make available VGF funding/budgetary support for PSUs

Hydrocarbon Vision 2030 for North East Region

- Develop NER as a dominant hub at the forefront of India's energy map by utilising its hydrocarbon potential:
  - Double production of Oil and Natural Gas (O + OEG in MMTOE)
  - Access of clean fuel to 100% households in the region (LPG/PNG) at affordable price
  - Bolster development through creation of service provider hubs
  - Ensure availability to support growth in per capita petroleum product consumption
  - Provide pipeline connectivity by installing new POL and LPG pipelines
  - Development of natural gas grid, CGD networks and spur CNG Highways
  - Generate employment opportunities through Industrial and skill development
  - Promote manufacturing industry related to Oil & Gas in the region
  - Incentivize production of bio fuel in the region for providing access to clean fuels and to boost rural economy
  - Promote trade between NER of India and neighbouring SAARC countries

The total investment requirement for NER is expected to be about Rs 130,000 crore by 2030.



The objectives and goals laid out under the Vision are as follows:

OBJECTIVES	GOALS
Leverage Hydrocarbon potential	• Increase production of Oil and Natural Gas (O+OEG in MMTOE) to 2 times • Moderate PSC structure considering challenges in NER • Develop service provider hubs
Enhance access to clean fuels	• Increase LPG pipeline connectivity to ensure access and availability • Develop Gas Grid, CGD networks and CNG Highways in the region • Pomote production of bio fuel in the region
Improve availability of petroleum products	• Plan for adequate refining capacity expansion in NER • Ensure connectivity for transporting POL and Crude Oil • Develop crude import infrastructure
Facilitate economic development	• Generate employment through promotion of manufacturing industry in the region • Promote trade between NER in India and neighboring SAARC countries • Focus on skill development

Implementation approach

Implementation of the proposed action plans will be complex and multi-layered. Some initiatives may require policy or organisational changes whereas others will require a review of on-going activities and refocusing efforts. Some others may require a set of fresh initiatives. An executive council should be appointed for the overall implementation of the recommended action plans for the first five years. The council chairman will be nominated by the Ministry of Petroleum & Natural Gas (MoPNG) and consist of representatives from national oil companies, state governments and industry bodies. The committee can then appoint sub-committees and implementation teams for different action areas that require coordination from other ministries or external stakeholders.

The executive council will be responsible for:

(i) Guiding the implementation of the recommended action plan

(ii) Establishing sub-committees and implementation teams to work on one or more action areas

(iii) Reviewing, adapting or refocusing the recommended action areas as appropriate

(iv) Reporting on a regular basis to MoPNG on implementation progress

In addition to serving on the council, the members may serve as co-chairs of individual sub-committees and implementation teams.

Some action plans will have set deadlines while others will be less specific. These performance objectives and deadlines may be adjusted subject to approval by the council. Each implementation team would be expected to complete implementation within set time. Also, each team will be expected to develop and institutionalise monitoring metrics and protocols that will provide an objective record of how well the goals are achieved. Appropriate members from the sub-committees will review these results and report to the executive council twice a year. The council will be responsible for providing quarterly progress reports to MoPNG and stakeholders. Prior to the sunset of the council (2021), a final report on implementation actions will be prepared and submitted to MoPNG.

2. Background

2.1 Introduction

Energy security is one of India's primary concerns today. Meeting the growing need for energy resources in a cost effective, sustainable and environment-friendly manner is a daunting task for the country and successfully addressing it is an enormous challenge. Currently, close to 80% of the country's domestic crude oil requirement is met through imports. With the need for energy set to increase in future, the energy situation is bound to deteriorate if steps are not taken to increase domestic supply. It is possible to reduce the annual energy import bill ($120-130 billion in 2014-15) substantially through focussed implementation of the proposed policy reforms and institutional measures. Fossil fuels are expected to continue to fuel the country's economic growth. It is necessary to recognise that India's growing dependence on energy imports exposes its import bill to external price shocks. For India, it is not a question of choosing among alternative domestic energy resources but of exploiting all available resources to the optimum as long as they are competitive. The critical elements of India's energy security, however, remain measures to increase efficiency, reduce requirements and augment the domestic energy resource base.

India's northeastern region is endowed with huge untapped natural resources and is acknowledged as the eastern gateway of India's 'Act East' policy. National oil companies (NOCs) ONGC and Oil India Ltd (OIL) have a long history of exploration and production (E&P) activities in the region. Later, the area was opened for exploration to private/JV and foreign companies through pre-NELP and NELP rounds of biddings. There was an encouraging response from the private sector.

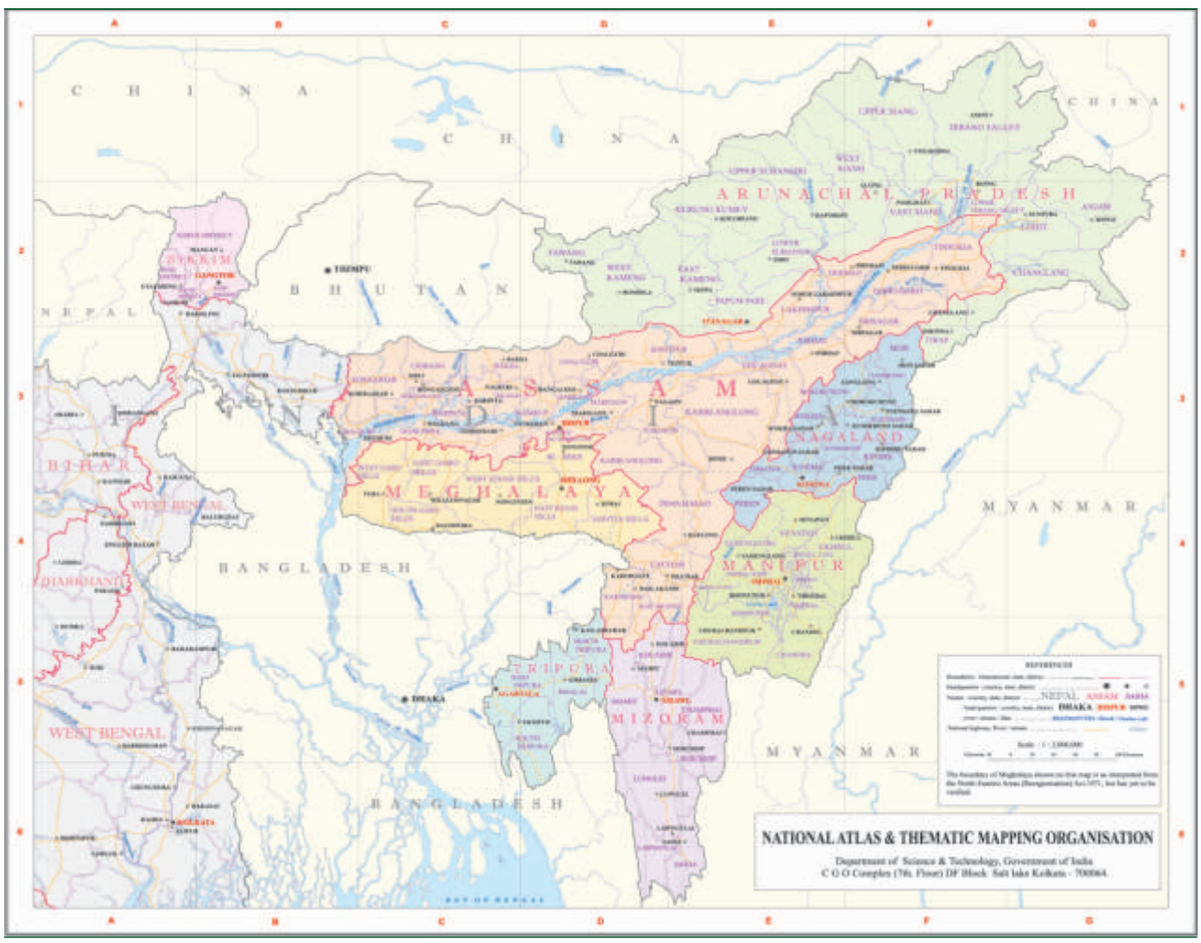
In this context, developing the North East is top priority for the government of India as a vital link in the overall economic development of the country. Also, the possibility of energy trading among the countries of the East and Southeast Asia (SEA) has opened up new vistas of cooperation. Cross-border energy trade can lead to effective utilisation of natural resources, increase reliability of power supply, build economies of scale, enable mutual support during contingencies, transform sectors on a large scale and contribute to economic growth, and act as the single most effective confidence building measure through the participation of multiple stakeholders. This will substantially promote market integration in energy-related goods and services.

Regional energy integration has long been a major thrust area among nations of South Asian Association for Regional Cooperation (SAARC). India holds the key to the strategy of regional energy integration. The northeast, as the vital link to Southeast Asian countries, could be the most significant region of the country in this regard. Hence, development of power and energy through proper utilisation of resources is the need of the hour. India's pivotal role in regional energy integration is consistent with its growing aspiration to be a global energy processing hub. An integrated South Asian energy market, with India as the hub, could offer member countries the opportunity to be more ambitious in their energy planning. Today, the new geopolitics makes it likely that India's status as the forerunner will make it easier for other countries to connect with it during the process of regional energy integration.

3. Brief description of Northeast India

Northeast India comprises seven states – Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura – also known as 'Seven Sisters' and Sikkim. These states have a total area of over 262,230 sq km (about 7.9% of India's territory) and, according to the 2011 Census of India, a population of 4.4 crore (almost 3.2% of India's population).

Figure 1: Map of Northeast India

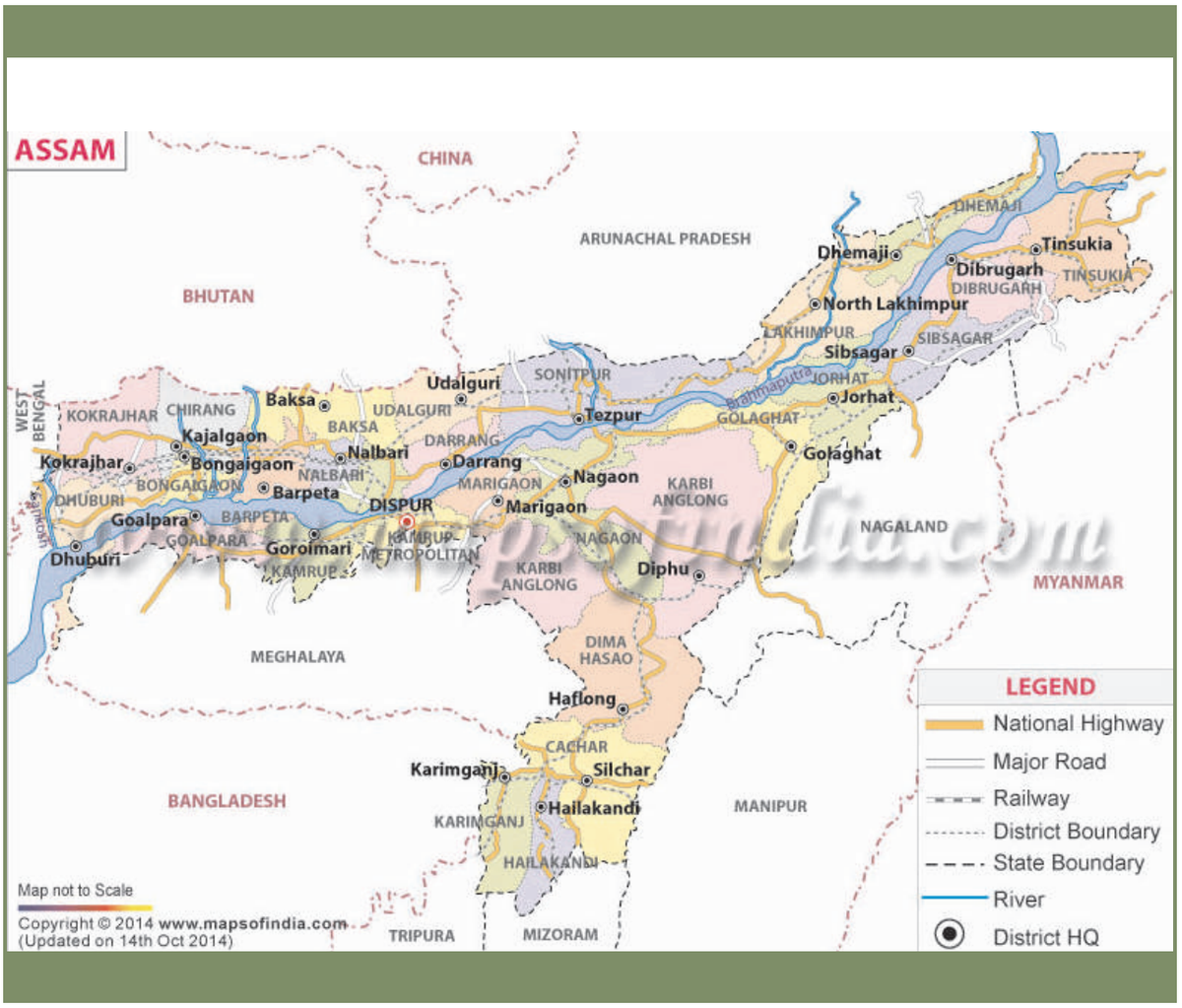


3.1 Demographic profile of Northeast India

Assam

The state of Assam, popularly known as the land of the red river and blue hills, is the gateway to northeast India. It is bordered to the North by Bhutan and to the East by Arunachal Pradesh. To its South lie Nagaland, Manipur and Mizoram. Meghalaya lies to the southwest, West Bengal and Bangladesh to the West. The state is divided into 27 administrative districts. With an area of 78,438 sq km, the state can be broadly divided into three physiographic domains, viz., Brahmaputra valley, Central Assam Hills comprising of Mikir Hill in Karbi Anglong and North Cachar Hill districts, and Barak valley covering the Cachar and Karimganj districts in the Barak valley.

Figure 2: Geographical map of Assam



According to the Census of India, 2011, the total population of Assam is 31.17 million; population density is 396.8/km2 and literacy rate is 73.18%. During 2001-11, population grew at 16.93% slightly below the national growth rate. The number of females per 1000 males in the state improved from 935 in 2001 to 954 in 2011, which is better than the national average. Further, the density of population per sq km has gone up to 397 as against 340 in 2001. The effective literacy rate for Assam as per 2011 Census is 73.18%; it is 78.81% for males and 67.27% for females. In the 2001 Census, literacy rate for the total population was 63.25%, with 71.28% for males and 54.61% for females.

Table 1: Demographic profile of Assam

States	Population	Area (square km)	Decadal population growth rate (%)	Sex-ratio (Number of females per 1,000 males)	Population density (per sq km)	Literacy rate (%)
Assam	31,169,272	78438	16.9%	954	397	73%

Source: Census of India

Arunachal Pradesh

Arunachal Pradesh is situated on the northeast extreme of India with an area of 83,743 sq km and has a long international border with Bhutan, China and Myanmar. There are sixteen districts in the state.

Figure 3: Geographical map of Arunachal Pradesh

The state's population grew 25.92% during 2001-11 as compared to 27% in 1991-01, a decline in the growth rate although it is high compared to the national growth rate of 17.64%. The number of females per 1000 males in the state improved from 893 in 2001 to 920 in 2011. The population density per square km in the state is only 17, far below the national average of 382. The percentage of literates in Arunachal Pradesh is 66.95% for the total population; 73.69% for males and 59.57% for females.

Table 2: Demographic profile of Arunachal Pradesh

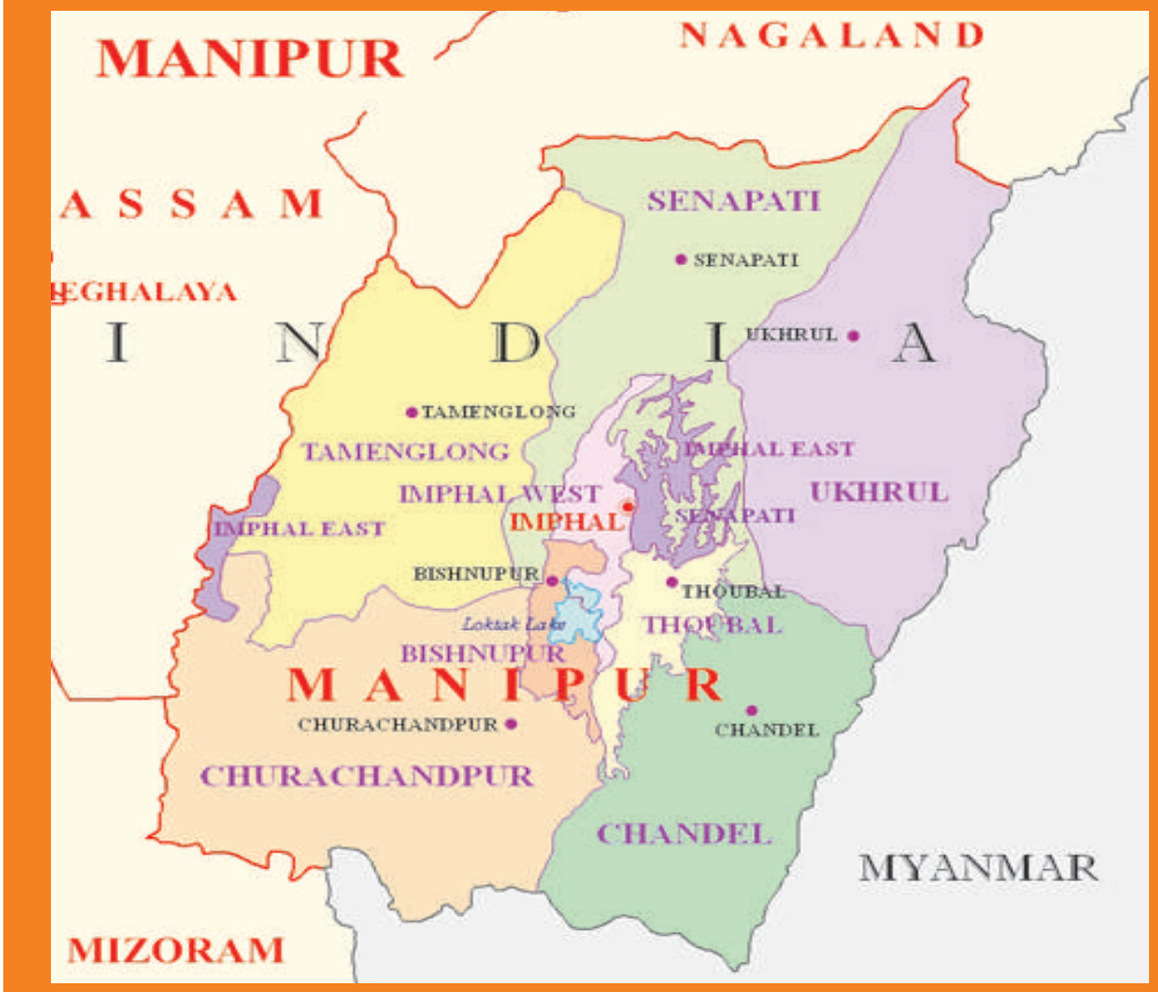
States	Population	Area (square km)	Decadal population growth rate (%)	Sex-ratio (Number of females per 1,000 males)	Population density (per sq km)	Literacy rate (%)
Arunachal Pradesh	1,382,611	83743	25.9%	920	17	67%

Source: Census of India

Manipur

Manipur can be geographically divided in two regions - the hills comprising five districts and the plains with four districts. The state, whose capital is Imphal, is bound by Nagaland in the North, Mizoram in the South, Assam in the West, and by Myanmar in the East as well as in the South.

Figure 4: Geographical map of Manipur



The state's population grew 18.7% during 2001-11, slower than 24.9% during 1991-2001 but higher than the national growth rate of 17.64%. The number of females per 1000 males in the state improved from 978 in 2001 to 987 in 2011, which is better than the national average. The population density per sq km in the state is only 122, far below the national average of 382. The total percentage of literates in Manipur is 80%; 86% for males and 73% for females.

Table 3: Demographic profile of Manipur

States	Population	Area (square km)	Decadal population growth rate (%)	Sex-ratio (Number of females per 1,000 males)	Population density (per sq km)	Literacy rate (%)
Manipur	2,721,756	22327	18.7%	987	122	80%

Source: Census of India

Meghalaya

Meghalaya, literally meaning the abode of clouds, is one of the most beautiful states of the country. The state is sandwiched between Bangladesh and Assam and its capital is Shillong. The Khashi and Jaintia hills occupy the central and eastern parts of the state and are at a higher elevation than the Garo hills. About 70-80% population lives in rural areas and only a small portion has moved to urban areas.

Figure 5: Geographical map of Meghalaya

The state's population grew 27.8% during 2001-11 compared to 30.7% in 1991-2001. The number of females per 1000 males in the state improved from 972 in 2001 to 986 in 2011, which is better than the national average. The population density per sq km in the state is only 132, far below the national average. The total percentage of literates in Meghalaya is 75%; 77% for males and 74% for females.

Table 4: Demographic profile of Meghalaya

States	Population	Area (square km)	Decadal population growth rate (%)	Sex-ratio (Number of females per 1,000 males)	Population density (per sq km)	Literacy rate (%)
Meghalaya	2,964,007	22429	27.8%	986	132	75%

Source: Census of India

Mizoram

The state shares an international border with Myanmar in the East and the South and Bangladesh in the West. To its North are Tripura, Assam and Manipur. The distribution of population is equal in rural and urban areas. In urban areas, the gender ratio has a perfect score, which means there are as many females as males. Literacy in urban areas is naturally high.

Figure 6: Geographical map of Mizoram

The state's population grew 22.8% during 2001-11, slower than 28.8% in 1991-2001. The number of females per 1000 males in the state improved from 935 in 2001 to 975 in 2011, which is better than the national average. The population density per sq km in the state is only 52, far below the national average. The total percentage of literates in the state is 92%; 94% for males and 89% for females.

Table 5: Demographic profile of Mizoram

States	Population	Area (square km)	Decadal population growth rate (%)	Sex-ratio (Number of females per 1,000 males)	Population density (per sq km)	Literacy rate (%)
Mizoram	1,091,014	21081	22.8%	975	52	92%

Source: Census of India

Nagaland

Nagaland is located on the extreme northern east just below Arunachal Pradesh. It has on its long eastern strip the neighboring country Myanmar. The north is bounded by Arunachal Pradesh, while on its west lies the state of Assam. Manipur borders it on its south.

Figure 7: Geographical map of Nagaland

The state population shrank by 0.5% during 2001-11 compared to a growth of 64.5% in 1991-2001. The number of females per 1000 males in the state improved from 900 in 2001 to 931 in 2011. The population density per sq km in the state is only 119, far below the national average. The total percentage of literates in the state is 80%; 83% for males and 77% for females.

Table 6: Demographic profile of Nagaland

States	Population	Area (square km)	Decadal population growth rate (%)	Sex-ratio (Number of females per 1,000 males)	Population density (per sq km)	Literacy rate (%)
Nagaland	1,980,602	16579	-0.5%	931	119	80%

Source: Census of India

Tripura

Tripura is bounded on the north, west, south and south-east by Bangladesh whereas in the east it has a common boundary with Assam and Mizoram. It is spread over a small expanse of about 10,000 sq km, which makes it one of the smallest states in India. Although small in area, its population density of about 300, is medium as compared to other states. Due to lack of urbanisation, three-fourths of the population resides in rural areas. Agartala is the state capital and also one of the very few urban regions.

Figure 8: Geographical map of Tripura

The state's population grew 14.8% during 2001-11, slower than 16% in 1991-2001. The number of females per 1000 males in the state improved from 948 in 2001 to 961 in 2011, which is better than the national average. The population density per sq km in the state is only 350, almost at par with the national average. The total percentage of literates in the state is 88%; 92% for males and 83% for females.

Table 7: Demographic profile of Tripura

States	Population	Area (square km)	Decadal population growth rate (%)	Sex-ratio (Number of females per 1,000 males)	Population density (per sq km)	Literacy rate (%)
Tripura	3,671,032	10486	14.8%	961	350	88%

Source: Census of India

Sikkim

Sikkim, enveloped by the Himalayas, is home to one of the world's highest peaks, Kanchenjunga. It is bounded by Tibet on the north, Nepal on the west, Bhutan on the east and West Bengal lies to its south. It is the least populous state in the union. The population density is less than 100 in Sikkim, and has undergone significant increment. The percentage of literates, however, has increased by about 20%, which is a huge leap towards progress. Increase in female literacy also tells an optimistic story. Only over 20% of the population of Sikkim lives in cities. Sikkim comprises four districts with Gangtok the capital. Population growth in urban and rural areas is vastly different; while the city population is growing at an alarming rate of above 150%, the rural population is not growing at all, it is decreasing.

Figure 9: Geographical map of Sikkim

The state's population grew at 12.4% during 2001-11, far slower than 33.1% in 1991-2001. The state has done tremendously well in curbing the population growth rate. The number of females per 1000 males in the state improved from 875 in 2001 to 889 in 2011. The population density per sq km in the state is 86, far below the national average. The total percentage of literates in Sikkim is 82%; 87% for males and 76% for females.

Table 8: Demographic profile of Sikkim

States	Population	Area (square km)	Decadal population growth rate (%)	Sex-ratio (Number of females per 1,000 males)	Population density (per sq km)	Literacy rate (%)
Sikkim	607,688	7096	12.4%	889	86	82%

Source: Census of India

The table below provides a summary of the demographic profiles of northeast India.

Table 9: Demographic profile of Northeast India

States	Population	Area (square km)	Decadal population growth rate (%)		Sex-ratio (Number of females per 1,000 males)		Population density (per sq km)		Literacy rate (%)
Arunachal Pradesh	1,382,611	83743	27.00%	25.92%	893	920	13	17	**67%**
Assam	31,169,272	78438	18.92%	16.93%	935	954	340	397	**73%**
Manipur	2,721,756	22327	24.86%	18.65%	978	987	103	122	**80%**
Meghalaya	2,964,007	22429	30.65%	27.82%	972	986	103	132	**75%**
Mizoram	1,091,014	21081	28.82%	22.78%	935	975	42	52	**92%**
Nagaland	1,980,602	16579	64.53%	-0.47%	900	931	120	119	**80%**
Sikkim	607,688	7096	33.06%	12.36%	875	889	76	86	**82%**
Tripura	3,671,032	10486	16.03%	14.75%	948	961	305	350	**88%**

Source: Census of India, 2011

3.2 Projected population growth in Northeast India

The population growth of northeast India has been estimated as per trends identified over the last two decades. It has been observed that the decadal growth rate in 2001-11 was lower than in 1991-2001. Therefore, it is assumed that in the coming decades the population growth rate will reduce further. The expected annual growth rate has been estimated as 1.7% till 2031.

Table 10: Projected population in northeast India

States	Population in 2001	Population in 2011	Population in 2021 (Projected)	Population in 2031 (Projected)
Arunachal Pradesh	1,098,000	1,382,611	1,726,052	2,087,487
Assam	26,656,000	31,169,272	35,825,961	3,9781147
Manipur	2,167,000	2,721,756	3,060,342	3,321,696
Meghalaya	2,319,000	2,964,007	3,704,712	4,486,036
Mizoram	889,000	1,091,014	1,273,650	1,437,186
Nagaland	1,990,000	1,980,602	2,252,737	2,474,406
Tripura	3,199,000	3,671,032	4,165,520	4,564,160
Sikkim	541,000	607,688	659,098	714,858

Source: Census of India, CRISIL Infrastructure Advisory Analysis

3.3 Macroeconomic profile of Northeast India

3.3.1 Assam

In rupee terms, gross state domestic product (GSDP) at constant (2004-05) prices was around Rs 88,537 crore in 2013-14 as against Rs 83,630 crore in 2012-13, reflecting a growth of 5.87%. Per capita income has gone up from Rs 28,383 in 2009-10 to Rs 46,354 at current prices in 2013-14.

An analysis of sectoral percentage contribution to GSDP at constant (2004-05) prices from 2004-05 to 2013-14 indicates that other than service sector, the percentage contribution of agriculture and allied activities and industry sector has declined steadily. The agricultural sector, although the major contributor to the state's economy, has been declining steadily and reached 21.3% in 2013-14 from 25.5% in 2004-05. The tea industry, which is about 170 years old, plays a vital role in the state as well

as in the national economy. Assam's tea industry is well known internationally. The total area under tea cultivation in the state is over half of the country's total area under tea. The tea industry of Assam provides average daily employment to more than six lakh persons in the state, which is around 50% of the total average daily number of labour employed in the country.

The percentage contribution of industry to the state's economy also shows the same declining trend and fell from 27.54% in 2004-05 to 21.27% in 2013-14. On the other hand, the percentage contribution of the service sector increased from 46.9% to 57.5%.

Table 11: Macroeconomic indicators of Assam

All figures in Rs crore	FY09-10	FY10-11	FY11-12	FY12-13	FY13-14	Growth Rate (4 Yr. CAGR)
Gross State Domestic Product (at constant 2004-05 prices)	69,794	74,860	78,851	83,630	88,537	6.13%
Net State Domestic Product (NSDP) (at constant 2004-05 prices)	61,294	65,726	69,035	73,081	77,376	6.00%
NSDP (at current prices)	85253	100627	112126	126149	146199	14.43%
Per capita NSDP at constant prices (in Rs)	20406	21611	22420	23,448	24533	4.7%
National GDP (at constant 2004-05 prices)	4516071	4918533	5247530	5482111	5741791	6.19%
GSDP as % of national GDP (at constant price)	1.55%	1.52%	1.50%	1.53%	1.54%	NA

Source: Planning Commission of India; Economic Survey of India, 2014-15; State Budget documents; CRISIL Infrastructure Advisory Analysis

3.3.2 Arunachal Pradesh

In rupee terms, gross state domestic product (GSDP) at constant (2004-05) prices was around Rs 6,171 crore in 2013-14 as against Rs 5,878 crore in 2012-13, reflecting a growth of 5%. Per capita income has gone up from Rs 33,825 in 2009-10 to Rs 37,051 at constant prices in 2012-13.

An analysis of sectoral percentage contribution to GSDP at constant (2004-05) prices from 2004-05 to 2013-14 indicates that other than service sector, the percentage contribution of agriculture and allied activities and industry sector has declined steadily. The agricultural sector, although the major contributor to the state's economy, has been declining steadily and reached 28% in 2013-14 from 35% in 2004-05. However, the percentage contribution of industry to the state's economy increased from 31.90% in 2004-05 to 33.03% in 2013-14. On the other hand, the percentage contribution of the service sector increased from 32.98% to 39.21% over the same period.

Table 12: Macroeconomic indicators of Arunachal Pradesh

All figures in Rs crore	FY09-10	FY10-11	FY11-12	FY12-13	Growth rate (4 Yr. CAGR)
GSDP (at constant 2004-05 prices)	5,020	5,210	5,588	5,878	5.30%
NSDP (at constant 2004-05 prices)	4,530	4,725	5,063	5,319	5.36%
NSDP (at current prices)	6840	8347	9841	11218	16.06%
Per capita NSDP at constant prices (in Rs)	33825	34470	35231	37051	3.08%
National GDP (at constant 2004-05 prices)	4516071	4918533	5247530	5482111	6.19%
GSDP as % of national GDP (at constant price)	0.11%	0.11%	0.11%	0.11%	NA

Source: Planning Commission of India; Economic Survey of India, 2014-15; State Budget documents; CRISIL Infrastructure Advisory Analysis

3.3.3 Manipur

In rupee terms, gross state domestic product (GSDP) at constant (2004-05) prices was around Rs 7,892 crore in 2012-13 as against Rs 7,231 crore in 2011-12, reflecting a growth of 9%. Per capita income has gone up from Rs 22,197 in 2009-10 to Rs 23,996 at constant prices in 2012-13.

An analysis of sectoral percentage contribution to GSDP at constant (2004-05) prices from 2004-05 to 2012-13 indicates that the percentage contribution of agriculture and allied activities and industry sector has declined steadily. The agricultural sector, although the major contributor to the state's economy, has been declining steadily and reached 18% in 2012-13 from 25% in 2004-05. However, the percentage contribution of industry to the state's economy has declined from 36% in 2004-05 to 27% in 2013-14. The percentage contribution of the service sector has increased from 39% to 54% over the same period of time.

Table 13: Macroeconomic indicators of Manipur

All figures in Rs crore	FY09-10	FY10-11	FY11-12	FY12-13	Growth rate (3 Yr. CAGR)
GSDP (at constant 2004-05 prices)	6,720	6,681	7,231	7,892	5.50%
NSDP (at constant 2004-05 prices)	6,039	5,862	6,340	6,901	4.55%
NSDP (at current prices)	7372	8020	9746	10919	13.99%
Per capita NSDP at constant prices (in Rs)	22197	21146	22739	23996	2.63%
National GDP (at constant 2004-05 prices)	4516071	4918533	5247530	5482111	6.19%
GSDP as % of national GDP (at constant price)	0.15%	0.14%	0.14%	0.14%	NA

Source: Planning Commission of India; Economic Survey of India, 2014-15; State Budget documents; CRISIL Infrastructure Advisory Analysis

3.3.4 Meghalaya

In rupee terms, gross state domestic product (GSDP) at constant (2004-05) prices was around Rs 13,215 crore in 2013-14 as against Rs 11,958 crore in 2011-12, reflecting a growth of 11%. Per capita income has gone up from Rs 32,569 in 2009-10 to Rs 42,467 at constant prices in 2013-14.

An analysis of sectoral percentage contribution to GSDP at constant (2004-05) prices from 2004-05 to 2012-13 indicates that the percentage contribution of agriculture and allied activities and industry sector has declined steadily. The agricultural sector, although the major contributor to the state's economy, has been declining steadily and reached 16% in 2012-13 from 23% in 2004-05. However, the percentage contribution of industry to the state's economy increases slightly from 26% in 2004-05 to 28% in 2013-14. Moreover, the percentage contribution of the service sector increased from 50% to 55 over the same period of time.

Table 14: Macroeconomic indicators of Meghalaya

All figures in Rs crore	FY09-10	FY10-11	FY11-12	FY12-13	FY 13-14	Growth rate (3 Yr. CAGR)
GSDP (at constant 2004-05 prices)	9,591	10,413	11,243	11,958	13,215	8.34%
NSDP (at constant 2004-05 prices)	8,396	9,226	9,748	10,309	11,466	8.10%
NSDP (at current prices)	11122	12852	15144	16070	18504	13.57%
Per capita NSDP at constant prices (in Rs)	32569	35363	34217	38627	42467	6.86%
National GDP (at constant 2004-05 prices)	4516071	4918533	5247530	5482111	5741791	6.19%
GSDP as % of national GDP (at constant price)	0.21%	0.21%	0.21%	0.22%	0.23%	NA

Source: Planning Commission of India; Economic Survey of India, 2014-15; State Budget documents; CRISIL Infrastructure Advisory Analysis

3.3.5 Tripura

In rupee terms, gross state domestic product (GSDP) at constant (2004-05) prices was around Rs 16,997 crore in 2012-13 as against Rs 15,637crore in 2011-12, reflecting a growth of 9%. Per capita income has gone up from Rs 34, 544 in 2009-10 to Rs 39,382 at constant prices in 2012-13.

An analysis of sectoral percentage contribution to GSDP at constant (2004-05) prices from 2004-05 to 2012-13 indicates that the percentage contribution of service sector has increased steadily. The agricultural sector, although one of the major contributor to the state's economy, has declined slightly to 24% in 2012-13 from 25% in 2004-05. The percentage contribution of industry to the state's economy has declined from 24% in 2004-05 to 20% in 2013-14. However, the percentage contribution of the service sector has increased from 51% to 55% over the same period of time.

Table 15: Macroeconomic indicators of Tripura

All figures in Rs crore	FY09-10	FY10-11	FY11-12	FY12-13	Growth rate (3 Yr. CAGR)
GSDP (at constant 2004-05 prices)	13,306	14,387	15,637	16,997	8.60%
NSDP (at constant 2004-05 prices)	12,287	13,215	14,339	15,585	8.25%
NSDP (at current prices)	14162	16573	19690	22453	16.60%
Per capita NSDP at constant prices (in Rs)	34544	36718	42315	39382	5.20%
National GDP (at constant 2004-05 prices)	4516071	4918533	5247530	5482111	6.19%
GSDP as % of national GDP (at constant price)	0.29%	0.29%	0.30%	0.31%	NA

Source: Planning Commission of India; Economic Survey of India, 2014-15; State Budget documents; CRISIL Infrastructure Advisory Analysis

3.3.6 Mizoram

In rupee terms, gross state domestic product (GSDP) at constant (2004-05) prices was around Rs 5,370 crore in 2012-13 as against Rs 5,158 crore in 2011-12, reflecting a growth of 4%. Per capita income has gone up from Rs 34,699 in 2009-10 to Rs 40,930 at constant prices in 2012-13.

An analysis of sectoral percentage contribution to GSDP at constant (2004-05) prices from 2004-05 to 2012-13 indicates that the percentage contribution of service sector has increased steadily. The agricultural sector, although one of the major contributor to the state's economy, has declined slightly to 18% in 2012-13 from 24% in 2004-05. The percentage contribution of industry to the state's economy has remained constant at around 16% over the same period of time. However, the percentage contribution of the service sector has increased from 60% to 66% over the same period of time.

Table 16: Macroeconomic indicators of Mizoram

All figures in Rs crore	FY09-10	FY10-11	FY11-12	FY12-13	Growth rate (3 Yr. CAGR)
GSDP (at constant 2004-05 prices)	4,249	4,979	5,158	5,370	7.18%
NSDP (at constant 2004-05 prices)	3,832	4,539	4,692	4,877	8.37%
NSDP (at current prices)	4717	5772	6230	7556	17.01%
Per capita NSDP at constant prices (in Rs)	34699	40072	37921	40930	5.66%
National GDP (at constant 2004-05 prices)	4516071	4918533	5247530	5482111	6.19%
GSDP as % of national GDP (at constant price)	0.09%	0.10%	0.10%	0.10%	NA

Source: Planning Commission of India; Economic Survey of India, 2014-15; State Budget documents; CRISIL Infrastructure Advisory Analysis

3.3.7 Nagaland

In rupee terms, gross state domestic product (GSDP) at constant (2004-05) prices was around Rs 10,492 crore in 2012-13 as against Rs 9,783 crore in 2011-12, reflecting a growth of 7%. Per capita income has gone up from Rs 40,590 in 2009-10 to Rs 46,889 at constant prices in 2012-13.

An analysis of sectoral percentage contribution to GSDP at constant (2004-05) prices from 2004-05 to 2012-13 indicates that the percentage contribution of service sector has increased steadily. The agricultural sector, although one of the major contributor to the state's economy, has declined to 26% in 2012-13 from 35% in 2004-05. The percentage contribution of industry to the state's economy has remained constant at around 13% over the same period of time. However, the percentage contribution of the service sector has increased from 52% to 61% over the same period of time.

Table 17: Macroeconomic indicators of Nagaland

All figures in Rs crore	FY09-10	FY10-11	FY11-12	FY12-13	Growth rate (3 Yr. CAGR)
GSDP (at constant 2004-05 prices)	8,463	9,254	9,783	10,492	7.43%
NSDP (at constant 2004-05 prices)	7,842	8,587	9,075	9,734	7.47%
NSDP (at current prices)	9711	10850	12788	14441	13.87%
Per capita NSDP at constant prices (in Rs)	40590	43992	46340	46889	4.93%
National GDP (at constant 2004-05 prices)	4516071	4918533	5247530	5482111	6.19%
GSDP as % of national GDP (at constant price)	0.19%	0.19%	0.19%	0.19%	NA

Source: Planning Commission of India; Economic Survey of India, 2014-15; State Budget documents; CRISIL Infrastructure Advisory Analysis

3.3.8 Sikkim

In rupee terms, gross state domestic product (GSDP) at constant (2004-05) prices was around Rs 5,491 crore in 2012-13 as against Rs 5,130 crore in 2011-12, reflecting a growth of 7%. Per capita income has gone up from Rs 60,774 in 2009-10 to Rs 75,137 at constant prices in 2012-13.

An analysis of sectoral percentage contribution to GSDP at constant (2004-05) prices from 2004-05 to 2012-13 indicates that the percentage contribution of industry sector has increased steadily. The agricultural sector has declined to 8% in 2012-13 from 19% in 2004-05. The percentage contribution of industry to the state's economy has increased rapidly from 29% in 2004-05 to 59% in 2012-13, indicating a major shift to industrialization. However, the percentage contribution of the service sector has decreased significantly from 53% in 2004-05 to 33% in 2012-13.

Table 18: Macroeconomic Indicators of Sikkim

All figures in Rs crore	FY09-10	FY10-11	FY11-12	FY12-13	Growth rate (3 Yr. CAGR)
GSDP (at constant 2004-05 prices)	4,401	4,784	5,130	5,491	7.65%
NSDP (at constant 2004-05 prices)	3,659	4,028	4,348	4,681	8.56%
NSDP (at current prices)	5463	6636	8029	9432	19.49%
Per capita NSDP at constant prices (in Rs)	60774	66136	73704	75137	7.33%
National GDP (at constant 2004-05 prices)	4516071	4918533	5247530	5482111	6.19%
GSDP as % of national GDP (at constant price)	0.10%	0.10%	0.10%	0.10%	NA

Source: Planning Commission of India; Economic Survey of India, 2014-15; State Budget documents; CRISIL Infrastructure Advisory Analysis

3.3.9 Comparison of per capita income with national average

The per capita income at constant prices varies significantly across states in the northeast region. It can be observed that per capita income in Arunachal Pradesh, Assam and Manipur are still below the national average, which indeed is a worrying sign. However, states such as Sikkim and Tripura have managed to outperform the national average.

Table 19: Per capita net state domestic product at constant (2004-05) prices

State	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	CAGR (8 Yr)
Arunachal Pradesh	26721	26870	27675	30287	32028	33825	34470	35231	37,051	3.99%
Assam	16782	17050	17579	18089	18922	20406	21611	22420	23,448	4.31%
Manipur	18640	19479	19431	20106	21169	22197	21146	22739	23,996	3.21%
Meghalaya	24086	25642	27242	27764	30963	32569	35363	34217	38,627	6.50%
Mizoram	24662	25826	26308	28467	31921	34699	40072	37921	40,930	6.54%
Nagaland	30441	33072	35074	37317	39041	40590	43992	46340	46,889	5.55%
Sikkim	26690	29008	30293	31722	35394	60774	66136	73704	75,137	13.8%
Tripura	24394	25688	27558	29022	31711	34544	36718	42315	39,382	6.31%
All India	24143	26015	28067	30332	31754	33901	36202	38048	38,856	6.13%

Source: Planning Commission of India

3.4 Financial inclusion in Northeast India

Financial inclusion, in its broadest sense, refers to the delivery of financial services at affordable costs to all sections, including disadvantaged and low-income groups. As India marches ahead with its vision to become an economic behemoth in the next few years, the average level of prosperity among its populace and the degree of equitable distribution of wealth will, to a large extent, be determined by the scale of inclusive growth achieved.

Financial inclusion ensures that a range of appropriate financial services are available to every individual and that the individual understands and accesses those services. These include basic, no-frills banking account for making and receiving payments, savings products suited to the cash flows of poor households, money transfer facilities, small loans, overdrafts, and insurance (life and nonlife). An inclusive financial system is among the top priorities for many countries, and considered to be instrumental in achieving equitable growth in several. Although India has adopted several measures to advance financial inclusion, an estimated 40% of its population is still without access even to basic services. Financial inclusion, therefore, isn't just an economic imperative for India, but also a socio-political one. Financial inclusion indicators, which include branch penetration, credit penetration, and deposit penetration, provide a holistic assessment on financial inclusion in India.

Financial inclusion in northeast India continues to be the lower than the rest of the country owing to geographical as well as socio economic problems. As many as 27 of the bottom 50 districts belong to the northeast, mainly Manipur, Arunachal Pradesh, and Nagaland, which indeed is a matter of concern. However, states such as Tripura and Assam have been able to improve their financial inclusion indexes owing to the presence of large micro finance institutions. Northeast India's macroeconomic parameters have improved over the last few years but the pace of improvement has not been sufficient to catch up with the national average, which necessities a further push from policy makers to the region's development agenda. The table below provides state-wise financial inclusion indicators and relative rankings for the region.

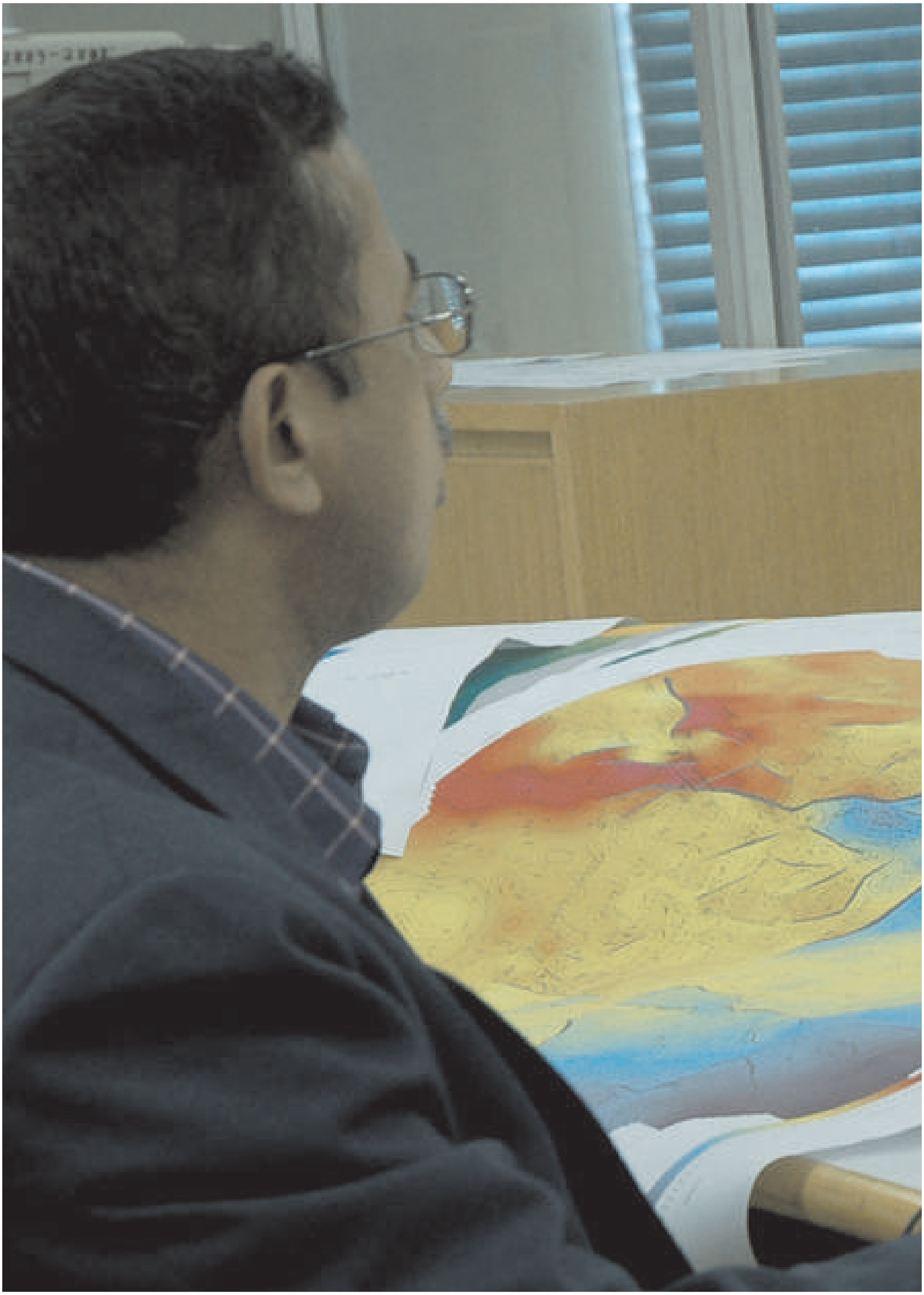
Table 20: Financial inclusion indicators in Northeast India[2]

State	CRISIL Inclusix Scores		CRISIL Inclusix Ranks	
	2013	2012	2013	2012
Assam	39.6	30.4	27	30
Arunachal Pradesh	30.5	28.4	32	32
Manipur	21.6	17.8	35	35
Meghalaya	36.4	31.6	30	28
Mizoram	42.6	39.3	24	22
Nagaland	28.9	26.1	34	33
Sikkim	46.8	41.4	18	17
Tripura	63.8	44.1	10	15
India	50.1	42.8	NA	NA

Source: CRISIL Inclusix Volume III

It can be observed from the table above that except for Tripura, the remaining states in the northeast are still far below the national average as far as financial inclusion is concerned. Although the central government has recently come up with 'Pradhan Mantri Jan-Dhan Yojana' for the entire country to facilitate access to financial services to the excluded sections of society, the implementation of such schemes needs to be monitored carefully especially for northeast India, which has been constrained by factors such as physical connectivity, social issues, awareness etc. These challenges have affected the penetration of every scheme that has been adopted. Therefore, a northeast-focused planning and execution guideline is required to bring the region at par with rest of the country as far as financial inclusion is concerned.

[2]*CRISIL Inclusix is measured on a scale of 0 to 100, with 100 indicating the maximum score achievable*



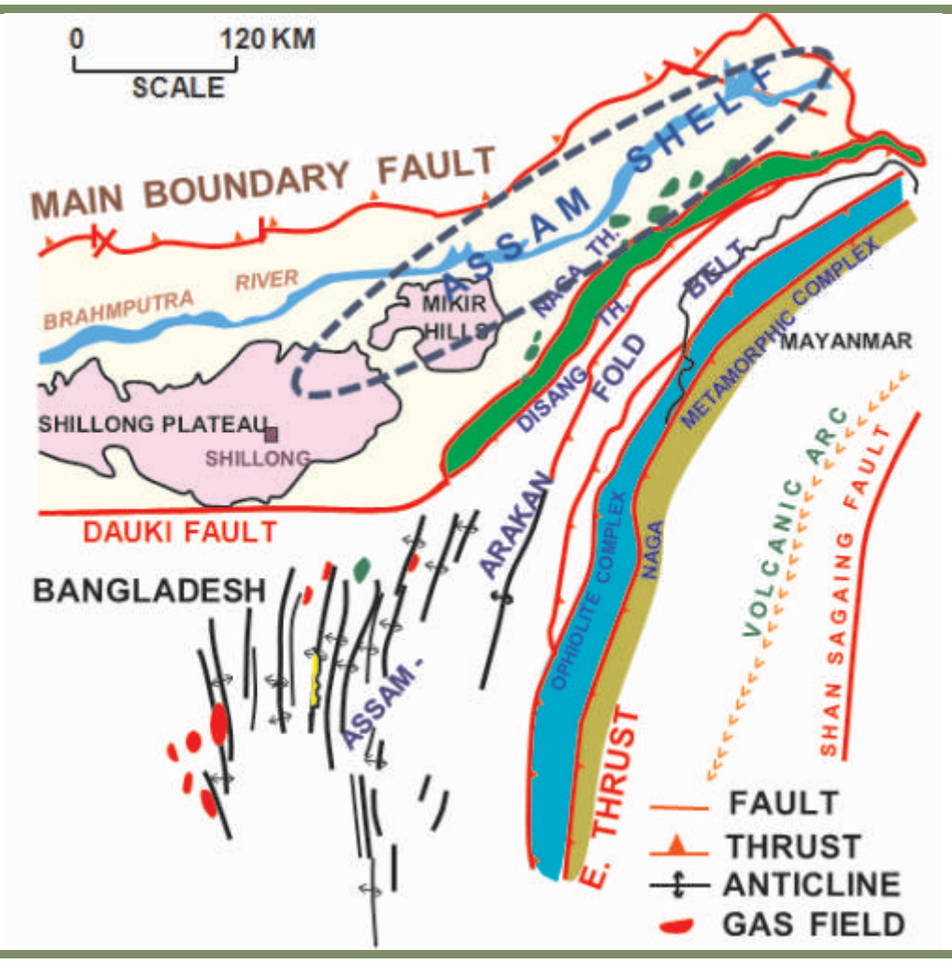
4. Oil & gas sector outlook in Northeast India

4. Oil & gas sector outlook in Northeast India

4.1 Sedimentary basins

In northeast India, there are two sedimentary basins, namely, Upper Assam Shelf and Assam-Arakan Basin. The Upper Assam Shelf basin covers the plains of upper Assam and parts of Arunachal Pradesh whereas the Assam Arakan fold belt basin covers the hilly terrains of Assam, Arunachal Pradesh, Nagaland, Manipur, Mizoram and Tripura. The Upper Assam shelf covers an approximate area of 56,000 sq km whereas the Assam-Arakan fold belt covers an area of 60,000 sq km. The basin is well explored (to the tune of 90%) and current production of oil and gas is mainly from here. The Assam Arakan fold belt is a well-established gas province. The major gas production is obtained from Tripura. The map below shows the location of Assam-Arakan fold belt and Assam shelf.

Figure 10: Sedimentary basins in Northeast India



Only about 10% of the total area of the Assam-Arakan fold belt has been explored. The major part of the Assam-Arakan fold belt falls between the prolific hydrocarbon producing regions of Bangladesh and Myanmar. In both these countries gas is the main constituent of hydrocarbons prodcued and oil production is very low. Huge yet to find gas potential is envisaged from unexplored Assam & Assam Arakan fold belt regions in Manipur and Mizoram, whereas Tripura would continue to add additional volumes through on-going exploration activities that are directed to realise the potential for OTPC as well as conceptualised fertiliser plant in the state.

4.2 Hydrocarbon resources

The prognosticated hydrocarbon resources in northeast India is around 18% of the national figure which is quite significant, taking into consideration the fact that vast expanse of the region is yet to be surveyed. Till now as a result of exploratory efforts by ONGC, OIL & Private companies 2224 MMt (O+OEG) inplace hydrocarbon volumes have been established in north east. In terms of resource conversion it corresponds to 44%. Therefore huge yet to find potential still exists in the northeast for exploration and exploitation, leaving considerable opportunities to establish the remaining 56% of hydrocarbons and discover, develop and produce the same.

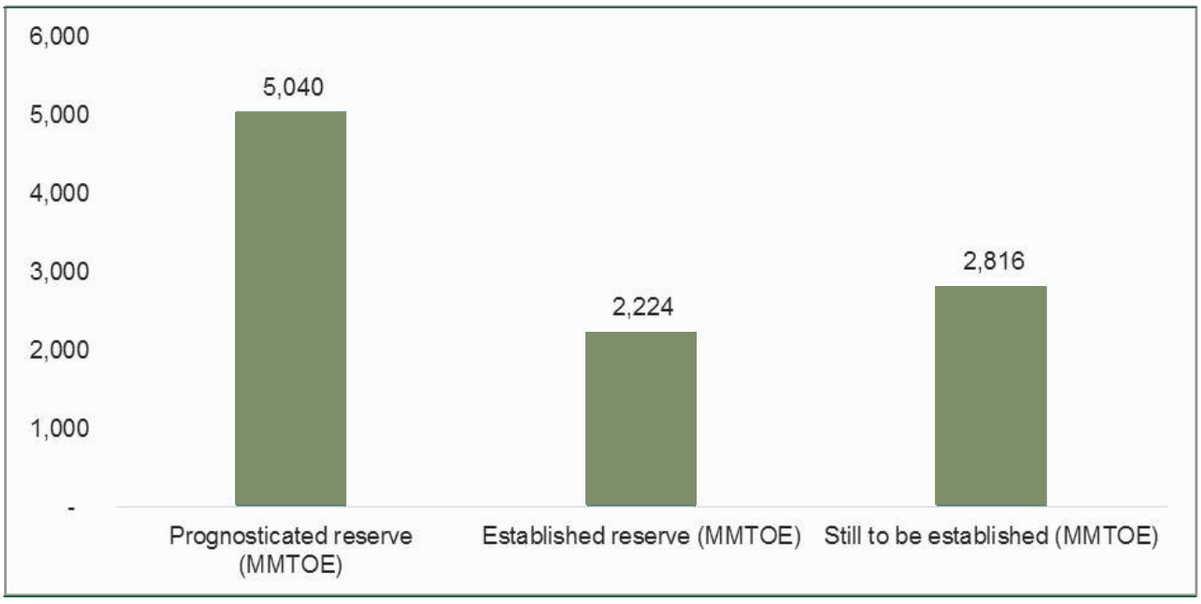
Table 21: Prognosticated hydrocarbon resources in Northeast India

Basin	Offshore (MMT)	On land (MMT)	Total (MMT)	% of Total
Assam-Arakan Fold Belt	0	1860	1860	7%
Upper Assam Shelf	0	3180	3180	11%
Total NER	**0**	**5040**	**5040**	**18%**
India	18815	9270	28085	100%

Source: DGH

Further, till now in-place (established reserve) hydrocarbon volume of 2,224 MT of oil and oil equivalent gas could be established through exploration by ONGC, OIL and private/JV companies. Therefore, about 56% of resources are under 'yet to find category' (still to be established) which clearly indicates deficiencies/difficulties in exploration activities in the region.

Figure 11: Prognosticated versus established (MMTOE)



Source: DGH

4.3 Crude oil and gas discoveries

Although the exploration for hydrocarbons began as early as 1866, with the country's first discovery made at the Digboi oilfield in 1890, the level of exploration conducted till now is not very encouraging. Only 50% of the total sedimentary basins have been explored till now, so a vast expanse of the region is yet to be explored.

Table 22: Prognosticated hydrocarbon resources in Northeast India

Sr. no	Key index	Values (sq km)	Exploration as % of total sedimentary basin in NE
1	Total sedimentary basin area	1,16,000	-
2	Area awarded under pre-NELP and NELP	43,722	37.69%
3	Currently active nomination PEL	4,905	4.3%
4	Currently active PML (Nomination + PSC)	9,665	8.3%
5	Total area under exploration in NER	58,355	50.3%
6	CBM area under exploration	113	-
7	Shale gas area under exploration	1262	

Source: DGH

At present, besides national oil companies such as ONGC and OIL, private operators, viz, GeoEnpro, Jubilant Energy, Assam Company of India Ltd, Essar Oil and Dart Energy are engaged in E&P activities in the northeast. Currently, average crude oil production from the region is around 12,444 TPD and average rate of gas production is around 11.32 MMSCMD.

All the blocks in India have been awarded under two operating regimes for exploration/production of oil and gas, namely:

- Nomination regime
- PSC regime

4.3.1 Blocks awarded under nomination regime

Prior to pre-NELP/NELP rounds, the northeast area was explored by ONGC and OIL. Exploration activities have been restrained as some petroleum exploration licence (PEL) blocks under nomination regime have been dealing with problems related to environmental clearances, local issues etc. Due to such issues, exploration activities are delayed from time-to-time in the region. The status of petroleum exploration licence (PEL) / petroleum mining lease (PML) in the region held by ONGC and OIL have been mentioned below:

Table 23: Status of PEL blocks under Nomination regime

Company	No of PELs	Area (km^2)	Present status
ONGC	5	1731	▪ Out of total 1,731 sq km of PEL area held by ONGC, activity is underway in only Golaghat district PEL (54.4 sq km) in Dhansiri valley area of upper Assam ▪ Exploration activity in one PEL block in Assam namely Sivasagar District (84 sq km) is constrained on account of the area falling under eco-fragile zone of Panidihing bird sanctuary. ▪ Exploration activity in three PELs in Nagaland (1,590 sq km) is also constrained on account of non-signing of MOU by the Nagaland government.
OIL	5	1229	▪ Exploratory activities are ongoing in all PELs

Source: DGH

The table below provides the status of 'nomination' blocks that have been in operation in northeast India.

Table 24: Status of PML of nomination blocks

Company	No of PELs	Area (km^2)	Present status
ONGC	61	6012 (besides ONGC has also applied for 20 sq km area as Nambar extension PML in South Assam shelf)	▪ Total production in 2014-15 around 1.06 MMT
OIL	20	4546.01	▪ Total production in 2014-15 around 3.412 MMT

Source: DGH

The PML blocks awarded under nomination regime are the major oil and gas producing blocks in northeast India. However, production from these blocks is declining and, thereby, needs to be supplemented by blocks under PSC regime.

4.3.2 Blocks awarded under PSC regime

4.3.2.1 Discovered field round

The following table provides status of blocks awarded in the pre-NELP regime in Northeast India.

Table 25: Status of pre-NELP operated blocks in Northeast India

Name of the field	Location Area	Details
Kharsang (oil field)	Arunachal Pradesh	▪ Oil initial in place (OIIP): 19.907 MMT ▪ Estimated ultimate reserve (EUR): 3.893 MMT ▪ Current production (oil): 135 tonnes/day; Gas 44,000 SCMD ▪ Operator: GeoEnpro ▪ Consortium members: OIL (40%), Jubilant (25%), Geo Petrol International Inc. (25%), GeoEnpro (10%)
Amguri (Oil field)	Assam	▪ JV of ACIL (Assam Company India Ltd) and ONGC ▪ Amguri field has cumulatively produced about 0.501 million barrel (0.061 MMT) of oil and 6781 MMSCF (203 MMSCM) of gas till its shutdown in December 2011. ▪ Presently there is no production of oil/gas from this field

Source: DGH

4.3.2.2 Pre NELP and NELP regime

The following table provides information on the blocks awarded to OIL under the NELP regime.

Table 26: Status of NELP blocks operated by OIL in Northeast India

Block	NELP	Work carried out			Discovery	Remarks
		2D (GLK)	3D (SKM)	Wells		
AA-ONN-2002/3 (Assam)	IV	337.66	-	-	-	▪ JV partner (ONGC) wants to exit from the block and its proposal under process as per MC dated 16-10-
AA-ONN-2004/1 (Assam)	VI	-	-	-	-	▪ Under relinquishment
AA-ONN-2009/4 (Assam)	VIII	286	84	-	-	▪ Processing of 2D seismic data is in progress. Preparing for drilling exploratory well as MWP of Phase 1.
AA-ONN-2010/2 (Assam)	IX	-	-	-	-	▪ PEL awarded on 29.12.2014. JV partner (M/s EWP) issue is not resolved
AA-ONN-2010/3 (Assam)	IX	-	130	-	-	▪ 130.2 sq km of 3D seismic acquisition completed. Processing & interpretation of data is yet to be
MZ-ONN-2004/1 (Mizoram)	VI	1352	613	1 (under drilling)	-	▪ Drilling of MZ#1 well terminated at 4,153 m. Production testing is in progress.

Source: DGH

The following table provides information on the blocks awarded to ONGC under the NELP regime

Table 27: Status of NELP blocks operated by ONGC in Northeast India

Block	NELP	Work carried out			Discovery	Remarks
		2D (GLK)	3D (SKM)	Wells		
AA-ONN-2001/1 (Tripura)	III	70	50	6	▪Khubal 4 ▪Khubal 7	▪ HF Job (Well KH-6, KH-7 and KH-9) for activation of well is in progress.
AA-ONN-2001/2 (Mizoram)	III	301	0	1	▪Hortoki 1 (HOAB)	▪ Exploratory Location AZAA (AZ-1): Drilled 17 1/2" hole from 1189m to 1523m. Further drilling is in progress. Hydro-fracturing job of well HO#1 also in progress
AA-ONN-2001/3 (DAB area)	III	-	130	1	-	▪ Operator has proposed for exiting from block under new GOI policy dated: 10.11.2014. DGH has asked the operator for submission of data.

Block	NELP	Work carried out			Discovery	Remarks
		2D (GLK)	3D (SKM)	Wells		
AA-ONN-2001/4 (Nagaland)	III	-	-	-	-	▪ Operator has proposed for exiting from block under new GoI policy dated: 10.11.2014. DGH has asked the operator for submission of data.
AA-ONN-2002/4 (Nagaland)	IV	-	-	-	-	
AA-ONN-2005/1 (DAB area)	VII	-	-	-	-	▪ Disputed area belt issues, under relinquishment.
AA-ONN-2009/3 (Assam)	VIII	146	84	-	-	▪ Applied for clearances to drill MWP well Also applied for excusable delay to MOPNG.
AA-ONJ/2						▪ Acquisition of 104.5 LKM completed. Processing of 100 LKM (4.5 LKM in the month of September 2015) of 2D seismic data completed.

Source: DGH

The following table provides information on the blocks awarded to private operators under the NELP regime.

Table 28: Status of NELP blocks operated by private operators in Northeast India

Block	Operator	NELP	Work carried out			Discovery	Remarks
			2D (GLK)	3D (SKM)	Wells		
AA-ONN-2004/3 (Assam)	EOL (Essar Energy, Essar Oil)	VI	412	95	-	-	▪ Environment & Forest clearances yet to be
AA-ONN-2003/1 (Assam)	Jubilant (JOGP, JSPL, GSPC, GAIL)	V		123.80	-	-	▪ Operator has proposed for exiting from block under new GOI policy dated: 10.11.2014. Exit from PSC, is under DGH consideration. granted
AA-ONN-2004/5 (Assam)	EOL (Essar Energy, Essar Oil)	VI	183	69	-	-	▪ Operator proposed for relinquishment due to delay in environmental clearance. Cost of UMWP has been approved by the MoPNG.
AA-ONN-2009/1 (Manipur)	Jubilant (JOGPL, JEKPL, JOPDL)	VIII	130.63	-	-	-	▪ Environmental clearance / forest clearance awaited from MoEF.
AA-ONN-2002/1 (Tripura)	Jubilant (JOGPL, GAIL)	IV	206	-	-	2 (Kathar chari, Athamura)	▪ MC has approved FDP on 05.08.15.
AAP-ONN-94/1 (R-VIII) (Assam)	HOEC (HOEC, OIL, IOC)	Pre-NELP	-	-	3	1 (Dirok)	▪ FDP has been approved on 28.03.15.
AA-ON/7 (Assam/ Nagaland)	ACL						▪ Assam part of the block relinquished on 27.03.2008. Operator requested for additional period for Nagaland part because of delay in obtaining PEL.

Source: DGH

The table below summarises hydrocarbon discoveries made under the PSC regime in Northeast India.

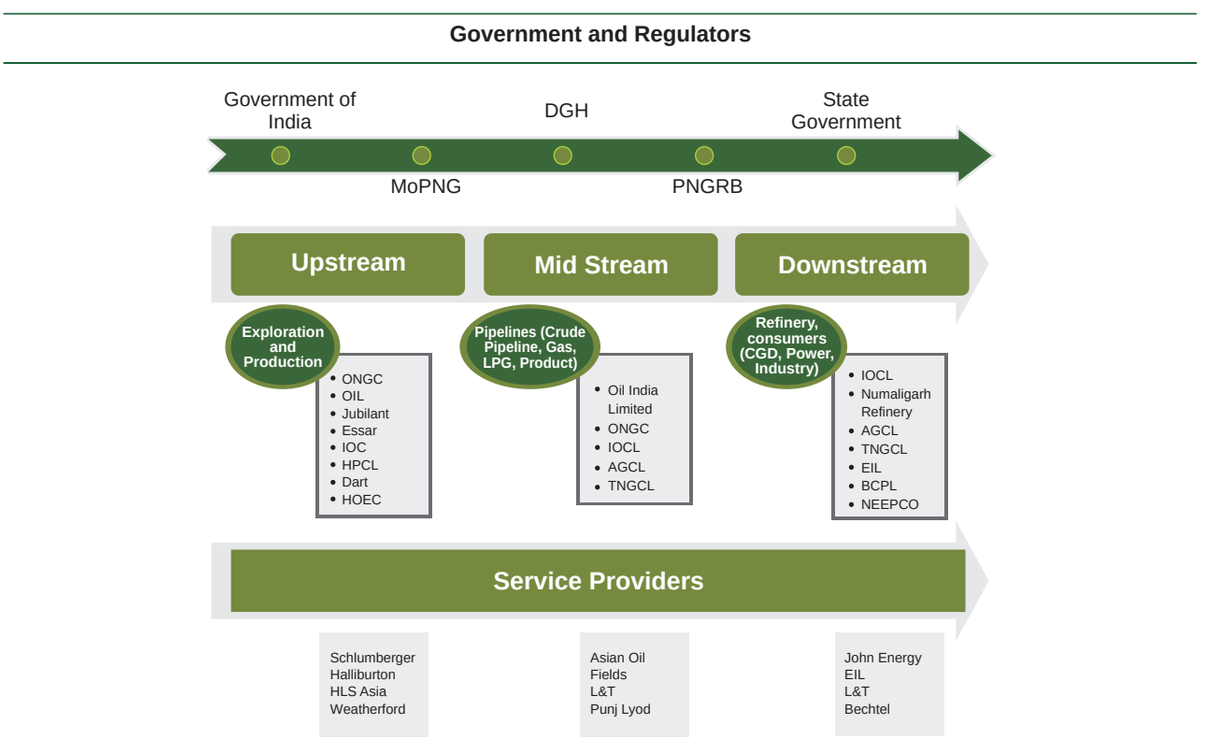
Table 29: Hydrocarbon discoveries under PSC in NER as on May, 2015

Block name	Operator	State	Discovery name	Time of discovery	Status
AAP-ON-94/1	HOEC	Assam	Dirok-1	Jan 2008	▪ FDP approved ▪ GIIP-244.5 BCF ▪ EUR-134.09 BCF
AA-ONN-2001/1	ONGC	Tripura	Khubal-4	Dec 2013	▪ Discoveries in early stage ▪ Under appraisal by operator
			KH-07	Feb 2009	▪ New discoveries for which appraisal programme is to be submitted
AA-ONN-2001/2	ONGC	Mizoram	HOAB	Dec 2011	▪ New discoveries for which appraisal programme is to be submitted
AA-ONN-2002/1	JOGPL	Tripura	Kathalchari-1	Feb 2010	▪ FDP has been approved.
			Atharamura-1	Jul 2013	▪ MC vide MCR dated 05.08.2015 reviewed the FDP of Kathalchari-1 discovery.
			N Ambassa	Nov 2009	▪ Discovery not pursued, as commercially not viable.

Source: DGH

4.4 Hydrocarbon value chain – Northeast India

Figure 12: Hydrocarbon value chain in Northeast India



4.4.1 Upstream

The upstream oil sector is also commonly known as the exploration and production sector. It includes searching for potential underground or underwater crude oil and natural gas fields, drilling of exploratory wells and, subsequently, drilling and operating the wells to recover and bring the crude oil and/or raw natural gas to the surface. Brief profiles of key entities operating in this segment in the northeast are given below.

Entity name	Profile
ONGC	▪ 55 discoveries at Assam and drilled about 1,225 wells, with offices at Nazira,Sivasagar, Jorhat and Silchar, 17 discoveries in Tripura, 3 discoveries in Nagaland and 1 in Mizoram. ▪ Owns a network of 230 km of trunk pipelines and 2,000 km of flow lines. More than 200 wells are planned in the next five years. ▪ Produces around 1.0 MMTPA of crude oil and 4.3 MMSCMD of gas from NER
OIL	▪ Owns the country's oldest oil field, Digboi. ▪ Owns the longest crude oil pipeline in NER of around 1,157 km from Duliajan to Barauni. ▪ Produces 3.4 MMTPA of crude oil, 7 MMSCMD of natural gas and over 50,000 tonnes of LPG annually from NER.
Jubilant Energy	▪ Emerging private sector oil and gas player in India engaged in hydrocarbon exploration and production since 1995. ▪ Exploration licencee for AA-ONN-2002/1 (Tripura Sub Basin in Assam-Arakam Basin) and AA-ONN-2003/1 (Assam-Arakam Basin).
Essar Oil	▪ Horizontally integrated enterprise with capabilities including drilling rigs, services equipment, engineering and construction, etc. ▪ Essar Oil also has two on-land gas blocks in Assam located in the prolific Assam-Arakan frontier basin in the north-eastern part of India; it has completed 2D seismic analysis of both the blocks.
HOEC	▪ First private company in India to enter oil and gas exploration sector. ▪ Owns exploration share of 40% and production share of 26% in AAP-ON-94/1, Assam as an operator.
GeoEnpro	▪ GeoEnpro Petroleum Ltd, a registered Indian company and 50:50 joint ventures between Jubilant Enpro Pvt. Ltd and Geopetrol Mauritus Ltd, is the operating company for the Kharsang Oil Field, Arunachal Pradesh, India. GeoEnpro became a Consortium partner & operator of the Kharsang Production Sharing Contract (PSC), the first ever medium-sized onshore oilfield awarded by the Indian government for private participation in 1995.
Assam Oil Company Ltd (ACIL)	▪ Assam Company India Ltd is an operator for Amguri Block.

4.4.2 Midstream

The midstream sector involves the transportation (by pipeline, rail, barge, oil tanker or truck), storage, and wholesale marketing of crude or refined petroleum products. Pipelines and other transport systems can be used to move crude oil from production sites to refineries and deliver various refined products to downstream distributors. Natural gas pipeline networks aggregate gas from natural gas purification plants and deliver it to downstream customers, such as local utilities. Brief profiles of key entities operating in this segment are given below.

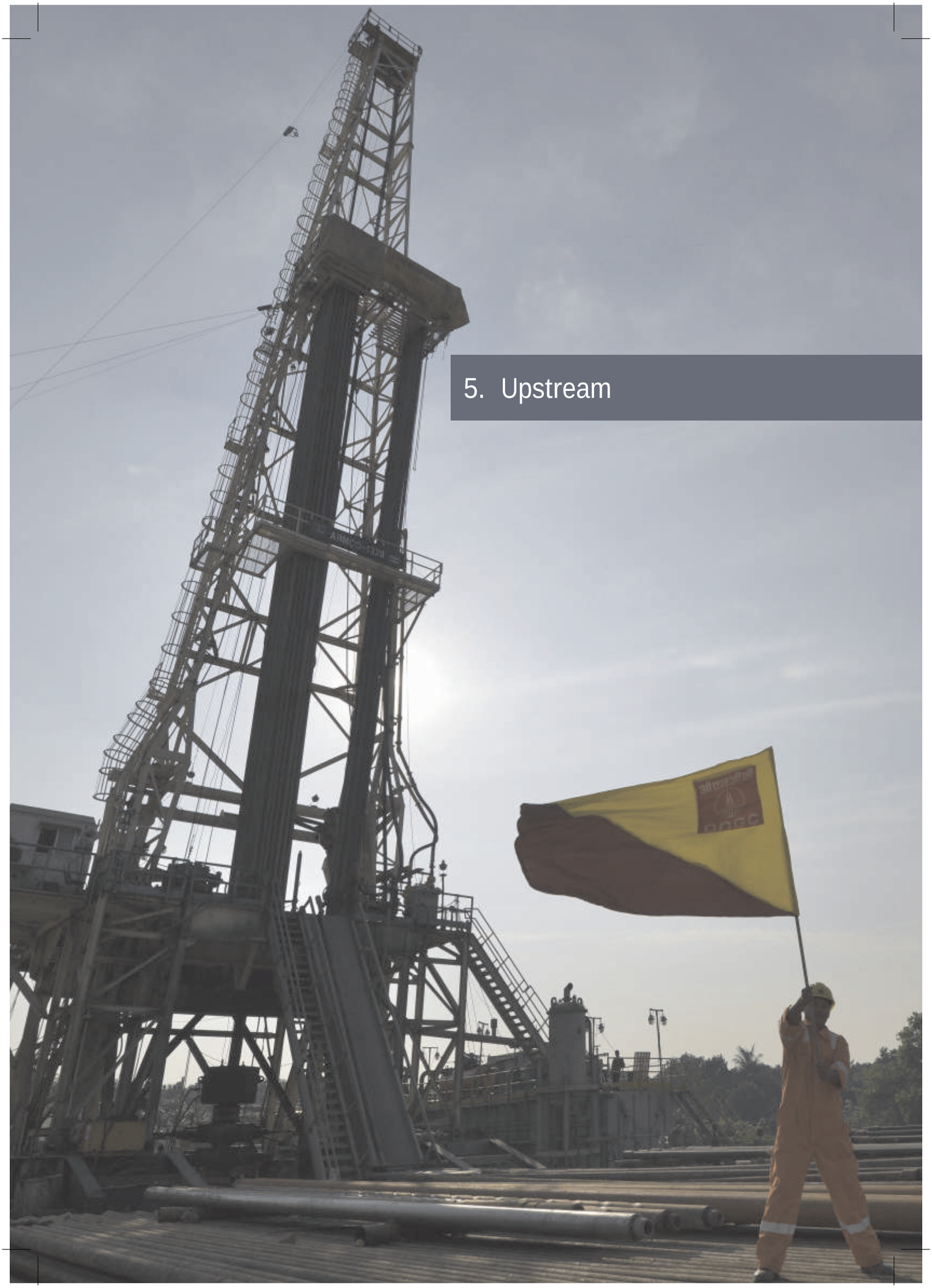
Entity name	Presence in NER
OIL	▪ Own and operate 1,157 km fully automated telemetric pipeline with 212 km of looping having a total capacity to transport over 5.38 MMTPA. This pipeline is partially used for transportation of imported crude from Barauni to Bongaigaon Refinery (reverse section) and partially for transportation of crude from Duliajan to Guwahati refinery (forward section). ▪ Owns and operates 35 km crude pipeline from Duliajan to Digboi. ▪ Also operates gas pipeline Duliajan-Numaligarh through a JV company DNP Limited (JV of AGCL, NRL and OIL) ▪ Also owns and operates Numaligarh-Siliguri product pipeline (NSPL).
GAIL	▪ Owns and operates two pipelines in Lakwa and Tripura for gas transportation. ▪ Has stake in Tripura Natural Gas company Limited (TNGCL), which is a CGD operator in Tripura
IOCL	▪ Mainly operates product pipeline from refinery to major cities. ▪ Guwahati-Siliguri (GSPL) and Digboi-Tinsukia (DTPL) product pipelines are operated by IOCL.
ONGC	▪ Operates three pipelines of 45 km in Johrat.

4.4.3 Downstream

The downstream sector commonly refers to the refining of crude oil, processing and purification of raw natural gas, as well as the marketing and distribution of products derived from crude oil and natural gas. The downstream sector touches consumers through products such as gasoline or petrol, kerosene, jet fuel, diesel oil, heating oil, fuel oil, lubricants, waxes, asphalt, natural gas, and liquefied petroleum gas (LPG) as well as hundreds of petrochemicals. Brief profiles of key entities operating in this segment in the North East are given below.

Entity name	Presence in NER
Digboi refinery (IOCL)	▪ India's oldest refinery commissioned in 1901 ▪ Current capacity is 0.65 MMTPA
Guwahati refinery (IOCL)	▪ Current refining capacity is 1.0 MMTPA
Bongaigaon refinery (IOCL)	▪ Formed by the amalgamation of Bongaigaon Refinery & Petrochemicals Limited (BRPL) with Indian Oil on March 25, 2009, Bongaigaon refinery is situated at Dhaligaon in Chirang district of Assam, 200 km west of Guwahati. ▪ The present capacity is 2.35 MMTPA.
Numaligarh Refinery Ltd (BPCL)	▪ Set up in accordance with the provisions made in the historic Assam Accord, commissioned in October 2000 and popularly known as “Assam Accord Refinery”. ▪ The present capacity is 3.00 MMTPA.

Entity name	Presence in NER
BCPL	▪ A joint venture of GAIL, OIL, NRL & Govt of Assam, Brahmaputra Cracker and Polymer Ltd (BCPL) was set up to construct a greenfield petrochemical plant in Dibrugarh, Assam with a nameplate capacity of 220 KTA of HDPE & LLDPE and 60 KTA of PP.
BVFCL	▪ The Namrup Fertilizer Complex, renamed as Brahmaputra Valley Fertilizer Corporation Ltd after bi-furcation from erstwhile Hindustan Fertilizer Corporation Ltd, is the first factory of its kind in India to use associated natural gas as basic raw material for producing nitrogenous fertiliser
Power plants	▪ Gas-based power plants have been set up by ▪ NEEPCO ▪ Assam state govt (ASEB) ▪ Tripura state govt (TSECL) ▪ ONGC Tripura Power Corporation (OTPC)
Assam Gas Company Ltd (AGCL)	▪ First gas transportation business started in 1967 ▪ Network of underground natural gas trunk and distribution pipelines that serves about 380 tea estates, 900 commercial establishments, about 27,500 domestic consumers and several big industrial consumers in the districts of Dibrugarh, Tinsukia, Sivasagar, Jorhat, Golaghat and Cachar in Assam.
Tripura Natural Gas Company Ltd (TNGCL)	▪ Incorporated in July 1990 and restructured in February 2005 with entry of GAIL as a major shareholder to facilitate the introduction of CNG in the transport sector of Tripura. ▪ Supplies gas to around 20,000 domestic, 300 commercial and 47 small industrial consumers and has set up 5 CNG stations in Agartala, which is catering to more than 11,000 vehicles.



5. Upstream

Hon'ble MoS (I/C), Petroleum & Natural Gas Shri Dharmendra Pradhan (center) with ONGC mangement and rig crew at a drill site in Geleki, Assam Asset

Hon'ble MoS (I/C), Petroleum & Natural Gas Shri Dharmendra Pradhan reviewing operations of ONGC Assam Asset on board rig EV 2000 5

5. Upstream

5.1 Crude oil & natural gas production in NER

The history of oil and gas exploration in India dates back to the 19th century in Assam. The first well that struck oil was in Makum area near Margherita during 1867 drilled by McKillop, Stewart & Co., barely nine years after Drake's well in 1859 in Titusville, Pennsylvania. Subsequently, a number of wells were drilled in Makum and Namdang areas of Margherita and they produced crude oil in minor quantities for over two decades. The Assam Railway & Trading Co. Ltd, which was involved in the business of timber, coal, tea & construction of railway lines, drilled the first commercial well Digboi-1 (September 1889 - November 1890, total depth of 662ft) with an initial production of 200 gallons per day. This opened up a new chapter in exploration and production of oil in this part of the world and the oil industry of India was officially born. In subsequent years, before India's independence, the Digboi oil field was extensively developed and the search for new oil fields continued.

5.1.1 Current scenario

Exploration of hydrocarbons in India began in Assam in 1866, with the country's first discovery at Digboi in 1890. At present, besides national oil companies such as ONGC and OIL, private operators such as Geo Enpro, Jubilant Energy, Assam Company of India Ltd, Essar Oil and Dart Energy are engaged in E&P activities in the northeast. Current average crude oil production from the northeast region is around 12,444 TPD and average rate of gas production is around 11.32 MMSCMD.

Table 30: Oil and gas production in NER

Basin	Oil production (MMT)		GAS production (BCM)	
	2013-14	2014-15	2013-14	2014-15
Northeast India	4.82	4.54	3.73	4.13
Total production in India	37.79	37.46	35.24	33.66
NER (%)	12.7 %	12.1%	10.5 %	12.2%

Source: PPAC, CRISIL Infrastructure Advisory Analysis

In the northeast, ONGC, OIL and other private players produced about 4.54 MMT of oil in 2014-15, which is around 12% of total national oil production.

Table 31 : Historical crude oil production from northeast region (in MMTPA)

Company/ regime	State (field)	2010-11	2011-12	2012-13	2013-14	2014-15
ONGC	Assam (LKW+GLK+RDS+Others)	1.02	1.05	1.03	1.07	0.90
	Assam – (Jorhat)	0.13	0.15	0.19	0.19	0.16
	Tripura	0	0	0.00	0.00	0.00
	Total Production by ONGC	1.15	1.21	1.23	1.27	1.06
OIL	Assam	3.56	3.82	3.64	3.45	3.41
	Arunachal Pradesh	0.02	0.03	0.02	0.02	0.01
	Total Production by OIL	3.59	3.85	3.66	3.47	3.41

Company/ regime	State (field)	2010-11	2011-12	2012-13	2013-14	2014-15
Others/PSC (Kharsang_Dirok)		0.10	0.09	0.10	0.09	0.07
Total		**4.84**	**5.14**	**4.98**	**4.82**	**4.54**

Source: DGH/ONGC/OIL

Table 32: Historical gas production from northeast (in MMSCM)

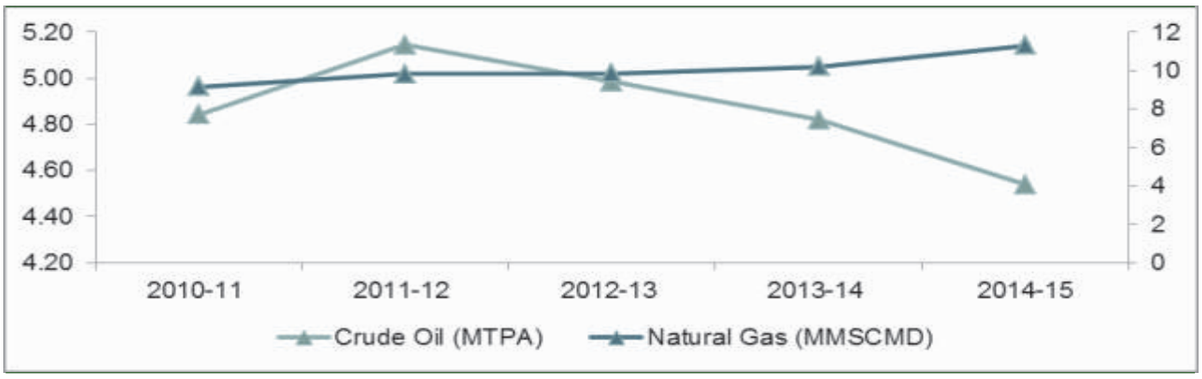
Company/ regime	State (field)	2010-11	2011-12	2012-13	2013-14	2014-15
ONGC	Assam (LKW+GLK+RDS+Others)	**394**	**428**	**418**	**404**	**399**
	Assam (Jorhat)	42	55	54	54	49
	Assam (Silchar)	27	22	13	1	1
	Tripura	610	644	647	822	1140
	Total Production by ONGC	1073	1149	1132	1281	1589
OIL	Assam	2178	2392	2425	2409	2510
	Arunachal Pradesh	17	18	19	19	12
	Total Production by OIL	2195	2410	2444	2428	2522
PSC/Others		70	30	22	22	22
Total		**3,338**	**3,589**	**3,598**	**3,731**	**4,132**
Total Gas (MMSCMD)		**9.15**	**9.83**	**9.86**	**10.22**	**11.32**

Source: DGH/ONGC/OIL

5.1.1.1 Trend of crude oil and natural gas production in Northeast India

Crude oil production has declined over the past five years due to a fall in production in already matured fields and inability to start production in new areas. Since the existing fields are already matured, the key to ramping up production lies in the ability of companies to develop and produce from yet-to-find areas (YTF). The table above shows the past five year field- and company-wise production from NER. In case of natural gas, OIL and ONGC have been able to produce about 4.132 BCM of gas in 2014-15, which is around 12.2% of the total gas production in India.

Figure 13: Trend of crude oil and natural gas production in Northeast India



Source: PPAC, CRISIL Infrastructure Advisory Analysis

The above chart indicates a decline in production of crude oil in NER.

As the fields in northeast India are very old and some of them have been in production since 1960s, most of them are in the third stage i.e. terminal decline. Every reservoir has a limited reserve of hydrocarbons, and follows a trend of increasing production, a plateau stage, and finally terminal decline. As a matter of fact, out of 15 producing fields of OIL in northeast India, 13 are in the third stage of production. Further, in northeast India, most of the fields are water driven, i.e., water is produced along with hydrocarbons. The natural course of production of a water-driven reservoir is progressively increasing water production till the point when individual wells start producing 100% water, at which point they must be shut.

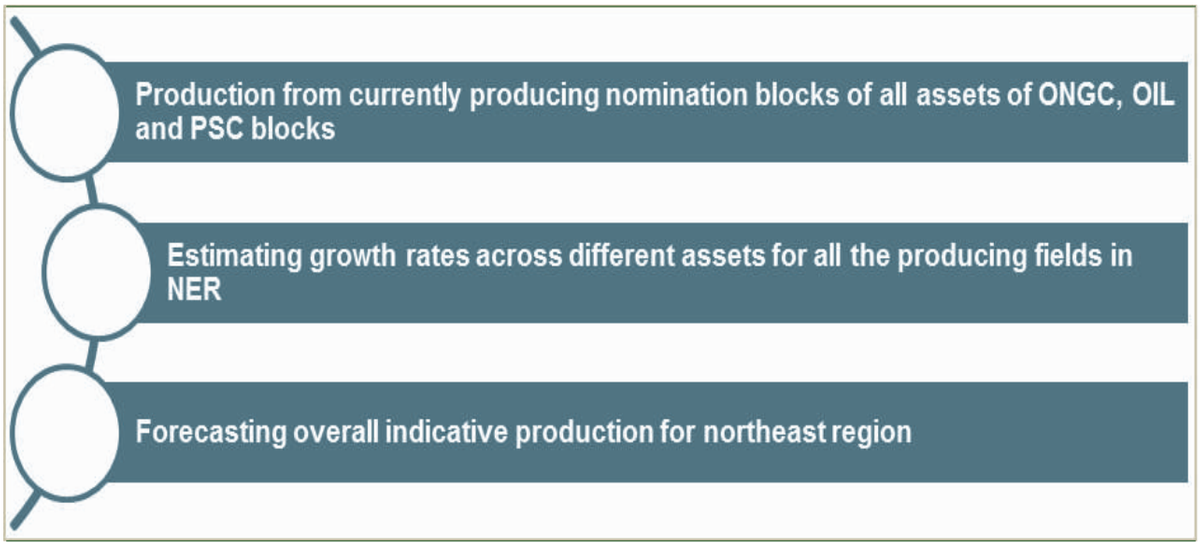
Moreover, these fields have already produced oil at their natural reservoir pressure; now, since the pressure has dropped in the reservoir, the natural flow rate has declined. To extract oil at the same rate and extend peak oil production, enhanced oil recovery techniques are required. Further, since production has been declining from mature areas, E&P companies need to find new areas for production of crude oil. Even though the effect of production from new discoveries made during last few years is not apparent in ramping up the oil production in NER, gas production shows an uptrend. Production from new discoveries has at best helped in offsetting the natural decline from mature fields.

5.1.2 Future outlook - Expected production

5.1.2.1 Crude oil production profile in Northeast India

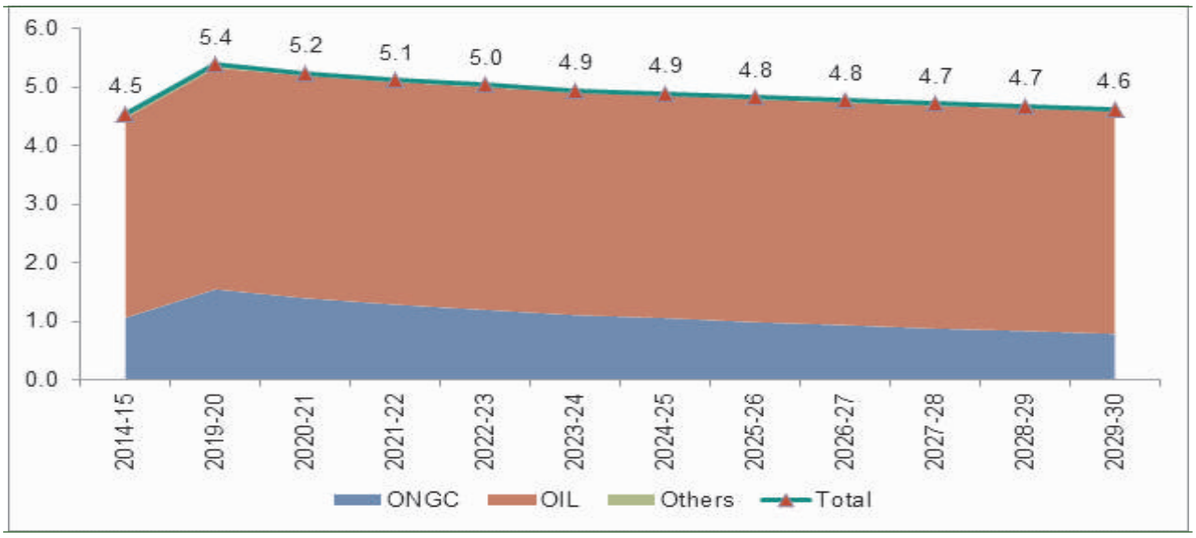
The crude oil production profile of the region is largely dominated by oil blocks of the 'nomination regime'. This trend is likely to continue in future as most of the blocks awarded under the NELP regime are still at the early stages of exploration; therefore, production from them has not been considered in the production profile.

Figure 14: Methodology for production forecast of crude oil in NER



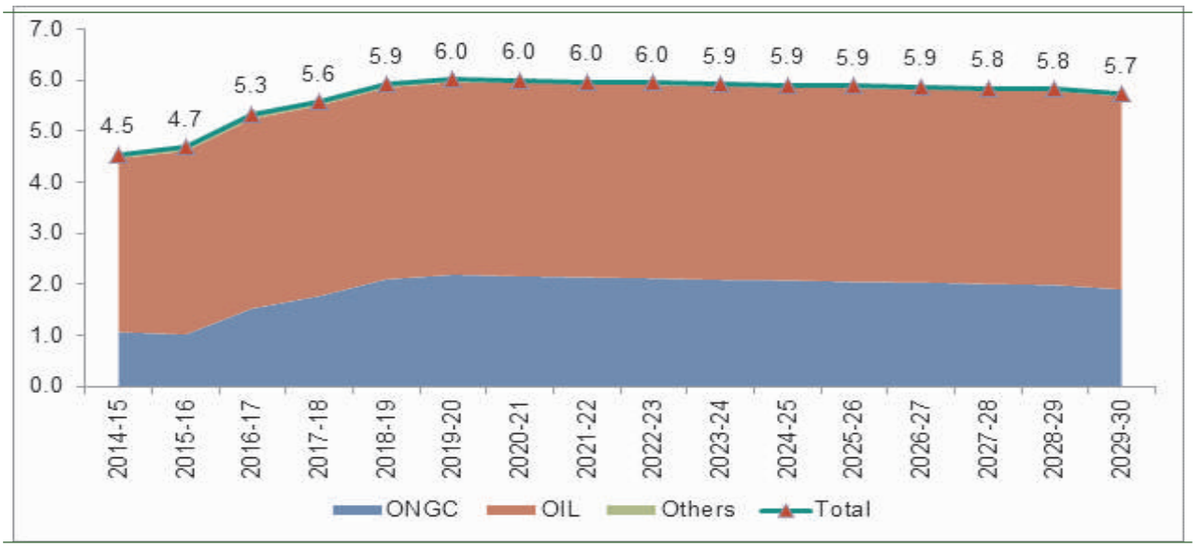
Based on the above methodology, estimated crude oil production in NER is presented below – with indicative and without indicative firm production profile of crude oil from 2021-22 onwards has been considered at the same level. However, there may be reduction in production due to matured fields.

Figure 15: Production forecast for crude oil in NER (in MMTPA) (without indicative)



Source: ONGC, OIL, DGH, CRISIL Infrastructure Advisory Analysis

Figure 16: Production forecast for crude oil in NER (in MMTPA) (with indicative)



Source: ONGC, OIL, DGH, CRISIL Infrastructure Advisory Analysis

It can be observed from the figure above that crude oil production is likely to decline in future as most of the producing blocks have reached maturity. The technological limitation of E&P players will further constrain production. Moreover, no major oil and gas discoveries have been made in the recent past, which will also impact the production profile in future.

Table 33: Production forecast for crude oil in NER (in MMTPA) (without indicative)

State/ blocks	2014-15	2019-20	2024-25	2029-30
ONGC	1.065	1.55	1.06	0.79
OIL	3.41	3.78	3.80	3.80
Others	0.07	0.05	0.04	0.04
Total	**4.54**	**5.38**	**4.89**	**4.62**

Source: ONGC/OIL

Table 34: Production forecast for crude oil in NER (in MMTPA) (with indicative)

State/ blocks	2014-15	2019-20	2024-25	2029-30
ONGC	1.065	2.19	2.08	1.90
OIL	3.41	3.78	3.80	3.80
Others	0.07	0.05	0.04	0.04
Total	**4.54**	**6.02**	**5.92**	**5.74**

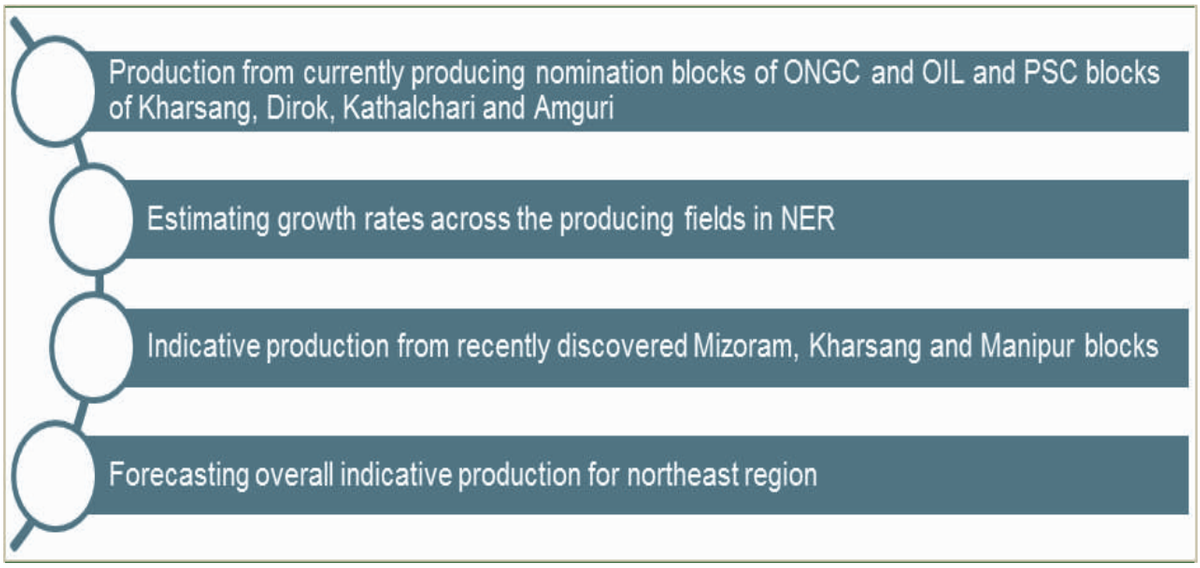
Source: ONGC/OIL

The current supply of crude oil is 4.54 MMTPA from OIL, ONGC and other fields (2014-15) and is expected to remain at the same level even after 15 years, i.e., 4.58 MMTPA (without including indicative production). However, if the indicative production figures are considered, the overall production level may increase to 5.7 MMTPA by 2029-30.

5.1.2.2 Natural gas production profile in Northeast India

Under the PSC (JV) regime, two discovered fields were awarded under 'medium and small sized discovered fields' rounds of bidding. The medium sized field 'Kharsang' in Arunachal Pradesh, covering an area of 11 sq km, was awarded in 1995 and the small sized field Amguri in Assam, covering an area of about 52.57 sq km, was awarded in 2001.

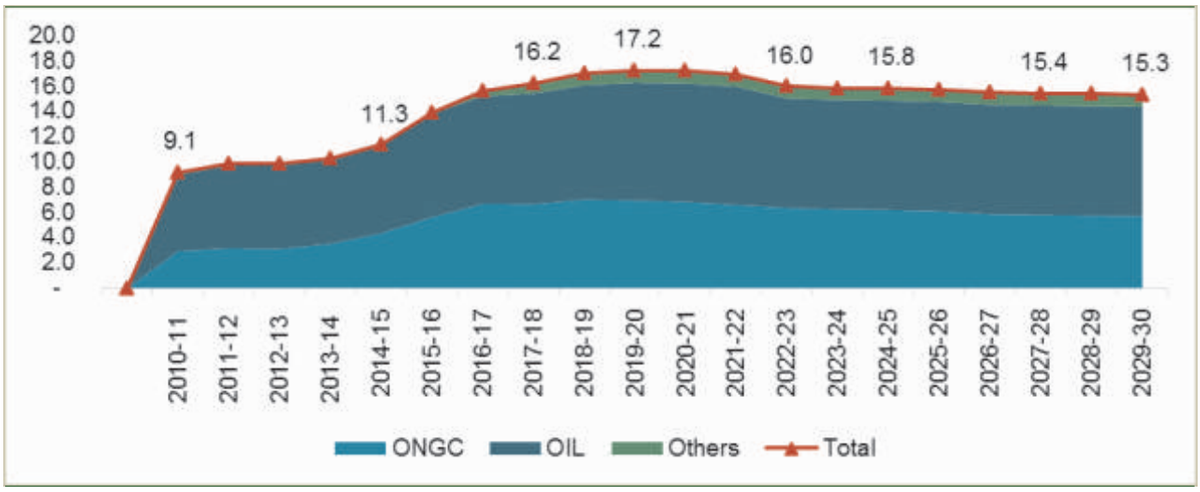
Figure 17: Methodology for production forecast of gas in NER



The production profile from both Kharsang and Amguri blocks has been considered for forecasting the gas production. Further, gas production from the Tripura asset is likely to provide a much-needed boost for the region. Moreover, there can be a significant increase in gas production from this region, particularly through exploration in Arunachal Pradesh and Mizoram.

Natural gas production profile for the coming years from the northeast region has been presented below.

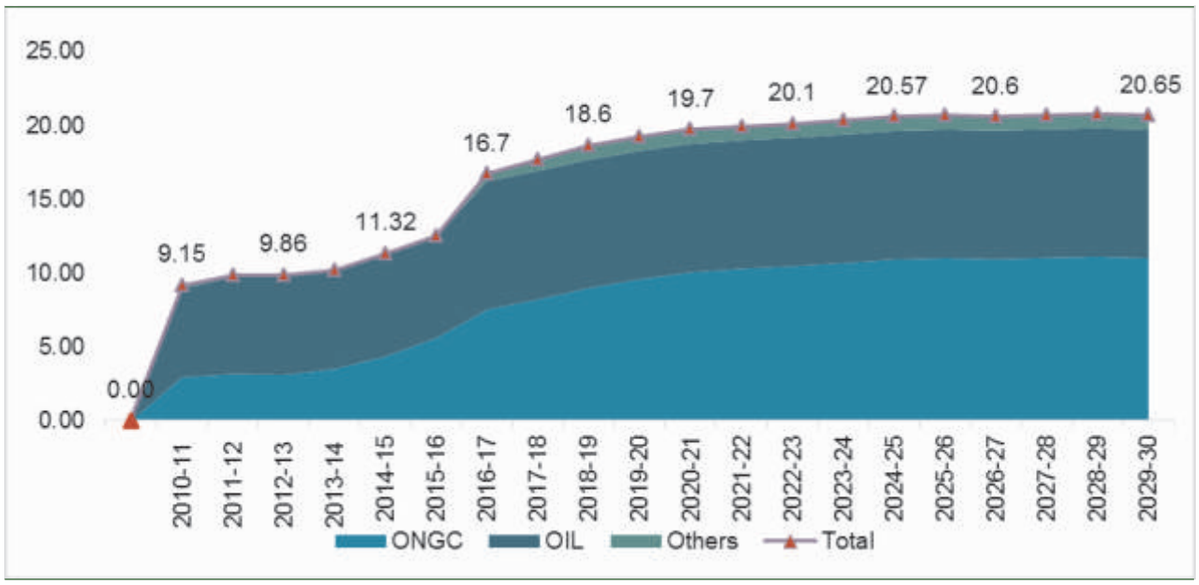
Figure 18: Production forecast for natural gas in NER (in MMSCMD) (without indicative)



Source: ONGC, OIL, DGH, CRISIL Infrastructure Advisory Analysis

The firm production profile of gas from 2021-22 onwards has been considered at the same level. However, there may be an increase in production.

Figure 19: Production forecast for natural gas in NER (in MMSCMD) (with indicative)



Source: ONGC, OIL, DGH, CRISIL Infrastructure Advisory Analysis

Table 35: Production forecast for natural gas in NER (in MMSCMD) (without indicative)

State/ blocks	2014-15	2019-20	2024-25	2029-30
ONGC	4.35	6.9	6.2	5.7
OIL	6.91	8.7	8.7	8.7
Others	0.06	1.0	0.9	0.9
Total	11.32	16.6	15.8	15.3

Source: ONGC/OIL

Table 36: Production forecast for natural gas in NER (in MMSCMD) (with indicative)

State/ blocks	2014-15	2019-20	2024-25	2029-30
ONGC	4.35	9.59	10.92	1.01
OIL	6.91	8.7	8.7	8.7
Others	0.06	0.96	0.94	0.94
Total	11.32	19.25	20.57	20.65

Source: ONGC/OIL

Taking into consideration the indicative production, natural gas production from northeast India is expected to reach 20.65 MMSCMD by 2029-30, expanding at a CAGR of 4.1% from the current level of 11.3 MMSCMD (2014-15). However, if only firm and upside production is considered, expected production is likely to be around 15.3 MMSCMD by 2029-30.

5.1.3 Key issues in upstream sector

Key issues	Descriptions
Production related issues	
Declining production of oil	▪ For both ONGC and OIL, crude oil production has declined at 4% over the past 4 years. ▪ There have been no major oil and gas discoveries over the past few years to supplement the decline in current production levels. ▪ Hindrance to adoption of new technology due to limited availability and cost factors.
Low acreages	**Pre-NELP (PEL & PML acreages)** ▪ As the nomination acreages were nearing its phase of initial 7 years and NELP process had already started in 1998, the nomination acreage was either converted as PML on exploration success or the area was surrendered. This has resulted into acreage relinquishment for the NOCs in the region as they could not convert it into PML due to issues ranging from difficult geographical terrain, environmental clearance and infrastructure constraints. ▪ The combined number of PML and PEL acreages for ONGC shrunk from approximately 15,000 km^2 to 1731 km^2 (PEL) & 6012 km^2 (PML) as on date. In addition, PEL area available for expending exploratory inputs is confined to Assam, half of which falls in eco-fragile zone, which has further constrained E&P activities in the region. ▪ PMLs are outcome of successful exploratory efforts, and are concerned primarily with obtaining production. However, some blocks being offered had either been relinquished or recycled since these were too small to effectively discharge exploration activities. **NELP acreages** ▪ Many blocks awarded in Assam & Nagaland are under the process of relinquishment and very little acreage has been offered in Arunachal Pradesh, Meghalaya & Sikkim. In case of blocks in Mizoram, limited exploratory inputs can be expended in tune with PSC & Committed programme. In Assam, nearly 80% of the blocks fall under wild life sanctuary wherein exploration is constrained. **Other issues** ▪ Acreages on offer are much lower than the actual potential in terms of volume and spread across geographical area. ▪ Most of the acreages are land locked consisting of private property. ▪ Low acreages leading to limited presence of operators and low momentum. The limited number of acreages deprives service providers of the continuity of the business thus making the investment to set up base unviable for the region.
Inadequate crude availability	▪ Though the region's refineries are primarily dependent on crude oil supplies from local oil fields, production of crude has been inadequate to meet requirements of the four units in the region. Extra efforts put by OIL and ONGC in production and exploration should help the refineries in getting sufficient crude. IOCL's Digboi, Guwahati, Bongaigaon and NRL's refinery at 3 MMTPA capacities are sub-economic in size. Even at such sub-optimal size, IOCL and NRL have to operate below installed capacity due to inadequate availability of domestic crude. On the other hand, importing limited quantities of crude for processing at IOCL and NRL is cost-prohibitive.
DAB area (disputed area belt)	▪ ONGC has 2 blocks stuck in DAB area due to dispute between states of Assam and Nagaland. These blocks have large potential for crude oil production.
Policy level issues	▪ Many of the projects related to oil & gas are delayed because of clearances (environment & forest clearances) ▪ Operating conditions in NER are tough and only a limited period is available for working in NER states due to rain/other weather conditions.

5.1.4 Action areas for upstream sector

The key action areas to improve production of oil and gas in NER have been described below.

- **Increasing production from mature fields**
  - Production enhancement contract (PEC)
  - Use of new technology
- **Enhancing exploration activities**
  - Conversion of 2P to 1P reserves
  - Development of yet to find areas (YTF)
- **Resolution of disputes**
- **Offering premium on gas production in high operational cost areas**
- **Policy level recommendations**
- **Re-allotment of relinquished blocks/areas to NOCs on nomination basis**
- **Concept of zero phase of exploration**

5.1.4.1 Increasing production from mature fields

Current production in NER is mainly from mature fields and advanced techniques are required to arrest the decline in production from them. The following methods can be adopted to increase production from the mature fields.

- Production enhancement contract
- Use of new technology

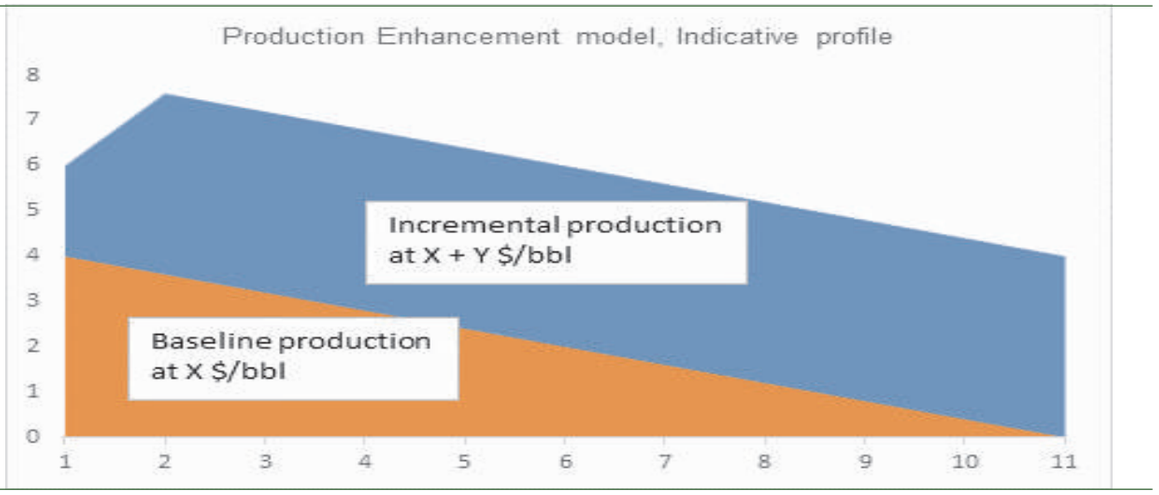
(i) Production enhancement contract

PECs are contracts that are signed between oil field services (OFS) companies and NOCs for mature fields, wherein, a NOC asks an OFS to provide its services for increasing production from a mature field. The service company uses integration of new technologies, work practices and enhanced oil recovery techniques to increase production.

The general terms of such a contract are as follows:

- Contracts are generally for a period of 15/20 years
- Control of all assets, reserves and production remains with the asset owner
- A joint management committee guides and directs the operations from the block
- All new capital expenditure is made by the service company

Figure 20: Production enhancement model



Source: Petrofrac

The service company either charges a single tariff $X /bbl for both baseline and incremental production or $X /bbl for baseline production and $ (X+Y) /bbl for incremental production. In the Indian context, the service company shall be charging for incremental production of $Y/BBL.

Such a PEC was signed between M/S Petrofrac and M/S OMV Petrom of Romania for Ticleni oil fields in 2010. Ticleni oil field is a mature field in Romania with a production history of over 50 years. However, Petrofrac withdrew from the contract on account of low oil prices in February 2015. Contracts such as PECs with oil field services companies can be a viable option for development of mature fields in NER.

Possible approach for production enhancement contracts

PECs globally have seen a fast, increasing trend over the past 10-12 years. Operator companies have collaborated with service companies to increase and accelerate production from mature oil and gas fields for significant improvement in the recovery factor. The model has gained success internationally due to the collaborative efforts of participants.

- Operating companies have rich experience and knowledge about their oil and gas fields.
- Service companies bring global experience, expertise and knowledge of fit-for-purpose technologies including proprietary ones.

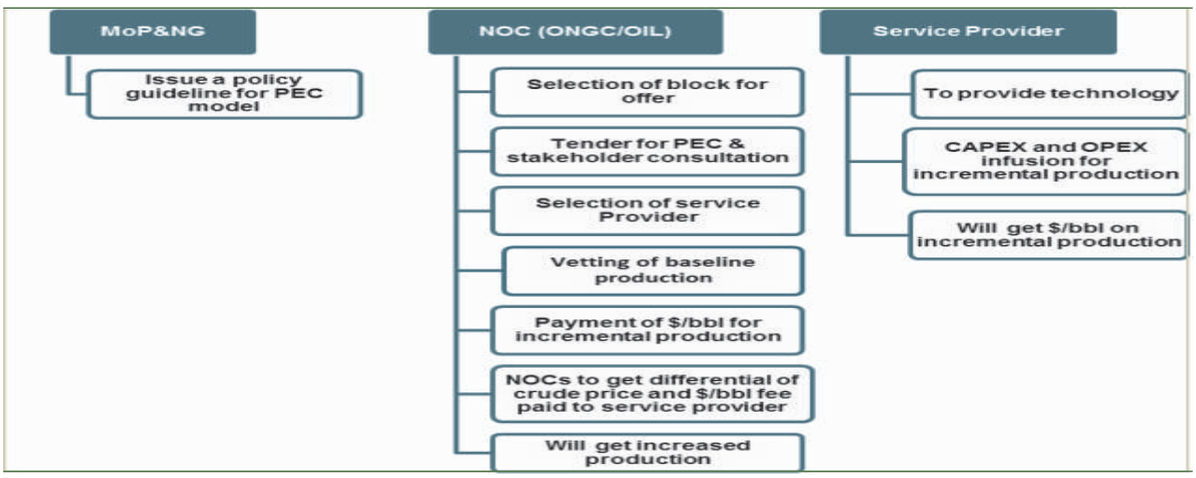
Globally, NOCs of various countries have adopted this mode for increasing production, including:

- Petronas in Malaysia
- Romgaz in Romania
- Pemex in Mexico
- Ecopetrol (Casabe) in Colombia
- PetroEcuador in Ecuador
- KOC in Kuwait
- Various NOCs in China

The fiscal structures of different types of production enhancement contracts have been analysed to understand the potential benefits that they may generate. In India's context, especially of northeast India, it has been observed that the contract with fee in USD per barrel for incremental production above the base production profile of the field can become a feasible proposition for the oil and gas industry.

The contractual and fiscal structure of the contract for a fixed (USD/bbl) fee for the service company has been described in the block diagram below:

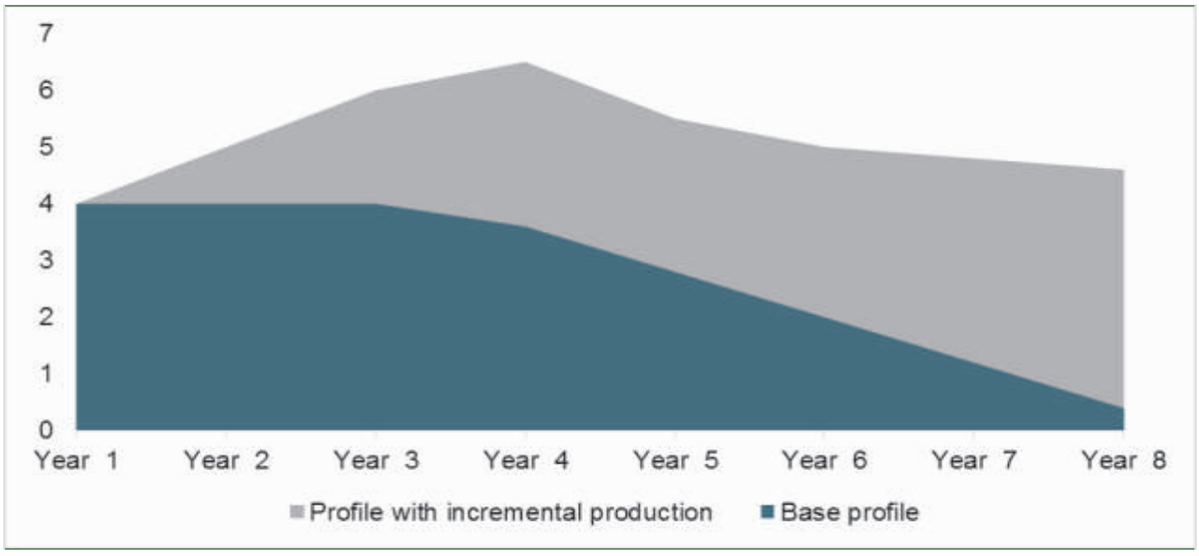
Figure 21: Structure of PEC model



A management committee with representatives from both the operator and the service company needs to be formulated to provide governance to the project. These contracts work best when companies form alliances for a long period of time, e.g., 15-20 years. Further, the base production profile of oil and gas for a particular block is mutually agreed upon by the service company and the operator/owner.

The following figure provides illustration of base production profile vis-à-vis production profile with PEC. The operator has to pay a fixed (USD per barrel) fee for production above the base profile, which has been shown in shaded grey in the figure below.

Figure 22: Base profile and incremental profile



All costs incurred, except for surface facility cost, for production above the base profile needs to be borne by the service company. Operator/owner will be responsible for the investments, required to maintain production up to the base profile. Service companies will receive a fixed fee, in USD per barrel, for each barrel of oil equivalent of oil and gas produced above the base production profile.

This structure provides an incentive to the service companies to produce more since its revenue stream is linked to incremental production.

Stages for signing of PEC

In the flow chart below we have shown the step-wise procedure, right from initiation of formulation of the contract to the signing of the contract between the operator and selected service company after the bidding process for entering into PEC.

Figure 23: Stages for signing of PEC

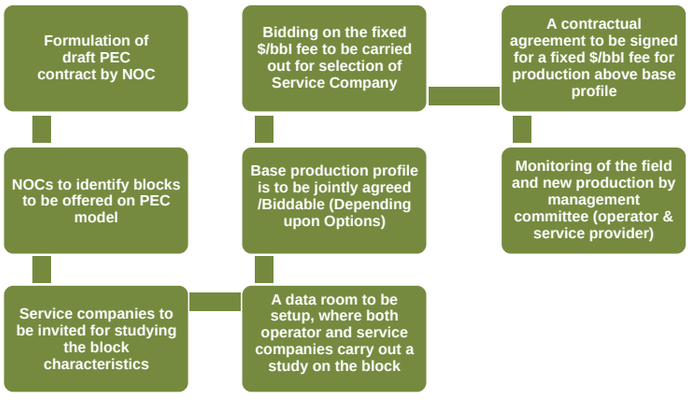
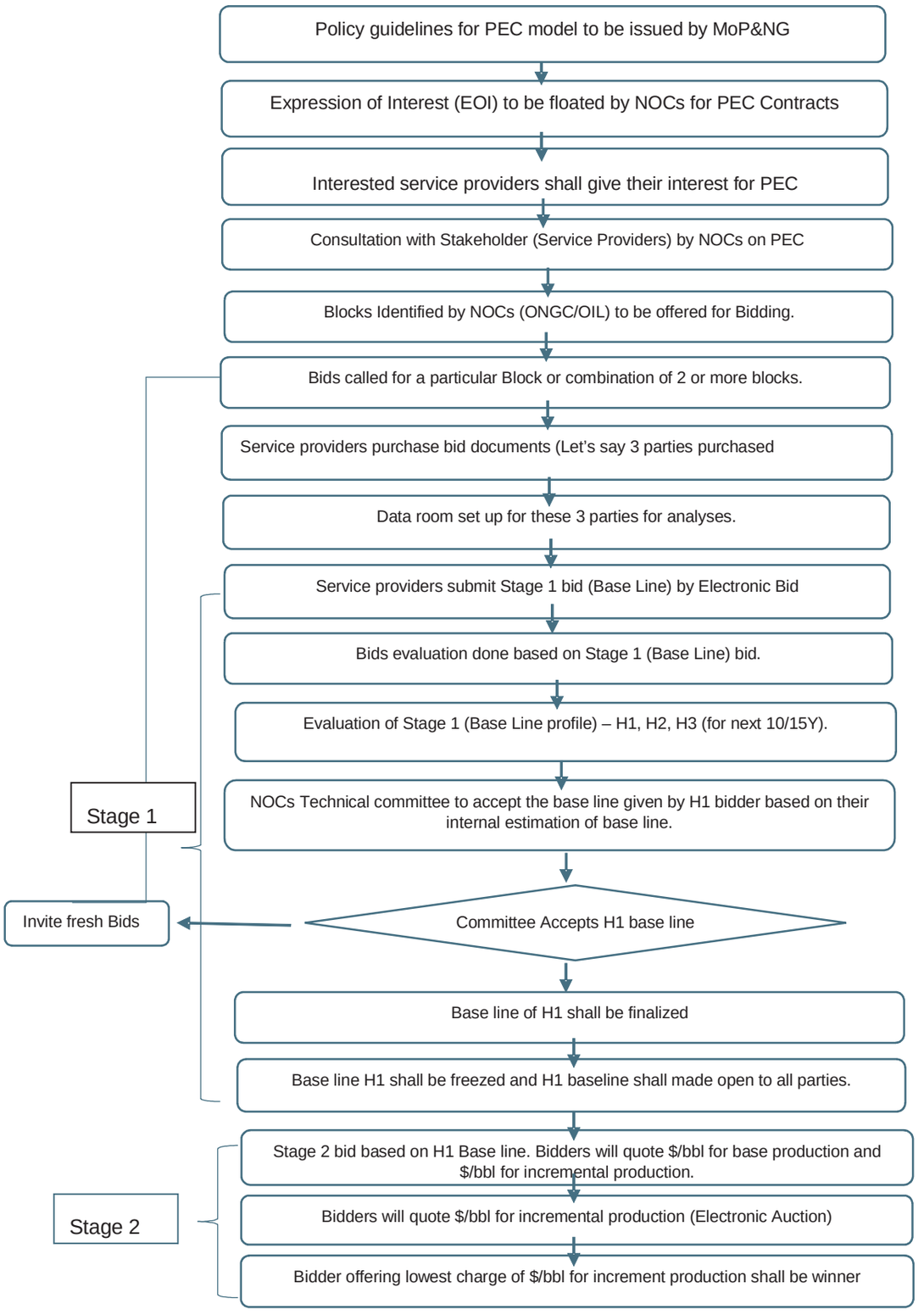


Figure 24: Detailed stages for signing of PEC



5.1.4.1.1 Action area

The table below provides an action plan that needs to be carried out for improving production in NER.

Table 37: Action plan for PEC

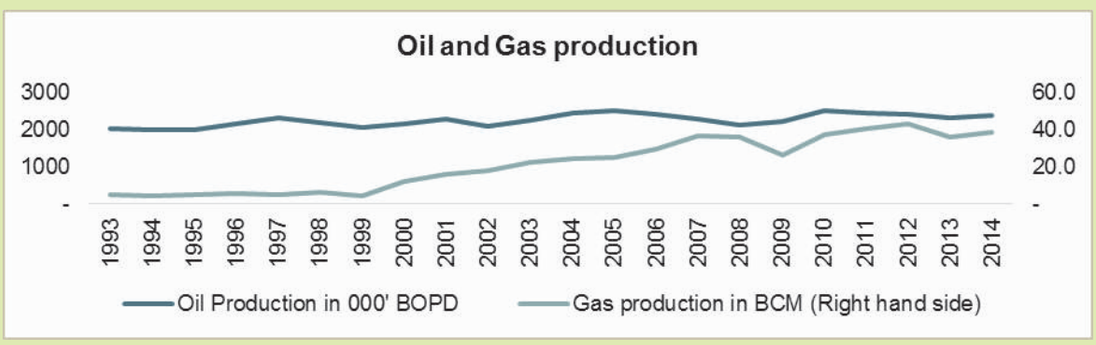
Action items	Authorities concerned	Timeline		
		Short term (0-2 years)	Medium term (0-2 years)	Long term (>5 years)
Increasing production from mature fields				
Production enhancement contract (PEC)	NOCs	NOC to finalise the structure/formulation of PEC after consultation with stakeholders - service providers		
	MoPNG	MoPNG to review and accept the same for implementation.		
	NOCs	NOCs to identify and offer blocks for PEC which can be included in contracts.		
	NOCs	NOCs to float tenders related to PEC in NER blocks and appoint a service provider.		
	NOCs		Implementation of PEC	

Case Study- Nigeria

Oil was first discovered in commercial quantities in Nigeria in 1956. The discovery was made by Shell D'Arcy, a company of Anglo/Dutch origin. The company began production in 1958 with an average production of 6000 barrels of oil per day (BOPD). Before this, almost the entire country was covered by a concession granted to the company to explore for petroleum resources since November 1938. Shell was a dominant player in Nigerian oil and gas industry until Nigeria became a member of OPEC in 1971. To promote development of oil and gas sector across the value chain, Nigerian National Petroleum Corporation (NNPC), the state oil corporation, was established in 1977. In 1988, NNPC was commercialised into 12 strategic business units, covering the entire spectrum of oil industry operations: exploration and production, gas development, refining, distribution, petrochemicals, engineering, and commercial investments.

The upstream oil sector is the single most important sector in the economy, accounting for over 90% of exports and about 80% of the federal government (FG) revenue. Crude oil is currently produced from three different basins: the onshore Anambra, the offshore Benin/Dahomey (deep-water and ultra-deep-water) and the Niger Delta (shallow and deep offshore basins). The Niger Delta and Benin basins are known to be the richest basins and hold the vast majority of reserves, and are the source of a large portion of current production. During the late 1990s, exploration focus turned to high risk ventures in the frontier basins of deep water offshore, with encouraging success. These ventures are becoming increasingly attractive, with developments in deep-water exploration and production technology.

Since 1993, gas production has grown eight-fold, while significant amount of oil production has commenced from deep water blocks, which was earlier restricted to shallow water and marshy areas. The graph below shows the oil and gas production from Nigeria since 1993, i.e., the beginning of the PSC era in Nigeria.



Case Study- Nigeria

Prior to 1993, mostly joint operator agreements (JOA) were in place in the E&P space. However, in 1993, the federal government of Nigeria opened up E&P activities to be carried out in offshore blocks and replaced JOAs with PSCs. During this period, NNPC entered into PSCs with eight IOCs and Nigeria was able to attract much needed additional foreign investment. We have described briefly below the type of agreements prevalent in upstream sector in Nigeria.

Types of agreements prevalent upstream sector

A. Joint ventures

This is the standard agreement between the national oil company, i.e., NNPC and an international oil company (IOC). Under this arrangement, both NNPC and the IOC contribute to funding oil operations in the proportion of their JV equity holdings, and generally receive crude oil produced in the same ratio.

Companies engaged in this form of arrangement are assessed to tax under the Profit Petroleum Tax Act (PPTA) at the rate of 65.75% of chargeable profits for the first five years of operation (when the company is yet to fully recover its capitalised pre-production cost), and 85% thereafter. The tax payable is modified by the provisions of the Memorandum of Understanding (MOU) between the parties.

The JV model is currently being phased out in Nigeria, mainly due to the inability of NNPC to fund its share of JV costs.

B. Production sharing contract

As a result of the increasing funding pressure from JVs, the Nigerian government adopted the PSC model in 1993 as the preferred petroleum arrangement with IOCs. Under the PSC contract, NNPC engages a competent contractor to carry out petroleum operations on NNPC's wholly held acreage. Under this arrangement, the concession is held by NNPC. NNPC engages the IOC or the indigenous company as contractor to conduct petroleum operations on behalf of itself and NNPC. The contractor takes on the financing risk. If the exploration is successful, the contractor is entitled to recover its costs on commencement of commercial production. If the operation is not successful, the contractor bears the loss.

The first set of PSCs was signed in 1993, followed by those executed in 2001, after the 2000 licensing rounds. Several other models of PSCs have been signed since then. The principles in the PSCs remain largely the same, except for variation in the profit oil sharing formula and cost oil recovery cap. The profit petroleum tax (PPT) rate applicable to PSC companies is 50% of chargeable profits for the contract area.

C. Service contract

Under this model, the contractor undertakes exploration, development and production activities for, and on behalf of, NNPC or the concession holder, at its own risk. The concession ownership remains entirely with the NNPC/ holder, and the contractor has no title to the oil produced. The contractor is reimbursed cost incurred only from proceeds of oil sold and is paid periodical remuneration in accordance with the formulae stipulated in the contract. The contractor has the first option to buy back the crude oil produced from the concession.

The contractor is assessed to tax on its service fees under the Companies Income Tax Act as amended (CITA) at 30%, while the concession holder (or the NNPC) is assessed to tax under the PPTA.

D. Marginal field concession

The federal government, in furtherance of its Nigerian Content agenda, encourages MOCs to surrender their marginal fields for assignment to indigenous concession holders. To provide special incentives to marginal field operators, the federal government promulgated the Petroleum (Amendment) Act No. 23 and the Marginal Field Operations (Fiscal Regime) Regulations 2005 on the development of marginal fields.

Generally, a marginal field is defined as any field that has reserves booked and reported annually to the DPR and has not produced for over 10 years.

(ii) Use of new technology

- Incentivise use of new technology to promote usage of new technology by NOCs in nomination blocks, compulsory phase out of old technology used by NOCs and inclusion of latest technology can increase production.
- Joint industry project initiatives with technology partners need to be identified to induct the right technology and prepare a clear road map for addressing the problem. Further, advanced technologies in the areas of electromagnetic telemetry, 3D micro seismic imaging and geological mapping shall be explored for recovery of production from matured fields.

The technologies that have seen successful results in OIL/ONGC fields are listed below:

- Improved oil recovery (IOR) / enhanced oil recovery (EOR) technology needs to be promoted to enhance recovery and optimise production from the existing and matured oil and gas fields in NER. Some of the IOR / EOR techniques are as follows:
  - Miscible gas injection, thermal injection methods such as steam flooding, cyclic steam injection methods used to heat the crude oil, chemical injection used to aid mobility etc.
  - Horizontal drilling and J-bend deviated well;
  - Stimulation services such as hydraulic fracturing and matrix acidisation
  - Polymer flooding and microbial technology
  - Advanced drilling methods such as radial drilling, extended reach drilling, and multilaterals etc. should also be examined/explored to drain hydrocarbon potential from inaccessible reserves. Oil India has carried out joint industry projects with Herriot Watt University, UK, on carbonated water injection, polymer and microbial flooding.

Assam Arakan fold belt covers the seismically challenging and logistically difficult areas falling in Assam, Manipur, Mizoram and Tripura. To address technical challenges pertaining to improved image of subsurface, induction of new technologies such as airborne gravity gradiometry, AEM-PTP passive source electromagnetic method and passive seismic tomography are being planned in NER by ONGC. The objective is to improve the subsurface imaging so that structural configuration/ geometries can be meaningfully interpreted. This would also effectively address logistic difficulties and save time. Passive seismic tomography has already been deployed in Sector VC in Cachar.

The details of these technologies are given below:

Airborne gravity gradiometry

Airborne gravity gradiometry is gaining interest of the exploration community, as this method provides quick and effective solutions such as mapping lineaments and gravity based reservoir limits associated with structural, stratigraphic and fluid based changes in logistically tough terrains. Gravity gradiometry is basically based on variation of gravity gradient information or known as tensor components of gravity field. Gravity gradiometry is known in the industry by trade names of FTG, Falcon etc. In the industry, vendors CGG, ARKeX, Bell Geospace and MacPhar are capable of conducting such gradiometry surveys. The following areas have been identified for airborne gravity gradiometry and gravity, magnetic studies (AGG & GM) for hydrocarbon exploration with the objective of providing estimation of sediment thickness, sub-surface structural disposition and basement configuration in the survey area.

The survey area mainly comprises of three blocks, namely, Block-1, 2 and 3. The area includes the acreages held by ONGC as well as adjoining open acreages. The details about the blocks are as follows:

Block	Name of the area	Approx. LKM
1	Sector-VC: Banaskandi ML, Cachar Dist. PML and AA-94/1 (Assam, Manipur & Mizoram)	7351LKM Grid: 500m x 5000m
2	AA-ONN-2001/2 (Assam, Mizoram)	4722 LKM Grid: 500m x 5000m
3	ML areas- Namti, Geleki, Geleki-Extn, SE-Geleki, and SE-Geleki Extension (Assam, Nagaland)	322 LKM Grid: 500m x 2500m
	Total LKM	**12395**

The above areas are largely mountainous, typical elevations from mountain top to valley ranges from 50 to 1,000m, rugged terrain with jungle cover and sparse population.

AEM-PTP passive source electromagnetic method

Electromagnetic methods provide cheaper means of supplementing seismic data. These methods respond to resistivity contrast of the formations unlike seismic, which respond to acoustic impedance contrast. FTB regimes often have thin high velocity near surface layers, which acts as an acoustic barrier whereas EM methods yield better results. "Audio electro magnetic passive transient impulse (AEM-PTP)" is a passive source transient electromagnetic prospecting technique based on detection of transients of secondary electromagnetic field associated with upward fluid flow associated with REDOX activity. It is a proprietary technology of Pinemont, a subsidiary of McPhar International Ltd. In June 2015, representatives from Mcphar international presented the Pinemont AEM-PTP survey techniques at ONGC, Jorhat. Following positive feedback and subsequent discussions, McPhar has given a proposal to undertake a test survey over a small block, covering approximately 100 sq km.

Passive seismic tomography

Passive seismic tomography involves listening to the earth passively over time and using it to derive subsurface information. P and S-wave travel times help in understanding structural configuration of the subsurface and Vp/Vs provides lithological information. Passive seismic tomography has already been deployed in Sector VC and survey completed in November, 2011 and data delivered as per the deliverables by M/S Land Tech Enterprises. The survey resulted in:

1. Vp/Vs values that helped in demarcating sand prone areas

2. PST velocity field, which were used in reprocessing of a few 2D lines and 3D volume in the area to see any possible improvement.

5.1.4.2 Enhancing exploration activities

(i) Conversion of 2P to 1P reserves

- The term 2P is used to denote the sum of proved and probable reserves and 1P is frequently used to denote proved reserves. The best estimate of recovery from committed projects is generally considered to be the 2P (sum of proved and probable reserves). However, probable reserves are lower categories of reserves, commonly combined and referred to as "unproved reserves," with decreasing levels of technical certainty. Probable reserves are volumes that are defined as "less likely to be recovered as proved, but more certain to be recovered than possible reserves".

- Increased drilling efforts are required for conversion of 2P reserves to 1P reserves. This action will help in increasing oil and gas production from existing fields. To increase drilling activity for exploration and production, more drilling and work over rigs should be inducted by way of acquisition as well as charter hiring to mitigate time overruns.

(ii) Development of yet to find areas (YTF)

Based on the experience of past five decades in the context of different tectonic style and logistical challenges, authorities need to

- Pursue new petroleum plays, leads and field growth possibilities in logistically difficult and geologically complex areas in Assam, Arunachal Pradesh and Mizoram.
- Targeting frontal belt corridor and pursue exploration for structural and strati-structural plays.
- Improve subsurface imaging and G&G understanding through technology induction and reprocessing.

Analysis of latent potential in NER

Both ONGC and OIL hold large number of PEL, PML areas in NER. As per data available, given below is the estimated conversion due to drilling efforts made by both companies. Assam's area has the maximum conversion factor of 65% for prognosticated to established category whereas Nagaland area has only 3%.

Table 38: Total prognosticated, established & recoverable reserves in NER in MMTOE for ONGC and OIL

	Sector/ area	Prognosticated resources (in MMTOE)			Established in-place (in MMTOE)			Recoverable reserves		
		OIL	ONGC	Total	OIL	ONGC	Total	Oil	Gas	Total
State	Area									
Assam	Shelf (Nazira & Jorhat sector)		1180			785		173	142	315
Assam	Cachar Fold Belt		435			9				
Tripura	Fold Belt		590			100		0.07	41	41
Arunachal Pradesh								3	1	4
Nagaland	Naga Schuppen Belt		555			17		3	0.12	3
Mizoram	Fold Belt		170			2				
Total NER		2,110	2,930	5040	1070	904	1974	179	184	363

Source: ONGC, OIL

Table 39: Conversion percentage of prognosticated to recoverable

Prognosticated to established	Established to recoverable	Prognosticated to recoverable
39.17%	18.40%	7.20%

The details of resource conversion by ONGC and OIL India in NER are given in Annexure X.

5.1.4.2.1 Action plan

The table below provides action plan that needs to be carried out for improving production in NER.

Table 40: Action plan for increasing production from NER

Action items	Authorities concerned	Timeline		
		Short term (0-2 years)	Medium term (2-5 years)	Long term (>5 years)
Enhancing exploration activities				
Conversion of 2P to 1P reserves	NOCs/ Pvt Players/MoPNG	Increased drilling efforts are required for conversion of 2P to 1P reserves by incentivising service providers or extension of services by NOCs to third parties.	Offering quantum of business in cluster form to service providers	
	MoPNG/MoEF	To make environment clearance process online. Waiver for EC and FC for exploratory blocks. Batch clearances for exploratory wells.		
	MoPNG	Central co-ordination committee for - Connectivity, EC, FC, Forest diversion, Law and Order etc.		
Development of yet to find (YTF) areas	DGH/ MoPNG	Associate with technology partners for improved subsurface imaging and G&G understanding in unexplored fronts	Bring new blocks for E&P bidding	

GOI has recently approved the marginal field policy, which will further provide opportunities to enhance the production from isolated and unexplored areas. The union cabinet approved the marginal field policy (MFF) on September 2, 2015, for development of hydrocarbon discoveries made by national oil companies. These discoveries could not be monetised for many years due to various reasons such as isolated locations, small size of reserves, high development costs, technological constraints, fiscal regime etc.

Under the new policy, 69 oil fields which have been held by ONGC and OIL for many years, but have not been exploited, will be opened for competitive bidding. Under this policy, exploration companies will be able to submit bids for exploiting these oil fields. These oil fields have not been developed earlier as they were considered as marginal fields, and hence were of lower priority. With appropriate changes in policy, it is expected that these fields can be brought into production. To facilitate the policy, significant changes have been made in the design of the proposed contracts.

Earlier contracts were based on the concept of profit sharing, where the government had to scrutinise costs submitted by companies, which led to many disputes and delays. Under the new regime, the government will not be concerned with the cost incurred and will receive a share of the gross revenue from the sale of oil, gas etc. The second change is that the licence granted to the successful bidder, will cover all hydrocarbons found in the field. Earlier, the licence was restricted to one item only (e.g. oil) and separate license was required if any other hydrocarbon, for example, gas was discovered and exploited. The new policy for these marginal fields also allows the successful bidder to sell at the prevailing market price of gas, rather than at administered price.

5.1.4.3 Resolution of disputes

5.1.4.3.1 Nagaland area

- Nagaland government passed the Nagaland Petroleum & Natural Gas (NPNG) regulations and the NPNG rules in 2012, under the powers of Article 371 A (1)(a)(iv) of the Constitution, which states that "ownership and transfer of land and natural resources shall apply to the state of Nagaland unless the legislative assembly of Nagaland by a resolution so decides." A NPNG board was also set up to monitor all activities related to oil and natural gas mining. NPNG regulations stipulated a three-level committee: the first comprising state ministers; the second with senior bureaucrats; and the third with junior government officers, advisers and others.
- After the notification of the Legislation in 2012, the government floated an expression of interest (EOI) for 11 oil and gas zones, including the Wokha oil zone in Wokha district. A ministerial group gave the permit for the oil zones at Wokha and Peren to a company called Metropolitan Oil & Gas Private Ltd (MOGPL). This included the Changpang oil field in Wokha, which had to be abandoned by ONGC in 1994. As per information available, a contract between Nagaland state and MOGPL has been signed on 18% revenue sharing basis with state, for production of oil and natural gas from the awarded blocks.
- Two blocks of ONGC fall in this area

Some of the possible resolutions on Nagaland issue

Solutions to the outstanding issues could be planned on following lines:

(a) The difference in the state government's 'revenue share' and 'royalty' could be taken care of in two ways:

- Enhance rates of royalty for the NELP blocks to match the minimum returns as prescribed by the state government in its revenue sharing model, and
- Request the state government to nominate a State PSU to partner E&P operations in the state. This will allow it access to petroleum profit, which the state can share as per their own arrangement.

(b) The arrangement proposed by the state government for sharing of revenue with the land owners etc, can continue.

(c) The process proposed by the state government for making available land for E&P activities can continue. The state government should facilitate the process of taking necessary permissions from the land owners, village councils, Tribal Hoho etc.

(d) The state government should repeal their PNG Regulation and Rules and operate within the ambit of the Oilfields (Regulation and Development) Amendment Act, 1969 and Petroleum and Natural Gas Rules, 1959 of the Government of India.

The salient features of the State Government of Nagaland Revenue Sharing Model and comparison with PSC are given as under:

Sr. no.	Nagaland government model		MoP&NG PSC
1	Award zone for 10 years, renewable every 10 years		8 years exploration period for frontier blocks with 20 years mining period (10 years exploration has been proposed under MRSC)
2	Separate permit for pre-production, production and post production activities.		PEL and PML recommended to state governments for issue of on-land blocks.
3	Land access fee to land owners as per uniform rates decided by state govt.		Lease money as per state govt rates.
4	Land access fee paid annually.		As per state govt lease rules.
5	Revenue share – not less than 16 % for oil and 12% for natural gas of total value produced. This shall be shared as follows: a. With individual land owner who own oil/gas well in the zone –not less than 2%. b. Other individual land owners who do not own oil or gas wells in the zone-not less than 4% and 2%, respectively for oil and gas. c. With district development board of the zone- not less than 2% for both oil and gas. d. With the state government- not less than 8% and 6%, respectively for oil and gas.		a. Nomination blocks (4 blocks) cum-royalty to the state; approximately 16% for oil and 9% of gas. b. Pre-NELP (1 block) cum royalty approximately 16% for oil and 9% for gas. c. NELP (4 blocks) ex-royalty 12.5% for oil and 10% for gas. As per gazette notification of 17.03.2003 of MoP&NG (Para 2 (ix), a special grant @ 2% over and above the applicable rate of royalty will be paid to Nagaland govt on crude oil production from the State.
6	No permit issued to a company shall be transferable.		PI can be transferred with permission of GoI
7	Valuation of petroleum - International Price Index.		Crude- International Price Index Gas- Fixed by government of India
8	No crude/gas shall be transported out of the state without being refined or bottled or converted into products in the state subject to production limits required for setting up such ancillary industry.		Crude sale – at arm's length market price Gas- allocated by GoI
9	Employment 50% unskilled 10% non-technical White collar	Nagas of respective district.	Not stipulated
	10% non-technical white collar 10% skilled	Nagas from any part of the state	
10	PNG Index for Revenue Share proposed by operator in EOI may be changed by state govt if more beneficial to land owner.		Fiscal stability- no change to the disadvantage of operator.

5.1.4.3.2 Disturbed area belt (DAB)

- DAB area (Assam-Nagaland border): The border dispute over the disputed Assam-Nagaland border belt, called the disturbed area belt (DAB), between the two states is awaiting a solution from the Supreme Court after Assam filed a petition in 1988 seeking a settlement. The Assam government wants no change in the current border demarcation. However, Nagaland refuses to accept the same and instead wants to follow the historical boundary, which was demarcated before the colonial rule. Blocks of ONGC are falling in this disputed border between Nagaland and Assam. Exploration and production has not progressed in these blocks due to issues related to DAB area.
- Two blocks of ONGC fall in this area. E&P has not progressed in these blocks due to issues related to DAB area. DAB area between Assam and Nagaland is shown below.

Figure 25: Map of Nagaland and DAB area blocks

5.1.4.3.3 Potential of DAB area

The state of Nagaland comes along with prolific resources of oil and gas, which has remained largely unexplored till date. The Naga Schuppen Belt is estimated to have 555 MMTOE of potential oil and oil equivalent of gas (O+OEG) of which only 17.05 MMTOE of oil and gas reserves come under established in place category, which translates into a conversion percentage of only 3% compared to Assam where 65% of oil and gas reserves come under established reserve category.

Blocks under relinquishment in Nagaland and DAB area are given in the table below:

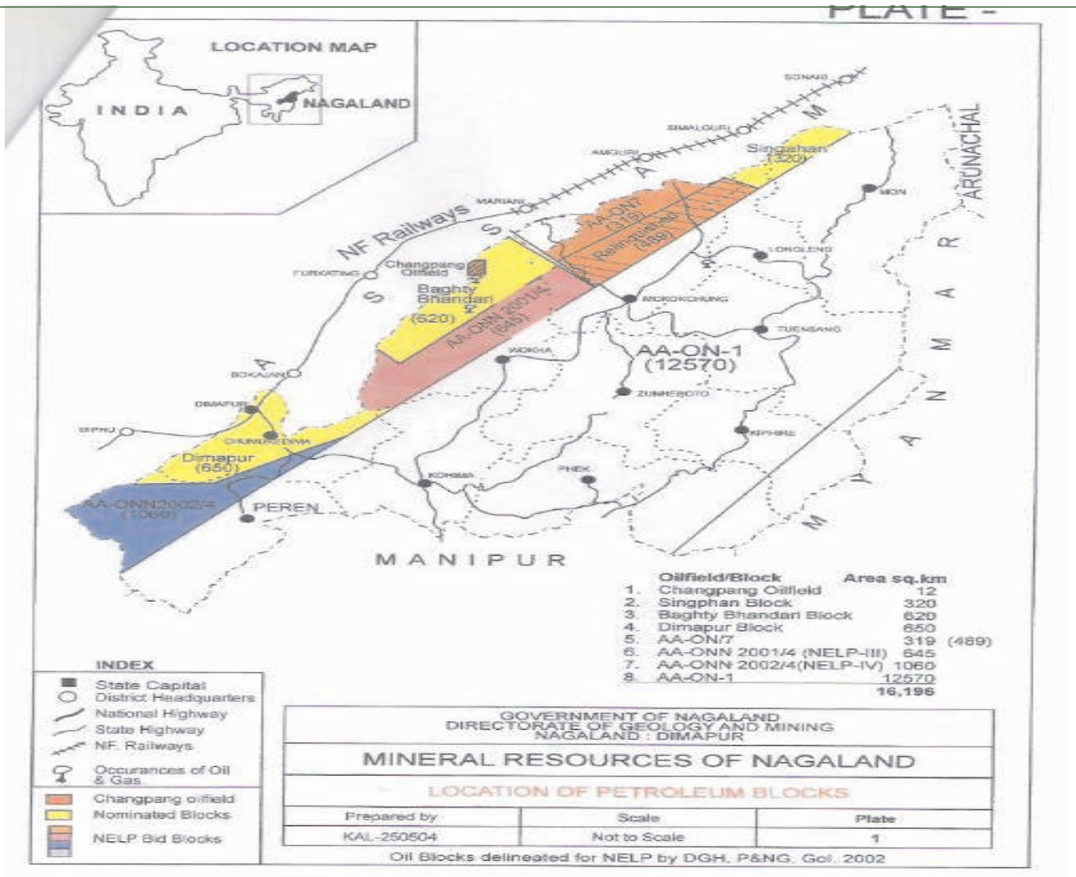
Table 41: Blocks in Nagaland and DAB area

Blocks	Status
AA-ONN-2001/3 (DAB area)	Disputed area belt issues, under relinquishment
AA-ONN-2001/4 (Nagaland)	Nagaland acreages, Relinquished
AA-ONN-2002/4 (Nagaland)	Nagaland acreages, Relinquished
AA-ONN-2005/1 (DAB area)	Disputed area belt issues, Relinquished

5.1.4.3.4 Status of blocks

- ONGC acquired a petroleum exploration licence to explore oil and natural gas in the villages of Changpang and Tsorri located in Wokha district in the state of Nagaland in 1973. ONGC started production from the area after signing a MOU with the state government in 1980-81. Peak production from the blocks was 0.1363 MMT achieved in 1989-90. However, production was suspended w.e.f. May 11, 1994 as per the directives of state government on account of rows over sharing of royalty.
- ONGC had acquired around 5,000 sq km of area for exploration in NELP III. However, there has been no progress in these blocks because the state government has not given permission for carrying out exploration work.

Figure 26: Hydrocarbon resource area in Nagaland



- **Nagaland Schuppen belt is estimated to have 555 MMTOE of O + OEG prognosticated resources.**
  - 17.05 MMTOE of the reserves come under the established category (in ONGC Area Only).
  - Only 3% of reserves in Nagaland in established category as compared to 65% in Assam.
  - ONGC started production in Wokha district of Nagaland in 1980-81.
  - Production was suspended from the block w.e.f. May 1994 over royalty sharing rows.
  - Considering the resource conversion percentage of 13% by ONGC in Assam from prognosticated to in place category, close to 72 MMTOE of O+OEG would come under in place category in Nagaland.

5.1.4.3.5 Action area

Based on the issues and challenges identified as above, we propose the following action plan along with responsibility and timelines.

Table 42: Action plan for disputed area between Nagaland and Assam

Action area - Assam-Nagaland border dispute	Immediate (0-2 years)	Medium term (2-5 years)	Long term (5 years+)
A committee of authorities nominated by the - MHA/MoPNG and Chief Secretary of Assam & Nagaland needs to be formed for resolution on these blocks. A review of royalty structure is required.	MoPNG/MHA		
Similar resolution under provision of existing laws for mutual agreement on starting of production from NELP/PSC regime and share of royalty between both the states.		MoPNG/MHA	
MoPNG to support ONGC in case of financial burden for increased royalty under PSC agreement. ONGC to submit the proposal to DGH for the same		ONGC/DGH	
The central and state governments need to initiate action to resolve the boundary issues within states as boundary issues between Assam-Nagaland, Manipur-Nagaland and Assam-Arunachal Pradesh have been instrumental in delaying exploration activities and in some cases the issue has led to abandonment of exploration activities by the E&P operator.	Chief Secretary-Government of India/ Assam/Nagaland/		

5.1.4.4 Cost of E&P in NER

The capital and operating cost of production of oil and gas plays a significant role in the momentum of E&P activity in a region. The section compares capital and operating costs in NER with rest of India – onshore and offshore blocks.

5.1.4.4.1 Exploration cost

Exploration costs contribute for about 20% of the overall cost incurred for development of an oil and gas field. Exploration cost is the initial cost that is incurred in an oil and gas field, which helps in ascertaining the resource potential of the field. Based on inputs provided by DGH, we have analysed the exploration costs in NER and compared it with the exploration cost in KG Basin. Major cost items incurred in the exploration phase are:

- Survey costs
- Exploratory well drilling costs
- General & administrative (G&A) costs

The analysis of these cost items revealed that exploratory well drilling costs in NER are typically higher by 20-25%, while G&A costs were higher by close to 220%. Survey and exploration study costs were lower in NER by 28% than that in KG basin. The higher/(lower) costs have been computed by calculating the average of costs provided by DGH in NER and the percentage by which this cost is higher/(lower) from the other block in rest of India.

Cost item	Exploratory well drilling and testing cost per metre	G&A cost per well	Survey and Exploration studies
% higher or (%) lower than in NER	23%	220%	(28%)

Source: DHG, CRISIL Infrastructure Advisory Analysis

5.1.4.4.2 Capital cost

After the exploration phase has been completed, the oil and gas blocks enter the development phase, which requires drilling of development wells for production of oil and gas and creation of surface facilities for processing, collection, transportation of the produced crude oil and natural gas. Hence broadly, the capital cost can be classified as:

a) **Well cost:** Well cost includes, costs related to hiring of rigs, well construction (including well and completion design), procurement of casings, tubulars, well head and X-mas tree, packers, line hangers, procurement of cementing services, additives, mud services, mud chemicals etc. Rig hiring charges are the most significant component of well cost, which makes the capital cost highly sensitive to operating day rate of rigs and number of days taken to drill a well.

b) **Facility cost:** For treatment and processing, collection, storage and distribution of produced crude oil and natural gas, various facilities such as flow lines, oil tanks, separators, electric lines, generators, effluent treatment plants, gas dehydration units, crude processing units, pipelines etc. need to be constructed. This cost component is generally much smaller when compared to well cost.

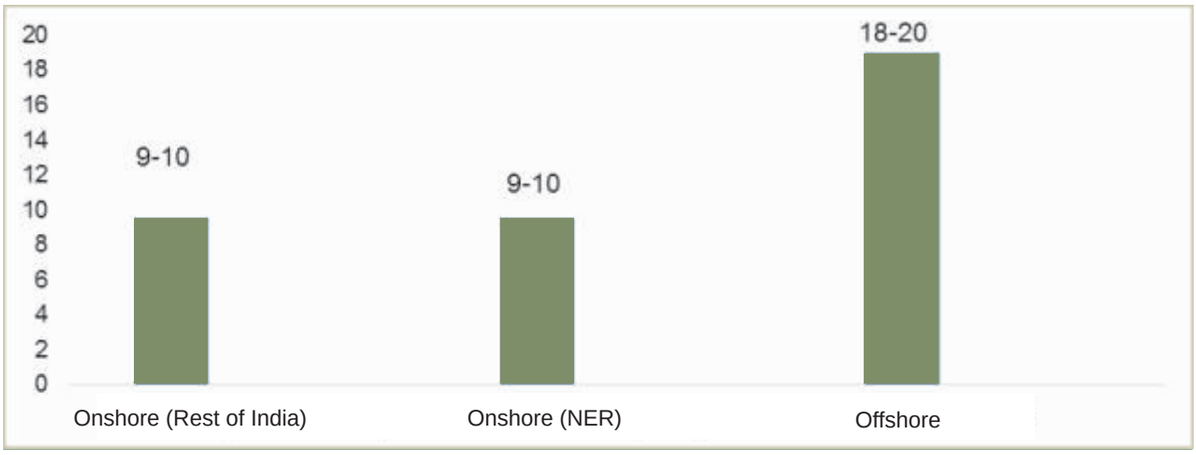
For the purpose of analysis, the capital costs of more than 30 blocks across India have been considered and have been grouped into offshore, onshore (rest of India) and NER category. Based on limited data review, it appears that indicative capital cost in northeast India is similar to that in the rest of the country as far as onshore blocks are concerned.

Table 43: Indicative capital cost for hydrocarbon blocks in India (USD/BOE)

In USD/BOE	Onshore (Rest of India)	Onshore(North East)
Indicative average value	9-10	9-10

Source: DGH

Figure 27: Average capital cost for hydrocarbon blocks in India (USD/ BOE)



Source: CRISIL Infrastructure Advisory Analysis

5.1.4.4.3 Operating cost

Once the development activities have been completed, production of oil and gas begins from the wells. The cost incurred to carry out the day-to-day activities in the blocks comes under the operating cost head. Some of the key costs in an oil and gas field that are clubbed together to form the operating costs are:

- Workover of wells cost
- Staff expenditure
- Produced water treatment cost
- Land lease expense
- Stores and spares
- Pollution control
- Insurance cost
- Repair and Maintenance
- Costs related to transport of oil and gas
- Contractual payments
- Power and fuel expense
- HSE related costs

The operating costs in USD/boe considered for this analysis is the same sample as that considered for capital cost analysis. Based on limited data review, it appears that the indicative operating cost is significantly higher in northeast India compared to onshore blocks in the rest of India. The indicative operating cost in northeast India has been found to be at par with the offshore blocks. The results of our analysis have been presented in the table below:

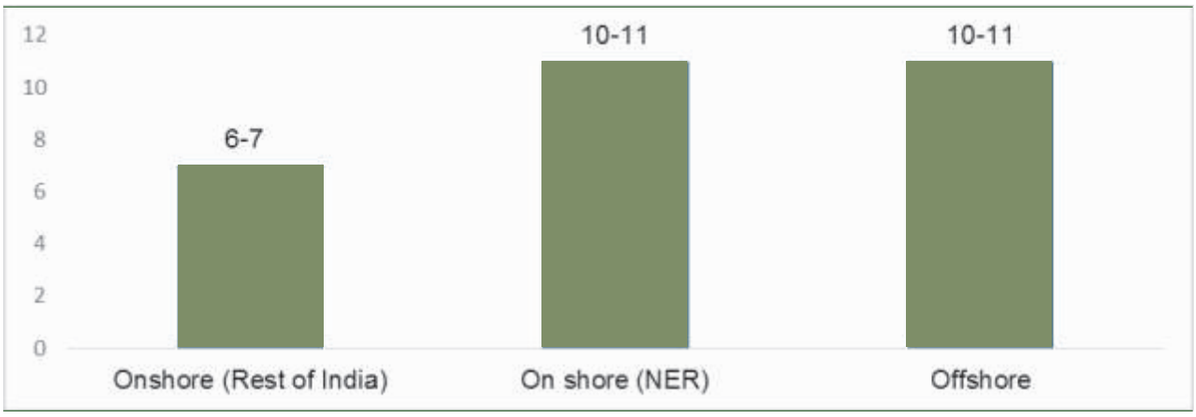
Table 44: Indicative average operating cost for hydrocarbon blocks in India in USD/BOE

In USD/BOE	Offshore Blocks	Onshore (Rest of India)	Onshore (North East)
Average value	10-11	6-7	10-11

Source: CRISIL Infrastructure Advisory Analysis

It can be observed from the figure below that the operational expenditure post development activities of blocks in NER are 50% higher compared to the operational expenditure requirement for other onshore blocks in India.

Figure 28: Average operating cost for hydrocarbon blocks in India (in USD/BOE)



Source: CRISIL Infrastructure Advisory Analysis

5.1.4.4.4 Key issues/ concerns

The table below provides key issues related to capital and operating cost in northeast India.

Table 45: Key issues in terms of capital and operating expenditure in Northeast India

Key Issues	Illustration
Issues related to cost of exploration and production	
Exploration cost	▪ Exploration cost in NER is higher than in rest of India, exploratory well drilling costs in NER are typically higher by 20-25%, while G&A costs were higher by close to 220%. Survey and exploration study costs were lower in NER by 28% than that in KG basin.
Capital cost	▪ Capital cost for offshore projects are much higher than projects implemented in onshore areas, and we observed a wide variability in their range, starting from USD 9.7/ boe to USD 42.2/ boe. Higher costs in offshore areas are due to higher complexity and higher drilling and facility costs in offshore regions. Generally, offshore drilling day rates are more than double the drilling day rates for land rigs. ▪ Capital cost for projects implemented in NER region is quite similar to other onshore projects implemented in rest of India. ▪ Onshore projects also have a high variability in costs depending upon the location of their implementation, complexity of the project and its development plan. For mature blocks, enhanced oil recovery (EOR) techniques are implemented, which lead to a significant increase in project cost.
Operating cost	▪ Operating costs in NER are nearly 50% higher than operating costs in other onshore projects implemented across India. Operating costs in NER are comparable to operating costs of offshore projects. ▪ Operating cost are higher in NER, because of intermittent production, due to which the facilities are lying idle, bandhs and blockades, higher stores and spares and consumables costs due to lack of availability of service provides in the region.

5.1.4.4.5 Action areas

The new discoveries in challenging blocks, i.e. NER blocks falling in the hilly regions and Brahmaputra River bed areas, may be treated differently and command a graded premium over and above the existing price of natural gas based on the level of difficulty encountered for extracting gas.

- The high exploratory, capital and operating costs in the region can be clearly attributed to the infrastructure constraints in the region, which increases capital costs owing to technical constraints (higher complexity and higher drilling costs).
- Relaxed terms of timelines, Minimum Work Programme (MWP), and tax incidence should be considered for these blocks.

5.1.4.4.6 Challenging blocks

- According to Oil India, NER blocks falling in the hilly regions and Brahmaputra River bed areas can be termed as challenging blocks. This will cover Mizoram, Manipur, Tripura, Nagaland, Meghalaya, Arunachal Pradesh and parts of Assam (Karbi Anglong, Dima Hasau, Sadiya, Brahmaputra Riverbed area etc.). Blocks considered by Oil India, which are considered challenging are given in table below:

Table 46: Blocks proposed by OIL to be considered as challenging

Name of block	States
Nomination	
Tinsukia PEL	Assam
Lakhimpur PEL	Assam
Murkongselek PEL	Assam
Ningru PML	Arunachal Pradesh
Ningru Extn PML	Arunachal Pradesh
Jairampur PEL	Arunachal Pradesh
Jairampur Extn PEL	Arunachal Pradesh
Namchik PEL	Arunachal Pradesh
Deomali PEL	Arunachal Pradesh
Namsai PEL	Arunachal Pradesh
NELP blocks in challenging category	
AA-ONN-2002/3	Assam
AA-ONN-2010/2	Assam
AA-ONN-2010/3	Assam
MZ-ONN-2004/1	Mizoram

Similarly, list of challenging blocks identified by ONGC are given below:

Table 47: Blocks proposed by ONGC to be considered as challenging

Block / sector	State / area	Rationale for being in challenging category
SE-Geleki ML	North Assam shelf-Sivasagar	Lying in DAB areas
Disangmukh-Panidihing sector	North Assam shelf-Sivasagar	Environmental challenges- Lying within the eco-fragile zone
Teok Area	North Assam shelf-Sivasagar	Environmental constraints, difficulty in getting EC
AA-ONN-2001/3	South Assam Shelf – Dhansari valley sector	Lying in DAB areas
AA-ONN-2005/1	South Assam Shelf – Dhansari valley sector	Lying in DAB areas
Karbi-Anglong and North Kachar hills	Souther part of South Assam Shelf	Logistically difficult, tectonically complex area with environmental concerns
Cachar	Assam	Logistically difficult area
Eastern Tripura	Tripura	Logistically difficult area
Tichna field	Tripura	Obtaining environmental clearance is constraint
Khubal	Tripura	Environmental constraints
Nagaland	Nagaland	MOU signing awaited with state Government

Source: ONGC

5.1.4.4.7 Action plan

The table below provides the action plan needed to devise a different model for special category fields in North Eastern region

Table 48: Action plan for special category challenging blocks in NER

Action items	Authorities concerned	Timeline		
		Short term (0-2 years)	Medium term (2-5 years)	Long term (More than 5 years)
Offering premium on gas production in NER				
Categorise special category "challenging blocks"	MoPNG/ DGH	Conduct studies to identify the criterion for special category blocks in NER	Declare special category and devise modified conditions in terms of timelines, royalty, price and tax incidence	
Govt/ MoPNG should focus on production maximisation by paying premium on prevailing gas prices for gas produced from challenging blocks, which may make many blocks commercially viable.	MoPNG	Review for implementation		

5.1.4.4.8 Analysis of life cycle cost in NER vs other parts of India

As has been described in the above sections of the report, exploration, development and production activities in the northeastern region pose a challenge to the developer, which escalates the overall cost of production. This escalation of cost discourages further investment in the region, thereby limiting exploration activity. Therefore, in order to improve the overall investment sentiment in oil and natural gas exploration activities in the region, a pertinent incentive mechanism needs to be incorporated. We have carried out our analysis based on data provided by DGH which is depicted in the table below.

Table 49: Key assumptions for cost comparison

Description	Average cost in NER blocks ($/mmboe)	Cost in a block in Cauvery basin	% higher/ (lower)
Unit exploration capital	7.60	1.70	348%
Unit developmental capital cost	4.92	3.57	38%
Unit production costs	3.37	9.12	-63%
Unit life cycle costs	15.88	14.39	10%

Source: DGH

As can be observed from the table above, the overall cost of production i.e. the life cycle cost is 10% higher for blocks in NER than in the rest of the country. Based on our analysis, an appropriate premium may be given on production of natural gas from the region. Crude oil prices are already linked to international market prices; hence, there is no need to offer incentives on oil production.

5.1.4.5 Service providers

Service providers are the backbone of any industry that is capital intensive in nature. The typical spends of E&P operators on outsourced work to service providers is more than 60% of their total E&P costs, which highlights the significance of service providers. The E&P service providers have played a key role in the success of E&P operators worldwide. India too relies heavily on the oilfield service providers. This reliance is expected to continue in the future if the country targets to explore and produce hydrocarbon resources from its vast sedimentary areas of 3.14 million square km.

Although significant oil and gas potential exists in the northeast region, exploration and development have been stalled by various issues. The presences of service providers are also limited in the northeast region due to issues such as law and order problems, inadequate connectivity infrastructure, lower business potential etc. The service providers who are present in the region provide limited service offerings instead of their entire service portfolio they offer elsewhere in India due to economic viability and other issues. Further, NOCs operating in the region have developed significant in-house service capacities to cope up with the challenges posed by such unavailability of reputed service providers. However, small players as well as other private E&P operators are facing the full brunt of such unavailability, as they could neither develop in-house services in a short span of time nor could they hire reputed service providers due to financial constraints. Moreover, local service providers are not technologically and financially sound enough to fulfill the requirements of E&P operators. Therefore, the E&P activities in northeast India are constantly being confronted by the unavailability of service providers.

Oilfield services cover a wide range of activities, which originate from exploration and continue at every stage till the final delivery of crude to refineries. E&P companies utilise specialised services and latest technology offerings of service providers to reduce the underground risks, thereby improving chances of success in E&P operations. The current oil and gas services market in India is dominated by foreign players such as Transocean, Schlumberger, Halliburton, Baker Hughes, Weatherford etc. The majority of the consumables and equipment or tools required in the different E&P activities are

also imported. Indian service providers and suppliers have a lot of catching up to do with their foreign counterparts in terms of technology, quality and skilled manpower.

Due to lack of service providers in the region, the cost of service is considerably higher in NER, than in rest of India. This also leads to a delay in E&P activities since the material/service procurement has a longer lead time due to lack of service providers in the region. Large service providers (both domestic and international) are reluctant to enter northeast India owing to the concerns mentioned below.

5.1.4.5.1 Key issues/ concerns

Key issues related to service providers in northeast India have been presented below.

Table 50: Key issues/ concerns related to service providers in northeast India

Issue	Description
Limited presence/ unavailability of service providers	▪ Low acreages and lack of marketing the true E&P potential in the region leading to lower business. ▪ No assurance of continuous business thus increasing the mobilisation cost, which in turn deters the service providers to enter into such market. ▪ Unfavourable policy regarding essentiality certificate. Approvals are obtained specific to individual end-use and contract duration only for moving the equipment into the region. Such approval is automatically revoked and the service provider has to move the equipment back to a SEZ / other geography and re-export for subsequent contracts. ▪ The SEZ Act and Rules thereto do not include E&P services. Therefore, the participants aren't eligible for any benefits under SEZ Act. ▪ Law and order problems ▪ Poor connectivity infrastructure hindering mobilisation of resources, which include heavy equipment. ▪ Absence of ancillary fabricating and manufacturing industries

5.1.4.5.2 Action areas

a) NOCs as service providers

NOCs can offer their services to other operators in the region on a chargeable basis creating a win-win situation for the country as well as individual organisations. This can be beneficial for NOCs as well as other operators who require such services at an affordable cost. NOCs need to extend their services to third parties as well as to private operators in oil and gas sector in NER. NOCs can turn around their service centre from being a cost centre into a revenue centre. This will ease the availability of services in remote areas as both the NOCs have large base, experienced manpower and presence in remote locations. The government, therefore, needs to facilitate the NOCs.

Service that NOCs are providing currently includes:

- Seismic equipment for exploration,
- Drilling services,
- Workover services,
- Well completion services,
- Rigs for drilling,
- Services for technical challenges while production or remedial action to be taken in case of blowouts.

b) Service providers hub

Taking into consideration the challenges discussed above, it is important to establish service hubs in suitable locations in the region so that the E&P operators including the NOCs can avail those services

at a reasonable price. This will encourage exploration activity in northeast India as project economics will be viable for E&P operators. Once created, such hubs can accelerate development of other industries as well. Further, such a hub can cater to the demands of other countries such as Bangladesh and Myanmar due to proximity of location.

Key criteria for setting up of service hubs could be:

- Strategic location to cater to the blocks spread across the region.
- Connectivity with mainland and other hubs in the country.
- Land availability for creation of such hub.
- Good infrastructure with scope for creating common facilities like accommodation, medical, educational facilities etc.
- Simplified legal framework.
- Companies in free industrial zones (FIZs) to be allowed duty free import of raw materials, parts, machinery and equipment directly required in the manufacturing process.
- Exemptions from import duty, sales tax and excise duty.
- Cost-effectiveness in terms of operational costs, property costs, taxation benefits.
- Minimum administrative procedures for imports and exports.

However, considering the connectivity and logistic constraints in the northeast region, one hub may not be sufficient to cater to the demand of whole area. E&P operators and service providers in the region have also shared their concerns regarding the creation of hubs. Some of the locations suggested by these players are Jorhat, Dibrugarh, Agartala, Guwahati and Tinsukia.

Table 51: Service hub identification matrix for NER

Location	Connectivity			Blocks location (range)	Hotel facility	Medical facility	Education facilities	Other industry/sector projects
	Rail	Road	Air					
Guwahati	Yes	Yes/ Good	Yes	400 km	Yes	Yes/Good	Yes/Good	Yes
Jorhat	Yes	Yes/ Not Good	Limited	100 km	No	Yes/Below average	Yes/Limited	Limited
Dibrugarh	Yes	Yes/Not Good	Yes	100 km	No	Yes/Above Average	Yes/Good	Yes
Agartala	Limited	Yes/ Very Bad	Yes	100 km	No	Yes/Above Average	Yes/Limited	Limited
Dimapur	No/Limited	Yes/very Bad	Limited	200 km	No	Yes/Below Average	Yes/Very Limited	No
Imphal	No/Limited	Yes/Very Bad	Limited	200 km	No	Yes/Below Average	Yes/Very Limited	No
Tinsukia	Yes/Limited	Yes/Bad	No	100 km	No	Yes/Below Average	Yes/Very Limited	Limited

Source: CRISIL Infrastructure Advisory Analysis

Jorhat/Dibrugarh seem to be an ideal location for catering to the demand and service requirement of upper Assam and Arunachal Pradesh as both NOCs have producing as well as prospective exploration blocks in the vicinity. However, blocks in Tripura, Manipur and Mizoram may be difficult to access from Jorhat/Dibrugarh owing to connectivity constraints. Therefore, a hub in Agartala may be well suited to serve the demand and service requirement of Tripura, Manipur and Mizoram. Moreover, Agartala can be connected through Bangladesh to Kolkata to access the greater Indian market. It can also be accessed through the existing Chittagong port in Bangladesh. However, it will be restrained to serve the requirement in upper Assam, Arunachal Pradesh and Nagaland. Therefore, the hub can be located either at Guwahati or Jorhat/Dibrugarh to service the requirement of E&P developers. Further, a hub in Agartala can also be thought of in future as well.

Some of the incentives that would promote such a hub are as follows:

- Identification of land in Jorhat/Dibrugarh and Agartala for a service providers' hub by MoPNG along with state governments.
- Notification for SEZ in line with other hubs operating in area- SEZ and extension of all benefits available in other SEZs.
- Benefit to companies and their employees in terms of medical insurance re-imbursement for employees posted in these area and hubs
- Favourable tax benefits that may include Income Tax Holidays for service providers having base in NER.
- Setting up of medium and small scale ancillary fabricating and manufacturing industries to promote oilfield services sector

5.1.4.5.3 Action plan

The table below gives the action plan for improving availability of service providers in northeast India.

Table 52: Action plan for promoting availability of service providers in northeast India

Action items	Authorities concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (>5 years)
NOCs as service providers	ONGC & OIL	NOCs need to extend their services to third parties on a chargeable basis	Extension of services by ONGC & OIL.	
New hub	MoPNG/ Ministry of Finance	Study strategic utility of Jorhat/Dibrugarh and Agartala as hub	Development of service hubs in NER	
State/policy support				
Fiscal incentives	MoPNG/ Ministry of Finance	Favourable tax benefits that may include Income tax holidays for service providers having base in NER for 10 years	Offer fiscal benefits to service providers willing to participate in such hubs	
Industrial policy promotion	Ministry of Commerce & Industry/ State Govt	Explore various models most suitable for oil and gas sector	Develop free industrial zones or special economic zones	

5.1.4.6 Policy environment

5.1.4.6.1 Current scenario

The North East is endowed with huge untapped natural resources and is acknowledged as the eastern gateway of India's Act-East Policy. The ambiguity related to the economic potential has added fuel to the turmoil.

Despite a robust production-sharing contract (PSC) regime, Indian oil and gas block auctions have not been able to attract big players such as Exxon, Chevron etc. The reason could be attributed to uncertainty in policy implementation and government interference.

The North East Industrial and Investment Promotion Policy 2007 of the Government of India has laid down a number of fiscal incentives for investors in the region. The provisions of the NEIIPP, 2007 had requisite incentives as well as an enabling environment to speed up industrialisation of the region. The highlights of the incentives for all industrial units, new as well as existing units and on their substantial expansion, located anywhere in NER included excise duty exemption, subsidy on capital investment, subsidy on plants and machinery, power subsidy and transport subsidy. The Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, Government of India, issued a circular to all the eight NER states to convey that registration under the schemes of NEIIPP, 2007 had been suspended with effect from December 1, 2014.

Oil & gas industry was never included in NEIIPP due to budget limitations, but NEIIPP has been able to lure small as well as large business establishments to set up their business in the state.

State governments play an important role in facilitating E&P activities, for both on-land and offshore blocks. One of the major bottlenecks facing E&P operators is the delay in awarding requisite approvals and clearances by the centre and state governments. This not only adversely affects investor sentiment but also results in significant project delays and financial losses for operators. As per current rules, the union government issues PELs/MLs in consultation with the state governments. State governments play a vital role in supporting environment approvals, facilitating land acquisitions etc. This indicates that support from state governments for E&P activities is critical. In the case of offshore blocks, issues such as siting of on-shore terminals, provision of support services and creation of pipelines for evacuation of hydrocarbons require significant state government support.

5.1.4.6.2 Latest developments

Exploration licensing policy

- OALP: To make India a favourable destination globally for exploration of oil and natural gas, the government plans to move to the OALP policy regime soon which is under formulation at present. This will enable upstream companies to bid for any oil and gas block without waiting for the announcement of bidding under the new exploration licensing policy (NELP) regime.
- The proposed uniform licensing policy for award of hydrocarbon acreages under a new contractual system and fiscal model will lift all restrictions on explorers hunting for hydrocarbons. In keeping with what the explorers have been seeking for long, they can hunt for all kinds of resources: oil, gas, coal-bed methane and shale gas. Launch of open acreage licensing policy (OALP) regime to explore hydrocarbons depends upon the readiness of the national data repository (NDR). The contract has been awarded to M/S Halliburton on February 28, 2014. Currently, initial data population phase of the NDR project is going on. The NDR centre is likely to be open for public in March 2016 once initial data population is over. However, setting up the infrastructure to feed the data in the system is bound to take some time. DGH is the coordinating body for NDR. The NDR will be hosted at the DGH office in Noida. The government had amended Rule 19 of the petroleum and natural gas rules to enable DGH obtain all the data from various operators or licensees, which could be disclosed to prospective bidders as and when required under the open acreage system.
- Open acreage will enable bidders to bid for blocks on offer at any time of the year. Data for the blocks will be made available to bidders through NDR. Pakistan also has such a system in place. The NDR is expected to play a much larger and significant role in the exploration and production

scenario in the years to come. It will also facilitate gathering of all geo-scientific data available in India under one roof so that it is easily available to the agencies that require it.

- GOI has recently approved the Marginal Field policy, which will further provide opportunities to enhance the production from isolated and unexplored areas. The Union Cabinet approved the Marginal Field Policy (MFF), on September 2, 2015, for development of hydrocarbon discoveries made by national oil companies. These discoveries could not be monetized for many years due to various reasons such as isolated locations, small size of reserves, high development costs, technological constraints, fiscal regime etc.
- Survery of unexplored areas in NER will enable further resource conversion from the prognosticated to established reserve category. The advent of new technology for exploration in oil and gas segment, which is described in the section on resource conversion from yet to find areas, will lead to significant increase in oil and gas resource potential from the region.

5.1.4.6.3 Action areas

Sector policy framework

- Categorise high risk areas, considering the tough conditions and connectivity issues, into a separate category, i.e., challenging blocks. According to Oil India, NER blocks falling in the hilly regions and Brahmaputra River bed areas can be termed as challenging blocks. This will cover all of Mizoram, Manipur, Tripura, Nagaland, Meghalaya, Arunachal Pradesh and parts of Assam (Karbi Anglong, Dima Hasau, Sadiya, Brahmaputra Riverbed area etc.).
- The government should focus on production maximisation by paying premium on prevailing gas price for gas produced from challenging blocks, which may make many blocks commercially viable.
- Implementation of OALP and identify larger acreages.
- Only those blocks for which environment and forest clearances are available should be made available for bidding (from earlier process of in-principal approval) as it reduces the risk for bidder and will increase competition in attractive blocks.
- Revenue maps/forest land demarcation maps should be made available to private parties along with bidding documents.
- Timeline and penalty in challenging blocks needs to be relaxed as compared to rest of India blocks.
- Build the national geo data repository and launch OALP — this allows prospective bidders to look at the data any time and offer a bid to explore in the most transparent manner.
- To encourage participation of operators in the appraisal of Indian basins, companies should be authorised to carry out seismic surveys in chosen blocks and should be given right of first refusal (ROFR) when the acreage is subsequently put up for bidding.
- Flexibility should be given to completion of MWP on alternate blocks: As per bids submitted under NELP, companies have to bid for minimum work programme (MWP) to be carried out, consisting of 2D and 3D seismic surveys and drilling of exploratory wells. The operator has to carry out the committed MWP or face penalties. However, if additional exploration activity leads to no incremental value, the operator should be given the flexibility of carrying out the outstanding MWP on a different block with similar characteristics where the operator holds a valid exploration licence.

Clearance and approvals

- Provide safety and security to goods and services of operators.
- The process of attaining approvals and clearances should be streamlined such that 'in-principle' approval or clearances that are granted should be honoured and not warranted-approval'. 'In-principle' clearances must be carefully evaluated prior to award and may highlight 'exceptions' or 'no-go areas'. Also, approvals not received within the set timeframe should be deemed as obtained.

Single window clearance/Approval should be provided for such projects. This will reduce the procedural delay in exploration and production activities.

- Exploratory drilling should be exempted from EC and FC. Exploratory drilling is usually a short duration temporary activity lasting a few months (~ 6 months). However, the present policy mandates obtaining of environmental clearance (EC) for exploratory drilling activities equating it with any other industry. Therefore intervention is sought for dispensation to exempt exploratory drilling from the purview of EC. Further, EC and FC clearances should come under the ambit of state government. The table below shows the list of blocks in which development work is held up due to lack of EC and FC clearances:

Operator	State	Block
Oil India	Assam	AA-ONN-2009/4
Oil India	Assam	Mechaki Block
Oil India	Assam	Doomdoma PML block
Oil India	Assam	Khagarijan and east Khagarijan block
Oil India	Assam	Naharkatiya – Deohal – Bagapani – Nagajan block
Oil India	Assam	Karbi Anglong block
Oil India	Arunachal Pradesh	Ningru PML
Oil India	Arunachal Pradesh	Deomali PEL
Oil India	Arunachal Pradesh	Namchik PEL
Oil India	Arunachal Pradesh	Jairampur Extn. PEL
Jubilant Oil & Gas Pvt. Ltd.	Tripura	AA-ONN-2002/1
ONGC	Assam	Khoraghat ML Extn.
ONGC	Assam	Golaghat District PEL,
ONGC	Assam	Kasomarigaon & Kalyanpur PML
ONGC	Assam	Sivsagar District PEL,
ONGC	Assam	Panidihing M
ONGC	Assam	North-Rudrasagar-Disangmukh ML, Assam
ONGC	Assam	Block AA-ONN-2009/3
ONGC	Assam	AA-ONJ/2 (Cachar district)
ONGC	Tripura	4 Locations falling in Tichna PML viz. TIAG, TIAF, TIAC and TL

Source: ONGC, OIL

Areas in which PEL-PML grants are awaited for ONGC are given in table below:

Area	Status	Agency
Grant of PEL/PML,	Golaghat district PEL (54.4 Km2): Grant awaited from State Govt.	Govt. of Assam
	Badarpur (2.3 Km2): GoI approval required in original by state Govt.	Govt. of Assam
	North patharia (60 Km2): Revised application submitted on 12.08.2014. Grant awaited from State Govt.	Govt. of Assam
	Adamtila PML (4 Km2): Under DGH/MoPNG consideration. Grant awaited from State Govt.	DGH/MoPNG & Govt. of Assam
	Adamtila Extension PML (148 Km2): Grant awaited from State Govt.	Govt. of Assam
	Sector V C PML(497 Km2): Grant awaited from State Govt	Govt. of Assam
Nambar PML,	ML Area falls along boundary of Disputed Area Belt between two States of Assam and Nagaland. Nambhar Extn. PML (Applied): Exploratory location KHAR and CJAA pending. Nambhar PML (Applied): Exploratory location NRAD pending.	Govt. of Assam and Nagaland.
Geleki ML, Geleki Extension ML, Namti ML, South East Geleki ML, Assam	ML Areas falls along boundary of Disputed Area Belt between Assam and Nagaland. Exploratory works postponed due to pending of approval from both Assam & Nagaland State Governments. Exploratory released locations like BSAA, GKBD and GKBI fall in this area could not be taken up for drilling. Disputed Area Belt (DAB), Approval from both Assam and Nagaland Govt. is awaited.	Govt. of Assam and Nagaland.

Source: ONGC, OIL

Further, there is work held up in three nomination blocks viz, Dimapur, Bhagti-Bhandari and Singphan and two NELP blocks viz., AA-ONN-2001/4 & AA-ONN-2002/4 for want of signing of MOU between ONGC and state government of Nagaland. Work is also held up in Geleki RF area due to border dispute between Assam and Nagaland. The details of the blocks mentioned above and the various issues associated with them are given in Annexure XII.

- Batch clearances should be operational for certain areas with certain timeline say (2 years) irrespective of number of wells in that area. This will reduce the time of getting clearances in case of drilling an alternate well due to land availability and other issues. For example, MoEF can grant EC to 50 wells to be explored in area of 5 sq km radius of a particular location.
- State governments have a stake in oil and gas exploration and are entitled to royalty accrual for on-land production and 50% share in profit of petroleum. State governments should be made aware of their potential financial interests from E&P operations, which extend beyond royalty, profit share and sales tax receipts, and could arise from the downstream activities undertaken within the state.

5.1.4.7 Re-allotment of relinquished blocks to NOCs

In the PSC regime, the contractor has an option to relinquish contract area after completion of MWP or proceed to the subsequent exploration period and retain the contract area by committing to carry out drilling of one well per year in the contract area (in case of on-land and shallow water blocks) / one well in 3 years in the contract area (in case of deep water blocks). At the end of the exploration period the contractor retains only the development and discovery areas and, all contract area except development and discovery areas have to be relinquished.

Therefore, the following suggestions can be evaluated to ensure all possibility of oil& gas production in Northeast India.

- Such relinquished areas in NER should be given back to NOCs on a nomination basis for exploration and production.
- These areas were previously relinquished due to inability of companies to make any discoveries in these areas. However, since that time, technologies have improved and further exploration in such areas may lead to newer oil and gas finds.

As the area is small for companies to bid in challenging areas, new bidders may not be interested in bidding this area.

5.1.4.7.1 Details of relinquished blocks

The details of relinquished blocks by ONGC and OIL are covered in this section. The table below shows the details of areas in which OIL has relinquished completely or part of the area awarded, and the area desired by the company for carrying out further E&P activity.

Table 53: Relinquished area that may be useful for OIL

S.No.	PEL name	Original area (sq km)	Relinquished area (sq km)	Present area (sq km)	Area desired (sq km)	Remarks
1	Dibrugarh	1230	428	nil	300	Additional PEL in Brahmaputra Riverbed
2	Tinsukia	1685	480	471	Nil	Including in Brahmaputra Riverbed part
3	Murkongselek F	191	191	Nil	191	Including in Brahmaputra Riverbed part
4	Murkongselek	1307	1307	Nil	1307	Including in Brahmaputra Riverbed part
5	Lakhimpur	4200	4200	Nil	550	In Brahmaputra Riverbed part only
6	Sadiya	1130	1130	161 (NELP IX block)	900	Including in Brahmaputra Riverbed part only
7	Margerita	750	750	Nil	750	
8	Jairampur	170	152	18	163	
10	Deomali PEL	365	351.5	113.5	351.6	
11	Namchik	260	65	195	65	
12	Namsai	494	494	Nil	494	

Source: OIL

Similarly, ONGC has provided a list of blocks, which have been relinquished over time due to issues in the DAB area.

Table 54: Relinquished areas of ONGC under the nomination regime

S.No.	PEL name	Original area (sq km)	Relinquished area (sq km)	Present area (sq km)	Area desired (sq km)	Remarks
1	Sivasagar District	1183	304	87	304	Mandatory relinquishment 25% in Nov.2011 during current PEL cycle
2	Golaghat Ext-IIA	317.5	192	-	192	Area relinquished after PEL expiry in Dec.2011
3	Cachar District	1470	365	732 as limited period PML	365	Area got relinquished after Partial grant of 732 sq.km as 7 year PML in Mar-2008
4	Sector-VC	1650	291	497	291	Area got relinquished after Partial grant of 497 Sq.km as long term PML in March-2009
5	North Agartala	500	211 (123+88)	288 as North Agartala PML	88	Mandatory 25% relinquishment in 2003 at the beginning of last PEL cycle. And 88sq.km after PEL expiry in Jan-2011
6	Large Area in Tripura	1260	151	1012.71	151	Mandatory relinquishment 25% in DEC-2003
7	West Tripura	3100	364	1327 sq.km as PML	-	In Sept-2008
8	Merapani	160	40	-	-	At the beginning of last PEL Cycle in 2003
9	Golaghat district	245	30	-	-	At the beginning of last PEL Cycle in 2003
10	Karbi-Anglong	620	155	-	-	At the beginning of last PEL Cycle in 2003
11	Kopili Valley	5330	2025	-	-	At the beginning of last PEL Cycle in 2003
	Sector-IX	3820	Total	-	-	Could not expend any input in PEL cycle. Issue with State Govt.
	Sector-X	3168	Total	-	-	

Source: ONGC

Initially, ONGC held close to 10,612 sq km of area in NER; after relinquishment, the area available with ONGC is around 3,704 sq km (relinquished around 6,908 sq km). However, of this, 2,660 sq km (72%) is in Mizoram wherein limited exploratory inputs can be expended in tune with PSC and committed programme.

A rough estimation is that offering of relinquished area to OIL may increase production of around 0.2-0.3 MMTPA in another 3-5 years.

Details of blocks relinquished under the PSC regime have been given in the table below:

Table 55: Details of blocks relinquished under PSC regime

S. No.	Block	Operator	Bidding Round
1	AA-ON/3	Okland	Pre-NELP
2	AA-ONN-2003/2	Geo-Petrol	NELP V
3	AA-ONN-2003/3	OIL	NELP V
4	AA-ONN-2004/1	OIL	NELP VI
5	AA-ONN-2004/2	OIL	NELP VI
6	AA-ONN-2004/3	EOL	NELP VI
7	AA-ONN-2004/4	Naftogaz	NELP VI
8	AA-ONN-2005/1	ONGC	NELP VII
9	AA-ONN-2010/1	PPCL	NELP IX
10	AS-ONN-2000/1	RIL	NELP II
11	CR-ON-90/1	Premier Oil	Pre-NELP
12	MZ-ONN-2004/2	Naftogaz	NELP VI

5.1.4.7.2 Action plan

The table below provides action plan that needs to be carried out for improving the policy environment in northeast India.

Table 56: Action plan for policy framework and approvals

Action items	Authorities concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (>5 years)
Sector policy framework				
Identification of high risk areas/challenging areas in NER by DGH as per past records and experience and categorise them as “challenging areas”.	DGH/MoPNG	Review for implementation		
Relaxation in timelines for challenging blocks to be revised to 12 years (8+4) from current 7 years (4+3) available for NER blocks considering only 6-7 months are available for survey and exploration.	MoPNG/DGH	Review for implementation		
Extension of tax holiday from 7 years to 12 years for challenging areas in future contracts to make blocks economically viable and attract bidders’ interest in future.	MoPNG/DGH	Review for implementation		
Making data and revenue maps available in NER Area to bidders during bidding.	DGH	Review for implementation		
Clear extension policy of PSC agreement to facilitate more investment	DGH/MoPNG	Implementation		
Inclusion of policy on giving flexibilities to operator on carrying out outstanding MWP on similar blocks where operator holds an exploratory license, in PSC	DGH/MoPNG	Review for implementation		
Inclusion of policy on giving flexibilities to operator on carrying out outstanding MWP on similar blocks where operator holds an exploratory license, in PSC	DGH/MoPNG	Review for implementation		

Action items	Authorities concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (>5 years)
Clearance and approvals				
Single window clearance to all oil & gas projects	MoEF	Review of single window clearance mechanisms for oil and gas projects in northeast region		
Exemption from environment clearance for exploratory drilling	MoEF	Review Review of implementation of mechanisms for the exemption		
Batch clearance to drilling wells (Within specified area)	MoEF	Review Review of implementation of such mechanism so that operator can get batch clearances		
Boundary demarcation of forest and non-forest area in land records	State government/ MoEF		Start updating land records so that type of land is clearly demarcated	
Availability of data - Topo sheets /revenue maps	State government	Review for implementation		
Offering of relinquished blocks/areas to NOCs				
Offering of relinquished areas to NOCs on a nomination basis for E&P	MoPNG/DGH	Identification of relinquished areas by NOCs and submission of list to DGH. Estimation of exploration acreage and tentative production potential need to be submitted to DGH. First refusal rights to be given to company having operations in proximity to relinquished area.		

Detailed calculation on analysis of revenue to states for increased production of oil & gas is given in annexure XI.

5.1.5 Zero phase of exploration

The concept of zero phase of exploration should be introduced, wherein the company holds discussion and talks with the local community, clearly highlighting the impact of oil and gas exploration and production activities and the measures that would be taken by the E&P Company to mitigate any such social and environmental impact. The details of zero phase of exploration are given below:

- Zero phase of exploration to last for a period of six months and extendable by a period of three months.
- A state/district level agency to be set up to facilitate interaction between the company and the local community.

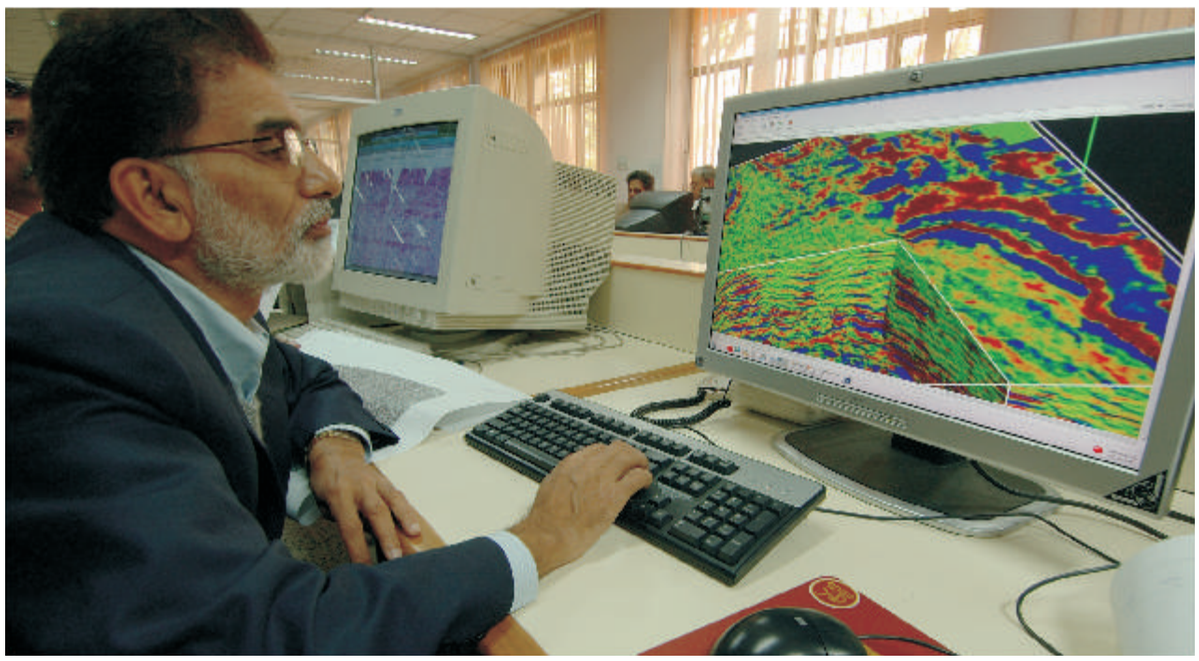
- The agency to facilitate the participation of the company and local community in socialising programmes, which are intended to create opportunities for dialogue and confidence building between the parties.
- The company to hold discussions with the local community regarding the potential impact of E&P activities on the local community.
- The company to highlight the measures to be adopted for mitigating any hazardous impact.
- The company and the representatives of the community to arrive at compensation that is to b e offered to the community members for use of land and resources of the community.
- The company to make the community aware about the development activities on social, economic, cultural and environmental fronts that will be carried out by the company.
- At the end of the zero phases, the company has an exit option if it is unable to come to agreement with the local community.

5.1.5.1 Action plan

The table below provides action plan needs to be carried out for including zero phase exploration period

Table 57: Action plan for zero phase of exploration

Action items	Authorities concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (>5 years)
Concept of zero phase exploration period to be included in the PSC, wherein the E&P company and the local community develop a platform for interaction	DGH/MoPNG	To be implemented in the new bidding rounds		
Setting up of a local agency to facilitate the interaction between company and local community	State Government/ MoP&NG	To be implemented		



6. Midstream

6. Midstream

In India, crude oil and petroleum products are transported by pipelines, rail, and road. Of these, pipelines account for the largest share. Given its characteristics, gas is primarily transported by pipelines. The advantages of pipeline transport compared with other modes of transport are given below.

Table 58: Advantages / disadvantages of using pipeline

Advantages	Disadvantages
▪ Lower transport cost ▪ Lower transit losses ▪ Lower energy intensity ▪ Economies of scale ▪ Safety & reliability - minimum disruptions. ▪ Environment-friendliness ▪ Ability to handle multiple products ▪ Stationary carrier ▪ Capacity Augmentation at low cost ▪ Minimal land costs ▪ Decongestion of surface transport systems	▪ Nonflexible ▪ Economical only after certain volumes are transported.

The table below clearly indicates that transportation by pipeline is far cheaper compared with either road or rail.

Table 59: Capital and operating cost of different modes

Particulars	Pipelines	Road (4 Lane)	Rail
Capital cost (Rs Cr/km)	4.5	5-6	10-12
Operating cost (Rs/t/km)	0.54*	4-5	2-2.25

Source: CRISIL Infrastructure Advisory Analysis
**Present cost for IOCL 0.49, BPC 0.53 and HPCL 0.60/t/km.*

6.1 Crude oil pipeline

6.1.1 Existing network

Currently, Northeast India has a crude oil pipeline network of over 1,500 km that is operated by Oil India Ltd (OIL) and ONGC; OIL is the largest player with a network of about 1,192 km. The company operates a 1,157 km cross-country pipeline spanning Naharkatia to Barauni that feeds regional refineries with crude oil produced by OIL, ONGC, and JVC as well as imported crude (by reverse pumping from Barauni to Bongaigaon). OIL operates another pipeline from Duliajan to Digboi to cater to Indian Oil Corporation Ltd (IOCL). Similarly, ONGC operates pipelines in the Lakwa-Moran, Geleki-Jorhat and Borholla-Jorhat sections.

Table 60 Crude oil pipelines in the Northeast

Company	Pipeline	Capacity (MMTPA)	Length (in km)	Supply to	Supply from
OIL	Section 1 (Forward) Duliajan- – Numaligarh-Guwahati 16”	5.38	401	NRL, IOCL Guwahati	OIL & ONGC
OIL	Section 2 (Reverse) Barauni-Bongaigaon 14”	3.00	600	IOCL Bongaigaon	Imported Crude
OIL	Duliajan-Digboi 14”	0.65	35	IOCL Digboi	OIL
ONGC	Lakwa – Moran	1.5	18	OIL	ONGC
ONGC	Geleki – Jorhat	1.5	48.5	OIL	ONGC
ONGC	Borholla – Jorhat	0.6	42.8	OIL	ONGC

Source: OIL, ONGC

6.1.2 Upcoming network

6.1.2.1 Paradip-Numaligarh imported crude oil pipeline

Crude oil production from oil blocks in the Northeast is insufficient to fully utilise existing refining capacity in the region, which already has an excess of 2.4 MMTPA. Nevertheless, NRL proposes to draw a 1400-km dedicated crude oil pipeline from the Paradip port and expand refinery capacity from 3 MMTPA to 9 MMTPA by 2020. The project is expected to cost Rs 5,000 crore.

The pipeline passes through Odisha (194 km), West Bengal (754 km) and Assam (450 km). and crosses the Brahmaputra from its north bank to the south bank at Gohpur before reaching Numaligarh.

6.2 Natural gas pipeline network in Northeast India

6.2.1 Existing network

Currently, the northeast has a natural gas pipeline network of over 950 km, of which Assam Gas Company Ltd (AGCL) operates the largest chunk (of over 434 km). Other major players are GAIL and ONGC.

Table 61: Existing natural gas pipelines in Northeast India

Route	Owner/Op	Length (km)	Supply from	Supply to	Supply (mmscmd)
Duliajan-Namrup-Lakwa 16”	AGCL	81	OIL	Lakwa TPP	0.67
Duliajan-Namrup 20”	AGCL	23	OIL	Namrup TPP	1.082
OIL-AGCL(Duliajan) Pipeline 1”	AGCL	32	OIL	-	0.00
Duliajan-Numaligarh Pipeline 16”	DNPL	192	OIL	NRL	0.91
AGCL(Duliajan) – Namrup (BVFCL) Pipeline- HP 16”	AGCL	25	OIL	BVFCL	0.65
AGCL(Duliajan)-Namrup (BVFCL) Pipeline-LP 16”	AGCL	25	OIL	BVFCL	1.24
Duliajan – Namrup (BVFCL) Pipeline) 14”	AGCL	26	OIL	BVFCL	0
Kathalguri – NEEPCO Pipeline 22”	AGCL	7	OIL	NEEPCO TPP	1.83
Namrup (NTPS) - APL, Namrup Pipeline 4”	AGCL	1	OIL	APL	0.10
Wilton(Tengakhat)–Madhabpur(Duliajan) Pipeline 12”	AGCL	22	OIL	-	0.00
Duliajan-Moran Pipeline	AGCL	78	OIL	CGD	0.067
Bhekulajan-Dibrugarh Pipeline	AGCL	47	OIL	CGD	0.164
Tenghakhat-DoomDooma Pipeline	AGCL	54	OIL	CGD	0.118
Kushijan (Digboi)-DoomDooma Pipeline	AGCL	28	OIL	CGD	0.000
Digboi-Margherita Pipeline	AGCL	23	OIL	CGD	0.067
Lakwa-Jorhat/Golaghat Pipeline	AGCL	117	OIL	CGD	0.093
Koraghat-Uriumghat -Golaghat Pipeline	AGCL	58	OIL	CGD	0.048
Lakwa 24”	GAIL	8	ONGC	ASEB, Tea,LPG	0.52
Tripura 12”	GAIL	61	ONGC	NEEPCO, TNGCL,TSECL	1.44
Agartala- OTPC	ONGC	35	ONGC	OTPC	
Duliajan – Dibrugarh	BCPL	49	OIL	BCPL	N.A.

Source: AGCL, ONGC, GAIL

The table shows that natural gas pipelines exist only in a few pockets, mainly covering parts of key demand centres such as Assam and Tripura. The existing gas pipeline network in the northeast is around 950 km, with a cumulative capacity of 13.98 MMSCMD. As the demand of network gas is expected to double by 2030, the present capacity will not be able to cater to demand requirements and hence needs to be expanded.

6.2.2 Planned network

Given the inadequacy of the current pipeline network, pipeline operators are making plans to connect major demand centres in the region. The planned route of the gas grid in the northeast is shown below.

a) National gas grid (Barauni- Siliguri-Bongaigon-Guwahati pipeline network)

The network is proposed to span 800-900 km and is expected to cost Rs 3,600-4,050 crore. Once completed, all key gas demand-supply centres in the region will be connected. However, the project is economically non-viable and still to take off.

Besides connecting the Northeast to the national gas grid, the gas-producing station needs to be connected to other demand centres. As Mizoram and Tripura will account for bulk of gas production, it is imperative to connect these two states on a priority basis. Further, as Barauni is already being connected to the national gas grid through Jagdishpur-Barauni pipeline, it makes sense to propose pipeline from Barauni to the rest of the Northeast. The figure below is the geographical map of the pipelines considered for feasibility network.

Figure 29: Geographical map of Barauni-Siliguri-Bongaigon-Guwahati pipeline

b) Proposed gas pipeline - Duliajan-Guwahati (by OIL)

The 1 MMSCMD Duliajan-Numaligarh gas pipelines, with utilisation rate of 75-80% is proposed to be extended to Guwahati and subsequently to Bongaigaon for catering refineries. AGCL has carried out pre-feasibility survey on this route. However, the project has not progressed further.

6.3 Product pipelines in northeast India

6.3.1 Existing pipelines

Currently, the region has a product pipeline network of over 1,126 km that transports petroleum products such as diesel, petrol, etc, from refineries to different locations. OIL is the largest player with a network over 654 km; followed by IOCL.

Table 62: Existing product and LPG pipelines in Northeast India

Route	Owner	Length	Capacity (MMTPA)	Supply from	Supply to	Through put MMTPA	Utilisation
Guwahati-Siliguri (GSPL)	IOCL	435	1.4	IOCL GWH, BGN	Siliguri	1.79	128%
Digboi-Tinsukia Product Pipeline (DTPL)	IOCL	37	0.5	IOCL Dig	Tinsukia	0.50	100%
Numaligarh-Siliguri (NSPL)	OIL	654	1.7	NRL	Siliguri	1.81	105%
TOTAL (MMTPA)			**3.6**				

Source: IOCL, OIL

These pipelines have limited capacity and are running at over 100% utilisation. All the four refineries in the Northeast use existing product pipelines. However, due to capacity constraints of these product pipelines, the refineries have been able to transport only around 61% of products through these pipelines. As a result, refineries are forced to use costlier alternate modes such as road and rail. Moreover, transportation via road is often delayed due to frequent bandhs and blockades in the region.

Table 63: Transportation of petroleum products using various modes in Northeast India

Refinery	Installed capacity (2015) in MMTPA	Installed capacity (2030) in MMTPA	Output in 2014-15 (MMTPA)	Pipeline (MMTPA)	Truck (MMTPA)	Rail (MMTPA)
Numaligarh Refinery	3.00	9.0	2.76	1.81	0.59	0.3
IOCL Guwahati	1.00	1.70	1.00	0.89	0.18	0
IOCL Digboi	0.65	0.65	0.599	0.48	0.12	0
IOCL Bongaigaon	2.35	4.5	2.332	0.89	0.34	1.0
Total	7.00	15.9	6.691	4.08	1.25	1.39
%	100%		**95.6%**	**61%**	**19%**	**21%**

Source: NRL, IOCL

6.3.2 Upcoming pipelines

Refining capacity in the Northeast is expected to increase to 15-16 MMTPA by 2020 (with NRL and IOCL expanding capacity at their existing refineries at Numaligarh, Guwahati & Bongaigaon).

However, transportation of petroleum products from these refineries will be a challenge given the road and railway network. Therefore, product pipelines need to be planned and executed in a timely manner to ensure efficient product transportation.

Further, if product pipeline capacity is augmented, refineries in the Northeast can also export petroleum products (subject to pricing considerations), to neighbouring countries such as Bangladesh, Myanmar and Bhutan. Considering such opportunities, NRL in collaboration with Bangladesh Petroleum, plans to set up a 135-km product pipeline from Siliguri in India to Parbatipur in Bangladesh. The project is expected to be completed by 2017.

Similalrly, IOCL plans to set up a pipeline linking Guwahati and Silchar; however, its technical feasibility is yet to be established. This proposed pipeline from Guwahati refinery to IOCL's Silchar depot with enroute connectivity to the existing Lumding depot will not only connect two of IOCL's depots but will also reduce secondary logistics costs of supplying products to locations that are presently linked to distant and uneconomical sources.

IOCL is expected to submit a feasibility report for the Guwahati-Silchar-Imphal pipeline. However, considering its length and the low volumes required at Imphal, this pipeline also will not be financially viable and will require viability-gap funding from the government.

Table 64: Proposed POL pipelines in NER

Pipelines considered for feasability	Owner/ Operator	Length (km)	Proposed capacity (MMTPA)[3]
Siliguri-Parbatipur (Proposed)	NRL	130	1 MMTPA
Numaligarh-Siliguri Expansion (Proposed)	NRL	600	6 MMTPA
Numaligarh-Dimapur-Imphal (Proposed)	NRL	304	-NA
Numaligarh-Gohpur-Itanagar (Proposed)	NRL	54	0.5 MMTPA
Guwahati-Lumding-Silchar-Imphal (Proposed)	IOCL	610	NA

Source: NRL, IOCL

6.3.3 LPG pipeline network in Northeast India

6.3.3.1 Existing network

Currently, northeast India transports LPG through bullet tankers/packed trucks. However, supply by road often suffers from regular interruptions, especialy when trucks ply to distant destinations. The absence of an LPG pipeline network and issues in LPG supply via road and rail network have adversely affected LPG coverage situation in the region. Further, movement of a large number of heavy vehicles increases traffic congestion.

6.3.3.2 Upcoming pipelines - Numaligarh-Dimapur-Imphal

To improve LPG supply in remote areas, IOCL proposes to build a pipeline that will connect the Numaligarh refinery (in Assam) with Imphal (in Manipur). The Numaligarh refinery will achieve a capacity of around 9 MMTPA in 2021. By linking Imphal through a pipeline, LPG can also be supplied to Dimapur BP, Sekmai BP and, through further nodal movement, to Mualkhang BP (in Mizoram) for which Sekmai BP can be used as a nodal point for loading tankers. Pipeline connectivity will ensure uninterrupted LPG supply, which, in turn, will also reduce the need to transport LPG by road.

The pre-feasibility study for the Numaligarh-Imphal LPG pipeline has been completed. However, as the pipeline will be laid through difficult terrain and remote areas, numerous security concerns will crop up while the pipeline is being constructed and operated. Special permissions will have to be obtained Central/state authorities concerned, namely the MoEF & CC, Ministry of Tribal Affairs, Ministry of Urban Development, public works departments of respective states, etc. for laying the pipeline in the NHAI/state highway corridor. Other permissions will also have to be taken for acquiring land in tribal areas, laying the pipeline in reserve forests, etc. Project is estimated to cost about Rs 470 crore. The annual operating cost as per the initial study is Rs 20 crore. The proposal seeks viability gap funding of about Rs 260 crore (or 58% of total capital cost).

6.4 Issues and Challenges

Gas evacuation in northeast India is extremely challenging for multiple reasons. It may be noted that most of the gas in upper Assam is 'associated gases' and a few small and isolated gas fields. Free gas though not very large in quantity, is largely locked up due to the isolated location of the fields and lack of local consumers. Further, existing gas networks are not interconnected; of course, interconnectivity may not be warranted considering the small volumes and long distance between

supply and consumption points. One option for monetising the isolated gas is by incentivising end-users to set up units in vicinity of these fields.

6.4.1 Pipeline capacity

6.4.1.1 Crude oil pipeline

Crude oil pipelines in the northeast have sufficient capacity to transport locally produced oil to the refineries. However, due to declining oil production, refineries have to import oil from other parts of the country. This has been a challenge as the region is not well connected to other parts of the country to enable transportation. Moreover, refineries in the region are planning their expansion assuming dependence on imported crude oil. Moreover, the regional pipeline network needs to be expanded so as to spur oil extraction.

OIL pipeline (Barauni-Bongaigaon section - reverse pumping)

The Bongaigaon-Barauni crude oil pipeline was established to transport excess crude oil from northeast India to the Barauni refinery. However, production of crude oil has declined steadily over the years and this section is used to reverse-pump imported crude from Barauni to Bongaigaon. Crude oil for Bongaigaon refinery is being imported through the Paradip port and transported to Haldia through the Paradip-Haldia crude oil pipeline. Thereafter, crude oil moves from Haldia to Barauni via the Haldia-Barauni pipeline.

To improve efficiency, OIL is in the process of abolishing two pump stations, which may reduce this pipeline's capacity to some extent. The project (to reduce the pipeline capacity to 2 MMTPA from 3 MMTPA) has already started and is expected to be commissioned soon.

As per OIL, this pipeline will still be sufficient to feed required crude oil to the Bongaigaon refinery and will not impact IOCL Bongaigaon's operations. However, the capacity of this pipeline can be increased incase there is a capacity expansion plan of IOCL Bongaigaon refinery later, provided both OIL and IOCL mutually agree for the same.

The Barauni-Bongaigaon pipeline should also be able to meet the gap between crude oil production in the Northeast and the maximum capacity of all four refineries (7 MMTPA) at present. Further, the imported crude oil needs to be transported even to the Guwahati refinery. IOCL believes, that as crude oil availability in the Northeast declines, crude oil imports through this pipeline will help refineries maintain utilisation rates. So, if its capacity is reduced, refineries in the region could face crude oil shortage. It was therefore suggested that OIL, if required needs to commission the new facilities to check the guarantee and thereafter revert to the old pumping system to ensure full supply of imported crude oil to refineries in the region. Meanwhile, OIL has to take steps to enhance the capacity of the pipeline back to 3.0 MMTPA by modernising the two intermediate pump-stations that are proposed to be shut.

To supply imported crude oil up to the Guwahati refinery, OIL has to implement some necessary modifications for pumping imported crude oil from Bongaigaon to Guwahati.

6.4.1.2 Natural gas pipeline

Major pipelines are connected from the gas fields to the refinery, fertilizer plant, cracker plant, power plants, and CGD in upper Assam and Tripura, where bulk of the pipeline network has been set up. No long distance pipeline exists in the region other than the Duliajan-Numaligarh gas pipeline. Given such a lack, gas (see table below) is flared from different fields of ONGC, OIL, and others.

Table 65: Gas flaring in northeast India in MMSCMD

Flare of gas	Assam	Arunachal Pradesh	Total
OIL	0.075	0.025	0.100
ONGC	0.083	0.000	0.083
Others	0.000	0.020	0.020
Total	0.1580	0.0450	0.203

Source: ONGC, OIL & Others

Table 66: Locations where gas is flared

Sr. No	Name of the company	Locations
1	Oil India Limited	▪ Assam: Makum, Habeda,Baghjan, Mechaki ▪ Arunachal Pradesh:Kumchai
2	Oil & Natural Gas Corporation	Geleki, Borholla, Koraghat,Nambhar,Kasomarigaon
3	Others	Kharsang

Source: OIL, ONGC and Others

Further, lack of connectivity to the national gas grid and lack of adequate gas supply has restricted growth of the natural gas market. The region will have to therefore tap neighbouring countries such as Myanmar, where there is excess output, by way of establishing pipeline connectivity.

While linking northeast India's needs to the grid, connectivity must be established especially with Tripura, Manipur, Meghalaya and Assam (Guwahati) to cater the needs of the medium and small scale industry, steel plants and other commercial establishments.

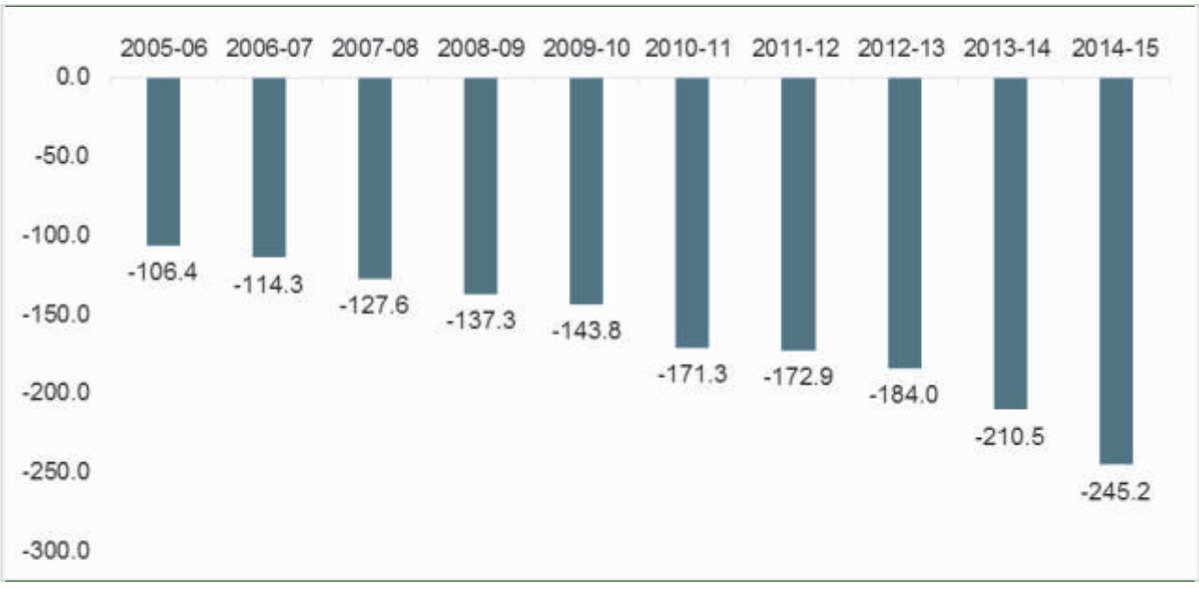
6.4.1.3 Product pipeline

Refineries have been able to transport only 61% of output via existing pipelines, which are overutilized. Transportation via road is often delayed due to frequent bandhs and blockades.

6.4.1.4 LPG pipeline

LPG is wholly transported via bullet tankers/packed trucks. Supply by road is often subject to various interruptions, if trucks ply over long distances. Moreover, LPG processing capacity of refineries lags ever-rising demand.

Figure 30: LPG shortage in northeast India (TMTPA)



Source: CRISIL Infrastructure Advisory Analysis

6.4.2 Policy issues

6.4.2.1 Tariffs

Tariff/price structure is a major hurdle in setting up pipelines. Different tariffs to transport the same amount of gas across the same distance in different parts of the country makes the infrastructure uneven. There is a debate favouring uniform pipeline tariff for all customers, irrespective of their distances from the gas field. Uneven geographical distribution of existing pipelines enables states

closer to gas sources devour the benefits of higher utilisation, and develop local markets. It is to be noted that of the 12,144 km of gas pipelines in India, around 60% is concentrated in Maharashtra, Gujarat, Delhi, Uttar Pradesh, Haryana and Rajasthan.

6.4.2.2 Right of way

This is a type of easement granted or reserved over land for transportation; this can be for a highway, public footpath, rail transport, canal, as well as electrical transmission lines, oil & gas pipelines. However, acquiring right of way for laying a pipeline is a time consuming and cumbersome process that delays project execution and, in effect, escalates the cost of the entire project.

6.5 Key action areas

The key action areas have been described below.

- **Increase pipeline capacity**
  - Increase crude oil pipeline capacity
  - Increase natural gas pipeline capacity
  - Increase product pipeline capacity
  - Increase LPG pipeline capacity
- **Policy-level issues**
  - Tariff
  - Right of way

6.5.1 Increase pipeline capacity

Given that the region's existing pipeline network is inadequate to meet demand, new pipelines must be set up.

6.5.1.1 Increase crude oil pipeline capacity

Paradip-Siliguri-Bongaigaon-Numaligarh imported crude oil pipeline

As crude oil production in the region has been declining, refineries have to import crude oil to utilise existing capacity. Further, NRL's refinery capacity is expected to be expanded, for which crude oil will have to be imported. NRL is looking to set up a crude oil pipeline from Paradip to Numaligarh (via Bongaigaon, Rangiya, Mohpur) to ensure crude oil supply to its refinery. IOCL is also considering to expand capacity of its Guwahati (from 1.0 MMTPA to 1.7 MMTPA) and Bongaigaon (from 2.35 MMTPA to 4.5 MMTPA) refineries. Post expansion, the Bongaigaon, Guwahati and Numaligarh refineries are to be linked to NRL's Paradip-Numaligarh pipeline to source crude oil.

Total petroleum product output will increase from 6.5 MMTPA in 2014-15 to 12.4 MMTPA by 2021-22. However, consumption is likely to increase from 3.2 MMTPA to only 4.5 MMTPA. Therefore, refineries will have surplus capacity of about 8 MMTPA by 2021-22. Hence, options need to be explored to transport this excess output to other parts of the country.

6.5.1.2 Increase natural gas pipeline capacity

Connect NER with national gas grid and develop regional gas grid

To ensure gas supply and connect demand centres in the Northeast, the current route of the national gas grid needs to be extended beyond Barauni-Siliguri-Bongaigon-Guwahati. The proposed route of the grid spans 800-900 km, at an expected cost of Rs 3,600-4,050 crore. As Mizoram, Manipur and Tripura will be major production centres, these states must be linked to the grid on priority. Further, as Barauni is already being connected to the national gas grid through the Jagdishpur-Barauni pipeline, it makes sense to lay a pipeline from Barauni to the rest of northeast India.

To ensure that the grid is extended up to the Northeast in a timely manner, the entire network can be divided into three phases. Further, the three phases need to be handled by a single entity, which can be formed as a joint venture among stakeholders such as GAIL, AGCL, TNGCL and other state

entities. State entities can play important roles in implementation and operation of the project. Considering the present demand-supply scenario, phases I and II need to be developed simultaneously whereas Phase III can be completed later.

Phase I: Extension of Duliajan-Numaligarh pipeline to Bongaigaon

Extension of the Duliajan-Numaligarh pipeline to Bongaigaon to connect upper Assam to Guwahati to start gas output from Kharsang Block needs to be considered. The production potential is estimated at 1.5-2.0 MMSCMD. A detailed feasibility study needs to be conducted to assess the cost of the project and VGF requirement. Further, to support such production, the existing Dulaijan-Numaligah pipeline capacity should be tripled to 3 MMTPA.

Phase II: Agartala-Silchar-Shillong-Guwahati-Bongaigaon (with two spur lines - Silchar-Aizawl and Silchar-Imphal)

In the first phase, Agartala should be connected to Bongaigaon through Guwahati (800 km) via Silchar and Shillong along the NH-44 route. Demand is estimated at 5-6 MMSCMD, while production from Tripura is expected to increase to ~12 MMSCMD by 2020 from ~4 MMSCMD in 2014-15. After fulfilling local demand from Tripura, including demand from OTPC expansion and ONGC's proposed fertilisers plant with Chambal Fertilisers, surplus gas can be transported to other cities/states. To fulfil external demand, the pipeline route from Agartala–Bongaigaon needs to be reviewed for implementation. Further, a detailed feasibility study needs to be conducted for this route.

Phase III: Connect Bongaigaon with Barauni

Gas demand from the region is going to far exceed supply in the coming years, with a supply shortage of 7-8 MMSCMD likely in the near term. If demand outpaces supply, connecting the Northeast to Barauni will play a key role in ensuring supply to the region.

Myanmar to Agartala gas pipeline

OIL has been offered two offshore blocks in Myanmar, whose total resources are forecasted at 3280 BCF (or about 93 BCM) of natural gas and 221 MMBbl, or about 35 MMKL of crude oil. Exploration in both blocks is in initial phases; therefore, the aforementioned figures can vary substantially. However, total plateau production is estimated to be 8-9 MMSCMD. As 25% of output will meet domestic obligations, balance 75% (estimated at 6.0-6.5 MMSCMD) will be exported to India from Myanmar.

6.5.1.3 Increase capacity

Product pipelines in the Northeast are over-utilized. Therefore, the proposed product pipelines (Numaligarh-Siliguri-Parbatipur, Numaligarh-Imphal and Guwahati-Silchar-Imphal) need to be fast-tracked. Pipelines considered for feasibility are Numaligarh-Siliguri-Parbatipur, Numaligarh-Imphal and Guwahati-Silchar-Imphal.

Figure 31: Route of Numaligarh-Siliguri-Parbatipur product pipeline

Source: Industry Reports, CRISIL Infrastructure Advisory Analysis

The figure below is a geographical map of the proposed Guwahati-Silchar-Imphal product pipeline.

Figure 32: Route of Guwahati-Silchar-Imphal product pipeline

Source: Industry Reports, CRISIL Infrastructure Advisory Analysis

Particulars	Company	Distance(km)	Capacity
Siliguri-Prabatipur (Bangladesh) (proposed)	NRL	130	1 MMTPA
Numaligarh-Dimapur-Imphal -Moreh (proposed)	NRL	304	NA
Guwahati-lumding-Silchar-Imphal (further extension to Agartala) (proposed)	IOCL	610	NA
Numaligath-Itanagar (future plan)	NRL	54	0.5 MMTPA

Numaligarh-Siliguri-Prabatipur Pipeline (Numaligarh-Siliguri)

NRL's expansion will leave it with surplus petroleum products capacity as local demand is expected to lag supply. Hence, petroleum products need to be transported to either Bihar/UP/Orissa or exported to Bangladesh. NRL is planning to expand its existing pipeline from Numaligarh-Siliguri and set up a new pipeline from Siliguri to Parbatipur to export to Bangladesh. The Numaligarh-Siliguri pipeline's capacity needs to be enhanced to 7.7 MMTPA from its existing capacity of 1.7 MMTPA.

Numaligarh-Dimapur-Imphal-Moreh

NRL is planning another 304-km pipeline spanning Numaligarh-Dimapur-Imphal-Moreh to improve supply of pproducts and reduce dependence on road transport.

Guwahati-Silchar-Imphal (Further extension to Agartala) product pipeline

The proposed Guwahati-Lumding-Silchar product pipeline will have four major sections connecting strategic depot locations in the Barak valley in Assam and three other states, viz., Nagaland, Manipur and Tripura.

The pipeline sections are as follows:

- Guwahati-Lumding-Silchar section (length: 345 km)
- Silchar-Jiribam-Imphal section (length:270 km)
- Lumding-Dimapur branch pipeline ex-Lumding (length: 84 km)
- Silchar-Dharamnagar-Agartala branch pipeline ex-Silchar (length: 290 km)

The pipeline is estimated to span a total distance of 1,000 km passing through hilly and inhospitable terrains that are also prone to adverse law & order situations and natural calamities. The project cost is estimated at Rs. 2500 crore. Once commissioned, these pipelines will reduce secondary logistics costs, dependence on road transport and successfully address perennial issues of road blockades and natural calamities.

Numaligarh-Itanagar Product Pipeline (future plan)

To improve supply in the north bank of the Brahmaputra, a pipeline can be set up from Numaligarh to Itanagar, spanning 100 km. As the route will pass through the Brahmaputra, it may require horizontal drilling (HDD) of 4 km under the river bed. However, this will shorten the transportation distance.

6.5.1.4 LPG pipeline

As there is no LPG pipeline and transportation in hilly areas has become difficult, an LPG pipeline from Numaligarh to Imphal has been identified and a pre-feasibility study has been completed. However, the project faces a different set of security concerns during construction and operation, as it will span difficult terrains. Special approvals will be required from the Central/state authorities concerned, namely, the MoEF & CC, the tribal affairs ministry, urban development ministry, and state public works departments (PWDs), etc to enable the pipeline to be laid in NHAI/state highway corridor. Additional permissions will be required for acquiring land in tribal areas, timely laying of pipeline in reserve forests, etc. as per requirement. The proposal seeks a VGF support of about Rs 260 crore, about 58% of its total capital cost.

To improve supply of LPG, another route for imported LPG that needs to be reviewed is Chittagong-Sabrum-Agartala. Currently, LPG is imported through the Paradip/Haldia terminal and then transported to the Northeast through Siliguri.

Numaligarh-Dimapur- Imphal LPG pipeline

The proposed Numaligarh-Imphal LPG pipeline will pass through Dimapur and Sekmai. This pipeline needs to be commissioned along with NRL's expansion plan.

Table 67: Proposed LPG pipelines

Name	Owner	Length (km)	Capacity (MMTPA)	Estimated Capital Cost (Rs cr)	Annual Operating Cost (Rs cr)	VGF/Budgetary supportrequirement (Rs cr)
Numaligarh- Imphal LPG Pipeline	IOCL	265	0.1	470	20	260
Chittagong-Sabrum-Agartala (with further extension to Silchar & Aizawl)	IOCL	230	NA	450	NA	NA
Durgapur-Siliguri-Guwahati (extension to Imphal if NRL extension does not happen) (Alternative to Chittagong – Agartala pipeline)	IOCL	900	NA	1800	NA	NA

Source: IOCL/CRISIL Infrastructure Advisory Analysis

Figure 33: Map of pipelines considered for feasibility in NER

6.5.2 Policy level action areas

6.5.2.1 Policy changes for E&P sector

- Identification of high risk areas/challenging areas in NER by DGH as per past records and experience and categorizing them as "challenging areas"
- Extension of tax holiday from 7 years to 12 years for challenging areas in future contracts to make blocks economically viable and attract bidders' interest in future
- Timeline for exploration phase for challenging blocks to be revised to 12 years (8+4) from current 7 years (4+3) for NER blocks considering only 6-7 months are available for survey and exploration
- Exemption of EC/FC clearances for exploratory phase

- Offering of relinquished areas to NOCs
- Offering premium on price of natural gas produced from challenging blocks NER
- Concept of zero phase of exploration to be introduced and implemented. Zero phase of exploration provides an opportunity to the E&P Company to hold discussion and talks with the local community, clearly highlighting the impact of oil and gas exploration and production activities and the measures that would be taken by the E&P Company to mitigate any such social and environmental impact

6.5.2.2 Tariff

The tariff/price structure is a major hurdle for developing gas pipeline infrastructure. Therefore, to develop a pipeline network in the Northeast, a uniform pipeline tariff for all customers can be considered, irrespective of their distance from the gasfield.

6.5.2.3 Right of way

As acquiring a right of way for laying pipelines has become time consuming and cumbersome, thereby escalating project cost, the government can allow pipeline players special permission to lay pipelines in the region.

6.5.2.4 VGF funding/Budgetary support

The limit of VGF funded projects is only 20% and is applicable only to PPP projects where PSUs are not eligible to participate.

6.5.2.5 Flaring of gas

A large amount of gas is flared in the Northeast as there is no mode to evacuate gas. The policy related to sale of gas from small and isolated fields favours the seller more; hence, ONGC/OIL is not able to sell the gas that is flared now.

Table 68: Details of the pipelines considered for feasability in Northeast India

Pipeline	Route	Distance (km)
Crude pipeline	Paradip-Siliguri-Bongaigaon-Numaligarh	1400
Gas pipeline	Ph-I Duliajan-Numaligarh-Guwahati	450
	Ph-II Agartala-Silchar-Shillong-Guwahati-Bongaigaon	600
	Ph-III Barauni-Siliguri-Bongaigaon	800
	Silchar-Aizawl-Sitwe (Myanmar)	350
Product pipeline	Siliguri-Prabatipur (Bangladesh) (Post NRL Exp)	130
	Numaligarh-Siliguri (Expansion) (Post NRL Exp)	700
	Guwahati-Lumding -Silchar-Imphal (Further extension to Aizawl/Agartala)	615
	Numaligarh-Dimapur-Imphal-Moreh (Post NRL expansion)	400
	Numaligarh-Itanagar (Future Plan)	54
LPG pipeline	Numaligarh-Dimapur-Imphal (with NRL Exp)	265
	Chittagong-Sabrum-Agartala (Further extension to Silchar/Aizawl)	230
	Durgapur-Siliguri-Guwahati (Alternative to Chittagong Pipeline) (extension to Imphal if NRL expansion does not happen)	900

6.6 Action plan

The action plan for augmenting the prospects of the oil and gas midstream sector in the Northeast region is given below.

Table 69: Action plan for midstream sector in Northeast India

Action items	Concerned authorities	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (More than 5 years)
Infrastructure - Crude oil pipeline capacity				
Paradip-Siliguri-Numaligarh Imported crude oil pipeline	NRL		Achieve financial closure and start laying pipelines	
Barauni-Bongaigaon pipeline	OIL	OIL to maintain the same capacity of pipeline as per requirement of NE refineries. OIL to consider capacity enhancement of pipeline for expansion of refineries in the region		
Infrastructure- Natural gas pipeline capacity				
Gas grid phase I: Duliajan/Numaligarh pipeline to Guwahati (enhancing capacity)	GAIL/NRL/OIL/ PNGRB/MoPNG/AGCL/TNGCL/State Govt (GAIL to coordinate)	▪ Route and demand survey ▪ Feasibility study ▪ Project needs to be undertaken on VGF/budgetary support model. Amount needs to be determined	Implementation	
Gas grid phase II: Agartala-Silchar-Shillong- Guwahati-Bongaigaon (spur lines-Silchar-Aizawl and Silchar-Imphal)	GAIL/ PNGRB/MoPNG/AGCL/TNGCL/ State Govt (GAIL to coordinate)	▪ Feasibility study needs to be developed for this route by GAIL ▪ Project needs to be taken on VGF/Budgetary support model. Amount needs to be determined.	Implementation	
Gas grid phase III: Connect Barauni with Guwahati	GAIL/ PNGRB/MoPNG/AGCL/TNGCL/State Govt (GAIL to coordinate)	▪ Conduct feasibility study ▪ Assess funding requirement and other support from other ministries	Implementation	
Gas pipeline from Myanmar to Agartala (Sitwe-Aizawl-Silchar)	MoPNG/MEA/GAIL (GAIL to coordinate)		Feasibility Study	Implementation
Phase I, II & III need to be given to PSUs (GAIL, AGCL, TNGCL etc) on nomination basis				
Infrastructure - Product pipeline capacity				
Guwahati-Lumding - Silchar-Imphal (further extension to Aizawl/Agartala)	IOCL	▪ Conduct feasibility study ▪ Assess requirement of VGF/budgetary support ▪ Assess support required from other ministries		Review for implementation

Action items	Concerned authorities	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (More than 5 years)
Numaligarh-Siliguri (capacity enhancement)	NRL/ MoPNG/PNGRB	▪ Conduct feasibility study ▪ Assess requirement of VGF/budgetary support ▪ Assess support needed from other ministries	Feasibility of Siliguri-Barauni-Mughalsarai Pipeline	
Siliguri-Parbatipur (Bangladesh)	NRL/ MoPNG/MEA/ Govt. of Bangladesh/ PNGRB	▪ Conduct feasibility study ▪ Assess requirement of VGF/budgetary support ▪ Assess support needed from other ministries	Review for implementation	
Numaligarh-Dimapur-Imphal-Moreh	NRL/ MoPNG/PNGRB PNGRB	▪ Conduct feasibility study ▪ Assess requirement of VGF/budgetary support ▪ Assess requirement of support from other ministries		
Numaligarh-Itanagar	NRL/MoPNG/PNGRB		▪ Conduct feasibility study ▪ Assess requirement of VGF/ budgetary support funding	
LPG pipeline				
Numaligarh-Dimapur-Imphal LPG pipeline	IOCL/MoPNG/ MoF	▪ MoPNG to link pipeline along with expansion of NRL refinery. ▪ MoPNG to evaluate already submitted proposal for viability gap funding	▪ Implem entation	
Chittagong-Sabrum-Agartala (With further extension to Silchar & Aizawl)	MoPNG/IOCL	▪ Conduct feasibility study ▪ Assess requirement of VGF/budgetary support	▪ Implem entation	Implemen tation
Dugapur-Siliguri-Guwahati (Extension to Imphal if NRL expansion does not happen) (alternate to Chittagong Agartala pipeline)	MoPNG/IOCL		▪ Conduct feasibility study ▪ Assess requirement of VGF/budgeta ry support	Implemen tation
Policy Level Changes				
Uniform pipeline tariff	PNGRB	▪ PNGRB to analyse credibility of uniform tariff structure of pipelines in the NER	Review for implementation if found viable	

Action items	Concerned authorities	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (More than 5 years)
Right of way	MoPNG/GoI/State governments	▪ MoPNG to analyse right of way issues and provision for special permission in laying of pipelines in NER	▪ Govt. to form inter-ministerial committee to evaluate proposal submitted by MoPNG ▪ Govt. to come out with recommendation	
Limit of VGF to increase to 50%	MoPNG/MoF	▪ Current limit of 20% is not sufficient to fund the requirement of projects as funding gap of more than 50% is expected. ▪ VGF should be made available for PSUs also.		
Flaring of gas: Contract terms should be equitable for both supplier and buyer of gas, with liability being equally shared for the contract period.	MoPNG/PNGRB/NOCs	▪ The practice of keeping current market price as minimum reserve price should be scrapped. ▪ NOCs to help long term customers like AGCL/TNGCL for off-taking of gas (by constructing small pipelines if required)		

6.7 Proposed energy corridor

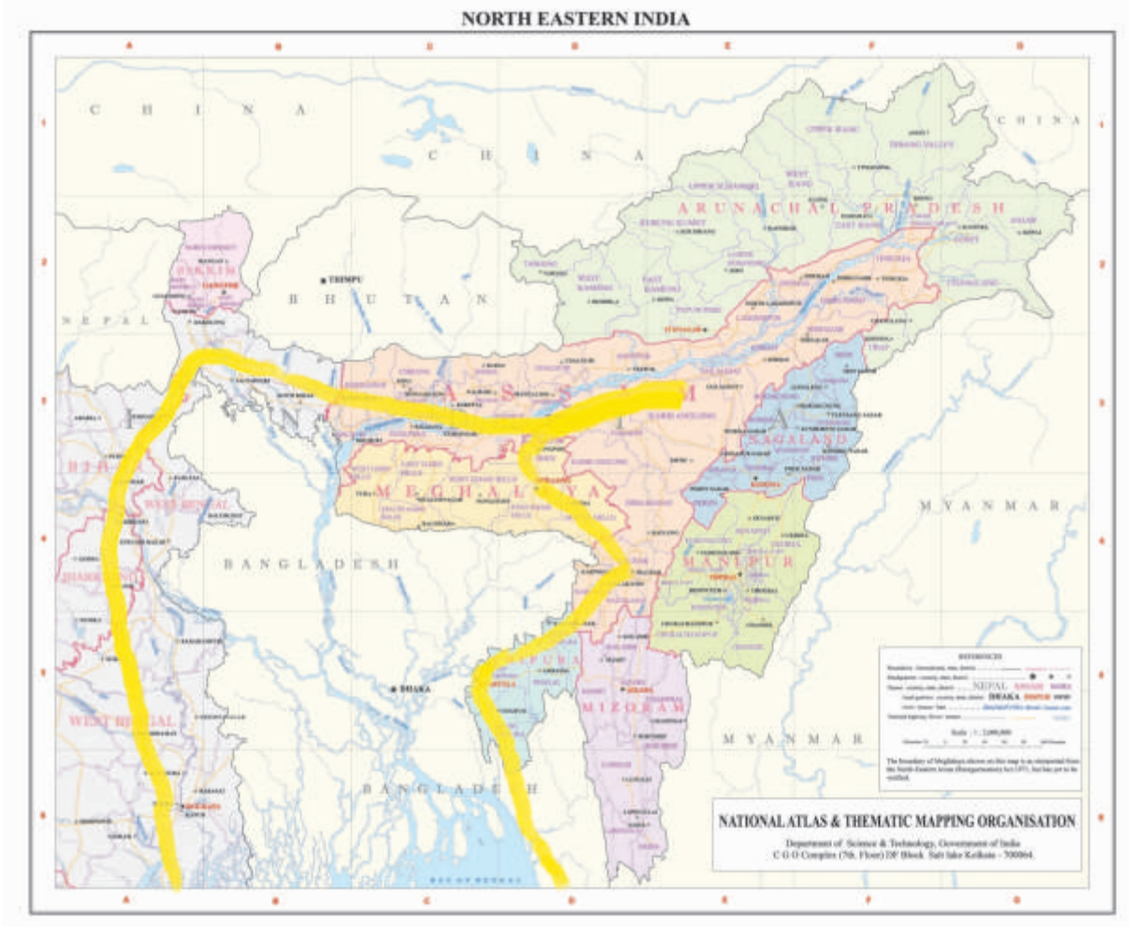
Proposed energy corridor for Northeast India

An energy corridor needs to be developed in the Northeast to utilise resources available and for overall growth of the area. The corridor is proposed to be built in two phases:

- Phase I - Linking Paradip to the Northeast
- Phase II- Linking Chittagong to the Northeast

The corridor will facilitate uninterrupted and economic transportation of hydrocarbon energy – the proposed energy highway will bring in crude oil and natural gas to the region and take out petroleum products.

Table 70: Map of the proposed energy corridor in Northeast India



Phase I: Paradip port to the Northeast: (Barauni-Guwahati-Numaligarh route common to extended national gas grid)

- Two-way movement of hydrocarbon energy along the corridor.
- NRL plans a 1,400 km crude pipeline from Paradip to Numaligarh
- The proposed ROU will intersect the national gas grid at Burdwan in West Bengal.
- From Burdwan, the national gas grid may be extended to the region along the same ROU.
- Ensure adequate availability of crude and gas in the region.

Phase II: Chittagong port to the Northeast

- Chittagong to Agartala: 234 km; Agartala to Numaligarh: 800 km

- Energy highway will pass through Tripura and Meghalaya and connect Numaligarh.
- From Numaligarh the highway will be extended east, up to Dibrugarh, crossing Numaligarh in between.
- The energy highway may be extended further east from Dibrugarh via Tinsukia and Ledo and then onwards using the 'Stilwell Route' to Myanmar.
- The same energy highway will again be extended from Guwahati towards west up to Burdwan (West Bengal) - proposed National Gas Grid gets connected.
- Connecting Myanmar will be in line with Government of India's 'Act East policy'.
- Major state capitals will be connected to the energy corridor via branch lines.
- Guwahati-Dibrugarh (via Numaligarh): 450 km
- Guwahati-Burdwan: 872 km (Bongaigaon)

6.8 Suggestions for VGF/budgetary support model

Natural gas pipeline projects for the Northeast can potentially fall short of viability owing to shortage of gas supply and slower demand growth. VGF, in case of gas pipelines, will be utilized to hedge the licence holder, primarily from the risk of volatility in supply volumes as well as slippages in demand build-up. The following pipelines are proposed to be taken up on an immediate basis through the VGF route as demand from these cities will not be enough to make projects viable. The expected timeline to commission these pipelines will be 2-3 years, provided all clearances are in place.

The following table provides the listing of pipelines that may require VGF/budgetary support to make it feasible.

Table 71: Pipelines proposed under VGF model

Pipeline	Route	Distance (km)	Capital Cost (Rs Cr)	Capacity	Average Tariff (Rs)	VGF %
Crude pipeline	Paradip-Siliguri-Bongaigaon-Numaligarh	1400	6,710	Assessed by NRL		50%
Gas Pipeline	Ph-I Duliajan-Numaligarh-Bongaigaon	450	2025	5	3.15/SCM	55%
	Ph-II Agartala-Silchar-Shillong-Guwahati-Bongaigaon	800	3600	5	3.15/SCM	65%
	Ph-III Barauni-Siliguri-Bongaigaon	800	3600	10	3.15/SCM	55%
	Silchar-Aizawl-Sitwe (Myanmar)	350	1575	5	3.15/SCM	42%
Product Pipeline	Siliguri-Prabatipur (Bangladesh)	130	500	1	1.6/t/km	60%
	Numaligarh-Siliguri (Expansion)	600	2100	6	1.6/t/km	50%
	Guwahati-lumding-Silchar-Imphal (Further to Aizawl/Agartala)	615	1800	2	1.6/t/km	60%
	Numaligarh-Dimapur-Imphal-Moreh	400	1600	1	1.6/t/km	60%
	Numaligarh-Gohpur-Itanagar	54	200	0.5	1.6/t/km	50%
LPG Pipeline	Numaligarh-Dimapur-Imphal	265	530	1	1.8/t/km	63%
	Chittagong-sabrum-Agartala	230	460	1	1.8/t/km	63%
	Durgapur-Siliguri-Guwahati	900	1800	1	1.8/t/km	63%
	TOTAL		**17,720**			**~50%**

Source: CRISIL Infrastructure Advisory Analysis
**Natural gas pipeline capital cost considered at Rs 4.5 cr/km for a 30 inch diameter pipeline.*

VGF requirement/budgetary support for Numaligarh refinery

NRL has initiated a plan for expanding refinery capacity from 3.0 MMTPA to 9.0 MMTPA to achieve economies of scale of and ensure sustained profitability. The key drivers for the expansion have been sub-economic size, lower capacity utilization owing to inadequate crude oil availability, falling crude oil production in North East and demand growth in NRL's supply envelope. At 3 MMTPA, the refinery's current capacity is sub-optimal. Moreover, the average capacity utilization of the refinery has been about 80% due to inadequate availability of crude oil, resulting in higher operating cost for every barrel of crude processed. Declining crude oil production from the North-Eastern oilfields has further added to the refinery's concerns. There have been no new finds in the region and in the foreseeable future; production is not expected to rise. Therefore, expansion of the refinery by sourcing imported crude oil in an economically feasible scale and establishing a crude supply line from a coastal port to ensure future crude availability has become necessary for long-term sustenance of the refinery.

Besides, there is growth in demand for petroleum products in markets supplied by NRL. It is envisaged that expansion of the refinery will ensure product availability in NRL's supply envelope and in particular, will reduce the supply-demand gap of LPG in North East.

The expansion project involves setting up a new, 6 MMTPA refinery at Numaligarh along with a crude oil pipeline (6-8 MMTPA) from Paradip to Numaligarh and a product pipeline (6-8 MMTPA) from Numaligarh to Siliguri. The project is estimated to cost Rs. 20,045 crore. The break-up of cost is new refinery train- Rs 11,355 crore, crude oil pipeline – Rs. 6,710 crore and product pipeline – Rs 1,980 crore. The need to construct a crude oil and a product pipeline has increased overall cost of implementing the project. Consequently, financing cost associated with the project has also increased affecting the financial viability of the project.

To make the expansion project financially feasible, capital subsidy to the tune of Rs. 10,094 crore will be needed as VGF. Besides, the continuation of 50% excise duty benefit will be required to sustain operations due to a rise in: operating cost, financial cost and under recoveries associated with marketing of products to places outside the Northeast. With a VGF of Rs 10,094 crore and 50% excise duty exemption, the internal rate of return (IRR) for the project improves from 5.77% to 13.69%.

With a decline in regional crude production, the proposed Paradip-Numaligarh pipeline can be utilized for bringing imported crude oil to the other three refineries in the region. Laying the pipeline will open up opportunities for other refineries to take up expansion projects and achieve economies of scale. Particularly, the pipeline can transport crude oil for the Bongaigaon Refinery as it is traversing very close to the refinery.

The right-of-use (ROU) of the crude pipeline can also be utilized to lay a natural gas pipeline, which can then be connected to the National Gas Grid. Thus an energy corridor can be established to and from the Northeast.

Right of way

There are common routes in the above-mentioned pipelines, where a common right of way (RoW) can be used to develop them. This will reduce project cost, time for implementation and, hence, funding requirement.

Table 72: Pipeline routes having common right of way (RoW)

Route	Usage
Numaligarh-Dimapur-Imphal	▪ Product pipeline ▪ LPG pipeline
Silchar-Aizawl	▪ Gas pipeline ▪ Product pipeline
Silchar-Agartala	▪ Gas pipeline ▪ Product pipeline
Silchar-Imphal	▪ Gas pipeline ▪ Product pipeline
Bongaigaon-Siliguri	▪ Crude oil pipeline ▪ Gas pipeline ▪ LPG pipeline

Financing

A VGF is a grant, one-time or deferred, provided to support infrastructure projects that are economically justified but are unable to meet funding requirements. It is designed to make projects economically viable over the long term and commercially viable for investors. It helps mobilise private sector investment for development projects while ensuring that the private sector still shares in the risks of infrastructure delivery and operation. The VGF mechanism for pipeline projects should be considered as a development mechanism to establish evacuation systems. Other options that need to be considered include:

- Soft loans
- Issue of tax-free infrastructure bonds by public sector undertakings – GAIL, IOCL, ONGC
- A national development cess on petrol/diesel or aviation turbine fuel (ATF) at national level for projects in the Northeast for a limited period.
- Increasing budget allocation from the central pool for the North Eastern Council (NEC).

Moreover, considering the quantum of funds required to build projects in the region, existing VGF limits (subject to a maximum of 20% of total project cost) may not be sufficient to make projects financially viable. Therefore, such limits needs to be suitably increased to make. VGF should be made available for PSUs also.

6.9 Case study –Public-private partnership (PPP) model for pipelines

Laying new pipelines in the Northeast faces multiple challenges, be it geographical, socio-political or financial. The financial challeges appear to be a key concern, given the requirement of massive capital investment for laying of a pipeline infrastructure. The market for natural gas in the Northeast still holds significant potential, due to which which a pipeline project in the region is financially lucrative for private investors. The government also has fiscal limitations; thus, getting resources for such projects becomes challenging. Therefore, different project structures need to be considered.to implement pipeline projects, in this context, PPP models are an interesting proposition. This case study provides an example of such a pipeline project that has been envisaged by the MoPNG.

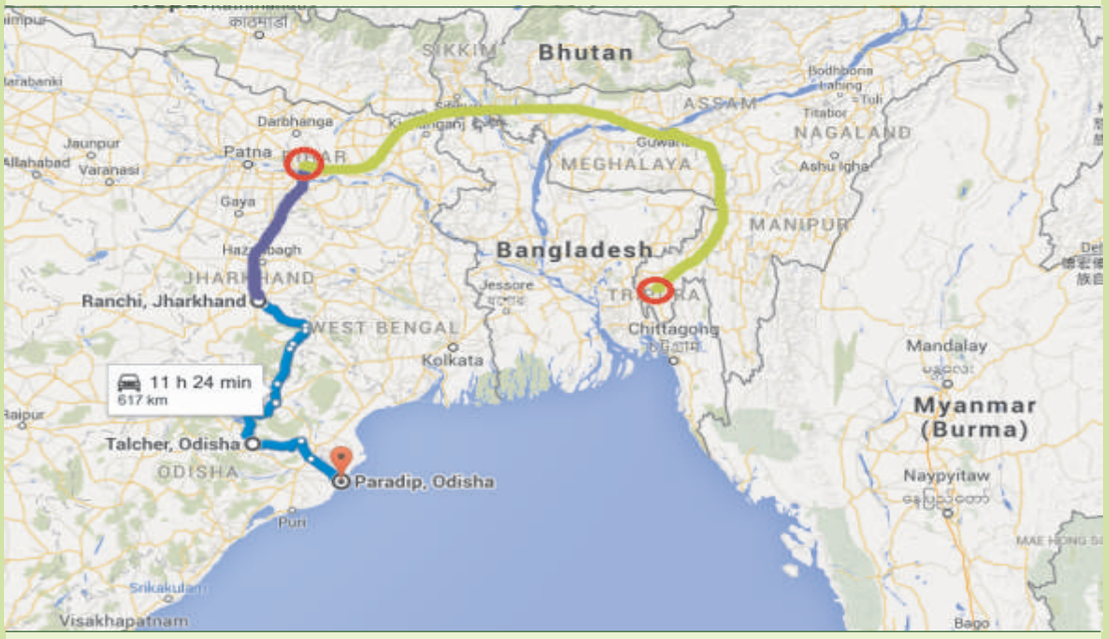
Ranchi-Talcher-Paradip pipeline network

The MoPNG has identified GAIL as the "sponsoring authority" for implementing the Ranchi-Talcher-Paradip pipeline section on a pilot basis with VGF. This is the first PPP pipeline project in the area. Once successfully implemented, this project can be replicated in economically non-viable areas such as the Northeast. Route reconnaissance survey has been completed and a detailed feasibility report is being prepared. The PPP agreement is expected to be finalized by March 2016. The route is 700 km long, including spur lines and the project is estimated to cost around Rs 2,500 crore. The pipeline will connect the LNG terminal at Paradip port to Ranchi and supply PNG and CNG to cities in Jharkhand.

Along with this route, two other routes (totaling 2,500 km) have been identified under PPP mode. The Ministry of Finance will provide VGF through the Indian Infrastructure Project Development Fund (IIPDF). The remaining two pipeline sections viz., Barauni-Guwahati-Agartala and Haldia-Paradip/Srikakulam will be considered through PPP mode with VGF after the pilot project (see details above) is successfully completed. The detail of these pipeline networks has been mentioned below:

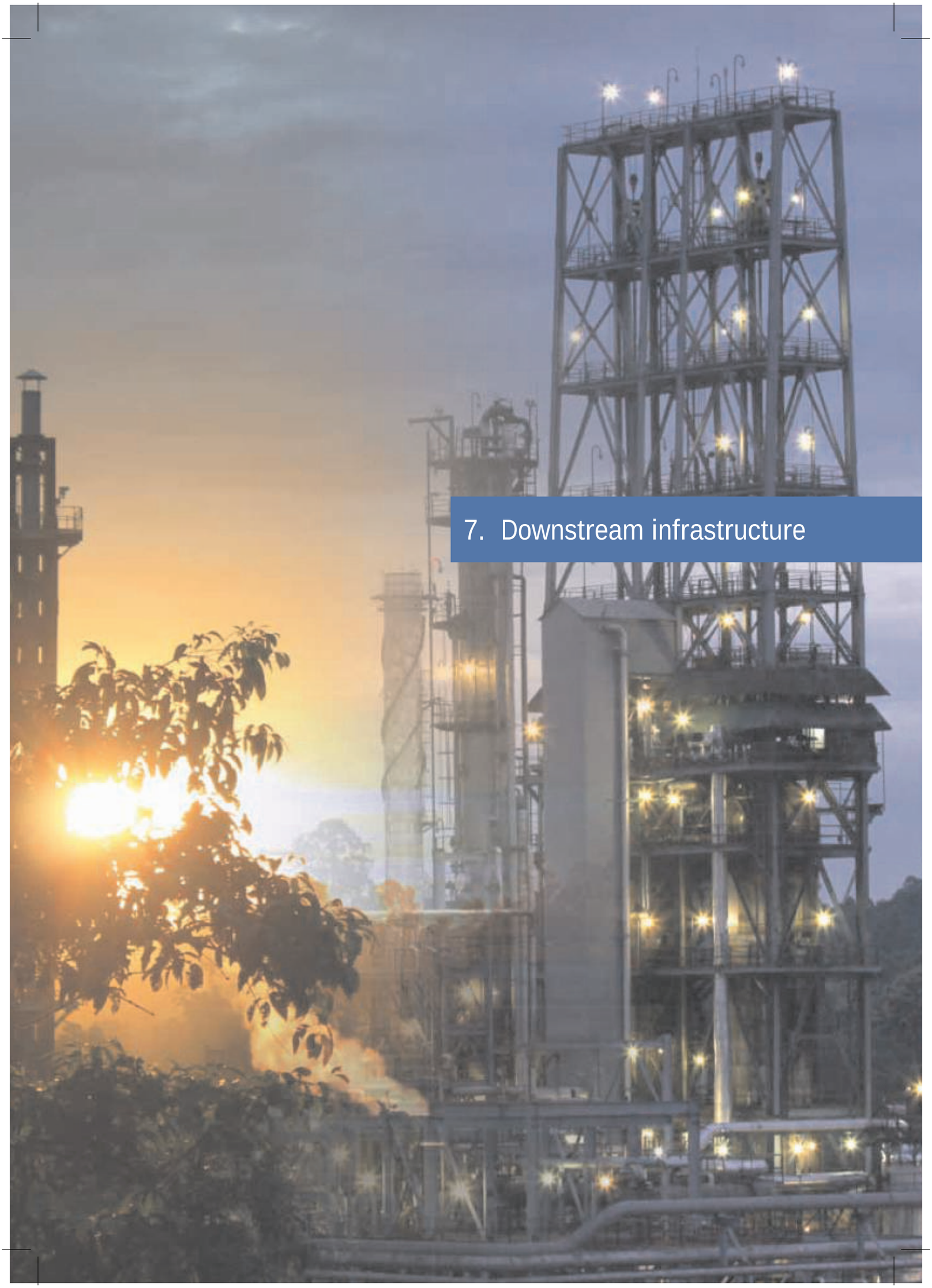
- Ranchi-Talcher-Paradip- 530 km
- Barauni-Guwahati-Agartala- 1300 km
- Haldia-Paradip/Srikakulam- 500/700 km

Figure 34: Proposed natural gas pipelines in India under PPP mode



Hon'ble MoS (I/C), Petroleum and Natural Gas Shri Dharmendra Pradhan along with other Dignitaries standing beside the "Still" exhibited inside Digboi Refinery

Hon'ble MoS (I/C), Petroleum & Natural Gas Shri Dharmendra Pradhan in conversation with students of Assam Oil School of Nursing at Digboi.
Assam School of Nursing is IndianOil's flagship CSR project.



7. Downstream infrastructure

7. Downstream infrastructure

7.1 Refining capacity

7.1.1 Existing refining capacity in Northeast India

Northeast India has four refineries with a combined capacity of 7 MMTPA, all of them in Assam. Of these, IOCL has three refineries at Guwahati, Digboi and Bongaigaon, with a combined capacity of 4 MMTPA, and Numaligarh Refinery Ltd (NRL) has one refinery of 3 MMTPA. The details of these refineries have been presented below.

Table 73: Refining capacity in the Northeast as on 31.03.2015

Company	Refinery	Date of commissioning	Installed capacity MMTPA	Crude oil processing (MMTPA)	
				2013-14	2014-15
IOCL	Guwahati, Assam	1962	1.00	1.0	1.01
IOCL	Digboi, Assam	1901	0.65	0.65	0.59
IOCL	Bongaigaon, Assam	1979	2.35	2.3	2.40
NRL	Numaligarh, Assam	1999	3.00	2.6	2.8
Total (MMTPA)	**-**	**-**	**7.00**	**6.6**	**6.8**
Supply from NER Blocks	**-**	**-**	**-**	**4.8**	**4.5**
Supply from outside NER	**-**	**-**	**-**	**1.8**	**2.3**

Source: IOCL, NRL

Despite having 7 MMTPA of capacity, the Northeast produces only 4.54 MMTPA of crude oil. Hence, excess capacity is being utilized by importing crude oil from other parts of the country.

7.1.2 Future outlook - expansion of refining capacity in Northeast India

7.1.2.1 Refinery capacity expansion

IOCL plans to expand the capacity of its Guwahati refinery from 1.0 MMTPA to 1.7 MMTPA by 2022-23. The extra crude oil requirment will be imported through OIL's Barauni-Bongaigaon pipeline (reverse section), which is currently used by IOCL's Bongaigaon refinery.

The Bongaigaon refinery also plans to expand its capacity from 2.35 MMTPA to 4.5 MMTPA in phases: up to 2.7 MMTPA by 2018-19, and up to 4.5 MMTPA in 2023-24. The additional crude oil requirement will be imported through the Paradip-Haldia-Barauni-Bongaigaon pipeline. This may require OIL to enhance its pipeline capacity.

NRL plans to triple refining capacity to 9 MMTPA by 2020, at a capital cost of about Rs 20,000 crore. About 70% of the products will be lifted by Bharat Petroleum Corporation Limited (BPCL), NRL's holding company, to fulfill its existing demand for petroleum products in other regions such as Orissa, Bihar and Uttar Pradesh; the region and its geographically contiguous neighbouring countries such as Bangladesh, Nepal and Myanmar are being explored for selling the balance output.

These refinery capacity expansions may undergo review at individual company level for appropriate technical and financial feasibility aspects and in consideration of funding requirements for budgetary support / VGF.

NRL has already inked important memorandums of understanding (MoU) with Cement Corporation of

India (CCI) for utilizing raw petroleum coke, likely to be generated at NRL after its proposed capacity expansion, which will also help the refinery achieve economies of scale and boost profitability. Considering the declining trend in domestic crude oil supply from northeastern oilfields, NRL will import crude oil to utilise its additional refining capacity. To transport about 6 MMTPA of imported crude oil from the Paradip port to Numaligarh, a new pipeline is envisaged to be constructed via Siliguri and Bongaigaon. Moreover, NRL plans to export a part of its excess output to Bangladesh through Parbatipur (150 km from the NRL terminal at Siliguri) and use another part to produce petrochemical grade naphtha for which adequate demand exists within the country.

7.1.3 Assessment of future refining capacity in Northeast India

The Northeast consumes 3.2 MMTPA of petroleum products, or about 2% of India's total consumption. However, during 2004-05 to 2014-15, consumption increased at 4.6% CAGR compared with a 4.3% CAGR in the rest of India over the same period. Assam accounts for about 60% of the Northeast's consumption, followed by Meghalaya, which accounts for 13% consumption share.

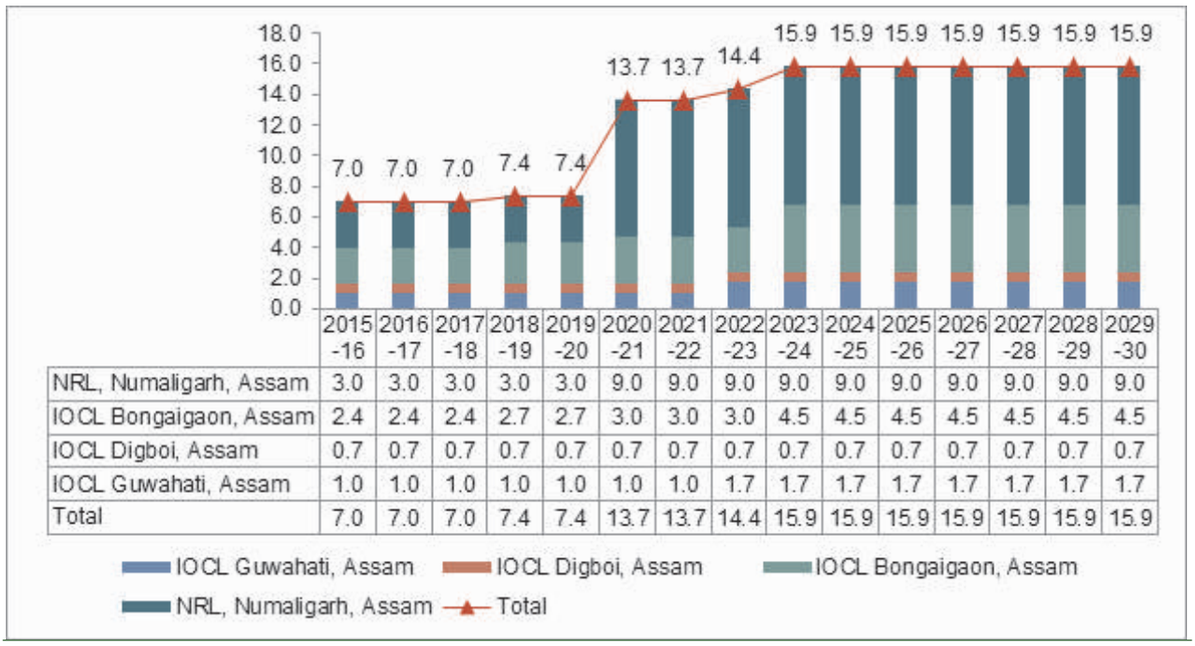
Table 74: Consumption of POL in NER states in 2014-15 (TMTPA)

NER	Assam	Arunachal	Manipur	Meghalaya	Mizoram	Nagaland	Tripura	Sikkim
3189.7	1905.4	177.7	173.3	422.4	107.4	120.3	190.3	92.9
100%	60%	6%	5%	13%	3%	4%	6%	3%

Source: PPAC

By 2030, the expected installed capacity of NER refineries will reach 16 MMTPA (after the expansions at the Numaligarh, Guwahati, and Bongaigaon refineries).

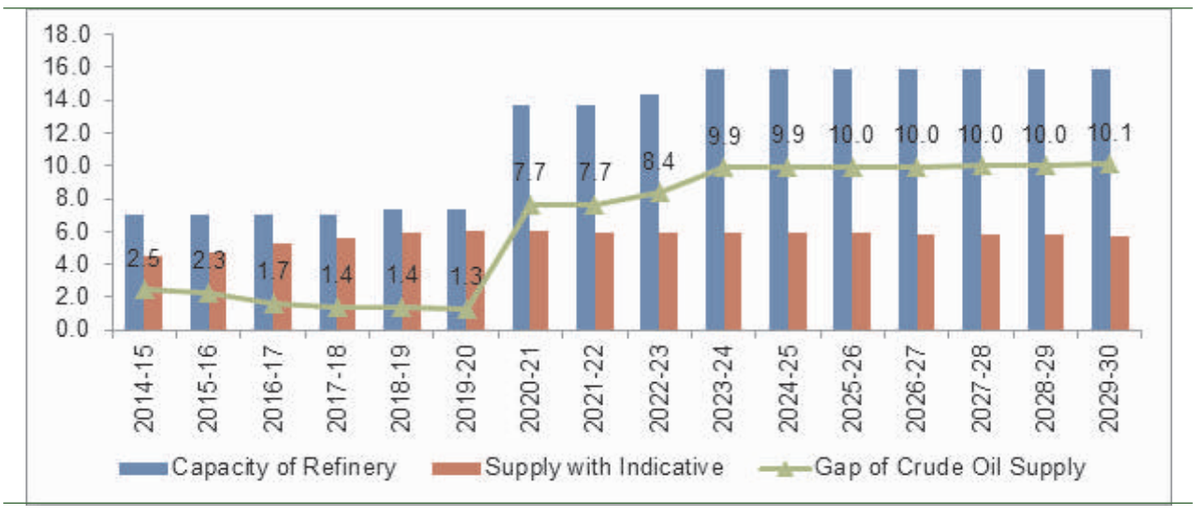
Figure 35: Break-up of refinery capacity from 2015-16 to 2029-30 in NER in MMTPA



Source: IOCL, NRL

However, by 2030, crude oil supply is likely to be at 5.1 MMTPA (considering firm production). Therefore, there will be significant shortage of crude oil (of 10.7 MMTPA) if these refineries have to run at 100% capacity. Hence, pipeline for imported crude transportation needs to be developed to connect these refineries with ports elsewhere in the country. Besides, all petroleum products, except for LPG, will be in surplus, which will necessitate their movement to possible demand centres within or outside the country. Neighbouring countries such as Bangladesh, Myanmar, Bhutan and Nepal could be possible export destinations. The figure below plots details of upcoming refining capacity and supply of crude from the region.

Figure 36: Refining capacity vis-à-vis crude oil production in Northeast India (MMTPA)



Source: ONGC, OIL, IOCL, NRL

As the figure above shows, after expansion of refining capacity in 2020-21 there will be a shortage of around 8.4 MMTPA of crude oil, which will increase to 11.3 MMTPA in 2029-30.

7.2 Demand-supply assessment of POL products in Northeast India

Northeast India constitutes 7.9% of India's area and 3.2% of the total population; yet it accounts for only 1.9% of the country's consumption of petroleum products, owing to lack of economic developments compared with other parts of the country. The table below provides comparison of petroleum products consumption in Northeast India vis-à-vis India.

Table 75: POL product consumption in the Northeast vis-à-vis India (MMTPA)

POL products	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
All-India consumption (MMTPA)	113.2	120.7	128.9	133.6	137.8	141.0	148.1	157.1	158.4	165.0
NER consumption (MMTPA)	2.1	2.1	2.3	2.5	2.7	2.8	3.0	3.0	3.2	3.2
% of all-India consumption	1.9%	1.8%	1.8%	1.8%	2.0%	2.0%	2.0%	1.9%	2.0%	1.9%
NER population	~ 3.2%									
NER area	~ 7.9 %									

Source: PPAC, CRISIL Infrastructure Advisory Analysis

7.2.1 Existing demand for petroleum products

Overall consumption of petroleum products has been growing steadily over the last few years, rising from 2.7 MMTPA in 2009-10 to 3.2 MMTPA in 2014-15, at a 3.28% CAGR. This is in line with national growth trends (3.7% CAGR). The region's consumption profile ought to exceed the national average to reduce the consumption imbalance.

Table 76: Existing consumption of POL products in Northeast India (TMTPA)

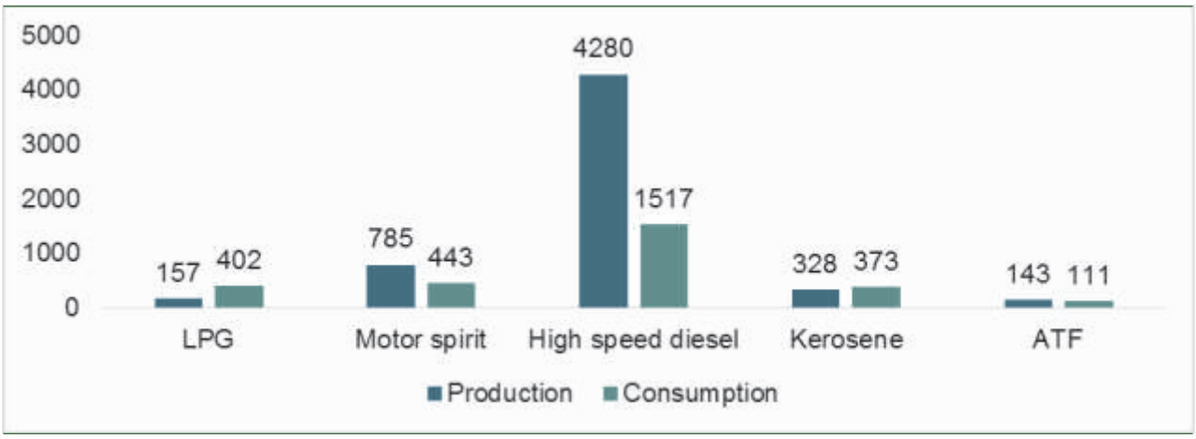
Consumption	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
LPG	296	315	335	330	365	402
Naphtha	0	0	0	0	0	0
Motor Spirit	284	312	345	363	403	443
High Speed Diesel	1233	1348	1489	1493	1535	1517
Kerosene	376	368	369	373	372	373
ATF	92	97	112	113	112	111
Bitumen	107	120	121	111	103	92
Others	326	267	233	188	294	252
Total NER (in TMTPA)	2714	2827	3005	2970	3184	3190
Total NER (in MMTPA)	2.7	2.8	3.0	3.0	3.2	3.2

Source: PPAC, CRISIL Infrastructure Advisory Analysis

Product balance

As can be observed from the table below, at the product level there is a surplus in most products with output of high-speed diesel (HSD) being at about three times consumption. However, there is a huge deficit of LPG, which has constrained supply in the rural market. Production of aviation turbine fuel (ATF) more or less matches consumption. Any future shortfall in ATF can be met by suitably modifying the production configuration of the refineries.

Figure 37: Major POL products, demand-supply balance in NER in 2014-15 (TMTPA)



Source: CRISIL Infrastructure Advisory Analysis

7.2.2 Existing supply and consumption of POL products in NER

Except for LPG, production of other major petroleum product meets the region's demand. The table below provides demand-supply scenario for POL products in Northeast India.

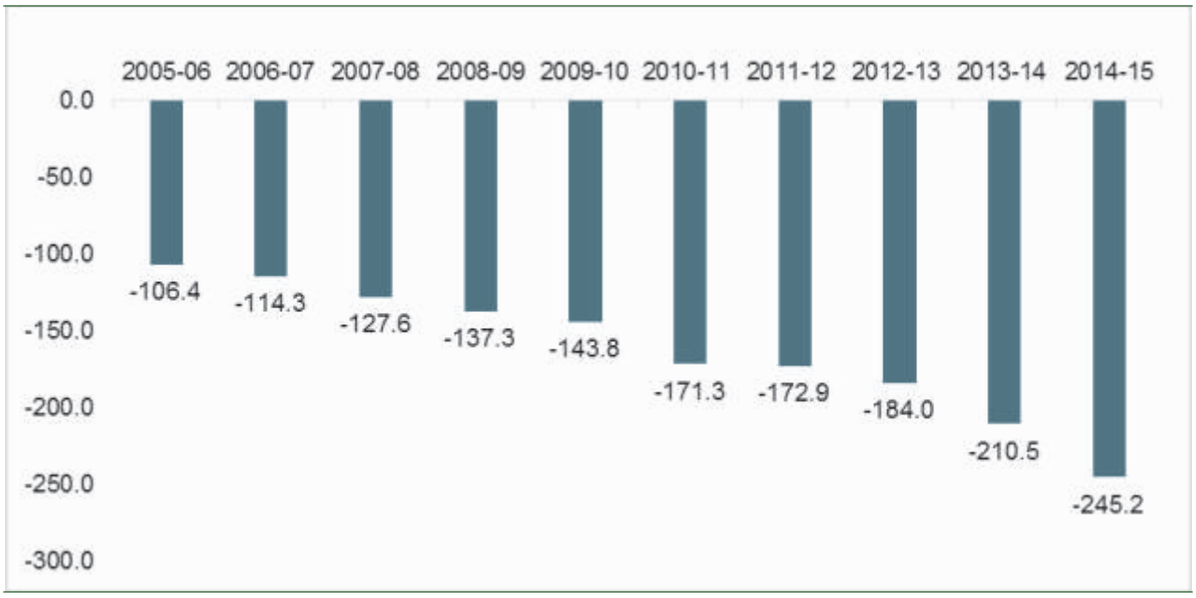
Table 77: Existing supply and consumption of POL products in Northeast India (TMTPA)

POL products	2013-14		2014-15	
	Supply	Consumption	Supply	Consumption
LPG	155	365	157	402
Naphtha	325	0	294	0
Motor spirit	710	403	785	443
High speed diesel	4102	1535	4280	1517
Kerosene	428	372	328	373
ATF	120	112	143	111
Bitumen	0	103	0	92
Others	566	294	555	252
Total (in TMTPA)	**6406**	**3184**	**6541**	**3190**
Total (in MMTPA)	**6.4**	**3.2**	**6.6**	**3.2**

Source: PPAC, CRISIL Infrastructure Advisory Analysis

It can be observed from the table above that except for LPG, bitumen and kerosene oil, the remaining POL products are in surplus. The shortage of LPG (see figure below) has been a cause of concern for quite some time now. In fact, LPG shortage in the region has been growing over the last 10 years. The LPG processing capacity of refineries has not been sufficient to meet the ever increasing demand from the region. This trend is likely to continue, going forward, as more consumers receive LPG connections, meaning demand will outpace the proposed LPG capacity expansions.

Figure 38: Trend in LPG shortage in north-eastern states (TMTPA)



Source: PPAC, CRISIL Infrastructure Advisory Analysis

Existing LPG connections in Northeast India

The Northeast has only 57.45 lakh LPG connections compared with the national figure of 1,910[4] lakh. However, as per 'PAHAL-Direct Benefits Transfer for LPG (DBTL) Consumers Scheme' the overall connection figure is around 14.25 crore (as per August 2015 data). As per IOCL's estimates, the DBTL scheme covers almost 82% of all connections. Therefore, the total number of active connections is estimated to be at 17 crore. Further, the growth rate of LPG connections in the Northeast matches the national growth rate. The table below provides details of LPG connection in northeast India in the last decade.

Table 78: LPG connection (domestic) in Northeast India[5]

No of LPG Connections (In lakh)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
NER	24.2	26.4	28.9	30.7	31.8	34.4	36.6	40.1	44.3	49.6	57.45
LPG connections All India	845	886	943	1010	1057	1151	1254	1371	1504	1663	1910
% of LPG connection in NER/India	2.9%	3.0%	3.1%	3.0%	3.0%	3.0%	2.9%	2.9%	2.9%	3.0%	3.0%

Source: CRISIL Infrastructure Advisory Analysis

7.2.3 Future outlook - Demand for POL products by 2030

7.2.3.1 Demand drivers

Broadly, the following factors are expected to drive the increased consumption of petroleum products in northeast India.

- **Economic growth, and resultant growth in demand from end-users**

Overall macroeconomic conditions are likely to determine the demand for energy and the growth rate of energy demand. India has been enjoying higher growth rates since the early 1990s because of economic reforms. However, northeast India has not been able to capitalise on this growth momentum owing to a variety of issues. But in future, the region is likely to grow at a much faster rate owing to policy initiatives at both the central as well as state level. Further, improvement in the law and order situation across the region could boost the larger development agenda, which will help improve the economic condition in the region. The robust growth outlook for the region's economy and the resultant increase in end-user consumption is expected to drive the petroleum product market in future.

- **Lower international crude oil prices**

Lower global crude oil prices will increase consumption of POL products such as petrol, LPG, naphtha, fuel oil, and low-sulphur heavy stock (LSHS).

- **Downstream regulator in place**

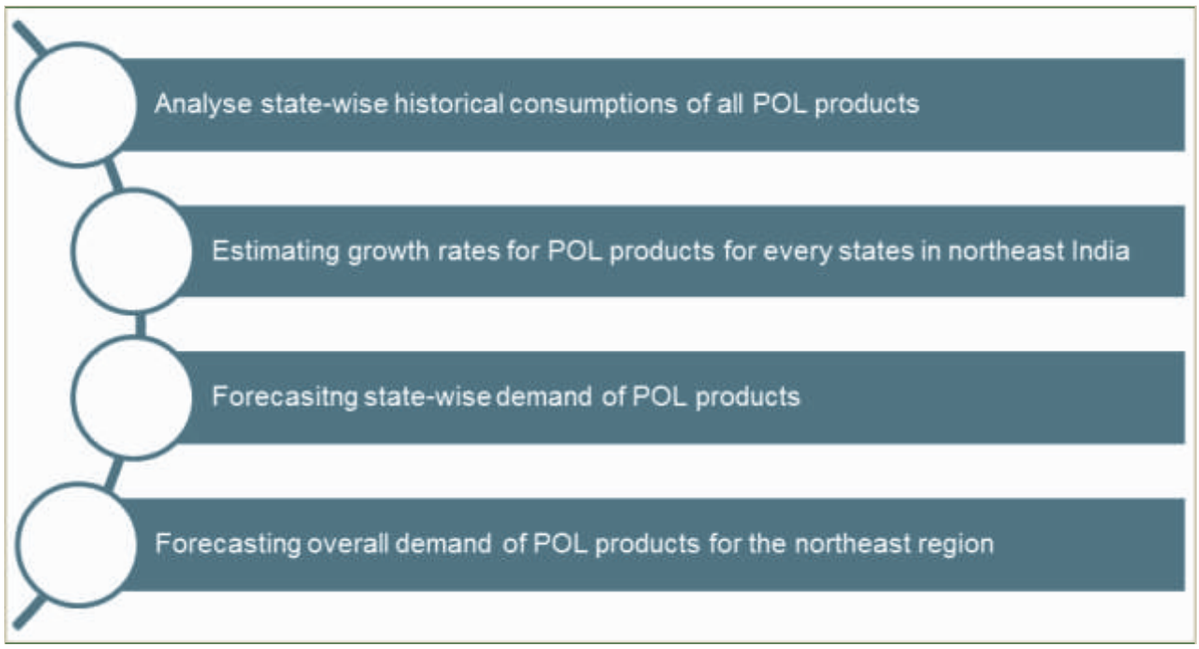
The current regulatory mechanism provides an overarching framework to attract, enable, and sustain much-needed capital into the downstream sector. While protecting consumer interests, prevailing downstream regulations also provide a level-playing field to all infrastructure providers.

7.2.3.2 Demand forecast for POL products

Demand has been assessed after considering the historical consumption profile of all states in northeast India. For estimating demand, the following approach has been considered:

[4]These figures are based on the connections data released by OMCs.Active connections are less than released connections.
[5]As per OMCs connections data, active connections are less than released connections.

Figure 39: Demand estimation for POL products in Northeast India



7.2.3.3 Historical consumption profile of POL products in Northeast India

Overall consumption of petroleum products in the region grew substantially over the last five years. However, growth rates vary appreciably across different states. Although Assam continues to be the largest consumer, demand grew by only 2.79% over the last 5 years; demand growth was strongest in Arunachal Pradesh, Mizoram and Nagaland.

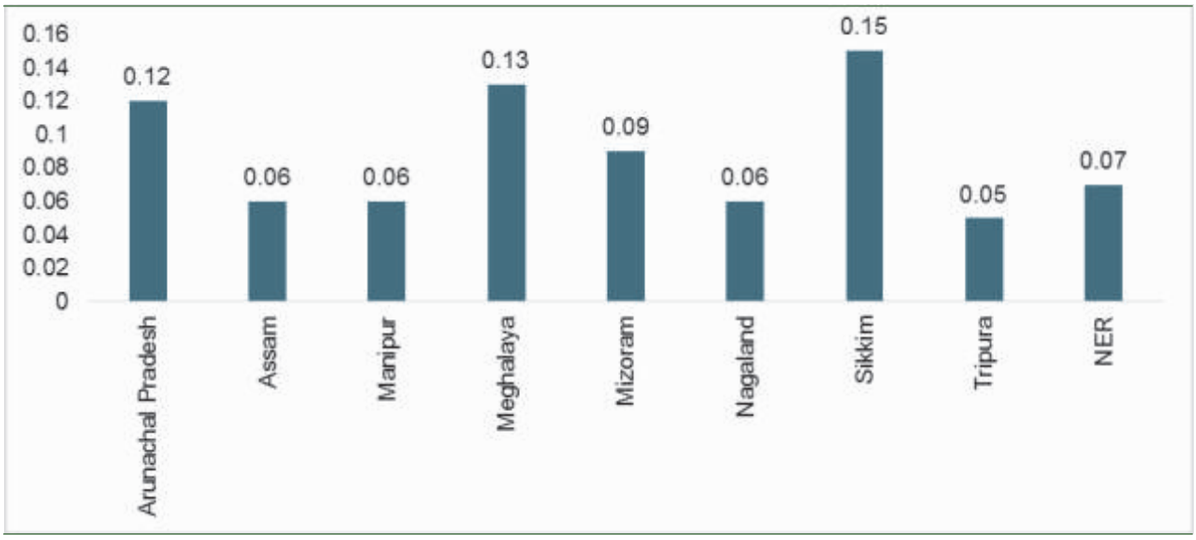
Table 79: State-wise historical consumption of POL products in Northeast India (TMTPA)

States	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	CAGR
Arunachal Pradesh	133	135	145	158	170	177	5.81%
Assam	1661	1714	1768	1686	1880	1905	2.79%
Manipur	139	104	134	156	164	173	4.53%
Meghalaya	351	394	457	472	469	422	3.75%
Mizoram	84	90	101	106	103	107	5.07%
Nagaland	94	111	116	118	120	120	5.05%
Sikkim	82	97	94	91	95	93	2.49%
Tripura	169	182	189	181	181	190	2.35%

Source: IOCL, OIL, PPAC

Per capita consumption of petroleum products in northeast India not only lags the national average but also varies significantly across states within the region.

Figure 40: Per capita consumption of POL products by Northeastern states (in tonnes)



Source: PPAC, IOCL, CRISIL Infrastructure Advisory Analysis

It can be observed from the table above that per capita consumption is highest in Sikkim and Meghalaya. Moreover, per capita consumption is higher than the national average in Arunachal Pradesh and Mizoram. Interestingly, Assam which stands as the largest consumer of POL products in the region has quite low per capita consumption figures with respect to national average as well as its tiny neighbours. Therefore, there is significant opportunity in the region to beef up consumption of POL products as most of the states are below the national average.

7.2.3.4 Estimating demand growth rates of POL products

The consumption of POL products across different states in Northeast varies not only in terms of overall growth rates but also in growth rates across product categories (See table below). The table below provides state-wise, product-category-wise growth rates of POL products for all states in northeast India. The growth rates presented below are an average of 5-year compound annual growth rates.

Table 80: Growth in consumption of POL products in Northeast India (CAGR 5Y 2009-10 to 2014-15)

Products	Assam	Arunachal Pradesh	Manipur	Meghalaya	Mizoram	Nagaland	Tripura	Sikkim
LPG	7.6%	5.4%	2.2%	2.9%	3.2%	3.3%	7.0%	3.3%
Naphtha	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Motor spirit	10.5%	8.4%	11.6%	7.1%	10.1%	5.0%	7.7%	8.2%
High speed diesel	3.7%	8.2%	6.3%	3.1%	7.0%	10.1%	3.1%	2.8%
Kerosene	-0.3%	3.4%	-0.6%	-0.3%	-1.3%	-0.3%	0.0%	-0.8%
ATF	6.2%	-8.0%	-9.4%	-100.0%	11.3%	-1.7%	-19.7%	-100.0%
Bitumen	-1.0%	-10.8%	-16.7%	10.8%	-13.9%	-7.6%	-7.1%	-2.6%
Others	-5.0%	-8.3%	-7.9%	3.8%	-23.6%	-0.5%	-1.3%	-25.5%
Total	2.8%	5.8%	4.5%	3.8%	5.1%	5.1%	2.4%	2.5%

Source: CRISIL Infrastructure Advisory Analysis

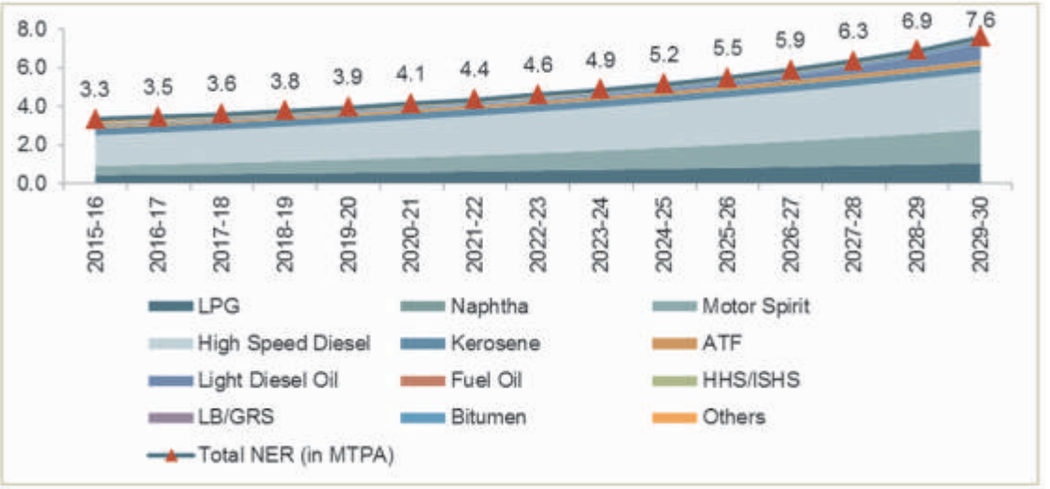
7.2.3.5 Forecasting overall demand of POL products in Northeast India

Considering historical growth trends and the current market conditions, demand for petroleum products in the Northeast is expected to grow significantly. Based on state-wise and product-wise growth rates, the expected demand of POL products has been estimated and presented in the following figure.

Scenario 1: Based on 5-year CAGR (2009-10 to 2014-15)

The total demand for POL products is expected to be around 7.6 MMTPA from 3.2 MMTPA currently. Demand in 2021-22 and 2024-25 is expected to be at 4.1 MMTPA and 5.2 MMTPA, respectively. The growth rate considered for future projection is the CAGR growth of the last 5 years (2009-10 to 2014-15) for each product individually. The table below shows the expected demand of each type of POL products in northeast India.

Figure 41: Projection of demand for POL products in Northeast India (MMTPA)

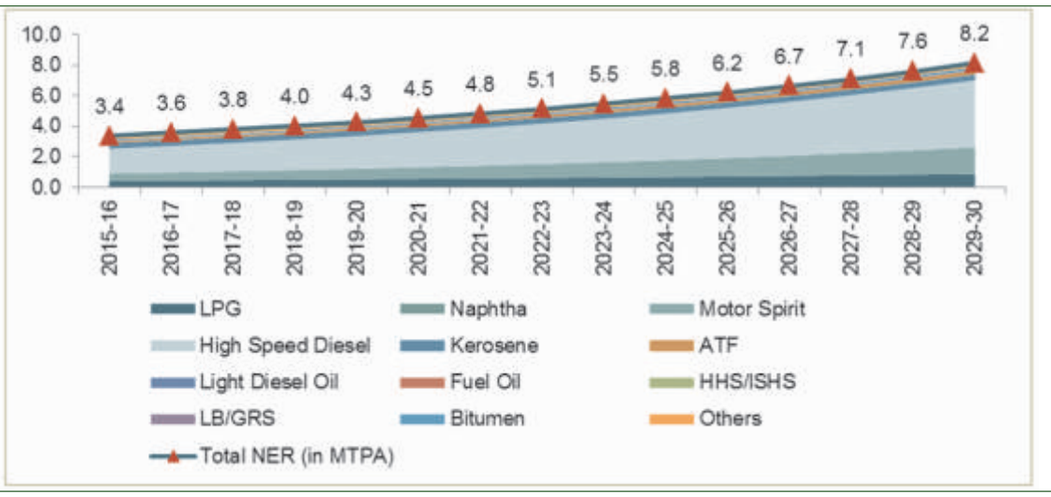


Source: CRISIL Infrastructure Advisory Analysis

Scenario 2: Based on CAGR of 9 years - 2005-06 to 2014-15

Total expected demand for POL products is expected to be at 8.2 MMTPA from 3.2 MMTPA currently. The demand in 2021-22 and 2024-25 is expected to be around 4.8MMTPA and 5.8 MMTPA, respectively. The growth rate considered for future projection is growth of the last 9 years (2005-06 to 2014-15) for each product individually.

Figure 42: Projection of demand of POL products in Northeast India (MMTPA)

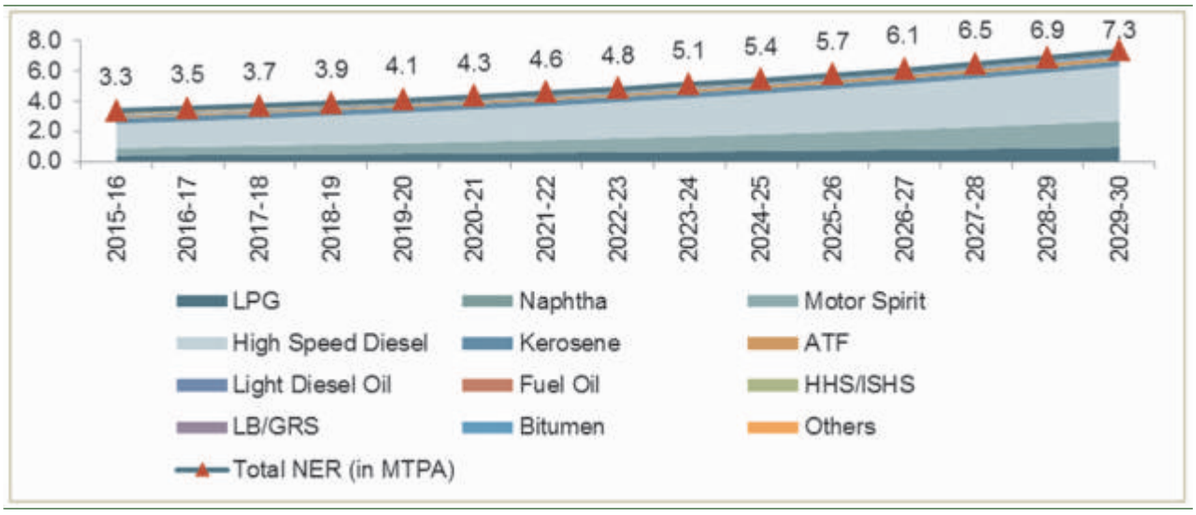


Source: CRISIL Infrastructure Advisory Analysis

Scenario 3: Based on average of 5-year and 9-year CAGRs

The total expected demand for POL products is expected to be around 7.3 MMTPA from 3.2 MMTPA currently. The demand in 2021-22 and 2024-25 is expected to be around 4.6 MMTPA and 5.4 MMTPA, respectively. The growth rate considered for future projection is the average of 5-year (2009-10 to 2014-15) CAGR and 9-year CAGR (2005-06 to 2014-15) for each product individually. The table below shows the expected demand of each type of POL products in northeast India.

Figure 43: Projection of demand of POL products in Northeast India (MMTPA)



Source: CRISIL Infrastructure Advisory Analysis

Table 81: Growth in consumption of POL products in Northeast India (MMTPA)

States	2015-16	2021-22	2024-25	2029-30
LPG	0.43	0.60	0.71	0.96
Naphtha	0.00	0.00	0.00	0.00
Motor spirit	0.48	0.84	1.10	1.75
High speed diesel	1.60	2.26	2.69	3.61
Kerosene	0.37	0.37	0.37	0.37
ATF	0.12	0.17	0.20	0.27
Bitumen	0.09	0.10	0.11	0.14
Others	0.24	0.20	0.18	0.16
Total	3.34	4.53	5.37	7.25

Source: CRISIL Infrastructure Advisory Analysis

State-wise demand of petroleum products in NER is given below. Demand has been estimated by considering the average of historical CAGR growth of petroleum products for 5 years and 9 years (IN TMTPA).

Table 82: Demand in TMTPA for POL products in Assam

Assam	2015-16	2021-22	2024-25	2029-30
LPG	285	419	508	700
Naphtha	0	0	0	0
Motor spirit	242	432	577	935
High speed diesel	816	1094	1266	1616
Kerosene	256	252	250	246
ATF	107	155	186	253
Bitumen	2	47	51	56
Others	235	191	173	146
Total	**1983**	**2590**	**3010**	**3952**

Source: CRISIL Infrastructure Advisory Analysis

Table 83: Demand in TMTPA for POL products in Arunachal Pradesh

Arunachal Pradesh	2015-16	2021-22	2024-25	2029-30
LPG	16	23	27	35
Naphtha	0	0	0	0
Motor spirit	30	50	65	99
High speed diesel	119	203	265	414
Kerosene	16	19	21	25
ATF	1	1	1	1
Bitumen	7	4	3	2
Others	1	1	1	0
Total	**191**	**301**	**383**	**576**

Source: CRISIL Infrastructure Advisory Analysis

Table 84: Demand in TMTPA for POL products in Manipur

Manipur	2015-16	2021-22	2024-25	2029-30
LPG	23	27	30	35
Naphtha	0	0	0	0
Motor spirit	46	90	126	219
High speed diesel	91	151	194	296
Kerosene	20	19	19	18
ATF	3	3	3	3
Bitumen	3	1	1	0
Others	0	0	0	0
Total	**186**	**291**	**372**	**571**

Source: CRISIL Infrastructure Advisory Analysis

Table 85: Demand in TMTPA for POL products in Meghalaya

Meghalaya	2015-16	2021-22	2024-25	2029-30
LPG	17	20	22	25
Naphtha	0	0	0	0
Motor spirit	64	101	128	188
High speed diesel	317	425	493	629
Kerosene	20	20	20	20
ATF	0	0	0	0
Bitumen	22	38	50	77
Others	5	6	7	8
Total	**445**	**611**	**718**	**948**

Source: CRISIL Infrastructure Advisory Analysis

Table 86: Demand in TMTPA for POL products in Mizoram

Mizoram	2015-16	2021-22	2024-25	2029-30
LPG	22	25	28	31
Naphtha	0	0	0	0
Motor spirit	25	43	57	90
High speed diesel	58	91	113	165
Kerosene	6	5	5	5
ATF	2	3	5	10
Bitumen	2	1	1	0
Others	0	0	0	0
Total	**114**	**169**	**208**	**301**

Source: CRISIL Infrastructure Advisory Analysis

Table 87: Demand in TMTPA for POL products in Nagaland

Nagaland	2015-16	2021-22	2024-25	2029-30
LPG	18	21	24	28
Naphtha	0	0	0	0
Motor spirit	26	36	42	56
High speed diesel	62	106	138	215
Kerosene	13	13	13	13
ATF	1	1	2	2
Bitumen	5	3	2	1
Others	0	0	0	0
Total	**126**	**181**	**221**	**315**

Source: CRISIL Infrastructure Advisory Analysis

Table 88: Demand in TMTPA for POL products in Tripura

Tripura	2015-16	2021-22	2024-25	2029-30
LPG	34	50	61	84
Naphtha	0	0	0	0
Motor spirit	35	58	74	110
High speed diesel	86	118	137	177
Kerosene	30	30	30	30
ATF	2	1	1	1
Bitumen	9	7	6	4
Others	1	1	1	0
Total	**199**	**264**	**309**	**408**

Source: CRISIL Infrastructure Advisory Analysis

Table 89: Demand in TMTPA for POL products in Sikkim

Sikkim	2015-16	2021-22	2024-25	2029-30
LPG	12	15	16	19
Naphtha	0	0	0	0
Motor spirit	16	27	35	54
High speed diesel	56	71	80	98
Kerosene	11	11	11	11
ATF	0	0	0	0
Bitumen	1	1	1	1
Others	0	0	0	0
Total	**97**	**125**	**144**	**184**

Source: CRISIL Infrastructure Advisory Analysis

Table 90: Total demand in NER in TMTPA

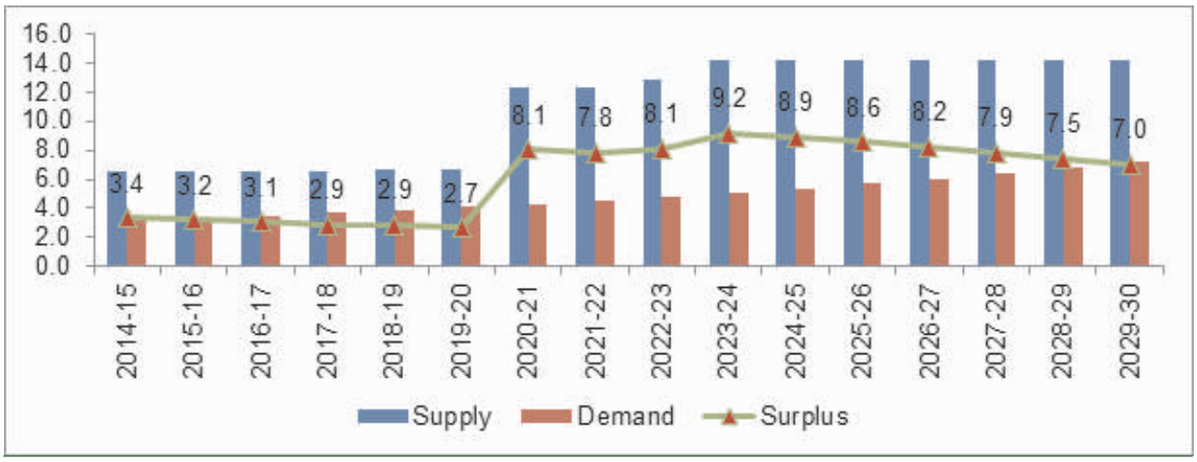
Sikkim	2015-16	2021-22	2024-25	2029-30
LPG	426	600	714	957
Naphtha	0	0	0	0
Motor spirit	485	837	1103	1750
High speed diesel	1605	2257	2686	3610
Kerosene	373	371	370	369
ATF	117	165	198	269
Bitumen	92	103	114	143
Others	242	199	181	155
Total	**3339**	**4532**	**5365**	**7254**

Source: CRISIL Infrastructure Advisory Analysis

7.2.4 Mapping demand-supply of POL products in Northeast India

Mapping demand and supply of petroleum products is important as it provides key insights about the annual deficit or surplus figures. It can be observed from the figure below that northeast India will continue to be a surplus region as far as petroleum products are concerned. Therefore, proper planning is required to utilize excess production from refineries in the region.

Figure 44: Demand-supply mapping of POL products in NER (MMTPA) (avg. of CAGR of 5Y & 9Y)



Source: CRISIL Infrastructure Advisory Analysis

Further, product-wise demand-supply analysis reveals that northeast India will continue to face a deficit as far as LPG is concerned. Moreover, even after considering INDMAX technology used by IOCL to increase LPG production, the deficit will amount to 0.15 MMTPA by 2029-30. However, concerted effort by refineries in the region is likely to cut LPG deficit by 2019-20. In fact, during 2021 to 2026, LPG supply is likely to be in surplus. As maximum quantity of LPG will be available from IOCL's Bongaigaon refinery, the surplus can be transported to other parts of the country via Siliguri.

However, demand for LPG in later years will be much higher, which, in effect, will once again exceed supply, leaving the region in a deficit once again.

Table 91: Demand-supply gap at product level (MMTPA)

Surplus/Deficit	2015-16	2021-22	2024-25	2029-30
LPG	-0.27	0.06	0.09	-0.15
Naphtha	0.28	0.29	0.29	0.29
Motor spirit	0.33	1.46	1.75	1.10
High speed diesel	2.64	5.28	5.92	5.00
Kerosene	-0.05	0.24	0.31	0.31
ATF	0.03	0.10	0.07	.001
Bitumen	-0.09	-0.10	-0.11	-0.14
Total	**3.20**	**7.8**	**8.9**	**7.0**

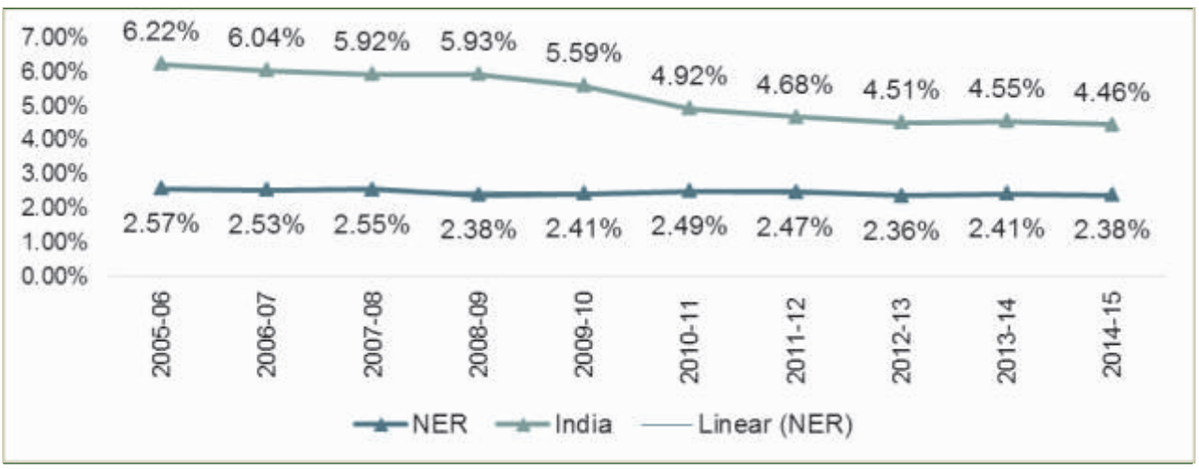
Source: CRISIL Infrastructure Advisory Analysis

Deficit of bitumen in NER

From the above table it can be seen that there is a deficit of bitumen production in the Northeast. Bitumen is primarily used in construction of roads and highways. The Northeast has an abundance of limestone mines, which is the major ingredient for manufacturing cement. This has resulted in a number of cement plants coming up in the region. Hence, to compensate for the bitumen deficit, instead of conventional roads, concrete roads can be constructed, which would use locally manufactured cement and give a further boost to cement manufacturing in the region.

LPG production has been compared with all-India production and also analysed as a percentage of total production. It has been observed that LPG production as a % of overall petroleum product output has been historically lower than that the all-India number. Average production of LPG, as a percentage of total POL produced in NER over 2005-06 to 2014-15, is around 2.4%, compared with the all-India figure of 5.3%.

Figure 45: Historical LPG production trends (as % of POL production) in Northeast India vis-à-vis India



Source: IOCL, OIL, CRISIL Infrastructure Advisory Analysis

Based on analysis of petroleum product data released by refining companies in the Northeast, the situation will only be slightly better in future; share of LPG production will reach a maximum of 5.6% by 2020-21. Initiatives are required from refineries to increase LPG production to the all-India average. This will require companies to upgrade their refineries and change their refinery configuration so that LPG output increases.

IOCL has started upgrading its Guwahati refinery by implementing its in-house patented technology INDMAX for enhancing LPG and gasoline production. Similar initiatives from the other three refineries are also warranted for increasing LPG production.

Table 92: LPG production in Northeast India

Year	2014-15	2020-21	2024-25	2029-30
LPG produced in TMTPA	157	656	806	806
LPG produced as a % of total POL products in NER	2.4%	5.3%	5.6%	5.6%

Source: IOCL, OIL, CRISIL Infrastructure Advisory Analysis

7.2.5 Special products in NER refineries

Indian Oil Corporation Ltd (IOCL)

Due to their smaller size, refineries in the Northeast face high operating cost compared with larger refineries elsewhere in India. To make these refineries more profitable, opportunities of producing value-added specialty products should be explored. Some of the areas that are being studied are:

- **Digboi:** Revamp of DHDT, paraffin wax, CRMB/hybrid bitumen, calcined petroleum coke/ needle coke, naphthenic base oil
- **Guwahati:** CRU installation, petcoke fired boiler, needle coke
- **Bongaigaon:** IndMAX, revamp of ISOM unit, CRU/DHDT capacity expansion, calcium carbide-acetylene-PVC and production of special boiling point solvents

Production of value-added specialty chemicals will not only improve profitability of refineries, it will also help in setting up new downstream units, thereby helping economic development. Emphasis, therefore, needs to be given to these refineries for production of specialty products.

In addition, Guwahati refinery's installation of a pet coke-fired boiler of 80 TPH capacities for reducing power cost is under approval.

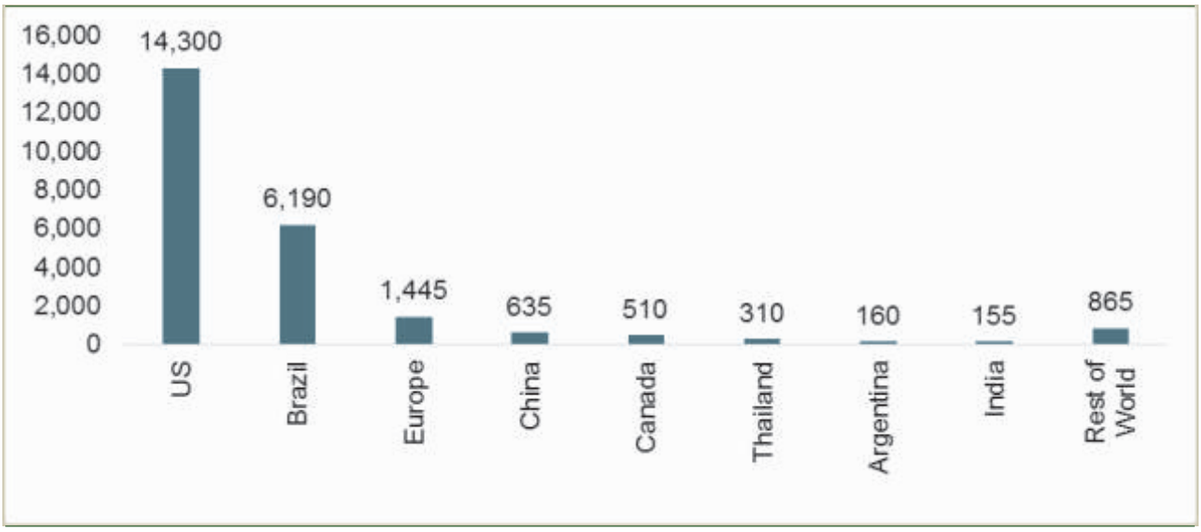
Numaligarh Refinery Limited (NRL)

Bioethanol

Bioethanol is a bio fuel made from feedstock such as grains, sugar beets, bamboo, rice-husk, straw etc. It is one of the most frequently used biofuel that can be mixed with petrol in varying proportions depending upon norms in the country.

The USA is the largest producer of bioethanol followed by Brazil and China. The figure below shows the major producers of fuel grade bioethanol and their production in 2014.

Figure 46: Fuel ethanol production in million gallons



Source: CRISIL Infrastructure Advisory Analysis

Currently, across the globe, ethanol is produced largely from sugarcane. However, new technologies for production of bioethanol using alternative feedstock are being explored to:

- Engaging in advanced technology to produce bioethnol from available surplus biomass (ligno-celulosic materials) to reduce dependency on conventional methods.
- Producing bioethanol with similar properties with better efficiency that are compatible with existing engines and distribution infrastructure (for air, long-distance freight, and shipping)

We have highlighted in this section the production of bioethanol using as a feedstock bamboo, which is in abundance in the northeastern region.

Use of bamboo as a feedstock for bioethanol

Globally, research has been carried out on utilising bamboo as a feedstock for bioethanol with positive results. The key reasons are the feedstock's natural abundance, rapid growth, perennial nature and low management requirements. As a member of the Gramineae family, the composition of bamboo is highly similar to other grasses utilized for producing biofuels (for e.g., switch-grass, Miscanthus). Its cell wall comprises the polymeric constituents' cellulose, hemicellulose and lignin. The complex physical and chemical interactions between these components prevent enzymes from readily accessing the microfibrillar cellulose during the saccharification stage of its conversion into biofuel.

The northeast region houses nearly 30% of the total area used for cultivating bamboo in the country and accounts for 66% of India's bamboo production. This makes it a region with abundant bamboo cultivation and a location where plenty of raw material is available for production of bioethanol.

Bio-refinery at Numaligarh

Looking at the abundance of bamboo in the region, NRL has signed an agreement with Finland-based Chempolis Ltd, for setting up a bio-refinery in Assam for production of bioethanol and co-production of furfural and acetic acid. The estimated cost of the project is Rs 790 crore and it is envisaged to be completed in 24 months after start of construction.

Table 93: Cost for setting up of bio-refinery at Numaligarh

Source of funding	Particulars
Capital investment subsidy from MNRE (Proposed)	40%
Equity	40%
Debt	20%

Source: NRL

Feedstock requirement and planned production of ethanol and other products is given in the table below:

Table 94: Feedstock requirement and planned production of ethanol and other products

LPG connection (domestic) in northeast India[6]	LPG connection (domestic) in northeast India[7]
Bamboo feedstock	300,000 (bone dry)/500,000(green)
Ethanol	49,000
Recovery	16%
Acetic acid	11,000
Furfural	19,000
Biocoal (20 MJ/kg)	160,000
Stillages (dry basis)	30,000

Source: NRL

[6] *As per OMCs connections data, active connections are less than released connections.*
[7] *As per OMCs connections data, active connections are less than released connections.*

Table 95: MS production from NRL refinery (TMTPA)

Particulars	2020-21	2025-25	2029-30
MS production (TMTPA)	1407	1407	1407
Ethanol production (TMTPA)	49	67	67
% of MS	3.5%	4.76%	4.76%

Source: NRL

Bio-coal and stillages will be combusted in the boiler to produce process steam and power. NRL has confirmed the availability of the bamboo feedstock on the basis of a feedstock availability study carried out by it.

Storage and transportation of ethanol

Transportation of 48 TMTPA of ethanol is planned through tank trucks (TTs) from the existing marketing terminal of NRL at Numaligarh to 13 depots in the northeast. As ethanol has an affinity to absorb water at ambient temperature. If the percentage of water in ethanol-blended MS increases above 0.5%, then phase separation may occur and ethanol along with water will separate from MS. To reduce the time between ethanol being blended in MS and finally consumed by the end-customer, ethanol is planned to be doped online into MS, only when making the final delivery to the retail outlet through tank trucks.

Perceived benefits from the project

- **Socio-economic benefits:** The bio-refinery project is a major socio-economic benefit to the region. Large-scale bamboo purchases by the NRL-Chempolis joint venture would cater to both the farm and non-farm sectors of the economy, especially in the Northeast. The opportunities created by this new demand will help build suitable models for sustainable livelihood and also augment the income of farmers & suppliers who are dependent on this resource. Bamboo as an economic resource is capable of generating employment for the rural poor in bamboo plantations and commercial activities such as semi-processing for supply to the bio-refinery can be taken up by local entrepreneurs. The Centre, through the National Bamboo Mission, and state governments of each state, through state bamboo missions, will play the role of facilitator responsible for creating an enabling environment by providing policy, technical and financial support.
- **Environmental benefits:** The value added should also be seen in ecological terms. Bamboo is an effective crop for environmental protection. Bamboo produces a full green canopy within three to four years after planting. So long as selective harvesting is practised, the canopy will remain green. This distinguishes bamboo from other forestry species where harvesting implies a reduction in forest cover. The direct purchase of bamboo by the proposed bio-refinery from the states in the region will have tremendous impact on the ecology, economy, poverty alleviation and employment. Once planted, the bamboo clumps will go on producing clumps and shoot for about 20 years.
- **Bio-fuels policy:** It is in line with the National Policy on Bio-fuels announced by Ministry of New and Renewable Energy in 2009, which sets an indicative target of 20% blending of bio-fuels, both for bio-diesel in diesel and bio-ethanol in petrol, by 2017.
- **Cost reduction for refinery:** Production of fuel grade ethanol will reduce NRL's requirement of imported MTBE and reformate for MS blending due to higher octane number of ethanol and result in net cost savings for NRL.
- **Improve efficiency of vehicles:** Mixing petrol with ethanol leads to increased engine efficiency of vehicles, and more oxygenation of the fuel, leading to cleaner emissions and reduction in air pollution.

Government Schemes to Support Bamboo farming

Pradhan Mantri Mudra Yojna (PMMY) is an initiative under the Micro Units Development and Refinance Agency (MUDRA) Bank and is a new institution being set up by Government of India for development and refinancing activities relating to micro and small units. The scheme provides opportunities to small entrepreneurs for growing their business. Loans are provided under three different schemes depending upon the loan size.

- Shishu (loan up to Rs 50,000)
- Kishore (loan above Rs 50,000 to Rs 5 lakh)
- Tarun (loan above Rs 5 lakh to Rs 10 lakh)

The scheme can be beneficial to entrepreneurs in North East region, who can develop micro units around oil and gas activities planned in the region. Businesses like candle manufacturing, bamboo processing, food processing, silk manufacturing and other agro processing industries can be supported through this scheme.

7.2.6 Storage of petroleum products in Northeast India

7.2.6.1 Existing storage facilities

Storage facilities for POL products in the Northeast are being handled by a few players namely IOCL, BPCL, NRL, HPCL and OIL. IOCL is the largest player; it owns the maximum share customer touch-points and is the only player in some categories.

Table 96: Storage facilities in Northeast India as on April 2015

Particulars	IOCL	BPCL+NRL	HPCL	OIL	Total
Terminals	3	1	1	-	5
LPG Bottling Plant	12	1	-	1	14
Bulk Depot	10	1	-	-	11
AFS	15	1	1	-	17
Retail Outlets	893	204	124	-	1221
SKO / LDO Wholesalers	556	2	-	-	558
LPG Distributors	587	51	25	-	663

Source: IOCL, CRISIL Infrastructure Advisory Analysis

Presently, the tankage capacity of POL products in northeast India is 192,055 kilolitres.

LPG Infrastructure

Currently, there are 14 LPG bottling plants across NER with a total bottling capacity of over 489 TMTPA and existing tankage of around 15 TMTPA. Additional tankages of 34 TMTPA and enhancement of bottling capacity by 100 TMTPA has already been planned by 2019-20. To meet the demand of around 1,200 TMTPA by 2030, IOCL has planned to commission five new bottling plants at Subroom, Silchar, Nogaon, Golaghat and Agartala with total capacity addition of 700 TMTPA, which should be adequate to cover excess demand. The tankage capacity will also have to be increased further and is expected to be at about 48 TMTPA, which should ensure adequate storage cover of 15 days. The estimated cost of upgrading the bottling and storage capacity is Rs 1,500 crore.

Table 97: Existing bottling plants in Northeast India

Sr. No.	Name of City	State	Capacity (TMTPA)
1	Bishalgarh	Tripura	29
2	Bongaigaon	Assam	38
3	Dimapur	Nagaland	12
4	Gopanari	Assam	36
5	Kimin	Arunachal Pradesh	15
6	Mualkhang	Mizoram	13
7	North Guwahati	Assam	166
8	Duliajan	Assam	19
9	Guwahati (Sarpara)	Assam	76
10	Sekmai	Manipur	32
11	Silchar	Assam	44
12	Sikkim	Sikkim	N.A.
13	Numaligarh	Assam	10
14	OIL-Duliajan	Assam	N.A.
	Total		**489**

Source: CRISIL Infrastructure Advisory Analysis

It is imperative to increase the LPG storage capacity in NER, to meet the demand for LPG. Hence there is a need to increase the bottling capacity and tankage of LPG in the next three years. The table below details the tankage available at the existing bottling plants and their proposed expansion in the next three years.

Table 98: LPG tankage at BPs in NER

Name	Existing (MT)	Additional (MT)	Total (MT)
Maulkhang	100	350	450
Bishalgarh	83	1800	1800
Kimin	100	0	100
Gopanari	1800	0	1800
Sarpara	900	0	900
Dimapur (AOD)	400	0	400
North Guwahati	1320	1200	2520
Silchar*	1800	0	1800
Sekmai	1800	0	1800
Bongaigaon	0	900	900
Refineries[8]	5330	0	5330
TOTAL	**13,633**	**4250**	**17,800**

Source: IOCL

**Existing tankage at Silchar will be decommissioned after commissioning of new tankage of 1800 MT*
*** Work towards additional tankage of 450 MT at Bisalgrah kept on hold due to proposal of new plant at Agartala. Proposal for new 60 TMTPA grassroot bottling plant at Agartala is being put up with 1800 MT tankage.*

[8] *Only 50% of tankange sources at refinery locations has been considered*

Gopanari LPG Bottling Plant

LPG bottling capacity at Gopanari LPG Bottling Plant is being augmented by installing additional 1 x 24 point LPG Cylinder filling carousal at an estimated cost of Rs. 9.48 Crores. On completion of project the LPG cylinder bottling capacity of the plant would be 60 TMTPA as against present capacity of 30 TMTPA. The project is likely to get completed by Apr'16.

North Guwahati LPG Bottling Plant

LPG storage capacity at the North Guwahati LPG Bottling Plant is being augmented by installing additional 2 x 600 MT Mounded Storage Vessels, at an estimated cost of Rs. 28.48 Crores. The project is likely to get completed by March - April'17. On completion of project the LPG storage capacity of the plant would be 2520 MT as against present LPG storage capacity of 1320 MT.

LPG tankage available at refineries/source location is given in table below:

Table 99: LPG tankage at refinery/source locations in NER

Sr. No.	Source	Tankage (in TMT)
1	IOCL-Bongaigaon	3960
2	IOCL-Digboi	700
3	IOCL-Guwahati	1700
4	NRL, Numaligarh	3000
5	OIL, Duliajan	1300
	Grand total	**10660**

Source: IOCL

Map of existing LPG bottling plants in NER are provided below:

Figure 47: LPG bottling plants in Northeast India

POL infrastructure

Currently, there are 11 depots/terminals in the Northeast other than refinery-linked terminals. The total tankages available are 165 TKL for petrol, high-speed diesel and superior kerosene oil. IOC has already undertaken re-sitement/augmentation of depot tankages. Keeping in view demand in 2030, an exercise on further augmentation of depot tankages, if any, has to be taken up on priority.

Taking into account the capital expenditure of approximately Rs 1,000 crore for augmenting tankage capacity, storage cover will increase to 40 days at a demand level of approximately 2,000 TMTPA. However, storage cover will reduce to 10 days in 2030 if demand rises to approximately 7,500 TMTPA. Therefore, additional tankages need to be put in place so that adequate storage cover is available in the NER.

Table 100: Product-wise tankage capacity in Northeast India

State	MS		HSD		SKO	
	Tankage (in Kls)	Days cover	Tankage (in Kls)	Days cover	Tankage (in Kls)	Days cover
Arunachal Pradesh	1167	11	4001	12	1580	50
Assam	35252	42	82410	32	35225	238
Manipur	1119	9	3591	15	2666	38
Meghalaya	0	0	0	0	0	0
Mizoram	283	3	758	4	233	9
Nagaland	1580	22	6280	38	2990	52
Tripura	91	6	4347	14	4153	32
Sikkim	675	12	1794	10	1033	59

Source: IOCL, CRISIL Infrastructure Advisory Analysis

Increase in tankage capacity for POL products has been planned over the next 3 years and feasibility studies have been already carried out by IOCL. The table below summarizes the planned capacity expansions and their current status.

Table 101: Planned tankages for POL products in NER

State	New Location	Product	Tankage (In KL)	Current Status	Expected Commissioning
Assam	Golai, Digboi	MS	8722	Construction activities in progress. Construction work affected pending issuance of NOC by Defence Authority for construction on 3.03 acres defence land.	Dec'16
		SKO	6626		
		LDO	Nil		
		HSD	13146		
		FO+LVFO	6626		
	Moinarband, Silchar	MS	7200	Land taken over. Estimated Cost of Construction - Rs.382 Crs. Approval in process.	Mar'19
		SKO	3200		
		HSD	16000		
		ATF	3600		

State	New Location	Product	Tankage (In KL)	Current Status	Expected Commissioning
Manipur	Imphal - New	MS	5052	Construction work in progress. To be commissioned as a road fed Depot.	Mar'16
		SKO	5055		
		HSD	11796		
Arunachal Pradesh	Doimukh	MS	9192	Depot with augmented tankages and Rail receipt facilities expected to be commissioned by Mar 2019.	Mar'19
		SKO	4398		
		HSD	16158		
Total		HSD	57,100		
		MS	30,166		
		SKO	19,279		
		ATF	3,600		
		FO	6,626		

Source: IOCL

A new automated rail head terminal at Malom (Imphal) is being developed to meet the ever increasing POL demand of Manipur area. The project is in advance stage of completion and is likely to be commissioned in May 2016.

To sustain air-connectivity in the Northeast, which is isolated from other parts of the country, it is imperative to have uninterrupted supply of aviation turbine fuel. At present, the region has 17 aviation fuel stations (AFS).

Table 102: Aviation fuel stations in Northeast India

State	Aviation Stations NOs
Arunachal Pradesh	3
Assam	9
Manipur	1
Meghalaya	1
Mizoram	1
Nagaland	1
Tripura	1
Sikkim	0

Source: IOCL

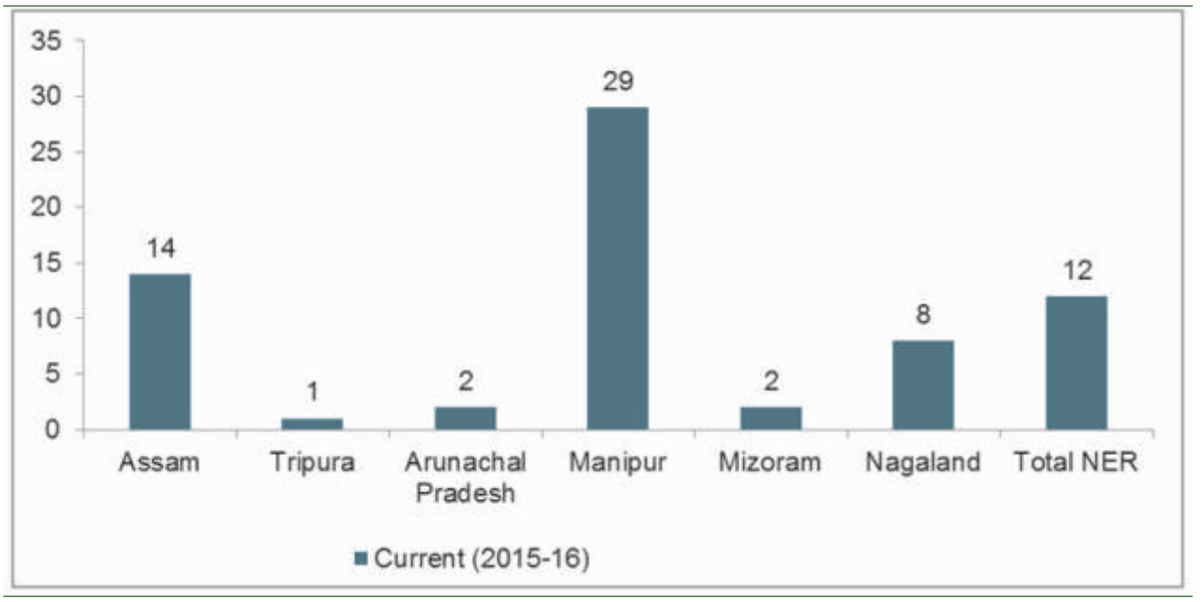
Assam has the maximum number of AFS as the state has maximum number of civilian airports in the region. The AFS in Arunachal Pradesh and Meghalaya are utilized by the Indian Air Force as of now; the remaining states have one AFS each, which supply fuel to the existing civilian airports in these states. However, Sikkim, where there is no airport yet, does not have an AFS.

7.2.6.2 LPG storage capacity in Northeast India

Storage of petroleum products, especially LPG, in the Northeast is very important as the region continues to be in deficit as far as LPG is concerned. It also faces severe connectivity challenges, be it via pipelines or road, rail connectivity. The infrastructural gap coupled with socio-political problems has isolated the region from other parts of the country. Therefore, to ensure smooth supply of LPG, storage capacity will have to be improved.

However, the state-wise LPG storage capacity figures, in terms of number of days, are not very encouraging. The figure is worse for Meghalaya, Tripura and Mizoram, which have 0-2 days' coverage. Therefore, efforts should be made to increase LPG coverage to 15 days from current level of 5-6 days.

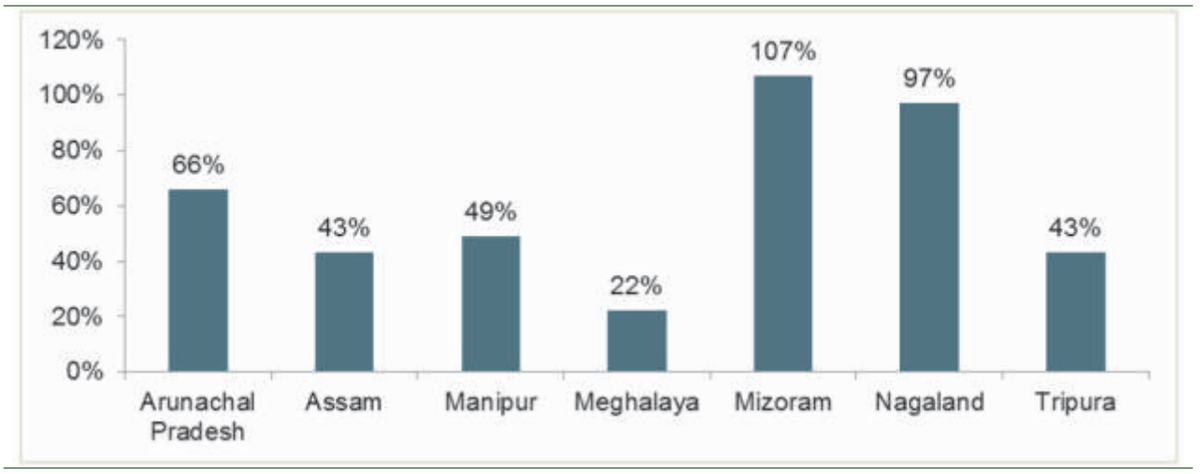
Figure 48: LPG storage capacity in days in Northeast India



Source: IOCL, CRISIL Infrastructure Advisory Analysis

Further, the Northeast fares poorly in terms of percentage of population having LPG access as well. The reason can be largely attributed to poor infrastructural connectivity network. LPG coverage nationally is estimated to be at 65-70% whereas it is only 59% in NER. However, LPG coverage in northeast India is likely to improve in the near future as initiatives have been taken to cover more areas under LPG network.The coverage in some of areas is higher due to multiple connections or due to inactive connections in that area.

Figure 49: LPG penetration level in Northeast India



Source: BPCL

7.2.6.3 Expansion projects of LPG storage in NER

Following are the initiatives undertaken by IOCL to increase the penetration/supply in NER.

Table 103: Initiatives undertaken by IOCL to increase the penetration/supply in NER areas

Name of the Project with Location	Existing storage (MT)	Approved Cost (Rs. crore)	Brief Description of the Projedt
3 x 600 MT Additional Storage project at LPG BP Silchar (Assam)	500	37.39	3 x 600 MT (Additional Mounded Storage)
2x600 MT Additional Storage project at LPG BP N. Guwahati (Assam)	1320	28.48	2 x 600 MT (Additional Mounded Storage)
3x150 MT Additional Storage project at LPG BP Bishalgarh (Tripura)	83	28.54	3 x 150 MT (Additional Mounded Storage)
2x150 MT Additional Storage project at LPG BP Dimapur (Nagaland)	99	17.97	2 x 150 MT (Additional Mounded Storage)

Source: IOCL

We have also estimated for each state, the year wise connection, to achieve 80% penetration of LPG and the balance 20% to be achieved by PNG connections. Our analysis is presented in the table below.

State	2018-19	2022-23	2025-26	2027-28	2029-30
Arunachal Pradesh	179,629	222,531	261,804	292,024	325,959
Assam	2,430,528	3,649,768	5,082,797	6,407,875	8,139,782
Manipur	375,489	501,037	624,615	724,916	842,626
Meghalaya	156,378	235,166	354,838	490,105	700,089
Mizoram	253,761	288,293	317,283	338,231	360,581
Nagaland	201,414	275,461	351,950	416,524	495,004
Sikkim	107,999	144,083	180,740	211,231	247,769
Tripura	558,336	747,825	931,553	1,078,751	1,249,461
Total	4,263,533	6,064,165	8,105,580	9,959,658	12,361,271
LPG connection as a % of total households	38%	48%	59%	69%	80%
Proposed CGD connections in NER	421,679	786,693	856,127	2,717,374	3,114,598
CGD connection as % of total households	4%	6%	6%	19%	20%
Total households	11,282,213	12,601,599	13,716,088	14,527,011	15,398,436

Source: CRISIL Infrastructure Advisory Analysis

7.3 Demand-supply assessment of natural gas

7.3.1 Existing consumption of natural gas in Northeast India

With the recent changes in the structure of the macro-economic factors and the economic boom in India, the total primary energy requirement has been increasing at a rapid pace. Coal and oil have been the dominant fuel in the primary energy basket; however, share of natural gas has gone up due to increased availability from domestic production by private players and LNG imports. One way to secure energy efficiently is through consumption of natural gas, which, being a reliable, cost effective (in comparison to liquid fuels) and cleaner fuel, can also address the issue of increasing pollution and global warming. However, due to lower production and increased demand for natural gas in India, there is greater focus on imported LNG.

The table below provides existing demand of natural gas in Northeast India.

Table 104: Demand of natural gas in Northeast India (MMSCMD) in 2014-15

Particular	2014-15
CGD	0.68
Power	5.78
Refinery	1.1
Industry	2.11
Fertiliser	1.65
Total demand	**11.2**

Source: CRISIL Infrastructure Advisory Analysis

7.3.2 Future outlook - Gas demand estimation

Demand for natural gas has been assessed on the basis of consumer categories, which include:

- City gas distribution
- Power
- Refineries
- Petrochemicals
- Industry
- Fertiliser

7.3.2.1 Drivers of natural gas demand in Northeast India

In India, the contribution of natural gas as a primary energy source is only at 9.3%[9] compared to the world average of 24%. Natural gas consumption in northeast India is much lower than the national average. Therefore, there is room for growth even after taking into account that gas may not be able to displace coal (attributable to fuel availability) in the power sector to the extent it may have in other developed countries. Broadly, the following factors are expected to drive the increased consumption of natural gas in India:

- **Economic growth and resultant growth in demand from end-users of gas**

Overall macroeconomic conditions are likely to determine growth in demand for energy. Although India has enjoyed relatively high growth rates since the early 1990s because of economic reforms, the Northeast has not been able to capitalise on this growth momentum owning to a variety of issues. But, in future, the region is likely to grow at a much faster rate due to policy initiatives both at the central as well as state level. Moreover, an improvement in the law and order situation across the region can push the larger development agenda and improve the region's economy. The robust growth outlook for the Indian economy and the resultant increase in end-user consumption of natural gas is expected to drive the region's natural gas market in future.

[9] *Source: BP Statistics 2015*

- **Lower volatility in gas prices vis-à-vis alternate liquid fuels**

Volatility in crude oil prices over the past few years has translated into price variability of alternate liquid fuels such as petrol, LPG, naphtha, fuel oil, and low-sulphur heavy stock (LSHS). In comparison, natural gas prices have been less volatile in India. Petroleum product prices are highly correlated to the dynamics of the crude oil market, whereas natural gas prices (across sources) in India have so far been set on a long-term basis, thereby making them less volatile.

- **Downstream regulator in place**

The current regulatory mechanism provides an overarching framework to attract, enable, and sustain the much-needed capital into the natural gas downstream sector. While protecting consumer interest, prevailing downstream regulations also provide a level playing field to all infrastructure providers.

- **Environmental concerns**

Globally, reduction in carbon emission has emerged as a key concern area. As natural gas is a cleaner and environmental friendly fuel (lower carbon emissions per unit energy generated), it is being promoted globally across key end-use segments, such as power generation, and also as industrial and auto fuel. End-users of natural gas are entitled to certified emission reduction credits and can, therefore, gain financially from such projects/transactions.

7.3.2.2 Demand from CGD sector

Gas demand from the city-gas distribution (CGD) sector has been estimated for existing cities and new demand from other cities has been arrived at after duly considering the likely timeframe within which cities/districts will receive pipeline connectivity. Existing CGD entities include cities that are deemed authorised, i.e., AGCL and TNGCL. Gas demand from these entities was at 0.68 MMSCMD in 2014-15 and is expected to reach 4.4 MMSCMD by 2029-30 assuming that phases 1, 2 and phase 3 of the gas pipeline are connected and spur lines within districts are implemented. Districts considered in each phase are:

- **Phase - 1:** Morigaon, Nagaon
- **Phase 2:** Guwahati, Silchar (Cachar Hills), Aizawl, Imphal, Kamrup, Shillong, Karimganj, Hailakandi, Goalpara, Bongaigaon
- **Phase 3:** Bongaigaon, Dhubri, Kokrajhar

The following assumptions have been considered for estimating CGD demand:

- Each family consists of five members and consumption per family is 0.5 SCM gas per annum
- Maximum conversion of 65-70% has been considered for all categories (domestic, commercial, CNG and industrial).
- Implementation has been considered in phases in all categories.
- Discount of 50% for CNG consumption and 80% for industrial consumption have been considered as per for all-India pattern for CNG and PNG.

The demand from CGDs is given below.

Table 105: Projected demand from CGD sector (MMSCMD)

CGD entity	2015-16	2017-18	2019-20	2021-22	2023-24	2025-26	2027-28	2029-30
TNGCL	0.08	0.09	0.09	0.10	0.11	0.12	0.14	0.15
AGCL	0.62	0.68	0.73	0.76	0.80	0.81	0.81	0.81
Future CGD	0.61	1.06	1.51	2.04	2.42	2.70	3.20	3.43
Total demand	**1.31**	**1.82**	**2.33**	**2.90**	**3.33**	**3.63**	**4.15**	**4.40**

Source: CRISIL Infrastructure Advisory Analysis

Availability of gas in Silchar

If ONGC is able to supply 20,000 SCMD of gas from Banskandi field's GGS-1 (BK-1) at Sonabarighat, which is about 11 km from Silchar town, a CGD network can be envisaged at Silchar on an immediate basis by AGCL. This would free up subsidised LPG from the area, which could be supplied to other locations in the Northeast.

7.3.2.3 Demand from power sector

Gas-based power plants constitute about 50% of installed capacity in NER. The total gas requirement from existing power plants was ~5.7 MMSCMD, supporting a total capacity of 1,721 MW as on March 31, 2015. Gas availability for the power sector takes into account current gas supplies from ONGC and OIL. Projected demand is based on proposed power projects, existing projects and expansion of existing power projects. The following power plants have been considered:

- NEEPCO (291 MW)
- Namrup (120 MW)
- APGCL Mailbela I
- APGCL Maibela II
- OTPC, Agartala
- NEEPCO (84 MW)
- TSECL Rokia
- TSECL Baramura
- NEEPCO Monarch (120 MW)
- APGCL Mailbela Expansion
- OTPC Expansion (365 MW) (Proposed)

The demand from the power sector has been presented below.

Table 106: Projected demand from power sector (MMSCMD)

Particular	2015-16	2017-18	2019-20	2021-22	2023-24	2025-26	2027-28	2029-30
Power	8.33	8.33	8.33	8.98	8.98	8.98	8.98	8.98

Source: CRISIL Infrastructure Advisory Analysis

7.3.2.4 Demand from refineries

Gas demand from refineries has been estimated considering internal fuel consumption of each refinery and gas required for hydrogen production in the refining process. Natural gas can be used in a refinery for various purposes such as:

- Process and utility heaters
- As fuel for the hydrogen generation unit
- As fuel for gas turbines

The current capacity of the refinery sector in northeast India is 7 MMTPA. The demand for natural gas from the refining sector was ~1 MMSCMD in 2014-15. Backed by better pipeline connectivity in coming years, total demand for natural gas from the refining sector in northeast India is expected to reach 5.0 MMSCMD by 2029-30.

Table 107: Projected demand from refinery and related sectors (MMSCMD)

Particular	2015-16	2017-18	2019-20	2021-22	2023-24	2025-26	2027-28	2029-30
Total demand	1.3	2.1	2.6	5.0	5.0	5.0	5.0	5.0

Source: CRISIL Infrastructure Advisory Analysis

Demand in 2029-30- IOCL Guwahati-0.5, IOCL Digboi 0.3, IOCL Bongaigaon 1.2, NRL- 3.0

7.3.2.5 Gas demand from industrial consumers

Gas demand from industries amounted to 2 MMSCMD in 2014-15 and is expected to rise to 4.2 MMSCMD by 2029-30. Industries considered include paper mills, cement plants, brick kilns, tea plantations and steel. Internal consumption of ONGC and OIL (about 1.95 MMSCMD) has also been factored into estimate demand from the industrial segment.

Table 108: Projected demand from industrial consumers (MMSCMD)

Particular	2015-16	2017-18	2019-20	2021-22	2023-24	2025-26	2027-28	2029-30
Total demand	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2

Source: CRISIL Infrastructure Advisory Analysis

7.3.2.6 Gas demand from petrochemical plants and cracker units

Gas demand from petrochemical plants and cracker units stood at 0.2 MMSCMD in 2014-15 and is likely to rise to 3.1MMSCMD by 2029-30.

Table 109: Projected demand from cracker plants and plastic units (MMSCMD)

Particular	2015-16	2017-18	2019-20	2021-22	2023-24	2025-26	2027-28	2029-30
Total demand	1.5	1.9	1.9	1.9	1.9	2.45	3.1	3.1

Source: CRISIL Infrastructure Advisory Analysis
Demand in 2029-30- APL 0.5, BCPL 1.38 and one more plastic Park 1.2 (after 2025)

7.3.2.7 Gas demand from fertiliser plants

Natural gas is used both as a feedstock and as a fuel in fertiliser units. Besides natural gas, urea units utilise alternate fuels/feedstock such as naphtha and fuel oil/LSHS. The new fertiliser policy mandates these units to use natural gas; therefore, they have been considered as potential consumers as well. Gas requirement from existing fertiliser plants was 1.65 MMSCMD in 2014-15. Expected demand from BCPL and the expected plant of ONGC-CFL has been considered to estimate demand from this segment.

Table 110: Projected demand from fertiliser plants (MMSCMD)

Particular	2015-16	2017-18	2019-20	2021-22	2023-24	2025-26	2027-28	2029-30
Total demand	1.7	1.7	3.7	3.7	3.7	3.7	3.7	3.7

Source: CRISIL Infrastructure Advisory Analysis
Fertiliser plants considered are: BVFCL and CFL

7.3.2.8 Summary of demand of natural gas in Northeast India

The table below summarises the overall expected demand of natural gas in northeast India till 2029-30.

Table 111: Total projected demand of natural gas in Northeast India (MMSCMD)

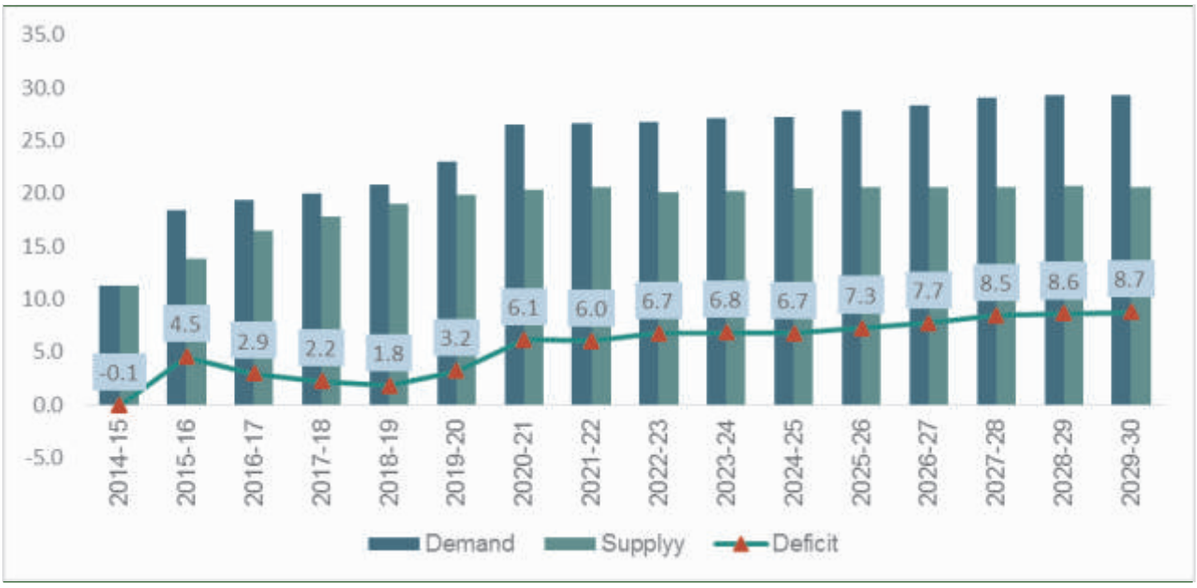
Particular	2015-16	2017-18	2019-20	2021-22	2023-24	2025-26	2027-28	2029-30
CGD	1.3	1.8	2.3	2.9	3.3	3.6	4.1	4.4
Power	8.3	8.3	8.3	9.0	9.0	9.0	9.0	9.0
Refinery	1.3	2.1	2.6	5.0	5.0	5.0	5.0	5.0
Industry	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Plastic	1.5	1.9	1.9	1.9	1.9	2.4	3.1	3.1
Fertiliser	1.7	1.7	3.7	3.7	3.7	3.7	3.7	3.7
Total demand	18.4	20.0	23.0	26.7	27.1	27.9	29.1	29.4

Source: CRISIL Infrastructure Advisory Analysis

7.3.3 Natural gas demand-supply scenario in Northeast India

Overall demand of natural gas in northeast India will exceed overall supply. A supply shortfall of ~8-9 MMSCMD is anticipated in 2029-2016. Therefore, the region may need to import natural gas to fulfil demand.

Table 112: Natural gas demand-supply scenario in Northeast India (MMSCMD)



Source: CRISIL Infrastructure Advisory Analysis

7.4 Key issues/ concerns

7.4.1 Refining capacity and POL Products

The key issues are given below.

Table 113: Issues with refining capacity and production of POL products in Northeast India

Sr. no.	Key issues	Description of issues
1	Inadequate crude availability from the oilfields in the region	▪ As the region's refineries primarily depend on crude oil supplies from local oilfields, a shortfall has left the region's refineries with no option but to import crude oil. All refineries in the region are sub-economic in size. Even at such a size, IOCL and NRL have to operate below installed capacity due to inadequate availability of domestic crude.
2	Refining margins	▪ Refineries have so far been processing crude oil from the northeastern oilfields and their crude procurement prices are linked to the international market. Therefore, price volatility in international market influences their crude procurement prices as well. The region's refineries, in particular, are sensitive to changes in duty structure for crude and petroleum products. In June 2011, the government reduced customs duty on crude oil, petrol and high-speed diesel by 5%. This measure does not significantly impact profitability of other refineries in the country processing imported crude. However, NER refineries are in a disadvantageous position vis-à-vis other refineries processing imported crude oil as they have to pay VAT at 5% and entry tax at 2%. Refineries processing imported crude oil do not have to pay anything as the incidence of customs duty/sales tax for them is nil now. ▪ The Centre provides a 50% excise duty concession in view of the sub-economic size and geographically disadvantageous location of NER refineries. In addition, enhancement in VAT rate from 4% to 5% on crude oil by the state government and revision in pipeline charges by OIL for the Barauni-Bongaigaon section have adversely affected refineries in the region. ▪ Refineries are designed for processing only Assam crude (low sulphur) and are, hence, not capable of processing of low-cost, high sulphur crudes. Intake of imported low-sulphur crude to the region's refineries adds to cost and, thereby, affects profitability. ▪ NER refineries are not considered at par with other consumers for grant of a subsidy of 40%. Thus, natural gas required as a feedstock is costlier for them. ▪ The Assam VAT Act debars refineries from availing VAT credit on raw material, including chemical catalyst. Entry tax, which was earlier applicable only on Assam crude, has also been extended to imported crude w.e.f. February 2015. This has an adverse impact on Bongaigaon refinery, which is importing crude oil to facilitate capacity utilisation of other NER refineries.
3	Inadequate pipeline capacity	▪ To achieve economies of scale, NRL has mooted a plan to triple capacity to 9 MMTPA by processing imported crude oil. Similarly, IOCL Guwahati and IOCL Bongaigaon are also planning to expand capacity from 1.0 MMTPA to 1.7 MMTPA, and 2.35 to 4.5 MMTPA, respectively. However, as crude oil production from the region has already been declining, additional refining capacity will require imported oil from elsewhere. An inadequate pipeline capacity may prove to be a cause of concern. ▪ Product pipelines in northeast India are running at over 100% utilisation, owing to which they have been able to transport only around 61% of their products through these pipelines.

Sr. no.	Key issues	Description of issues
4	Market for POL products	Except for LPG, there is a surplus for other petroleum products. Further expansion of refinery capacity will increase the surplus appreciably, finding a market for which will be a challenge.
5	Limited production of LPG	Refineries have not been able to produce enough LPG to meet local demand. In fact, LPG shortage has been escalating ever since. The limited LPG processing capacity of refineries in the region is a big challenge.
6	Storage and coverage of LPG	▪ State-wise LPG storage figures in the Northeast in terms of number of days are not very encouraging, at present. The storage capacity is even worse for Arunachal Pradesh, Nagaland, Meghalaya, Tripura and Mizoram, which have 0-2 days' storage capacity. ▪ All-India LPG coverage is estimated at 65-70%, whereas it is only 59% in NER, much lower than the national average.
7	IOCL Digboi-specific issue	▪ **Encroachment on refinery property at Digboi:** Digboi refinery is facing a serious problem of illegal/ unauthorised encroachment in and around Digboi, including periphery of oil installations of IOCL such as the refinery, new tank farm (NTF), nazirating water line and the Digboi-Tinsukia product pipeline (DTPL). Encroachment over any petroleum product pipeline is a grave safety and security hazard. Any serious accident in the pipeline can hugely impact life and property. ▪ **Delay in construction of the new tank farm and loading gantry at Digboi due to land ownership issue:** IOCL is building a new terminal at Golai near Digboi refinery on a land acquired by it. NOC from deputy commissioner, Tinsukia was obtained in May 2010 following which construction work commenced for the Rs 250 crore project. The local military authority (LMA) claimed that a portion of land totalling 3.03 acres within the proposed terminal belonged to the army. The LMA has also made a simultaneous claim on an additional 38.11 acres, under possession of IOCL, as defence land. **BG railfed petroleum storage depot at Moinarband (Silchar):** Acquisition of 2.56 acres for the approach road is under litigation. The state government may expedite handing over of this portion of land. The project is also awaiting EC from Pollution Control Board, Assam.

7.4.2 Natural gas

The key issues are discussed below.

Table 114: Issues with natural gas market in Northeast India

Sr. no.	Key issues	Description of issues
1	Pipeline capacity	▪ Capacities of existing pipelines are not sufficient to meet local demand as demand centres are not connected. ▪ Moreover, pipelines are only available in limited areas in upper Assam and lower part of Tripura. Due to lack of a pipeline network, gas is flared from different fields of ONGC, OIL and others.
2	Market development for natural gas	▪ Most towns/cities in northeast India have individual houses, which makes CGD connection economically unviable. ▪ Due to critical geographic location and lack of business (TNGCL is the only CGD player in northeast India that has CNG infrastructure), there is hardly any base of vendors who support the PNG and CNG businesses, resulting in much higher project and O&M expenditure. Vendors are not easily available for PNG material, CNG station construction job, spares related to CNG business, and calibration of instruments ▪ There are very few small and medium-scale industries in Tripura, so there is very low business opportunity for any CGD entity. ▪ As Agartala and cities in Assam are not planned cities, there are no utility corridors to lay pipeline in most areas. Hence, asphalt roads need to be cut to lay pipelines, restoration of which becomes very costly, increasing the project cost. ▪ The small size of the commercial segment makes the MDP price unaffordable for them. Hence, the subsidised rate needs to be made applicable for those consumers.

7.5 Key action areas

The action areas for improving the downstream segment have been presented below.

- **Refining capacity**
  - Ensure adequate crude oil supply for refineries
  - Refining margins
- **Increase consumption of petroleum products**
  - Develop new markets for petroleum products
  - Increase LPG output
  - Increase LPG penetration
  - Utilise naphtha production
  - Develop northeast as a wax production hub
  - Develop common user facility in the Northeast
  - National waterways for petroleum products
  - LNG skid mounting trucks
  - Co-operation between SAARC countries
  - Bio-ethanol production
- **Increase demand for natural gas**
  - Increase pipeline capacity
  - Offset LPG requirement with natural gas
  - Identify new areas for setting up a CGD network
  - Develop end-consumer segment.

7.5.1 Refining capacity

7.5.1.1 Ensure adequate crude oil supply for the refineries

Falling crude oil output in the Northeast is a matter of concern; it amounts to 4.54 MMTPA whereas requirement for the refineries in the region is about 7 MMTPA. Hence, for these refineries to run at 100% utilisation, crude oil is being imported from other parts of the country. Further, NRL and IOCL have been planning expansion of refining capacity from 3 MMTPA to 9 MMTPA by 2020 (NRL), 1.0 MMTPA to 1.7 MMTPA (IOCL Guwahati), and 2.35 MMTPA to 4.5 MMTPA (IOCL Bongaigaon).

Therefore, to ensure crude oil supply to refineries of the region, the Paradip-Siliguri-Bongaigaon-Numaligarh imported crude oil pipeline network needs to be planned and implemented.

7.5.1.2 Modernisation of OIL pipeline capacity

OIL's 3 MMTPA pipeline between Barauni and Bongaigaon is being modernised and its capacity will be reduced to 2 MMTPA from April 2016 as two intermediate pump stations will be taken out from the system. In view of the decline in the Northeast's crude availability, capacity utilisation of refineries depends on imported crude supply through this pipeline. If the capacity of the pipeline is reduced, NER refineries may be starved of crude oil. It was suggested that OIL should ensure that NER refineries do not starve on account of de-rating of the Barauni Bongaigaon pipeline. If required, OIL should commission new facilities to check the guarantee and thereafter revert to the old pumping system to ensure full supply of imported crude oil. In the meantime OIL is planning to take steps to enhance capacity of the pipeline back to 3 MMTPA by modernising the two intermediate pump stations that are proposed to be taken out from the system and putting them back onstream.

7.5.1.3 Refining margins

VAT and entry tax: In June 2011, the government reduced customs duty on crude oil, MS and HSD by 5%. Following this change, northeast refineries are at a disadvantage vis-à-vis refineries processing imported crude oil as they have to pay VAT at 5% and entry tax at 2%. Refineries processing imported crude oil do not have to bear any tax as the incidence of customs duty/sales tax is nil. Therefore, the central and state governments need to take appropriate steps to reduce VAT or entry tax so that the refining margins of NER refineries do not suffer.

Stream exchange: To facilitate the sharing of intermediate products within four refineries (to optimise cost and improve product yield), suitable tax exemption may be provided at the first point even for those categories of sale where goods are used by the buyer for further processing. This can be done by incorporating a clarification to the effect that VAT is not applicable for exchange/sale of any intermediaries to be used as raw material to produce finished petroleum products. Such an exemption also needs to be extended to entry tax and all other local levies, which otherwise also is paid at the time of sourcing of raw material by the dispatching companies. Alternatively, the tax on input may also be permitted to be set off against tax on output.

7.5.2 Increasing availability of POL products

7.5.2.1 Develop new market for POL products

Surplus petroleum products generated by the region's refineries can primarily be exported to Bangladesh and Myanmar subject to pricing considerations, while some of it can be utilized for production of petrochemical grade naphtha for which adequate demand exists within the country. Therefore, steps needs to be taken to create pipeline infrastructure in collaboration with neighbouring countries.

7.5.2.2 Increase production of LPG

The refineries in the Northeast India do not have sufficient LPG production capacity to meet the LPG demand of the region. Therefore, the refineries must look to increase LPG production capacity by introducing new technology or with further capacity addition.

To increase LPG production, IOCL has commissioned an Indmax unit (a technology developed by IOCL's R&D centre for upgrading heavy ends to LPG gasoline and diesel), at the Guwahati refinery in June 2003. Such technologies can be shared with other refineries so that production of LPG can be enhanced.

7.5.2.3 Increase LPG penetration

LPG penetration is the lowest in the Northeast among all areas. Therefore, concerted efforts need to be taken by all the stakeholders to increase LPG penetration in the region. IOCL proposes to lay an LPG pipeline, which will connect Numaligarh refinery (in Assam) with Imphal to address the supply scenario in remote areas in NER. This pipeline connectivity is expected to ensure uninterrupted supply, which, in turn will also reduce dependence on road for LPG transportation.

Proposed strategies for meeting LPG demand by OMCs

In order to ensure higher LPG penetration by 2018, immediate focus on Assam, Manipur, Meghalaya and Tripura is required. Moreover, to strengthen the bottling infrastrucuture so as to achieve the targeted LPG penetration, the following requirements have been identified:

- Capacity Augmentation at LPG bottling plant at NRL: This is expected to be completed by March/ June 2017. After the augmentation, the capacity will be 30 TMT in sigle shift. In the meantime, NRL is planning to operate the existing plant in two shifts.
- BPCL has identified Tezpur, Assam to set up a LPG bottling plant of 30 TMT capacities in single shift and a proposal for procuring land from Assam industrial development corporation limited is underway. This plant is expected to be commissioned by March, 2019. The proposed plant will be with LPG storage for bulk and packed stock. Initailly, it is proposed to put up bulk storage of 900 MT.
- Further, BPCL along with other OMCs is expected to set up new distributorship in the region, which is likely to ensure LPG access to more numner of households

Apart from the above initiatives of the OMCs, a new LPG distributorship guideline is being prepared by MoPNG. The modified guideline is expected to address specific issues of the hilly and difficult regions; thereby is likely to facilitate and enhance LPG coverage in the Northeast India. Further, the plan to add 10,000 LPG distributors in the immediate future is expected to increase LPG penetration in the country, especially in rural and hilly areas. Moreover, removal of subsidy for people who have annual income of Rs. 10 lakhs or more is likely to lessen the subsidy burden of the government of India to some extent. The resources thus freed, can be utilized to provide more LPG connections in rural and hilly areas.

Overall strategies required for meeting long-term LPG demand

Given the inherent constraints of refinery production, wherein a fixed slate of products is available depending on the configuration, LPG production (about 4% of refinery production) can be maximised only to a limited extent. Augmenting LPG production capacity will also lead to higher production of other products, mainly petrol and diesel, which also have to find their markets and related logistics are to be developed, either for evacuation or absorption.

In this context, the strategy for tackling the projected demand has to be multi-pronged as broadly described below:

- Utilise locally available natural gas in place of LPG
- Boost refining capacity
- Address issues surrounding lower crude oil production increased demand of crude oil for the expanded/new refineries
- Create an intra-regional pipeline grid to ensure uninterrupted supplies of petroleum products
- Develop marketing infrastructure in NER in keeping with increased demand
- Import LPG directly via Chittagong Port, Bangladesh

Each of these above approaches has been elaborated in various sections of the report as described below:

- Utilising locally available natural gas for substitution primarily of LPG is described below.
- Increasing the capacity of NER refineries is described in section 7.1.3
- Addressing the issues related to decreasing trend of crude production within NER and increased demand of crude oil for the expanded/new refineries is described in section 7.1.3
- Creating an intra-regional pipeline grid to ensure uninterrupted supplies of petroleum products is described in section in section 6.3
- Developing marketing infrastructure in keeping with increased demand is described in section 7.2.6
- Imports of LPG directly to NER via Chittagong Port, Bangladesh

Strategies for logistics and transport of LPG to challenging areas

High altitude areas like Arunachal Pradesh have seen massive deforestation in the past for heating purpose. The rejuvenation of forest in high altitude areas is very difficult and therefore there is a need to address the heating requirement in high altitude.

The Vision document includes three pronged strategy for accessibility of LPG in high altitude/challenging areas in the North East Region towards addressing this concern:

- Enhanced production of LPG from NE refineries
- Supply of bulk LPG
  - from Haldia to Guwahati
  - from Chittagong (Bangladesh) to Sabroom (Tripura)
- Strengthen intra regional logistics by laying pipelines

The vision document envisages that the availability of LPG in the state of Arunachal Pradesh would increase from 16 TMTPA in 2014-15 to 35 TMTPA in 2029-30 through this strategy.

Further, alternatives like supply of bulk LPG by road eg. Haldia / Paradip to Agartala, Tripura (and onwards to Manipur, Mizoram & Silchar) may also be considered to significantly reduce the distance as compared to movement via Guwahati. This route also skirts the logistics issues related to LPG access in some of these states. This would facilitate development of Agartala as a LPG hub for southern part of NER, with Guwahati remaining the hub for northern part.

Moreover, to strengthen the last mile delivery of LPG cylinders to the customers particularly in the hilly areas, a committee under Hon'ble MP, Sikkim is currently working. The learning / recommendations from the study once accepted by the Government may be considered for the hilly states of the North East.

A pilot project on using LPG for heating requirements of civilian, military and other population, residing above 6000 feet height could be considered. The learnings from the pilot project can further be evaluated to design appropriate programs for using LPG as heating fuel.

Utilisation of natural gas locally available within NER to substitute LPG

Natural gas production in the Northeast is expected to scale up significantly in future. As per ONGC and OIL - the two main E&P operators in the Northeast - natural gas production is estimated to increase from 13.9 MMSCMD in 2015-16 to 20.6 MMSCMD in 2029-30. A significant part of this increased quantity is likely to come from two major sources – Tripura fields and Assam & Assam-Arakan (A&AA) fields. During the reference period, in case of Tripura, the bottling quantity is likely to go up from 3.1 MMSCMD to 8.4 MMSCMD, an increase of over 60%. In case of the A&AA fields, the increase is likely to be around 2 MMSCMD from near negligible levels today. This increase offers a sizeable opportunity for absorbing and monetizing this increased gas availability in industrial, commercial, transport & domestic applications. It is imperative to develop a full-scale gas distribution network. The government has to; therefore, consider allocating this increased availability of natural gas for CGD on priority.

The following options are, therefore, proposed:

Gas from upper Assam fields (A&AA)

A case for a gas pipeline from upper Assam fields (near Duliajan) to Bongaigaon via Guwahati and associated CGD networks is highly compelling.

At present, the Duliajan-Numaligarh gas pipeline with capacity of 1 MMSCMD is operated by M/s DNPL, a JV between Assam Gas Company Ltd (AGCL), NRL & OIL. In fact, AGCL wants to extend the pipeline to Guwahati and, subsequently, to New Bongaigoan depending on availability of gas in the upper Assam gasfields. AGCL is currently authorised to supply PNG to the upper Assam geographical area, up to Golaghat district.

To maximise the use of gas and enhance project viability, the Guwahati & Bongaigaon refineries may be considered as major anchor loads, which between them can absorb 1 MMSCMD of gas at existing capacities. Additionally, this pipeline will pass through major demand centres of Assam such as Nagaon, Guwahati, Nalbari, Bongaigaon, Kokrajhar & Dhubri, which together account for around 125 TMTPA of domestic LPG usages (equivalent to 0.5 MMSCMD of gas). Currently, LPG penetration in Assam is around 55%. The projected LPG demand for the Northeast is based on the target of 80% coverage by 2029-30. Further, a large part of the projected LPG demand in NER is expected to come from these major demand centres in Assam and adjoining suburban areas. In this context, the LPG deficit can be bridged through fuel substitution, i.e., moving from LPG to PNG. Accordingly, spur lines on the Duliajan-Numaligarh-Guwahati-Bongaigaon for supplying domestic customers through CGD networks could be an attractive proposition, given the high demand potential. At the same time, this will alleviate the pressure on LPG demand. In addition, the automotive and industrial sectors could also be supplied through the CGD network, thereby further enhancing the viability of CGD operations in these areas. The PNGRB may consider adding further geographical areas beyond Golaghat district and Bongaigaon.

Gas from Tripura fields

Production of natural gas from Tripura is expected to increase significantly. It is proposed to lay two major cross-country gas pipelines from Tripura gas fields to Guwahati with spur lines connecting to Mizoram and Manipur. Presently, LPG demand in Tripura amounts to 31 TMTPA. CGD networks along these two proposed gas pipelines could cater to the present combined (Tripura, Barrak valley & Mizoram) LPG demand of around 100 TMTPA (equivalent to 0.365 MMSCMD of gas).

These pipelines, based on enhanced Tripura Gas, will alleviate the pressure on LPG demand by fuel substitution.

Imports of LPG directly to NER via Chittagong Port, Bangladesh

Chittagong (Bangladesh) to Sabrum (Tripura) LPG pipeline

Currently, LPG deficit in the Northeast is met through imports received at Haldia and other ports and transported through tank trucks. Considering the location advantage, the Tripura government has already undertaken construction of a bridge over the Feni river in Tripura to access Chittagong Port in

Bangladesh for movement of heavy machinery for NER. Developing all-weather access for import of LPG at Chittagong Port can be explored thereafter.

Once the import facility is developed at Chittagong Port, LPG can be transported through a pipeline connecting it to Sabrum in Tripura. This Chittagong-Sabrum 172 km pipeline could considerably reduce transportation costs and time. At Sabrum bulk storage facility would need to be created and LPG can be moved in bulk through tank trucks and transported to Vishalgarh LPG plant in Tripura, Silchar BP in Assam, and Aizawl BP.

Summary of LPG demand/supply in Northeast India

Total LPG demand is expected to reach 1,100-1,200 TMTPA by 2030 in the Northeast considering 80% penetration and 1,500 TMTPA considering universal availability and access to all. LPG production from existing sources as well as from envisaged capacity additions will be approximately 806 TMTPA. Further production from upper Assam fields and enhanced production from Tripura gasfields will take the total supply to 1,010 TMTPA, which will match demand.

Table 115: LPG Demand-Supply scenario in the Northeast in 2030

Particulars	Figures in TMTPA
Demand (access to all)	**1,504**
Supply	
IOCL Digboi LPG production	9
IOCL Guwahati LPG production	66
IOCL Bongaigaon	415
Expansion in NRL (6 MMTPA)	316
Total (supply)	**806**
Gas from upper Assam	100
Gas from Tripura fields	125
Grand total (supply)	**1031**
Shortage (TMTPA) with access to all	**698**
LPG shortfall could be made up through LPG imports at Chittagong Port, Bangladesh to Tripura	

However, in another scenario, if additional gas from the upper Assam fields and Tripura gasfield is not available, the shortfall of about 225 TMTPA may be imported. It may be possible to import gas from Chittagong to Sabrum through a dedicated gas pipeline, which can further meet demand in Agartala, Barak Valley and Aizawl. Additional bottling and storage infrastructure need to be created in these areas.

LPG storage facility at Chittagong (Bangladesh)

The Bangladesh Petroleum Corporation plans to set up a 1 lakh MT LPG bottling plant in Chittagong that will be completely import-based. Presently, close to 80,000 MT of LPG is imported in Bangladesh. Currently, the Chittagong Port has a bottling capacity of 10,000 MT of LPG per shift per year.

The new LPG plant at Chittagong will be installed on 10 acres with LPG import facilities and storage tanks. The facility is planned to be set up under the PPP mode by the Bangladesh government.

Table 116: Port handling facilities at Chittagong Port

Facility	Capacity (No of berths)
For Ocean going vessels	
General cargo berths	6
Container berths	11
Dolphin oil jetty for POL products	3
Grain silo jetty	1
Cement clinker jetty	1
TSP jetty	1
CUFL jetty1	
KAFCO urea jetty	1
Ammonia jetty	1
For Inland coastal vessels	
Jetty births for POL	1
Concrete berths (grains)	1
Pontoon berths for POL	3
Pontoon berths for cement	1
Single point mooring	14

Source: CPA

Cargo storage space available at Chittagong port

Table 117: Cargo storage space available at Chittagong Port

Protected area	Nos.	Sq. metre
Transit sheds 1-9	9	64,364.70
Warehouses D,F,P,O	4	20,712.41
Car sheds (P shed & F shed)	1	8,696.63
Open dumps	-	90,000.00
Outside protected area:	**Nos.**	**Sq. Meters**
Warehouses	6	25,179.36
Open dumps	-	2.00

Source: CPA

7.5.2.4 Naphtha consumption

Naphtha production from NER is expected to amount to 0.48 MMTPA after all refinery expansion projects are completed. Naphtha has a wide variety of uses in production of fertilisers and petrochemicals, the major ones being:

- Feedstock for production of ethylene, propylene, butadiene and benzene.
- Solvent in various industries
- For production of fertilisers (urea)

Petrochemical and fertiliser plants that consume naphtha as a feedstock can be built at nearby locations, which can consume the naphtha produced in the Northeast.

Table 118: Production forecast of naphtha in Northeast India (TMTPA)

Year	2014-15	2020-21	2024-25	2029-30
Quantity (TMTPA)	294	292	292	292

Source: CRISIL Infrastructure Advisory Analysis

7.5.2.5 Developing Northeast as a wax production hub

Crude oil produced in NER has high wax content; hence, the region has been developed as a major wax-producing area. The region has two paraffin wax producing units located at IOCL's Digboi refinery producing (60,000 TPA) and Numaligarh refinery (producing 50,000 TPA); together, they account for majority of wax production.

In view of such large availability of wax in the region, the government may formulate policies to incentivise industries to set up downstream units that consume wax as raw material. Some industries that use paraffin wax as a feedstock are tyre manufacturing, small-scale candle manufacturing units, pharmaceuticals and cosmetic industries.

As candle manufacturing is not capital intensive and requires minimal resources, the Northeast can be developed as a candle manufacturing hub for the country. Proximity with Bangladesh, Myanmar, Nepal and Bhutan will ensure a ready market for export for these small scale industries. Already, India, Nepal, Bhutan and Bangladesh have signed a landmark Motor Vehicles Agreement (MVA) for the regulation of passenger, personnel and cargo vehicular traffic among them. The agreement paves the way for seamless movement of people and goods across their borders for the benefit and integration of the region and its economic development.

Wax project by NRL

NRL has commissioned its Wax Plant in March 2015 at a cost of Rs. 676 crores. The Wax project was implemented as a Value Added Project for production of Paraffin and Semi Micro-crystalline Wax utilizing inherent properties of Assam Crude (high wax content of around 7%). This unit has production capacity of 43 TMT of paraffin wax and 4.5 TMT of Semi micro-crystalline wax per annum. Since commissioning of the Wax unit, Numaligarh Refinery has emerged as the largest wax producing unit of in India. The wax block comprises of two major units namely Solvent De-oiling Unit (SDU) and the Wax Hydo-finishing Unit (WHFU). Technology for the Solvent De-oiling unit has been provided by Engineers India Limited (EIL) and Indian Institute of Petroleum (IIP). Technology for the Hydo-finishing unit has been provided by M/s Axen of France.

The technology used in the Solvent De-oiling Unit (SDU) of NRL's Wax plant was developed indigenously by IIP, Dehradun, EIL and NRL. Prior to commissioning of the NRL's SDU, the knowhow and technology of SDU was available only with foreign licensors. Successful commissioning of NRL's SDU has established the indigenous technology as proven for production of Wax. The research and development activities for the SDU technology were done at IIP, Dehradun and detail engineering was done by EIL. NRL has pioneered in investing on the demonstrative plant using the indigenous technology which was at R&D stage till then. In the context of Paraffin Wax, against the country's total estimated demand of 130 TMTPA, domestic production excluding NRL's recently commissioned Wax plant; is in the range of 52 TMTPA (32 from Digboi Refinery and 20 from CPCL Refinery) and remaining quantity is met through import. With regard to Microcrystalline Wax, entire domestic demand of around 12 TMTPA is being imported.

NRL's Wax is estimated to ensure reduction in import dependency for the product by 53%. By virtue of facilitating import substitution and promoting indigenous technology, NRL's Wax plant is expected to contribute towards the "Make in India" campaign. In its endeavor to leverage the geographical proximity to the South Asian Countries like Nepal, Bangladesh, Thailand etc, NRL is in advance stage of selling its wax to these countries.

Importance of Wax to the Local Community:

Paraffin wax is used for making Candles and also used in Tarpauline, and PVC pipe manufacturing industries. Microcrystalline wax is used in manufacturing of tyre, rubber products, paints and polishes, pharma and cosmetics etc.

NRL has also encouraged budding entrepreneurs of its nearby locality of the refinery to venture into candle making industry. In this regard, enterprising youths from the locality were imparted training on technical knowhow of candle manufacturing. As a result few candle manufacturing units are already set up by those trainees. NRL has also assisted those units by ensuring supply of Paraffin Wax as raw material to these units whenever required by these entrepreneurs.

Setting up of Wax Park:

Setting up a Wax Park to facilitate small scale industries like candle making from North East Wax will go a long way in providing livelihood for the local entrepreneurs.

7.5.2.6 Development of common user facility in NER

The Northeast has difficult terrain; therefore, the associated logistics cost for transporting petroleum products is high. Only IOCL has depot infrastructure in all states other than Assam for storing petroleum products. None of the other oil marketing companies (OMCs) have any such storage facility in the region, as demand for POL products in any of the northeastern states is not very high and it is, therefore, not economical for any individual oil company to operate depots in all these states. This leads to:

- **Higher freight cost:** OMCs are taking product to their retail outlets directly from the refineries by tankers, thus incurring higher freight cost.
- There is no safety stock to meet exigency in demand and supply.

To overcome the problems related to logistics and high operational costs mentioned, we recommend:

- To achieve economies of scale by integration of volume, develop common marketing facilities in NER, which can be shared by all of the individual OMCs.
- Depots for storage of POL products can be built by considering demand of the entire state and individual OMCs can book storage space on lease to cater to local demand. These depots can be connected by a pipeline as a common carrier or connected to the nearest rail network.

7.5.2.7 National Waterways-2 (NW-2) for petroleum products

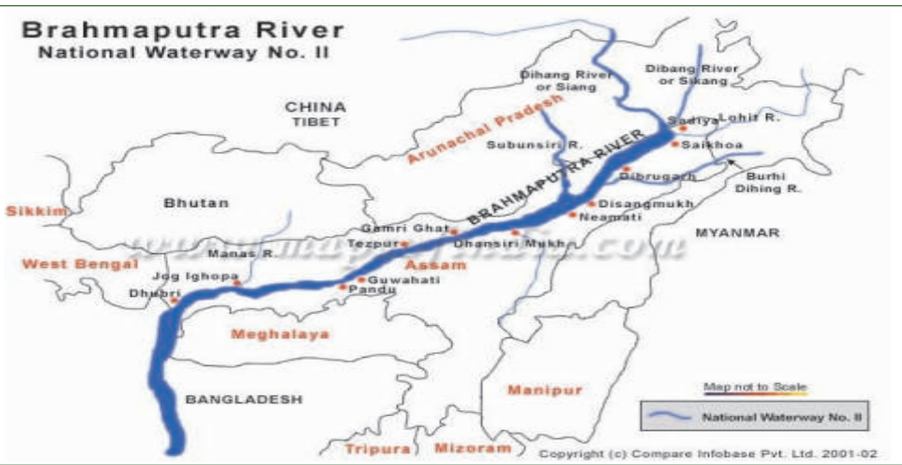
Development of the NW-2 through Bangladesh for easy movement is expected to prove critical for POL products to Bangladesh. The Brahmaputra, with a length of 891 km between the Bangladesh border and Sadiya, was declared as a National Waterway no. 2 (NW-2). The advantages of using NW-2 compared to roads and railways are presented below:

Particulars	Waterways	Road	Railway
1 horsepower	Moves 4000 kg	Moves 150 kg	Moves 500 kg
1 litre fuel	Runs 105 t-km	Runs 24 t-km	Runs 85 t-km

Source: CRISIL Infrastructure Advisory Analysis

The costs of developing waterways are much lower than railway and road. Further, waterway transportation is environmentally friendlier compared with roads and railways as it consumes lower fuel to traverse the same distance. The average CO2 emission in waterway transportation is 50% lesser than in case of road transportation. Further, as the road and railway network requires land acquisition, the process is much more time consuming. Moreover, by developing the NW-2, a trade corridor can be created for economic import / export of goods, including export of petroleum product from the region. This will facilitate industrialisation of NER.

Figure 50: National Waterways- 2



7.5.2.8 Cascading of gas

The flaring of gas is mainly due to three reasons:

- Technical flare
- Flare due lack of infrastructure
- Flare due to lack of consumers

Currently more than 0.203 MMSCMD of gas is being flared in the Northeast because of lack of consumers and infrastructure; over 60,000 SCMD of gas is being flared in Jorhat itself. Flaring due to lack of infrastructure and lack of consumers is a significant portion of the total gas being flared. Looking at the situation both in the region and nationally, where natural gas is scarce and where a large portion of the gas demand goes unmet, it is vital to utilise and consume every gas molecule that is being produced. To monetise gas from isolated fields, or where gas is being flared, the objective is to transport gas from production centres to the gas demand centres.

Table 119: Quantity of gas flared in NER (MMSCMD)

Flaring of gas	Assam	Arunachal Pradesh	Total
OIL	0.075	0.025	0.100
ONGC	0.083	0.000	0.083
Others	0.000	0.020	0.020
Total	0.1580	0.0450	0.203

Source: OIL, ONGC, Others

For monetising this flared gas, we propose the use of cascades for transporting gas from the production location to demand centres. A cascade consists of a number of steel cylinders, valves, fittings, pressure gauges and pipelines that can be mounted over a vehicle and be taken to the demand location where the stored natural gas can be dispensed.

Table 120: Evacuation arrangement proposed for flared gas

Location	Company	Volume (MMSCMD)	Viable monetisation method	LPG (TMTPA)
Makum (Assam)	OIL	0.015	Construction of Makum CGS is in progress.	4
Habeda (Assam)	OIL	0.060	Construction of CGS Is in progress. To be supplied to CGD networks	16
Mechaki (Assam)	OIL	0.030	Supply to Local grid started.	-
Kumchai (Arunachal Pradesh)	OIL	0.025	10 MW power plant planned by OIL	-
Borholla,Koraghat, Nambhar, Kasomarigaon	ONGC	0.054	To be supplied to CGD networks by pipeline or by cascading options	15
Geleki (Assam)	ONGC	0.029	To be supplied to BCPL by compressors	8
Kharsang (AP)	Others	0.020	To be supplied to CGD networks by pipeline or by cascading options	5
Total		**0.203**		**48**

Baghjan, which was earlier a flare gas location, has been connected through a pipeline by OIL.

Cascading of gas

- Connecting the flare gas location via pipelines is economically unviable given the low volumes.
- Power plant can be developed at locations where profile of gas is for long term (say 10-15 years).
- Cascading of gas and transport to demand centres is not capital intensive and easy to implement.
- Compression and transportation cost of flared gas is Rs 10-14 per kg, while the landed cost to consumer will be Rs 25-30/kg (cheaper than LPG).

Figure 51: Cascading of gas

Gas is filled in the cascade at a pressure of 200-250 bars, for which compressors are used. Compressed gas is filled in the cylinders, which are taken to the demand centres and then delivered to small industries or supplied to meet CNG demand from vehicles.

7.5.2.9 LNG skid mounted trucks

LNG skid mounted trucks can be another mode for supplying surplus flared gas, where the gas blocks are not connected with the pipeline network. However, this technology is quite costly as of now as it requires multiple conversions before the gas can be used; thus, it is unattractive for small-scale industries. Moreover, the flared volume at most of the locations is not significant enough to make induction of such expensive technologies financially feasible. Further, poor road connectivity is another concerning area which makes transportation difficult. Therefore, monetizing flared gas will require financial support such as VGF/budgetary support.

Figure 52: Flared gas transportation by using LNG skid mounting trucks

7.5.2.10 Co-operation between SAARC countries

Though northeast India has surplus capacities of petroleum products that can be transported to Bihar, UP and West Bengal, the proposition is costly, given the high transportation cost. Exports to Bangladesh and Myanmar, which are net importers of petroleum products, is a desirable alternative instead.

Table 121: Demand potential of POL products in neighbouring countries (MMTPA)

Country	2014-15	2019-2020	2024-25	2029-30
Demand potential in neighbouring countries				
Myanmar	2.00	1.25	1.00	0.75
Bangladesh	4.00	4.00	3.60	5.40
Nepal	1.40	1.70	2.07	2.52
Bhutan	0.10	0.12	0.15	0.18
Sri Lanka	2.00	1.50	2.50	3.50
Total demand potential for POL products	**9.50**	**8.57**	**9.32**	**12.35**
Supply potential in NER				
Production Capacity (POL)	6.5	7.0-	14.3	14.3
Demand from NER	3.20	4.0	5.4	7.3
Surplus POL available	**3.3**	**3.0**	**8.9**	**7.0**

Source: CRISIL Infrastructure Advisory Analysis

However, exports of surplus petroleum products can be made possible only if adequate pipeline network can be set up. Co-operation agreements with target markets will be a pre-requisite for getting access.

7.5.3 Boosting natural gas availability

7.5.3.1 Increase pipeline capacity

Capacities of existing pipelines are not sufficient to meet local demand. To ensure supply to connect demand centres in northeast India, the national gas grid (currently spanning Barauni-Siliguri-Bongaigon-Guwahati), needs to be extended and modified in three phases:

Phase I: Guwahati-Duliajan

Phase II: Agartala-Bongaigaon

Phase III: Barauni-Siliguri-Bongaigon

As bulk of natural gas will be produced in Mizoram, Manipur and Tripura, it is important to connect these states with the national gas grid on a priority basis. Further, as Barauni is already being connected to the national gas grid through Jagdishpur-Barauni pipeline, it makes sense to propose a pipeline from Barauni to the rest of northeast India.

7.5.3.2 Substitute LPG with natural gas

Refineries in the Northeast have not been able to produce enough LPG to meet local demand; excess demand can therefore be met by PNG and CNG. Based on the population, the following cities have been shortlisted (where PNG and CNG can be supplied to push use of cleaner fuels). The expected demand from these cities for PNG will not be more than 0.1 MMSCMD in the initial years. Peak demand, once cities have a CGD network, will amount to 0.5 MMSCMD for PNG. Demand from small-scale industries and other commercial establishments are estimated at 0.5 MMSCMD in the initial years, which could increase to 2.0 MMSCMD in 2022.

Table 122: Quantity of gas required (MMSCMD) to offset LPG requirement

Quantity of LPG requirement (TMTPA)	2019-20	2024-25	2029-30
As per existing growth pattern (in TMTPA)	534	714	957
Growth to achieve 100% penetration (in TMTPA)	624	968	1504
Quantity of gas required to offset LPG demand (MMSCMD)	3.7	4.15	4.4

Source: CRISIL Infrastructure Advisory Analysis

The capital cost for supplying PNG and CNG will amount to Rs 1,750 crore for Phase 1, Rs 570 crore in Phase 2, and Rs 430 crore in Phase 3 for all cities mentioned in Table 121. Initially, each of the state capitals can be considered through nomination basis to GAIL/AGCL/TNGCL and other state entities, considering the fact that private bidders would not be interested in the of a city-gas distribution projects in these areas as such projects may not be economically viable.

7.5.3.3 Identifying new areas for CGD network

To create a market for natural gas in the Northeast, it is important to identify key areas that can be brought under the CGD network (See table below).

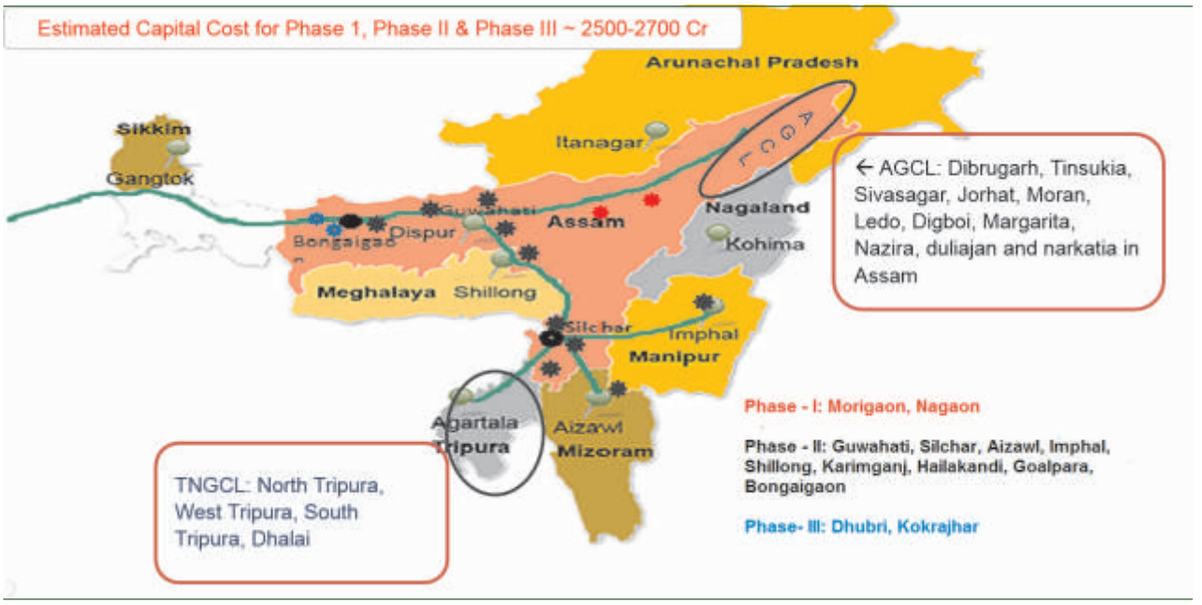
Table 123: List of cities identified for CGD in future

City	Population in district (as per Census 2011)	Capital cost required Rs Cr (estimated)
Phase I		
Morigaon	Morigaon	Morigaon
Nagaon	Nagaon	Nagaon
Phase II		
Silchar	172000	22
Aizawl	400000	61
Guwahati	968549	944
Imphal	1000000	152
Shillong	143007	22
Karimganj	1228686	187
Hailakandi	659296	100
Bongaigaon	732639	111
Phase 3		
Kokrajhar	886999	135
Dhuburi	1949258	296
Total		2,726

Source: Census of India, CRISIL Infrastructure Advisory Analysis

The above cities need to be connected to the gas pipeline network and may require VGF from the government, as the investment requirements for such projects is expected to be quite large and demand in these cities may not be significant to make it financially remunerative enough for developers. The estimations of above capital cost are based on rough assessment. A detailed study may be conducted at a later stage to determine the actual investment requirements for such projects. 8 cities in Northeast region have been identified by GoI for being considered for 'Smart Cities' initiatives. These cities may be considered for prioritization from CGD network perspective, subject to technical and pipeline connectivity considerations.

Figure 53: Map of future CGD cities Phase I, II & III and CNG highway



Source: CRISIL Infrastructure Advisory Analysis

7.5.3.4 Development of the end-consumer segment

The proposed Chambal fertiliser plant in Tripura, which has been in the planning stage for long, needs to be fast-tracked not only to ensure fertiliser supply in the region but also to create adequate demand for gas fields in Tripura. Further, the opening of Chittagong Port can meet the gas requirement of regional industries, as importing LNG through the port will be easier and economical. Access to Chittagong Port will ensure trade between the Northeast and Bangladesh as well as with the rest of the country. Further, ONGC's gas-based power plant can be expanded to supply power to Bangladesh, which is a power deficit country.

The NEIIPP (2007) was suspended by government temporarily. The policy has led to positive results in Northeastern states, especially in Assam. Therefore, re-instating the NEIIPP can be considered as it will help in setting up medium and large-scale industries in the region. These industries can then be targeted for gas consumption.

Hon’ble Prime Minister of India Shri Narendra Modi at the control room of ONGC Tripura Power Company during his visit to Tripura

Hon’ble Minister of State (I/C), MoPNG Shri Dharmendra Pradhan reviewing the progress of NRL during his visit to Numaligarh Refinery on 16th April, 2015 as part of his visit to oil installation in the North East.

Hon’ble Minister of State (I/C) MoPNG Shri Dharmendra Pradhan at ONGC site in Geleki, Assam

Shri Dharmendra Pradhan Hon’ble MoS (I/C), Petroleum & Natural Gas and
Hon’ble MoS, Ministry of Youth Affairs and Sports
Shri Sarbananda Sonowal at Well No 1 in Digboi Centenary Museum.

7.6 Action Plan

Table 124: Action plan for downstream segment

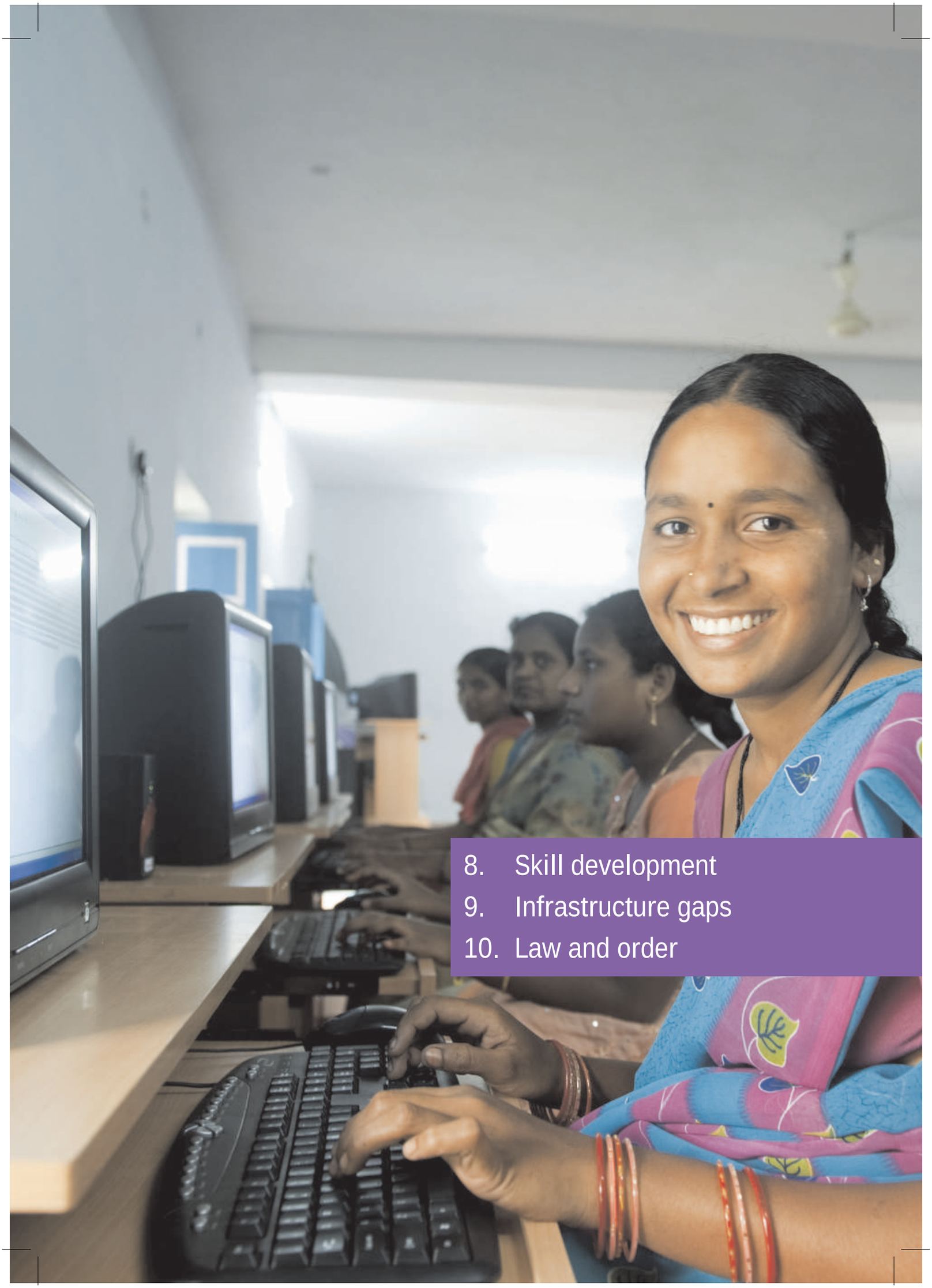
Action items	Authorities concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (More than 5 years)
Refining capacity				
Expansion of refining capacity	NRL			▪Expansion needs to be planned along with other infrastructure like pipelines for imported crude oil and a product pipeline along the Siliguri-Parbatipur route ▪Product pipeline from Siliguri to Orissa /Mughal Sarai needs to be planned.
Expansion of refining capacity	IOCL Guwahati, Bongaigaon	Expansion needs to be planned along with other infrastructure such as pipelines for imported crude and petroleum products	▪ Product pipelines from Bongaigaon to Siliguri-mainland in India.	
Expansion of bottling Capacity	IOCL	▪Gopanari LPG Bottling Plant ▪North Guwahati LPG Bottling Plant		
Enhancement of LPG production in refineries using INDMAX technology	IOCL		▪IOCL needs to urgently implement the INDMAX technology for enhancing LPG production.	

Action items	Authorities concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (More than 5 years)
Export of POL to SAARC countries	NRL/IOCL/MoPNG/MEA	▪MoPNG to form a committee to evaluate possibility of exporting petroleum products, to Bangladesh, and Myanmar, subject to pricing considerations. ▪Discussion with the governments of Bangladesh, Nepal, Bhutan, Sri Lanka and Myanmar for exporting petroleum products. These countries are net importer of POL products.		
Increasing availability of POL products				
Increase availability by laying product pipeline network and LPG pipeline	MoPNG/ IOCL/ NRL	▪Numaligarh-Imphal route (LPG and product pipeline) to cater the demand in Dimapur (Nagaland), Sekmai (Nagaland) and Mualkhang (Mizoram)	▪Guwahati-Silchar-Imphal product pipeline (with further extension of Silchar-Agartala & Silchar-Aizawl) ▪LPG pipeline from Chittagong-Sabrum-Agartala	LPG Pipeline from Durgapur-Guwahati as an (alternative route to the Chittagong-Sabrum route)
Re-instatement of NEIIPP	DIPP	▪Re-instatement of NEIIPP with increased budgetary allocation of up to 10 times the current level, will not only ensure higher hydrocarbon consumption but also will create jobs for local people .	▪Inclusion of medium-scale industries also in NEIIPP. ▪To promote local manufacturing of spare parts for hydrocarbon industry in Tripura/Guwahati/Dibrugarh by including a special provision to mentioned industries.	
Industries	DIPP/MoPNG	▪Development of small scale industries like wax, bamboo-based manufacturing units, candle manufacturing units, tyre, rubber based industries, etc		

Action items	Authorities concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (More than 5 years)
Improve connectivity to increase industrial development and hence consumption of petroleum products	NRL/GoI/DIPP/ MORTH	▪Four-laning of NH 37 and 2-laning of NH 150 ▪Connectivity to Agartala via NH-44 needs to be upgraded to two-lane.	▪ Upgrade Silchar, Shillong, Dimapur and Jorhat civilian airports to improve connectivity and promote tourism.	
National Waterways-2 for petroleum products	IWAI/MEA/MoPNG	▪To improve connectivity from upper Assam to mainland in West Bengal and Bangladesh, the NW-2 needs to be extended to Bangladesh	▪Review for implementation of proposed roadmap	
Development of common marketing facilities in the Northeast, which can be shared by all of the individual OMCs.	MoPNG, IOCL, NRL, BPCL		▪Development of common user facilities	
Setting up ancillary plants manufacturing fertilisers and petrochemicals around refineries in the region, which can utilise the naphtha produced from the refineries as a feedstock	DIPP, MOCI, MSME	▪Implementation stategy to be formulated.	▪Setting up of ancillary industries	
Increase demand of natural gas				
CGD Development (Phase I, II, III) –Silchar City	GAIL/PNGRB/AGCL/TNGCL/State Governments	▪Cities falling on the proposed gas pipeline route of Agartala-Bongaigaon and Guwahati-Duliajan need to be considered in Phases I & II. ▪GAIL to analyse potential demand for gas from industries and commercial users in these cities for making pipeline projects viable. ▪CGD in Silchar city needs to be implemented using gas from ONGC block by connecting it with a pipeline.	▪Cities falling on the proposed gas pipeline route of Barauni-Bongaigaon need to be considered in Phase-III.	
Incentives for CGD development	MoPNG/PNGRB/AGC/ TNGCL/GAIL	▪**Option 1** – Bidding route – PPP mode (VGF) ▪ MoPNG to evaluate various incentive schemes such as VGF, tax benefit,s subsidy for initial years, etc. to attract CGD players to the region ▪**Option 2**: Nomination basis to GAIL/AGCL/TNGCL. ▪ Financial support required by AGCL and TNGCL to be submitted to MoPNG. MoPNG to evaluate the proposal.		

Action items	Authorities concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (More than 5 years)
Offset LPG requirement by - cascading of gas	GAIL (feasibility)	▪On a trial basis, this stranded gas need to be utilized as gas demand is high and exploration & production companies are not able to supply; hence, gas is flared. ▪GAIL to identify exact costs of transporting gas to demand centers by using cascades (estimated cost Rs 25-30/Kg)	▪If projects are financially not viable, MoPNG to provide support GAIL/end consumers by offering subsidies to consumers choosing stranded gas. Preference should be given to consumers using LPG. This will also offset the requirement of LPG to some extent (124 TMTPA).	
Utilisation of flared gas by using LNG skid mounted trucks	GAIL/NOCs	▪GAIL to assess conversion of gas to LNG, transportation cost, re-conversion cost and hence landed cost to consumers/industry, while supplying LNG through trucks.	▪If projects are financially not viable, MoPNG to support GAIL/end consumers by offering subsidy to consumers for opting flared gas.	
Modular power plants	ONGC/OIL/APGCL	▪Small- power plants need to be established near the location of flared gas. Typically a 10 MW power plant requires 0.04 MMSCMD of gas.		
Development of end-consumer segment	MoPNG/MoF/State governments/DIPP	▪DIPP to re-implement NEIIPP ▪Increase budgetary allocation under such schemes ▪State government to come out with industrial policy		
Development of end-consumer segment (fertiliser)	ONGC/ CFL/ MoPNG/MEA	▪Fertiliser plant, which is under the planning stage at Tripura by ONGC and Chambal Fertilizers, needs to be fast-tracked along with opening up of Chittagong Port route.		
Development of end-consumer segment (power)	ONGC/MoP		▪Capacity expansion of OTPC Power plant.	

Action items	Authorities concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (More than 5 years)
Bio-ethanol	MoPNG/Department of Agriculture and co-operation(DAC) / NABARD	▪To add the Northeast as a location for setting up of bio-refinery under CIS scheme and for granting of 40% CIS. ▪Government to incentivise production of bamboo in the Northeast, through the National Bamboo Mission and fund the intermediary bamboo processing industry through NABARD for incentivising farmers and entrepreneurs.		
Policy level/ state government support/ MoPNG support				
Tax Incentives (VAT, entry tax)	MoPNG, MoF, state government (Assam)	▪MoPNG to take up the concern of the refineries w.r.t VAT, entry tax; state government is requested to waive VAT and entry tax for new projects and expansion projects in Assam ▪Facilitation of stream exchange between the four refineries in the Northeast by permitting setting off of tax on inputs against tax on output. ▪MoPNG to take up the issue with MoF and state government. ▪MoP&NG to review instructions on imposing sales tax and transportation cost of indigenous crude onNortheastern refineries, instead of OIL/ONGC		
Land acquisition, encroachment etc.	MoPNG/State Government	▪BG rail-fed petroleum storage depot near Jirania (Agartala): Confirmation needed on funding two associated projects and clearance required from the All Tripura Tribal Association (ATTA) for the use of the identified land for the project is awaited from Tripura government. ▪BG rail-fed petroleum storage depot at Moinarband (Silchar): 2.56 acre for the approach road is under litigation. State government to expedite handing over of this portion of land. EC need to be provided by PCB, Assam for the project. ▪Delay in construction of new tank firm and loading gantry at Digboi: State government is requested to review matter favourably, so as to avoid such delays in projects. ▪Encroachment at Digboi Refinery/DTPL pipeline, new tank farm and waterline: State government needs to take early action to avoid mishaps.		



8. Skill development
9. Infrastructure gaps
10. Law and order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8. Skill development

8.1 Background

Globally, significant oil & gas discoveries have been reported in the past five years. This will enhance E&P activity in the coming years. India, the fourth-largest consumer of crude oil in the Asia-Pacific, has also witnessed an increase in E&P activity. Oil & Gas accounts for more than 30% of its total import bill, and going by the growth of key end-user sectors, this proportion is bound to increase further unless substantial discoveries are made in the country. Till date, about 20% of oil and gas discoveries have been made in the Northeast alone. This translates into significant workforce requirement, particularly in petroleum and production engineering, besides drilling crews and geoscientists in the region.

Table 125: Sample list of major skill set requirement for E&P industry

Sl. No.	Specific skills	Parent branch/specialised branch
1	JE- Drilling	**Mechanical engineers/Diploma** ▪ Geologist may be employed only if he/ she has experience in drilling
2	Technical Assistance (Drilling/Cementing)	**Mechanical engineers/Diploma** ▪ Geologist may be employed only if he/ she has experience in drilling
3	Sr Technical Assistant (Chemistry/Mud)	M.Sc./B.Sc. Chemistry or Chemical Engg
4	Technical Assistant (Chemistry/Mud)	M.Sc./B.Sc. Chemistry or Chemical Engg
5	Sr Technical Assistant (Geology/Pylonolgy)	Geology
6	Technical Assistant (Geology/Pylonolgy)	Geology
7	Sr Technical Assistant (Exploratory/Logging)	Geology
8	Technical Assistant (Maps)	Geography/Cartography
9	Technical Assistant (Photography)	NA
10	Technical Assistant (Survey)	Diploma in surveying/ Civil Engg.
11	JE- Reservoir	Diploma/ Petroleum Engineering
12	Technical Assistant (Shot Hole)	NA
13	JE- Production	Mechanical Engg/Diploma
14	Technical Assistant (Production)	Mechanical Engg/Diploma
15	Technical Assistant (mechanical)	Mechanical
16	Technical Assistant (Civil)	Civil
17	Motor Vehicle Driver	Diploma/ITI
18	Technical Assistant (Welding)	Diploma/ITI
19	Operator Deck Hand	Diploma/ITI
20	Technical Assistant (Marine Radio/ Wireless/Telecom operator)	Telecom/Diploma/ITI
21	Fire Inspector	Fire Engineer/Diploma
22	Assistant Fire Man	Fire Engg/Diploma

Source: CRISIL Infrastructure Advisory Analysis

8.2 Educational facilities available in the Northeast

Educational institutes offering professional degrees/ diplomas and vocational training institutes indicate the skill availability in NER is at a satisfactory level.

Table 126: List of educational institutes in NER

State	ITI	Diploma colleges	Engineering colleges
Arunachal Pradesh	ITI ROING ITI Dirang ITI Tabarijo	▪ NEFTU ▪ Rajiv Gandhi Government Polytechnic ▪ Govt Polytechnic colleges at Palighat, Roing, DirangNamsai and Laying	NIT, AP NERIST
Assam	▪ POWI Jorhat ▪ **ITIs** ▪ Nagaon, Srikona ▪ And Barpeta	▪ Nowgong Polytechnic College ▪ Gyan Sagar Foundation group of institutions. ▪ Bongaigaon polytechnic College ▪ Dibrugarh polytechnic College ▪ Assam engineering institute ▪ Hrh the Prince of Wales Institute of Engineering & Technology, ▪ Dibrugarh Polytechnic	▪ Oil Institute Of Well Control Technology ▪ IIT Guwahati ▪ NIT Silchar ▪ Tezpur University ▪ Girijananda Chowdhury Institute Of Management And Technology ▪ NITS, Mirza ▪ Assam Engg College ▪ Dibrugarh University Institute Of Engineering And Technology (Petroleum)
Tripura	▪ ITIs ▪ Indranagar, Jatanbari, Belonia, Kailahahar, Ambassa, Dharmanagar	▪ Tripura Institute of Technology ▪ Dhalai District Polytechnic ▪ North Tripura District Polytechnic ▪ Techno India Agartala ▪ Gomati District Polytechnic	▪ Tripura Institute of Technology, ▪ NIT Agartala
Manipur	▪ ITI Takyel	▪ Government Polytechnic	▪ GOVERNMENT COLLEGE OF TECHNOLOGY ▪ NIT Manipur
Mizoram	▪ ITI ▪ Aizawal, Saiha	▪ Mizoram Polytechnic	▪ NIT Aizawl ▪ Mizoram University
Meghalaya	▪ ITI ▪ Rynjah, Tura, Nongpoh, Shillong ▪ GITI ▪ Tura, Shillong, Jowai, Williamnagar, Nongstoin, Sohra, Resubelpara	▪ Shillong Polytechnic	▪ Regional Institute Of Science and Technology ▪ UTM (Petroleum)
Nagaland	▪ ITI ▪ Kohima, Mon, Wokha, Phek, Tuensang, Zunheboto, Mokokchung	▪ Kheloshe Polytechnic	**NIT Nagaland** **Nagaland University**

Source: CRISIL Infrastructure Advisory Analysis

8.3 Team composition for E&P activity

Based on inputs provided by ONGC, we have detailed the team composition for different stages of E&P activity.

Table 127: Team composition during exploratory drilling (data acquisition phase)

Particulars	Numbers
Geologist	4
Geophysicist	14
Observers	2
Data processors	2
Crew manager	2
MDT- processing and interpretation	**Per rig (requirement on each rig)**
Geologist	8
Geophysicist	12
Geochemist	3
Reservoir engineer	2
Mud logger	2
Programmer	3

Table 128: Team composition during exploratory drilling (subsurface)

Particulars	Number
Geologist	6
Geophysicist	2
Petro physicist	3
Geochemist	3
Reservoir engineer	2
Mud logger	2
Drilling crew	**Per Rig (Requirement on each rig)**
Drilling superintendent (rig manager)	1
Tool pusher	2
Driller	4
Asst driller	4
Derrickman	4
Oil well cementer	2
Roughnecks	16
Crane operator	4
Roustabout	20
Chief mechanic	2
Chief electrician	2
Welder	2
Motorman	4
Electrician	2

Table 129: Team composition during development drilling

Team composition during drilling	Numbers
Drilling superintendent (rig manager)	1
Tool pusher	2
Driller	4
Asst driller	4
Derricman	4
Oil well cementer	2
Roughnecks	16
Crane operator	4
Roustabout	20
Chief mechanic	2
Chief electrician	2
Welder	2
Motorman	4
Electrician	2
Geologist	8
Geophysicist	2
Production engineer	4
Reservoir engineer.	8
Mud logger	4
Driller	2

Source: CRISIL Infrastructure Advisory Analysis

Table 130: Team composition during production/processing

Team composition during production	Number
Geologist	12
Geophysicist	4
Drilling engineer	12
Geochemist	4
Production engineer	16
Reservoir engineer	16
Logger	8
Chemical engineer	2
Production engineer	10
Mechanical engineer	4
Electrical engineer	4
Fire & safety engineer	1
Corrosion engineer	1
Instrumentation engineer	2
Technicians	96
Geologist	2
Geophysicist	1
Reservoir engineer	4
Production engineer	2

Source: CRISIL Infrastructure Advisory Analysis

8.4 Course-wise detail

We have analysed the institutes (graduate, diploma and ITI) offering technical courses and their discipline-wise annual intake of students in Northeast India. In some institutes, particularly in some of the disciplines where student intake information was not available, the average student intake figure per discipline in that particular state has been considered for the purpose of analysis.

Table 131: List of courses for ITI and diploma in Arunachal Pradesh

Institute	Courses	Professional recognition	Strength
NEFTU	Civil	Diploma	30
	Mechanical	Diploma	30
	Electrician	Diploma	30
	Fitter	Diploma	30
	Welder(G&E)	Diploma	30
	Draughtsman	Diploma	30
Rajiv Gandhi Government Polytechnic	Civil	Diploma	30
	Civil	Diploma	30
	EEE	Diploma	30
Govt Polytechnic, Palighat	Civil	Diploma	60
	Electrical	Diploma	60
Govt Polytechnic, Roing	Civil	Diploma	60
	Electrical	Diploma	60
Govt Polytechnic, Dirang	Civil	Diploma	60
	Electrical	Diploma	60
	Mechanical	Diploma	60
Govt Polytechnic, Namsai	Civil	Diploma	60
	Electrical	Diploma	60
Govt Polytechnic, Laying	Mechanical	Diploma	60
	Civil	Diploma	60
	Electrical	Diploma	60
ITI			
ITI ROING	Electrician	ITI	14
	ITESM	ITI	14
	Wireman	ITI	14
	MVM	ITI	14
	Fitter	ITI	14
	Plumber	ITI	14
	Draughtsman	ITI	14
	Surveyor	ITI	14
	Welder	ITI	14
	Carpenter	ITI	14
ITI Dirang	Welder	ITI	10
ITI Tabarijo	Electrician	ITI	24
	ITESM	ITI	24
	Draughtsman	ITI	24

Source: CRISIL Infrastructure Advisory Analysis

Table 132: List of courses for ITI and diploma in Meghalaya

Institute	Courses	Professional Recognition	Strength
Shillong Polytechnic	Civil	Diploma	60
-	Mechanical	Diploma	30
-	Electrical	Diploma	30
ITI			
ITI Rynjah	Electrician	ITI	21
	Fitter	ITI	21
	Welder	ITI	21
	Civil Draughtsman	ITI	21
	Surveyor	ITI	21
ITI Tura	Basic Welding(Gas)	ITI	20
	Basic Welding(Arc)	ITI	20
GITI Tura	Electrician	ITI	20
	Draughtsman(Mechanical)	ITI	20
	Fitter	ITI	20
	Draughtsman(Civil)	ITI	20
	Surveyor	ITI	20
	Welder	ITI	20
ITI Nongpoh	Basic Welding(Arc)	ITI	20
ITI Shillong	Electrician	ITI	20
	Mechanical(M.V)	ITI	20
	Draughtsman(Mechanical)	ITI	20
GITI Shillong	Fitter	ITI	20
	Draughtsman(Civil)	ITI	20
	Surveyor	ITI	20
	Welder	ITI	20
	Electrician	ITI	20
GITI Jowai	Welder	ITI	20
	Electrician	ITI	20
GITI Williamnagar	Wireman	ITI	20
GITI Nongstoin	Mechanic	ITI	20
GITI Nongpoh	Welder	ITI	20
GITI Sohra	Wireman	ITI	20
GITI Resubelpara	Mechanic	ITI	20

Source: CRISIL Infrastructure Advisory Analysis

Table 133: List of courses for ITI and diploma in Manipur

Institute	Courses	Professional Recognition	Strength
Government Polytechnic	Civil	Diploma	60
	Mechanical	Diploma	20
	Electrical	Diploma	40
ITI			
ITI Takyel	Electrician	ITI	20
	Surveyor	ITI	20
	Draughtsman (Mech)	ITI	20
	Draughtsman (Civil)	ITI	20

Source: CRISIL Infrastructure Advisory Analysis

Table 134: List of courses for ITI and diploma in Tripura

Institute	Courses	Professional Recognition	Strength
Tripura institute of technology	**Civil**	**Diploma**	**30**
	Electrical	Diploma	30
	Mechanical	Diploma	30
Dhalai district polytechnic	Civil	Diploma	40
	Electrical	Diploma	40
North Tripura district polytechnic	Civil	Diploma	60
	Mechanical	Diploma	60
Techno India Agartala	Civil	Diploma	60
	Electrical	Diploma	60
	Mechanical	Diploma	60
Gomati district polytechnic	Civil	Diploma	60
	Electrical	Diploma	60
ITI			
ITI Indranagar	Welder	ITI	16
	Draughtsman(Civil)	ITI	16
	Surveyor	ITI	16
	Fitter	ITI	16
ITI Belonia	Welder	ITI	12
	Electrician	ITI	16
	Draughtsman(Civil)	ITI	16
ITI Kailahahar	Fitter	ITI	16
	Electrician	ITI	16
	Draughtsman(Civil)	ITI	16
	Surveyor	ITI	16
ITI Ambassa	Welder	ITI	12
ITI Dharmanagar	Welder	ITI	16

Source: CRISIL Infrastructure Advisory Analysis

Table 135: List of courses for ITI and diploma in Nagaland

Institute	Courses	Professional Recognition	Strength
Kheloshe Polytechnic	Civil	Diploma	60
	Mechanical	Diploma	15
	Electrical	Diploma	15
ITI			
ITI Kohima	Carpentry	ITI	20
	Plumber	ITI	20
	Turner	ITI	20
	Machinist	ITI	20
ITI Mon	Carpentry	ITI	16
	Electrical	ITI	16
	Motor Mechanic	ITI	16
ITI Wokha	Carpentry	ITI	16
	Motor Mechanic	ITI	16
ITI Phek	Carpentry	ITI	20
	Plumber	ITI	20
	Motor Mechanic	ITI	20
ITI Tuensang	Carpentry	ITI	16
	Diesel Mechanic	ITI	16
	Motor Mechanic	ITI	16
ITI Zunheboto	Plumber	ITI	20
ITI Mokokchung	Draughtsman	ITI	16
	Motor Mechanic	ITI	16

Source: CRISIL Infrastructure Advisory Analysis

Table 136: List of courses for ITI and diploma in Assam

Institute	Courses	Professional Recognition	Strength
Nowgong polytechnic	Civil	Diploma	60
	Electrical	Diploma	40
	Mechanical	Diploma	40
Bongaigaon polytechnic	Civil	Diploma	60
	Electrical	Diploma	30
Dibrugarh polytechnic	Civil	Diploma	60
	Electrical	Diploma	40
	Mechanical	Diploma	40
Assam engineering institute	Chemical	Diploma	35
	Civil	Diploma	90
	Electrical	Diploma	30
	Mechanical	Diploma	40
Hrh the prince of wales institute of engg. & tech.	Civil	Diploma	60
	Mechanical	Diploma	40
	Electrical	Diploma	40
Dibrugarh Polytechnic	Civil	Diploma	60
	Electrical	Diploma	40
	Mechanical	Diploma	40
ITI			
POWI Jorhat	Drilling Technician (Oil Drilling)	ITI	20
ITI Nagaon	Electrician	ITI	20
	Fitter	ITI	84
	Draughtsman (Civil)	ITI	21
	Welder	ITI	48
	Electrician	ITI	21
ITI Srikona	Electrician	ITI	23
	Fitter	ITI	23
	Draughtsman(Civil)	ITI	23
	Welder (G&E)	ITI	23
	Electrician	ITI	23
ITI Barpeta	Electrician	ITI	46
	Fitter	ITI	46
	Welder	ITI	46

Source: CRISIL Infrastructure Advisory Analysis

Table 137: List of courses for ITI and diploma in Mizoram

Institute	Courses	Professional Recognition	Strength
Mizoram Polytechnic	Civil	Diploma	30
Mizoram Polytechnic	Electrical	Diploma	30
Mizoram Polytechnic	Mechanical	Diploma	30
ITI			
ITI Aizawal	Electrician	ITI	20
	Mechanic	ITI	40
	Welder	ITI	15
ITI Saiha	Electrician	ITI	40
	Welder	ITI	40

Source: CRISIL Infrastructure Advisory Analysis

8.5 Manpower requirement in NER by ONGC & OIL

We have analysed the manpower requirement for E&P activities in the Northeast for the next decade based on provisional recruitment data provided by ONGC and OIL. Manpower requirement has been segregated under different major heads required for carrying out E&P activities and is shown in the table below:

Table 138: Manpower requirement by ONGC & OIL

Skill Sets	2016-2020	2021-2025
Geo science	285	235
Production	505	420
Drilling	660	595
Engineering	610	585
Support function	1295	1175
Total	**3355**	**3010**

Source: CRISIL Infrastructure Advisory Analysis

This table above shows the requirement of manpower in NER over 2016 to 2020 and 2021 to 2025 in five-year slots. On an annual basis, the manpower requirement in NER works out as given in the table below:

Table 139: Manpower requirement by ONGC & OIL (yearly)

Skill Sets	2016-2020 Requirement	2021-2025 Requirement
Geo science	57	47
Production	101	84
Drilling	132	119
Engineering	122	117
Support	259	235
Total	**671**	**602**

Source: CRISIL Infrastructure Advisory Analysis

The ratio of requirement of executive to staff is 1:4, which shows that there is a large impending requirement of employees at the staff level in the Northeast, with more than 75% of demand coming from production, engineering and drilling related services.

8.5.1 Supply of manpower

We have calculated the workforce required for E&P activities and passing out from professional institutions as stated above in NER on an annual basis. For this, we have looked into the student intake data of universities/ engineering colleges, diploma colleges and ITIs located in NER. The detailed breakup is shown in the table below:

Table 140: Supply of technical Manpower

Graduate courses		Diploma		ITI	
Course	Seats	Course	Seats	Course	Seats
Chemical	221	Civil	1,241	Electrician	429
Civil	1,435	Mechanical	502	ITES	55
Mechanical	1,327	Electrical	718	Wireman	20
Electrical	956			Mechanic	149
Chemistry	148			Fitter	274
Physics	101			Plumber	79
Geology	30			Draughtsman	210
				Surveyor	98
				Welder	375
				Carpenter	96
Total	**4,218**	**Total**	**2,460**	**Total**	**1,784**

Source: CRISIL Infrastructure Advisory Analysis

8.6 Estimation of employment generation across upstream, midstream and downstream segments in NER

We have estimated the employment generation (based on additional requirement and replacement) that would entail the Oil & Gas development activities in the Northeast at the end of 2029-30. For each of the upstream, midstream and downstream segments, employment generation has been estimated separately.

Table 141: Employment Generation from Oil & Gas development activites

Segment	Employment generation till 2030
Upstream	7437
Midstream/ Downstream	4476
Downstream - CGD	650
Total	**12,563**

Source: OIL, ONGC, IOCL, CRISIL Infrastructure Advisory Analysis (Note: Manpower requirement in the CGD sector is based on indicative estimation by CRIS)

8.7 Initiatives by central government/ state government

8.7.1 Premier institutes to cater to oil & gas sector

Institute of Information Technology and Advanced Sciences (IIITAS)

The Assam government, in partnership with Tata Group and Oil India Ltd (OIL), has set up IIITAS. Emphasis will be on industry-interface research & development (R&D) relevant to Assam, besides skill development, helping the state's youth to be employable. While the Centre will hold a 57.5%

stake in the project, the state government will hold 35% share; Tata Group and OIL will hold the balance.

Rajiv Gandhi Institute of Petroleum Technology (RGIPT)

The Assam centre of RGIPT, a technical and management training and education institute for the petroleum industry, located at Jais, Rae Baraeli, Uttar Pradesh is under construction at Sivasagar. RGIPT, which was formally opened on July 2008, has been accorded the status of Institute of National Importance. It offers courses in engineering, pure sciences, management and humanities with a focus on petroleum engineering. The programmes and courses have been changing as the school evolves into a full-fledged petroleum engineering university.

In consonance with the charter of RGIPT, the primary objective of the Assam centre is envisaged as education and training of skilled technical manpower at the diploma and advance diploma levels, including B.Sc.-M.Sc. integrated courses in various areas as per requirements of the oil, gas and petrochemicals industries.

CSIR-Indian Institute of Petroleum (CSIR-IIP)

CSIR-IIP is one of the leading constituent laboratories of the Council of Scientific & Industrial Research (CSIR). Established in 1960, the Institute is devoted to multi-disciplinary R&D in the hydrocarbon and related industry downstream sector. It has experienced and qualified staff, and is equipped with state-of-the-art R&D facilities, including pilot plants. The institute undertakes R&D in petroleum refining, natural gas, alternative fuels, petrochemicals utilisation of petroleum products in Internal Combustion (IC) engines and in industrial and domestic combustion. It also provides technical and analytical services to petroleum refining and related industries, including technology transfer for developing novel, state-of-the-art technologies and products.

Dibrugarh University

Dibrugarh University, the eastern-most University of India, was set up in 1965. Situated at Rajabheta, 5 km to the south of Dibrugarh, it is a teaching-cum-affiliating university with limited residential facilities. It is well connected to road (NH-37), rail, air and waterways. The university is accredited by National Assessment and Accreditation Council (NAAC) with an institutional score of 71% (B grade). Re-accreditation was done in March 2009. The university has around 200 affiliated and permitted colleges and institutes.

8.7.2 Setting up of National Skill Development Corporation

National Skill Development Corporation (NSDC) is a not-for-profit company set up by the Ministry of Finance, under Section 25 of the Companies Act. A one-of-its-kind public-private partnership, NSDC aims to promote skill development by catalysing creation of large, quality, for-profit vocational institutions. It provides funding to build scalable, for-profit vocational training initiatives. Its mandate is also to enable support systems such as quality assurance, information systems and train trainer academies either directly or through partnerships. NSDC acts as a catalyst in skill development by providing funding to enterprises, companies and organisations that provide skill training. It will also develop appropriate models to enhance, support and coordinate private sector initiatives. NSDC has 207 approved partners, which together have 2,904 operational NSDC partner centres, including 676 mobile centres, spread over 471 districts in 28 states and five union territories.

8.7.3 Skill India Initiatives

Skill India initiative was launched by the Government of India on 15th July 2015, with the target of providing skill training to more than 40 crore individuals by 2022. There are 4 key initiatives launched under skill India, National Skill Development Mission, National Policy for Skill Development and Entrepreneurship 2015, Pradhan Mantri Kaushal Vikas Yojana (PMKVY) scheme and the Skill Loan scheme.

These schemes are aimed at providing skill training programs to individuals, and incentivizing by offering rewards to candidates who successfully complete the approved skill training programs. Skill loan scheme will provide, loans ranging from Rs. 5,000-1.5 lakh to youth seeking to attend skill development programs over the next five years.

This initiative can prove highly beneficial to individuals in north east for developing skills which can benefit the overall population. Skill development specific to the oil and gas sector can be imparted to individuals, so that the manpower required to cater to the needs of oil and gas activities is available locally.

8.8 Key issues

- The E&P segment faces a critical challenge in attracting young talent. The Indian education sector prepares over 500 students in E&P-related geo-science courses, but only a few of those passing out of petro-technical streams join E&P companies. This can be attributed to a low level of awareness of job opportunities in the sector at the entry level and the higher attractiveness of other sectors, mainly IT and telecom.
- Indian industry will require an additional 800 petro-technical students by 2017. This will require an increase in the number of students taking up education related to this sector. However, the sector faces the following challenges in attracting young talent:
  - **Low industry attractiveness:** Tougher working conditions and low attractiveness of field jobs, coupled with a favorable alternative job market scenario, make the E&P sector's attractiveness low for employees at all levels.
  - **Attraction to global players:** Experienced talent available in India is generally attracted to foreign and global players offering higher salary and better working conditions compared with Indian employers.
- Companies need to train diploma and Industrial Training Institute (ITI) engineers for getting the right output.
- Local people are available but do not have good experience. Problems are faced recruiting experienced manpower.
- Specialized professionals such as firemen, doctors, etc are not easily available locally.

8.9 Action plan for skill development

8.9.1 Key action areas

- ONGC and OIL to sponsor specialised courses through entrance test and direct recruitment of students passing out from these courses.
- Upgradation of infrastructure of existing ITI and diploma colleges in the northeast: PSU/ private players need to adopt each ITIs in their respective areas and upgrade the same.
- Guest lectures from PSU/ private players to be made compulsory at educational institutes for enhanced industry exposure and interaction.
- Vocational training to be included in curriculum of ITI and diploma engineers with support from PSUs operating in that area.
- Vocational education possibilities on oil rigs – drilling maintenance, plant operation and maintenance – to be explored.
- Inclusion of specialised professional degree courses in reservoir engineering and drilling engineering
- Need to create universities along the lines of petroleum institutes in Dehradun and Gandhinagar.

8.9.2 Action plan

Table 142: Action plan for skill development

Action items	Concerned Authorities	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (>5 years)
ONGC and OIL to sponsor specialised courses through entrance test and direct recruitment of students passing out from these courses.	ONGC/OIL	▪ Identify candidates for diploma and ITI courses through entrance test, and sponsor them for specialised courses for E&P and induct them directly into companies		
Upgradation of infrastructure of existing ITI and diploma colleges	NSDC/ NOCs		▪ Provide support to ITI and diploma colleges to equip them with better training facilities	
Inclusion of vocational training in educational institutions		▪ Add vocational training in the curriculum of educational institutions		
Specialised professional colleges/ universities				▪ Establish colleges/ universities specifically for petroleum and natural gas courses
To start new streams in ITIs on fire safety management		▪ Starting a course on fire hazard and safety in the existing ITIs where educational infrastructure is already present		

9. Infrastructure gaps

Infrastructure gap is a major concern in the region, and acceleration of economic growth and economic development will depend on how fast this deficit is overcome. Lack of connectivity, for one, has virtually segregated and isolated it from the rest of the country, and the world, and even within. Even interconnectivity between different states in the region is limited. Poor density of road and rail transportation has hampered mobility and hindered development of markets. Air connectivity has improved in the last few years, but the frequency of flights remains a concern. Although inland water transport (IWT) is economical, has high fuel efficiency and is environment friendly, its development has remained dormant.

Lack of connectivity has been a barrier to industrial development and also restrained E&P activity in the region despite the huge potential.

The following key action areas have been identified for plugging such infrastructure gaps.

9.1 Key action areas

9.1.1 Manipur

Road infrastructure

- Improve of road conditions by ensuring black top surface along the entire stretch of the national highways (NHs), i.e. NH 53, NH 150 and NH 102B.
- The approach road for reaching the blocks needs to be developed by the operator. However, the state government should provide impromptu clearances required for laying such roads.
- Improve load-carrying capacity so that heavy equipment can be transported easily.
- Steel bailey bridges need to be replaced with modern bridges with adequate load-carrying capacity to allow heavy equipment to be transported to project locations.
- Proposed double-laning of NH 53 under Special Accelerated Road Development Programme for North East (SARDP-NE) should be fast-tracked as this could be used as an alternate route to NH 39, which is block from time-to-time.
- Double-laning of NH 53, NH 150 and NH 102B needs to be taken up immediately as this will improve accessibility in the state.
- Facilitate development of proposed Asian highways as this will allow the region to be connected with Southeast Asian markets, thereby providing much-needed economic impetus.

Railway infrastructure

- As access to the railway network is non-existent, it imposes serious challenges on transportation of goods and services in the state. A proposed railway network also covers limited part of the state. Considering the strategic importance of Manipur, both in terms of security and resource potential, better railway connectivity is essential. The railway authority needs to take cognisance of this and include more areas as part of the grand development plan for the state. Also, focus on timely implementation is essential.

Airport infrastructure

- The air infrastructure in Manipur is adequate to serve the market requirements.

9.1.2 Tripura

Road infrastructure

- Improve road conditions by ensuring black top across the entire stretch of NH 44.
- The approach road to the blocks needs to be developed by the operator. However, the state government should provide impromptu clearances for laying of such roads.
- Improve load-carrying capacity so that heavy vehicle/ equipment can be transported easily.

- Double-laning of NH 44 needs to be taken up immediately, as proposed under SARDP-NE, as this will improve the accessibility concerns in the state.

Railway infrastructure

- Access to the railway network is limited, which imposes serious challenges on transportation of goods and services in the state. The proposed railway network also covers a limited part of the state. Considering the strategic importance of Tripura, both in terms of security and resource potential, better railway connectivity is essential. The railway authority needs to take cognisance of this and include more areas as part of the grand development plan for the state. Focus on timely implementation is essential, too.

Airport infrastructure

- Air infrastructure in Tripura is good enough to serve the market requirement.

9.1.3 Arunachal Pradesh

Road infrastructure

- Proposed double-laning of NH 52 B under SARDP-NE should be implemented in a timebound manner.

Railway infrastructure

- Access to the railway network is limited, and this has imposed serious challenges on transportation of goods and services in the state. The proposed railway network also covers a limited portion of the state. Considering the strategic importance of Arunachal Pradesh, both in terms of security and resource potential, better railway connectivity is essential. The railway authority needs to include more areas as part of the grand development plan for the state. Focus on timely implementation is essential, too.

Airport infrastructure

- Development of civilian airport is required to provide easy access to this difficult terrain. This will spur business development in the state.

9.1.4 Mizoram

Road infrastructure

- Proposed double-laning of NH 54 under SARDP-NE should be implemented in a timebound manner.
- The approach road to the blocks needs to be developed by the operator. However, the state government should provide the necessary clearances.
- Increase the operational hours of the airport in Aizawl so that more routes can be operated.

Railway infrastructure

- Access to the railway network is limited, which has imposed serious challenges on transportation of goods and services. The proposed railway network covers a limited part of the state. The railway authority needs to take cognisance of this and include more areas under its tutelage as part of the grand development plan for the state. Focus on timely implementation is essential, too.

Airport infrastructure

- Although the state has an airport in Aizawl, the limited operational hours greatly restricts air travel. Operational hours need to be increased so that more routes can be operated.

9.1.5 Assam

Road infrastructure

- Four-laning of NH 37 under SARDP-NE should be implemented in timebound manner. This will congestion and ensure faster delivery of exploration equipment to the project locations, thereby expediting the exploration process in the state.

- Improvement of existing single-lane road stretches on NH-36, 52, 61 to double-lane, as proposed under SARDP-NE, in a timebound manner
- Numaligarh-Golaghat-Dhodali-Namrup – Upgradation to double-lane (alternative route to NH 37)
- Stillwell road development for inter-country linkage - specifically China, India and Myanmar
- Alternative roads for inter-northeast connectivity:
- Digboi-Duliajan-Lakwa-Nagaland-Manipur
- Guwahati-Shillong-Silchar-Aizawl
- Guwahati-Shillong-Silchar-Agartala
- Further, the Koraghat-Nambar-Kasomarigaon-Borholla ring road can be developed as a national highway, as resources can be explored in this region if such connectivity is established.
- The approach road to the blocks needs to be developed by the operator. However, the state government should provide impromptu clearances required for laying of the roads.

Railway infrastructure

- Although the state is well-connected via rail, the present capacity is less than adequate. Therefore, augmentation of capacity as well as expansion to unconnected areas is needed to improve access to the railway network.
- Considering the E&P activities in the Jorhat-Dibrugarh region, the railway authorities need to convert the Guwahati-Dibrugarh railway line into a double-line network. This will ensure faster transportation of equipment and materials in the region.

Airport infrastructure

- The airport at Jorhat needs to be converted into an entirely civilian airport. This will provide better access to the region, which has been one of the key centers of oil & gas exploration in the state.

9.1.5.1 Waterway Infrastructure for the Northeast

- The Indian givernment, through the transport ministry, has already initiated the process of developing and operating NW 2 as an alternative to road and rail for connectivity in the region. Along the same lines, NW 6 also needs to be connected to Manipur and Mizoram with Assam.
- Fast-tracking of project clearances is essential, and authorities at the state and central levels need to provide adequate assistance to create waterway connectivity in the region.

9.1.6 Implementation of Special Accelerated Road Development Program in North East

The Ministry of Road Transport & Highways had initiated mega road development program in North East with name "Special Accelerated Road Development Program in North East (SARDP-NE). The objective of SARDP-NE is to:

- Upgrade National Highways connecting State Capitals to 2/4 lanes.
- To provide connectivity of all 88 District Headquarter towns of NER by at least 2- lane roads.
- Improve roads of strategic importance in border area.
- Improve connectivity to neighboring countries.

The timely implementation of the program will benefit the E&P industry of the region as it is likely to improve the connectivity in the region.

9.2 Action plan

Table 143: Action plan for infrastructure development

Action items	Authority concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (>5 years)
Road infrastructure				
Improving condition of national highways	▪ NHAI ▪ PWD ▪ BRO	▪ Ensure black top surface on NH 53, NH 150 and NH 102B in Manipur ▪ Ensure black top surface across the entire stretch of the NH 44 in Tripura		
Improve load carying Capacaity of roads	▪ NHAI ▪ PWD ▪ BRO		▪ Improve load-carrying capacity of NH 53, NH 150 and NH 102B in Manipur ▪ Improve load-carrying capacity of NH 44 in Tripura	
Increase number of Lanes	▪ NHAI ▪ PWD ▪ BRO		▪ Double-laning of NH 53, NH 150 and NH 102B in Manipur ▪ Double-laning of NH 44 in Tripura ▪ double-laning of NH 52 B in Arunachal Pradesh ▪ Double-laning of NH 54 in Mizoram ▪ Four-laning of NH 37 in Assam Double-laning of NH-36, 52, 61 in Assam	
Replace steel bailey bridges with modern infrastructure	▪ NHAI ▪ PWD ▪ BRO		▪ Replace all steel bailey bridges across all national highways in the region	▪ Replace all steel bailey bridges across all the national highways in the region

Action items	Authority concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (>5 years)
Create new national/ international highways	▪ Central and state governments			▪ Facilitate development of proposed Asian highways through Manipur
				▪ Stillwell road development for inter country linkage specific to China and Myanmar. ▪ Constructing national highway from (Numaligarh - Golaghat-Dhodali-Namrup) Numaligarh-Namrup as an alternate route to NH 37 ▪ Alternative road should be developed for inter North-East connectivity ▪ Digboi-Duliajan-Lakwa-Nagaland-Manipur ▪ Guwahati-Shillong-Silchar-Aizawl ▪ Guwahati-Shillong-Silchar-Agartala ▪ Koraghat-Nambar-Kasomariga on- Borholla ring road to be developed as national highway

Action items	Authority concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (>5 years)
Railway infrastructure				
Covering more area under railway network	Ministry of Railways			▪ Including more areas of Manipur, Mizoram, Tripura and Arunachal Pradesh under railway network
Strengthen existing railway network	Ministry of Railways		▪ Guwahati-Dibrugarh railway network to be made double-line	
Conversion of Narrow gauge to broad gauge	Ministry of Railways		▪ Convert all narrow gauge network into broad gauge network	
Rail connectivity of India with Bangladesh	Ministry of Railways			▪ Connect Agartala with Amhara in Bangladesh
Airport infrastructure				
Improving airport facilities			▪ More number of operating hours for Aizawl airport	
Full civilian status to airports under IAF now	AAI		▪ Jorhat airport in Assam to be converted into an entirely civilian airport	
New airport development	AAI		▪ Development of civilian airport in Arunachal Pradesh	
Waterways infrastructure				
Development of NW 1 and NW 6	IWAI		▪ Development of NW 6	▪ Connect Manipur and Mizoram with NW 6

10. Law and order

The following action areas have been identified for supporting development of the oil & gas industry in the region.

10.1 Key action areas

- Boundary issues between Assam-Nagaland, Manipur-Nagaland and Assam-Arunachal Pradesh have been instrumental in delaying exploration activities, sometimes leading to abandonment of the project by the E&P operator. The central and state governments need to initiate action to resolve such issues.
- A multi-pronged strategy needs to be evaluated to curb bandhs and blockades, which are choking economic development and social harmony in the region. The considerations include:
  - Shifting focus to progress and development
  - Creating alternative route for supply to affected states
  - Involving local media in a responsive and impartial way to create public consensus

10.2 Action plan

Table 144: Action plan for law and order issues in the northeast

Action items	Authorities concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (>5 years)
Law and order				
State boundary issue	Central & state governments	Yes		
Bandhs and blockades	State government & local bodies	Yes		

11. Trade opportunity with neighbouring countries

The excess refining capacity in the northeast is an opportunity for exporting petroleum products, subject to pricing considerations, to neighbouring countries such as Myanmar, Bangladesh and Nepal.

In this section we have analysed production, demand and consumption of crude oil, natural gas and petroleum products in neighbouring countries, and the opportunities available for exporting petroleum products to these countries.

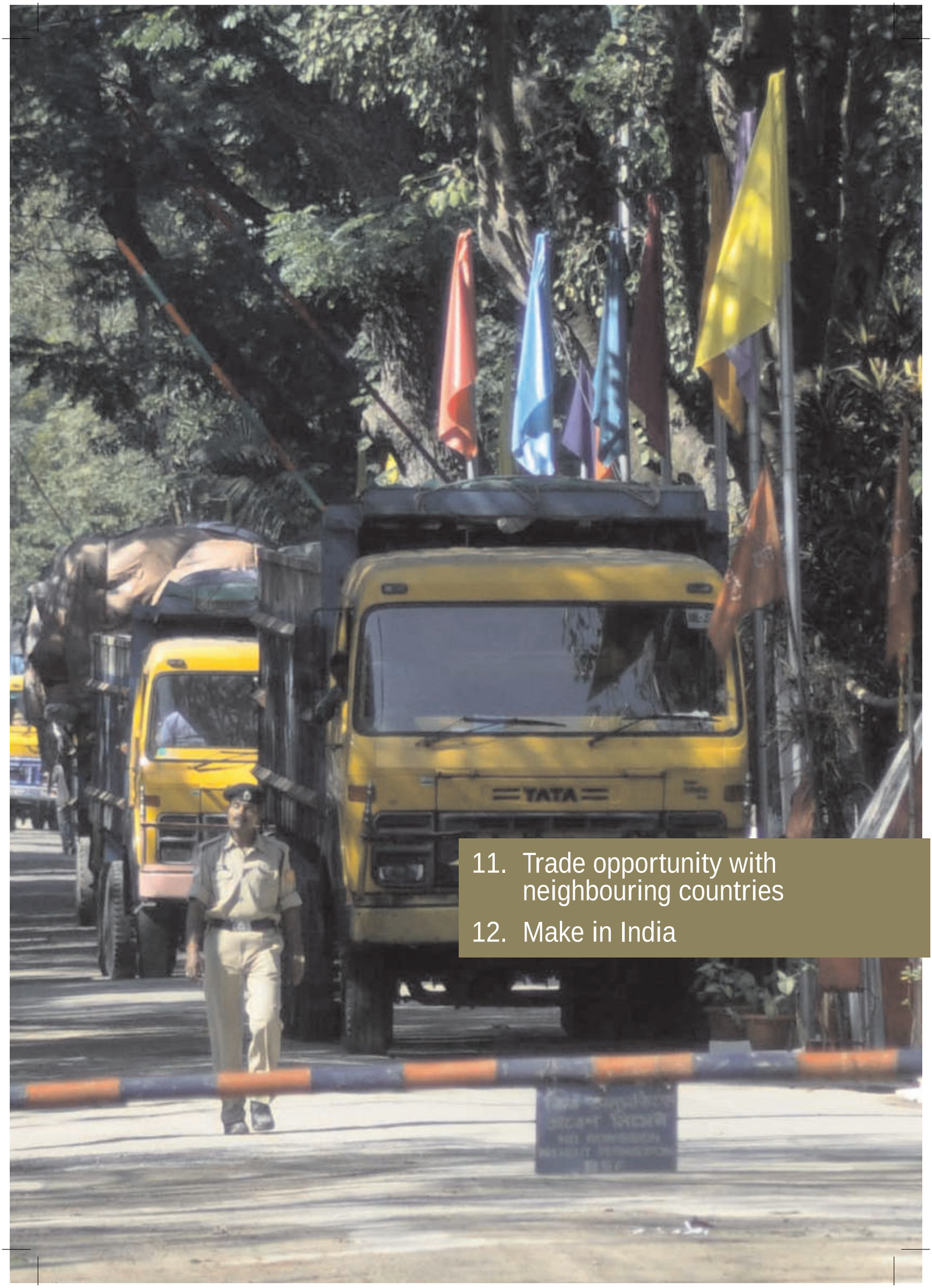
11.1 Myanmar

Myanmar has remained underdeveloped for decades. The country produces a minimal amount of crude oil and condensates from the onshore Salin basin and offshore Yetagun field. However, the country is an important natural gas producer in Southeast Asia, and is among the top 10 gas-exporting countries.

Financial constraints confronting Myanmar's national oil company, lack of technical capacity, opaque regulatory policy, insufficient investment by foreign firms, and international sanctions have significantly impeded the country's efforts to realise its oil and natural gas production potential. These factors have also severely hampered the development of necessary energy infrastructure.

However, with the easing or suspension of US and EU sanctions in 2012 and 2013 in response to political and economic reforms in Myanmar, the government initiated the process of attracting foreign investment and technical assistance, and has since awarded 16 onshore and 20 offshore blocks to several foreign and domestic companies.

Hon'ble PM of India Shri Narendra Modi greets Energy Advisor to the PM of Bangladesh
Dr Tawfiq-e-Elahi Chowdhury at the Ph-II inauguration of ONGC Tripura Power Company (OTPC)



11. Trade opportunity with neighbouring countries
12. Make in India

Myanmar has proven oil reserves (onshore and offshore) of 459 million barrels (MMBBL), and proven gas reserves of 11.8 trillion cubic feet (TCF).

11.1.1 Refining capacity

State-owned Myanmar Petrochemical Enterprise operates three small refineries. Two barely function while a third operates at only just over half its capacity, processing local condensate to make low-quality gasoline. The refinery has a capacity of 20,000 barrels per day (BPD), with its production rate declining.

The Ministry of Energy has plans to invite foreign bidders to build a new oil refinery with a processing capacity of 5-10 MMTPA. The government and foreign companies, including China's Guangdong Zhenrong Energy Company and Thailand's largest refiner Thai Oil Plc, have submitted proposals for constructing the refineries, although these are in preliminary stages of development.

Table 145: Petroleum product import requirement for Myanmar (MMTPA)

State	2014-15	2019-2020	2024-25	2029-30
Refining capacity	0.5	2.5	4	5.5
Oil demand	2.5	3.75	5	6.25
Imports	2.0	1.25	1	0.75

Source: CRISIL Infrastructure Advisory Analysis

11.1.2 Crude oil

Fuel demand has gradually increased from 13,000 BPD in 2000 to approximately 50,000 BPD in 2015, as per the energy ministry's data and undocumented fuel flows smuggled from Thailand. However, the country's limited domestic production and refining capacity makes Myanmar a net importer of petroleum products.

11.1.3 Natural gas

Natural gas production in Myanmar has accelerated over the last decade, from 3.4 BCM in 2000 to 13.1 BCM in 2014, which is a CAGR of 12.1%. Economic development has resulted in higher consumption, which reached a peak of 4.59 BCM in 2013.

Yet, surplus availability of natural gas makes Myanmar an exporter. Most of the natural gas produced in Myanmar is exported to Thailand and, more recently, to China. However, in anticipation of greater local gas demand from power, fertiliser and transportation industries, Myanmar has placed a domestic obligation to retain 25% of its production in any new project for the domestic market.

PTTEP, Thailand's national oil company, launched commercial operations of the Zawtika gas project in the second half of 2014, and expects to produce 3.11 BCM per year at the field's peak. This project is slated to increase natural gas exports to Thailand and serve Myanmar's domestic market.

This surplus reflects an opportunity for imports from Myanmar into India's northeast.

11.2 Bangladesh

11.2.1 Refining capacity

Bangladesh processes crude oil at Eastern Refinery Ltd's (ERL) 33,000-BPD refinery; the company is a subsidiary of Bangladesh Petroleum Corporation. The company plans to nearly triple the refinery's capacity to 90,000 BPD by 2016.

Table 146: Petroleum product import requirement for Bangladesh (MMTPA)

State	2014-15	2019-2020	2024-25	2029-30
Refining capacity	1.5	1.5	4.5	4.5
POL demand	5.5	5.5	8.1	9.9
Imports	4	4	3.6	5.4

Source: CRISIL Infrastructure Advisory Analysis

11.2.2 Crude oil

Bangladesh is a net importer of crude oil and petroleum products with minimal domestic production. In 2013, the country produced 4,500 BPD of crude oil and consumed nearly 119,000 BPD of petroleum products. Majority of the country's petro-products come from Malaysia and Singapore. In 2012-13, Bangladesh imported petroleum products totaling only $138 million from India, while imports from Malaysia and Singapore added up to $1,362 million.

Steadily rising demand for petroleum products in the country indicates significant demand potential despite ERL's capacity expansion.

11.2.3 Natural gas

Bangladesh is the seventh-largest producer of natural gas in Asia, having produced 23.6 BCM in 2014. Production of natural gas in the country has grown at close to 7% CAGR over 2000 to 2014. All of the natural gas produced is consumed domestically. The country, which once considered the possibility of exporting natural gas in the wake of promising new gas discoveries offshore, is currently short of 5-10 BCMA versus domestic demand, primarily from the power sector.

11.3 Nepal

Nepal's primary source of energy is firewood, fulfilling 65-70% of the country's energy needs; petroleum products fulfill 15% of the demand. Nepal does not produce any oil and gas, and is solely dependent on import of petroleum products from India.

Demand of products such as Motor Spirit (MS), High Speed Diesel (HSD), Superior Kerosene Oil (SKO), Aviation Turbine Fuel (ATF) and Liquefied Petroleum Gas (LPG) is about 1.2 MMTPA, annually growing at 10%. All petroleum products consumed in Nepal are procured and imported from India under an agreement with IOCL. Nepal Oil Corporation (NOC) uplifts petroleum products as per its requirement from IOCL's refineries, terminals and depots situated in the eastern and northern parts of India. The supply of LPG is arranged under a PDO (product delivery order) system, and IOCL provides bulk LPG to Nepalese LPG industries from Haldia, Barauni, Mathura, and Panipat refineries.

To meet the rising demand, an MoU between IOCL and NOC for construction of cross-border petroleum product pipeline from IOCL's depot (Raxaul) to NOC's depot (Amlekhgunj) has been signed.

Table 147: Petroleum product import requirement for Nepal (MMTPA)

State	2014-15	2019-2020	2024-25	2029-30
Refining capacity	-	-		-
POL demand	1.4	1.70	2.07	2.52
Imports	1.4	1.70	2.07	2.52

Source: CRISIL Infrastructure Advisory Analysis

As the table above indicates, Nepal is a big market for petroleum products by replacing firewood with petroleum products.

11.4 Bhutan

Bhutan has no natural petroleum or natural gas reserves. The kingdom has some 1.3 million tonnes of coal reserves, but extracts only about 1,000 tonnes of coal annually, entirely for domestic consumption. Bhutan also imports 1,000 BPD of oil. Majority of the oil import is for automobiles.

In the early 21st century, households comprised about 70% of Bhutan's energy consumption. Lately, heating and cooking with firewood, in particular, accounted for 70-90% of total energy consumption and virtually 100% of household energy consumption. In contrast, commercial activities in Bhutan are fueled mostly by hydroelectricity (about 97%), some fossil fuel-based thermal power (about 3%), and a minimal amount of other fossil fuels. As a result, Bhutan sells much of its hydroelectricity to India during the summer months.

This also presents a potential for petroleum products by replacing firewood with petroleum products.

11.5 Sri Lanka

11.5.1 Refining capacity

The domestic oil & gas industry is small, with no hydrocarbon production, despite a refinery at Sapugaskanda with a processing capacity of 50,000 BPD or 2 MMTPA. The Sri Lankan government has been considering setting up another refinery, and looking at expressions of interest from various countries. IOCL, which is present in Sri Lanka through its subsidiary Lanka IOC, has come forward to set up the refinery in a joint venture with the Sri Lankan government. Considering Sri Lanka's fuel consumption targets for 2020 and 2030, IOCL may look at a capacity addition of 5-9 MMTPA.

Table 148: Petroleum product import requirement for Sri Lanka (MMTPA)

State	2014-15	2019-2020	2024-25	2029-30
Refining capacity	2	5	5	5
POL demand	4.5	6.5	7.5	8.5
Imports	2.5	1.5	2.5	3.5

Source: CRISIL Infrastructure Advisory Analysis

11.5.2 Crude oil

The country is dependent on petroleum imports for its domestic requirement, with crude oil consumption of around 92,000 BPD. Over the last 15 years, demand for petroleum products has risen at an annual average rate of about 5%. The current demand of 4.5 MMTPA is expected to reach 8 MMTPA by 2030.

Sri Lanka's only refinery has a capacity of 2 MMTPA. The country's fuel consumption is 4.5 MMTPA, which necessitates 2.5 MMTPA of imports. Sri Lanka's fuel needs are estimated to rise to 6.5 MMTPA by 2020 and 8.5 MMTPA by 2030. Instead of importing fuel, the country plans to import crude oil and process it.

The South Asian island-state, located off the southeastern coast of India in the Indian Ocean, will still be dependent on imports of petroleum products for its domestic needs, despite the proposed expansion in refinery capacity.

11.5.3 Natural gas

Cairn India Ltd made two gas discoveries at Dorado and Barracuda wells in 2011 as part of a four-well drilling programme in Sri Lanka's Mannar Basin. The first gas from Cairn is expected to be produced by end-2017 or early 2018 in ideal conditions. The gas discovery in the Mannar Basin has encouraged Sri Lanka to proceed with the second offshore licensing round in the Cauvery and Mannar basins. Separately, the government is exploring the prospect of launching a third licensing round for offshore blocks in Sri Lanka.

11.6 Trade opportunity

11.6.1 Petroleum products

The crude oil produced in India's northeastern region is treated in four refineries, the oldest being Digboi refinery in Tinsukia district of Assam; the other three are Guwahati refinery, Bongaigaon refinery and Numaligarh refinery. The installed capacity of the four refineries is 7.1 MMTPA.

To achieve economies of scale, Numaligarh Refinery Ltd has mooted a plan to expand the refinery from 3 MMTPA to 9 MMTPA for processing imported crude oil. To facilitate transportation of around 6 MMTPA imported crude oil from Dhamra port in Orissa to Numaligarh refinery a new pipeline is being envisaged. There are no expansion plans for the other refineries in the region.

According to the company, additional products generated from the refinery expansion can primarily be absorbed in its existing supply envelope. Part of Numaligarh refinery's increased production is planned to be exported to Bangladesh through Parbatipur (150 km from the Numaligarh refinery terminal at Siliguri), and the remainder will be utilised for production of petrochemicals grade naphtha for which adequate demand exists within the country.

Figure 54: Unmet demand potential in neighbouring countries (MMTPA)

Particulars	2014-15	2019-2020	2024-25	2029-30
Demand potential in neighbouring countries				
Myanmar	2.00	1.25	1.00	0.75
Bangladesh	4.00	4.00	3.60	5.40
Nepal	1.40	1.70	2.07	2.52
Bhutan	0.10	0.12	0.15	0.18
Sri Lanka	2.00	1.50	2.50	3.50
Total demand potential for POL products	9.50	8.57	9.32	12.35
Supply potential in NER				
Production capacity (POL)	6.5	7.0	14.3	14.3
Demand from NER	3.20	4.0	5.4	7.3
Surplus available	3.3	3.0	8.9	7.0

Source: CRISIL Infrastructure Advisory Analysis

The current demand of petroleum products is around 3.2 MMTPA in the northeast region (NER). With excess refining capacity of 7 MMTPA in the region, after accounting for NRL's expansion, NER will have excess capacity. India, already a net exporter of petroleum products, can utilise the excess capacity better by catering to demand in neighbouring nations rather than exporting to markets located at a considerable distance.

Bangladesh, Myanmar, Sri Lanka and Bhutan hold significant demand potential, and the aim should be to service that demand from the NER. Nepal is being already served by IOCL.

11.6.2 Natural gas

In the case of Bhutan and Nepal, firewood contributes 65-70% of their primary energy needs. This presents an opportunity to initiate steps to replace firewood by cleaner sources of energy, i.e. natural gas and LPG.

In the case of Myanmar, there exists a significant gap between production and consumption of natural gas. Therefore, the option to import gas from Myanmar, through the NER, may be considered for consumption in the region, and taking the gas into the rest of the country once the gas pipeline network in the NER is developed and linked to the national gas grid. Development of a gas grid in the NER will benefit states in the region, in terms of additional revenues, and provide opportunities for setting up industries such as power and petrochemical plants in the region, which will bring investment and employment opportunities to the local population. China's CNPC has already commissioned an onshore natural gas pipeline from Myanmar of capacity 12 BCM/year to carry gas from the Shwe gas project.

12. Make in India

The 'Make in India' initiative was launched by the Prime Minister of India on September 25, 2014, with an objective of making India a manufacturing hub for key sectors. The Make in India programme focusses on pursuing initiatives to facilitate investment and foster innovation, attract foreign direct investment into the country, protect intellectual property rights of innovators by developing conducive policies, and develop national manufacturing and raise its standards to global levels. The policy is the first of its kind for the manufacturing sector, addressing regulation, infrastructure, skill development, technology, availability of finance, exit mechanism and other pertinent factors related to growth of the sector.

12.1 Key sectors

Key sectors identified for the Make in India drive are:

- Oil and gas
- Mining
- Thermal power
- Construction
- Automobiles
- Defense manufacturing
- Renewable energy

Oil & gas is a key sector under the initiative as India is largely dependent on import of oil & gas to meet its domestic requirement, with close to 80% of oil and 30% of natural gas being imported.

12.2 Make in India – Oil and gas sector

India is energy starved with one of the lowest per capita energy consumption within developing countries. To boost manufacturing, maintain GDP growth rate of 7-8 % and lift the nation to the developed category requires huge energy consumption. As per estimates, demand for energy will increase roughly three times by 2035 to 1,516 MMTOE from the current consumption of 638 MMTOE in 2014. With lower crude oil prices and the impetus on increasing consumption of natural gas, the share of oil and gas in India's primary energy mix will increase. Presently, oil and gas together contribute around 30% of India's energy requirement. To promote development of the country's oil and gas sector, the government has taken several initiatives:

- Government will auction 69 marginal oil and gas blocks under the revenue sharing model. These blocks are estimated to hold 89 MMTOE of oil and gas resources.
- The government plans to announce the 10th round of bidding for the National Exploration Licensing Policy; 60% of prognosticated oil and gas resources are yet to be harnessed.
- Pricing reforms in the natural gas sector have been introduced to transition towards international market-driven prices.
- Policy formulated on coal bed methane (CBM) and shale gas to encourage E&P companies to invest in the development of these energy sources.

12.2.1 Make in India – Northeast focus

The Make in India plan and the Northeast development can go hand-in-hand. The key manufacturing activities that can be planned in the region to improve overall development of oil and gas sector have been identified.

12.2.2 Upstream

Equipment such as drill pipes, nuts and bolts, casing and tubing, and well-head equipment will be manufactured in the region for local consumption and export to neighbouring countries such as Myanmar and Bangladesh. Further, setting up a service provider hub in NER can be considered so that small and private players can have access to technologies/services that have been developed by ONGC and OIL with their long experience of operating in the region.

12.2.3 Midstream

There is a proposal to lay over 7,500 km of pipeline for natural gas and petroleum products and develop city gas distribution (CGD) infrastructure in the NER. Construction activities related to the pipelines can be carried out in the region, which will provide an opportunity for domestic and global manufacturers to set up pipeline manufacturing units in the NER.

12.2.4 Downstream

- Expand refineries in NER and supply surplus petroleum products to neighbouring countries such as Bangladesh and Myanmar.
- Develop NER as a wax hub, as raw material is abundantly available.
- Brahmaputra Cracker and Petrochemical Ltd have set up a petrochemicals unit in Assam. Feedstock for the project will be natural gas and naphtha. OIL and ONGC will supply natural gas while the Numaligarh refinery will supply naphtha. The principal end-products of the complex will be high density polyethylene (HDPE) and linear low density polyethylene (LLDPE) totalling 220,000 tonnes per annum (TPA) and 60,000 TPA of polypropylene (PP). Other products include raw pyrolysis gasoline and fuel oil.

The products produced at BCPL have varying uses in the manufacture of various plastic products.

Ues of principal end-products from BCPL

Products	Usage
LLDPE grade (MFI 0.9)	Packaging films, liners
LLDPE grade (MFI 2.0)	Stretch films and stretch film rolls
LLDPE grade (MFI 4.0)	High quality packaging films, bubble film packaging
HMHDPE (MFI I21-10)	Trash bag, carrier bags
MDPE (MFI 3.0)	Draining parts, fuel tanks etc.
MDPE (MFI 4.0)	Tanks, containers, waste bins, road dividers
HDPE (MFI 4.5)	Dustbins, pallet boxes, fish crates, technical mouldings
HDPE (MFI 8.4)	Crates, boxes, pallets, closures, helmets
HDPE (MFI 21)	Housewares, buckets and baskets
HDPE (MFI 1.0)	Fishnets, raffia bags
HDPE (MFI 0.2)	Oil containers, lube containers
HDPE (MFI I21-10)	Large containers
Polypropylene	
TQ Film (MFI 12)	Textile overwraps, garments bag, snack food packaging
Raffia (MFI 3.4)	Raffia bags, leno bags
Injection moulding (MFI 12)	Rigid packaging, furniture, house wares, closures etc.

- Downstream plastic manufacturing industries such as polybags, plastic containers, packaging, housewares, etc. can be developed in the NER using products produced at BCPL as a feedstock.

12.2.5 Other industries around oil and gas

- Tyre manufacturing can be an option in the NER, as the region is naturally rich in raw material. Moreover, rubber produced can be consumed domestically or exported to Bangladesh and Myanmar.
- With surplus refining capacity in the region, and with availability of plastic and cracker plants, small industries in plastic goods manufacturing can be set up by providing tax incentives.
- Gas-based power generation plants that consume locally-produced natural gas can be set up
- As a large proportion of the country's wax production is in NER, the region can be developed as a wax hub by promoting candle manufacturing industry

- Numaligarh Refinery Ltd has already envisaged production of bio-ethanol from bamboo in the NER.
- Other units can be set up in the region to utilise bamboo or other feedstock like rice husk/straw.

12.2.6 Imports in NER

The region is deficient in production of various materials despite being rich in raw material. Some of the key items that are required to be imported in the region are:

- Bitumen
- Readymade clothes/synthetic fibers, textile items, cotton waste,
- Cement, bricks and precious stone
- Foodgrains, processed food items and drinks, ginger, chips,
- Fertiliser

Most of these items can be produced locally at much cheaper rates as raw materials are locally available in abundance. Therefore, steps need to be taken to incentivise setting up of industries to produce such items locally.

12.3 Action plan

Table 149: Action plan for Make in India programme in NER

Action items	Authorities concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (>5 years)
Upstream				
Manufacturing equipment such as drilling rigs, drill pipes, nuts and bolts, casing and tubing and well head equipment to be manufactured in NER and exported to Bangladesh, Myanmar and Malaysia	DIPP/MoPNG	Review for implementation	Development of manufacturing units in the region	
Midstream				
To promote industries related to pipe manufacturing/steel in NER as potential is for development of pipeline	DIPP/MoPNG	Review for implementation	Plants to be set up in the region	
Downstream				
Expansion of refineries in NER	NRL/IOCL	Review for implementation along with crude oil pipelines	Develop roadmap for implementation of refinery along with pipeline network	

Action items	Authorities concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (>5 years)
Other industries around oil and gas				
Development of concomitant infrastructure to facilitate production and evacuation of finished products from hydrocarbon related industries	MoPNG/Ministry of Finance/Ministry of Commerce/Ministry of power	Identifying key industries to be setup	Envisaged plan to be implemented in the medium term	
To promote industries related to decorative items based on wax.	DIPP	Candle manufacturing industry to be developed in the region		
To promote bio-ethanol production in NER as large quantity of raw material (bamboo) is available.	MNRE/MoPNG	Identification of key regions where bio-ethanol production units can be set up	Implementation plan to commence	

13. Health/medical services
14. Corporate Social Responsibility

13. Health/medical services

National Health Mission (NHM) has been set up for the "Attainment of universal access to equitable, affordable and quality healthcare services, accountable and responsive to people's needs, with effective inter-sectoral convergent action to address the wider social determinants of health."

13.1 Objectives of NHM

The objectives identified and included as a part of the Twelfth Five-Year Plan are:

- Reduce mother mortality rate (MMR) to 1/1,000 live births
- Reduce infant mortality rate (IMR) to 25/1,000 live births
- Prevention and reduction of anemia in women aged 15-49 years
- Prevent and reduce mortality and morbidity from communicable, non- communicable, injuries and emerging diseases
- Reduce household out-of-pocket expenditure on healthcare expenditure
- Reduce annual incidence and mortality from tuberculosis by half
- Reduce leprosy to <1/1,0000 population and incidence to zero in all districts
- Annual malaria incidence to be <1/1,000
- Less than 1% microfilaria prevalence in all districts
- Kala-azar elimination by 2015, <1 case per 10,000 population in all blocks

13.2 Initiatives under NHM

Initiatives taken by the government to meet the objectives are:

- **Mobile medical units (MMU):** It is a mechanism to provide outreach services in rural and remote areas. This is not meant to transfer patients. It provides on-the-spot medical treatment.
- **National ambulance service:** Develop a network of ambulances to reach critical areas without delays.
- **Accredited Social Health Activist (ASHA):** It provides villages with a trained female community health activist. The activist will be selected from the village itself and accountable to it; the ASHA will be trained to work as an interface between the community and the public health system.
- **Rogi Kalyan Samiti (patient welfare committee) / hospital management society:** Objective of this scheme is to provide better medical facilities with certain standards that are met.
- **Janani Suraksha Yojana (JSY):** It is being implemented with the objective of reducing maternal and neonatal mortality by promoting institutional delivery among poor pregnant women.
- **Janani Shishu Suraksha Karyakram (JSSK):** This initiative promotes safe child delivery in hospitals rather than at homes. The scheme is slated to benefit over 12 million pregnant women.
- **Rashtriya BAL Swasthya Karyakram (RBSK):** This initiative recognises diseases in children from 0-18 years of age and provides health services to these children.
- **Mother and child health wings (MCH wings):** With a focus to reduce maternal and child mortality, dedicated mother and child health wings with 100/50/30-bed capacity have been sanctioned in high case load district hospitals and Community Health Centers (CHCs), which would create additional beds for mothers and children.
- **Free drugs and free diagnostic service:** An initiative is launched under the NHM to provide free drugs and diagnostic service with a motive to lower the out-of-pocket expenditure on health.
- **District hospital and knowledge centre (DHKC):** District hospitals are being strengthened to provide multispecialty healthcare, including dialysis care, intensive cardiac care, cancer treatment, mental illness, emergency medical and trauma care, etc. These hospitals will act as knowledge support for clinical care in facilities below it through a tele-medicine centre located in the district headquarters, and will also be developed as centres for training of paramedics and nurses.

- **National Iron+ initiative:** To address iron deficiency anemia beneficiaries will receive iron and folic acid supplementation, irrespective of their iron/Hb status.

In addition to these initiatives, we have, listed down a few more recommendations to strengthen the rural health mission:

- One-time financial aid covering all compulsory vaccination for children from a government hospital.
- Medical records and history to be linked to Aadhar cards and issue of smart medical cards.
- Compulsory yoga classes in schools and work places to maintain health of workers.
- Setting up of three medical institutes with the help of PSUs along the lines of AIIMS in Guwahati, Dibrugarh and Agartala.
- Targeting specific communicable and non-communicable diseases and lowering the incidents caused by them.

13.3 Action plan

Table 150: Action plan for health /medical services

Action items	Authorities concerned	Timeline		
		Short term (less than 2 years)	Medium term (2-5 years)	Long term (>5 years)
Setting up of nursing schools in NER in vicinity of operations, with help of entities operating in the region and linking it with NHM	Operating entities/Ministry of health and family welfare		To be implemented	
Provision of health camps and health facilities (including ambulances) to be provided, with a joint effort between initiatives of NHM and operating entities	Operating entities/Ministry of health and	To be implemented		

14. Corporate Social Responsibility

Corporate Social Responisbility (CSR) has become a widely-applied concept and is an increasingly central concern in business decision-making. The scope of activities included in CSR programmes is wide; however, most definitions include three key pillars of economic growth, ecological balance, and social progress. CSR, at present, is being viewed as a means to create reliable cooperation among the business and the local population by way of facilitating larger developmental agenda for the area.

The growing understanding of CSR, as a concept, has enabled PSUs to invest more into promoting various activities under the aegis of CSR. The following sections describe various CSR initiavites that have been planned by the PSUs in Northeast India to promote larger developmental agenda in the region.

14.1 Healthcare

ONGC Super Speciality Hospital Project

A super criticality hospital project, with an estimated project cost of Rs. 100 crore, has been envisaged by ONGC. Land has already been acquired for the project. Furher, a partner has been shortlisted thorugh EOI to construct, operate and maintain the hospital. The financial modalities are being reviewed at present.

OIL's school of Nursing

The School of Nursing was started in the year 1991 for General Nursing & Midwifery (GNM) Course. At present, the annual intake is 20 and the school is recognized by Indian Nursing Council, New Delhi. OIL has proposed to enhance the annual intake for its Nursing school from 20 to 30 students.

Nursing school by NRL

NRL is planning to set up a nursing school under the aegis of 'Vivekananda Kendra Hospital NRL' and technical assistance from 'Apollo Knowledge'. The process of completing the permanent infrastructure and approval of Indian Nursing Council to start the course will take around 2-3 years. Until then to have a ready reserve of skilled manpower already 14 students for GNM and Auxiliary Nursing Midwifery (ANM) course have been sponsored at Assam Downtown University, Guwahati for the session 2015-16. In accordance with the requirement of manpower, it is being proposed to sponsor 20 students every year in GNM courses till the functioning of the VKNRL Nursing School.

Further, initiavies such as 'Niramoy'- mobile medical camp for the villagers, 'Dhristi'- regular eye screening camps and free Cataract operations covering villages and tea gardens of Golaghat district, and 'Helping Hand'- to cater to the needs of the differently abled persons are being conducted by NRL to facilitate healthcare in the region.

Assam Oil School of Nursing (AOSN), Digboi

IOCL has been comtemplating on doubling the capacity for both B.Sc. & GNM course from 2016-17 onwards. New college infrastructure will be built for catering to both courses. The upgradation will help to extend free education, medical facilities and other amenities to 270 students per year.

14.2 Education and Training

The Exploration and production of hydrocarbons is technologically challenging and scientifically ever evolving in nature. In order to keep in tune with the technological demands, the PSUs have been collaborating with academia by awarding grant-in-aid projects for undertaking high quality basic and applied research in the field of interest to their sphere of work of exploration and exploitation of hydrocarbons. Further, various initiaves are being taken by the PSUs to ensure affordable education to the students, especially for poor and weaker sections of the society. OILs 'Super 30'- 11 months completely residential coaching program for IIT-JEE & other engineering entrance examinations, 'Project Dikhya'- for imparting computer education to school students, 'Shikshya Ratna Puraskar'- for recognizing the all-round contribution of the teaching fraternity have helped to promote education in the region. These initiavies are likely to create better educational opportunites in the region.

Education and Training by NRL

NRL has planned to set up a Common Facility Centre (CFC) near refinery to impart skills in various trades such as wood craft, weaving and traditional handicraft, wax based craft , manufacturing of handmade paper, sanitary napkin, bandage, incense stick etc. to promote entrepreneurship of unemployed youth.

RGIPT-Assam Centre, Sivasagar

To facilitate petroleum sector education in Northeast India, ONGC has decided to provide grant of Rs. 238 crore to set up Rajeev Gandhi Institute of Petroleum Technology (RGIPT) at Sivasagar in Assam. Disbursement to the tune of Rs. 104 crore has already been made for the project. IOCL also has contributed Rs. 39.52 crore as endowment fund, for setting up the Institute. Once completed, the institute can ensure availability of a specialized institute which is expected to unlock opportunities for the students as well as the E&P comapnies in the region.

Linkages with premier institutions

ONGC-Pan IIT Memorandum of Collaboration (MoC) envisages execution of R&D projects by ONGC under Pan IIT forum comprising of seven IITs namely, IIT-Kharagpur, IIT-Kanpur, IIT- Bombay, IIT-Madras, IIT-Delhi, IIT-Guwahati and IIT-Roorkee, in the jointly agreed thematic research areas matching ONGCs needs and expertise available with IITs. Projects have been conceptualized jointly by ONGC Institutes and IITs. Following 3 projects with IIT-Guwahati have been approved.

- Estimation of petro-physical properties from seismic attributes and well logs using artificial intelligence
- Development of Comprehensive interactive well monitoring software tool for drilling supervisors
- Production of hydrocarbon oil via hydrothermal liquefaction (HTL) of microalgae grown on flue gas and organic nutrients recycled from HTL unit

Apart from above, another project on bio-ethanol production and scaling up from lingo-cellulosic biomass is also agreed to be undertaken jointly by IIT Guwahati and IIT Roorkee.

14.3 Arts, Sports and Culture

The PSUs are actively involved in preserving and developing local culture. Intiatives have also been taken to promote sports and arts in the region. NRL has started a football academy in Numaligarh to train and develop talents of budding football players below 15 years. In similar line a badminton academy is also supported by NRL at Furkating, Golaghat.

OIL's contribution and collaboration with the social groups, district administration and sports bodies, has helped in making rural sports as one of the most popular sports event in the rural areas creating social advantage, over the years. The company has been organizing various sporting events to provide a platform and motivate the budding talent from the rural parts of OIL's operational areas. Further, ONGC has sanctioned Rs. 35 lakh to upgrade sporting infratructure in Nurul Amin Stadium in Nowgong.

14.4 Local Heritage

In order to restore the ancient monuments in the region, NRL has planned to support development & upliftment of Deoparvat Archeological Site which bears a rich cultural heritage of Assam. It has also proposed preservation & conservation of Numaligarh Rampart which has a historical & cultural heritage of mediaeval period.

ONGC has undertaken intitiatives to conserve and develop four Ahom monuments, namely Rang Ghar, Karen Ghar, Talatal Ghar and Maidam at Charaideo in Sibsagar, Assam. Archaeological Survey of India (ASI) and National Culture Fund (NCF) have been associated as project partners for execution of these projects. Amount to the tune of Rs. 3.97 crore has been sanctioned for the initiave. Further, project on conservation of Hoolock Gibbon and the rainforest biodiversity is being implemented by a renowned environmental activists group of Northast India across OIL operational areas, where the endemic populations of this highly endangered ape are found.

In an effort to preserve the history of the petroleum industry in India as well as to create awareness among the people about the richness of the industry's heritage, K D Malaviya National Oil Museum (KDMNOM) has been conceived by the Ministry of Petroleum & Natural Gas. The Museum is a joint effort on the part of the public sector units of the petroleum industry under the aegis of the MoP&NG. A number of activities have been carried out, such as appointment of an architect, approval of concept & design, earth filling, soil testing, boundary wall etc., to create the infrastructure. The project is estimated to be completed in two phases spanning six years. In the first phase, major building and other infrastructures would be completed and the Museum can be made open to public with a few Galleries. Rest of the allied facilities and Galleries are to be completed in another two years' time.

14.5 Skill Development

Project Swabalamban on Skill Building

Under the project, OIL provides skill based placement oriented training to youth from its operational areas, by focussing on various employable skills in sectors like Construction Industry, Hospitality & House Keeping Management, Industrial Sewing, Jewellery Making, Electrician besides setting up of livelihood clusters in areas like handloom & handicrafts. The project is being implemented by three reputed agencies, viz. Indian Institute of Entrepreneurship (IIE), Guwahati, Construction Industry Development Council (CIDC), New Delhi and IL&FS Educational Technology Services (IETS), New Delhi. Through this initiative, OIL aims to provide skill based employment oriented training to more than 10, 000 youth from the catchment areas where OIL operates within a five year period. Till date over 3200 candidates have been trained and over 500 candidates have been successfully placed under the project.

IndianOil Multi-Skill Development Institute (IMSDI), Digboi

The institute provides courses on hospitality & tourism, welding, beauty & wellness and fitters. The future action plan aims to provide training to 400 beneficiaries annually. Further, it also aims to provide training under Pradhan Mantri Kaushal Vikas Yojana (PMKVY) scheme in near future.

14.6 Livelihood Generation

Agriculture is the mainstay of Indian economy and has direct impact on poverty alleviation, containing inflation, rural incomes and employment generation. To improve the food security in the region, cultivation of various crops using modern agricultural technology and practices has been promoted under PSU's CSR schemes in collaboration with state agriculture department. To boost the farmers, the Oil India Rural Development Society (OIRDS) introduced high yielding paddy seeds specially collected from Regional Agriculture Research Centre, Titabor and organic manure to revitalize the paddy fields. Till date, OIRDS has adopted more than 102 villages, covering more than 15202 farm families under its Agriculture Project. The project is expected to extend the benefits of its research to more number of families in future.

Under the project 'Swa-nibhar' of NRL, 'Rupantar' of OIL, assistance is provided to joint liability groups /self help groups (SHGs) of the nearby areas for setting up establishments of sustainable livelihood ventures in the form of farm mechanization, agri-based horticulture, floriculture & composite farming, food processing, agro marketing, commercial nursery, diversified handloom & handicraft production and animal husbandry such as development of diary, poultry, piggeries, goatery, fish farming etc.

OIL's Handicraft Training and Production Centre, located at Duliajan, Assam has been imparting nine-month stipendiary training in weaving, cutting & tailoring, embroidery and knitting to young girls from OIL operational areas. Post training assistance is also provided to the trainees. Further, OIL has taken up a cooperative dairy development project to provide sustainable livelihood opportunities to local communities modelled on the Gujarat's Amul success story. The Baseline Survey of the project has been completed.

15. Immediate Term Initiatives
16. Hydrocarbon Vision 2030 for NER
17. Vision 2030 - Key initiatives planned for the states


India Limited

15. Immediate Term Initiatives

The objectives which require immediate action and can be implemented in the short term (0-2 years) in the upstream, midstream, downstream, policy related initiatives and other allied areas have been summarized below and have been discussed in brief in the following sections.

Segment	Recommendation	Target Impact
Upstream	Production Enhancement Contracts	Increase production from mature fields
	Induction of new technology	Increase production from mature fields
	NOCs to offer services	E&P services available to private operators
	Service provider hubs	Services available to all at low costs
Midstream and Downstream	Reinstatement of NEIIPP policy	Promote industry development in NER
	Utilization of flared gas	Increase access to clean fuels
	Increasing LPG & POL storage capacity	Increase days of coverage for LPG and POL
	Development of a bio-refinery at Numaligarh	Promote usage of clean fuels
	Development of NER as wax processing hub	Manufacturing and export of wax products
Policy	Policy changes in the New PSCs	Promote oil & gas production from NER
	Premium on price of natural gas produced	Incentivize production of natural gas in NER
	Increasing the VGF limit from 20% to 50%	Promote investment in high cost projects
Other Allied Areas	Skill development	Develop the local talent pool for employment
	Make in India	Develop manufacturing industry in the region
	Health/Medical services	Making available health and medical facilities

15.1 Action Points – Upstream Segment

15.1.1 Production enhancement contracts (PEC)

PECs are contracts that are signed between oil field services (OFS) companies and NOCs for mature fields, wherein, a NOC asks an OFS to provide its services for increasing production from a mature field. The service company uses integration of new technologies, work practices and enhanced oil recovery techniques to increase production. NOCs can finalize the structure of the PEC in consultation with MoPNG and can float tenders for blocks identified for PEC implementation in NER to appoint a service provider.

15.1.2 Induction of new technology

Induction of new technology is to be carried by NOCs to arrest the declining production of crude oil in NER, and to ramp up production from mature fields. Old technologies to be phased out and usage of new technologies like EOR/IOR, miscible gas injection, polymer flooding etc. to be promoted.

15.1.3 NOCs to offer services

NOCs can offer their services and expertise to other operators in the region on a chargeable basis. This can be beneficial for NOCs as well as other operators who require such services at an affordable cost. NOCs can turn around their service facilities from being a cost centre into a revenue centre. This will ease the availability of services to all in remote areas, as both the NOCs have large base, experienced manpower and presence in remote locations.

15.1.4 Service provider hub

In order to overcome the challenges related to limited presence of service providers and unavailability of service facilities for E&P companies in NER, it is imperative to establish service hubs at suitable locations in the region so that the E&P operators can avail those services at a reasonable cost. The

identified locations for setting up of service provider hub are Jorhat, Dibrugarh and Agartala. An assessment needs to be carried out for feasibility analysis and strategic utility of these locations for establishment of service provider hubs.

15.2 Action Points – Midstream & Downstream Segments

For the midstream and downstream segment, the critical objectives which can be achieved over the immediate term have been discussed below:

15.2.1 Reinstatement of NEIIPP policy

The North East Industrial and Investment Promotion Policy (NEIIPP) 2007 of the Government of India laid down a number of fiscal incentives for investors in the region. The provisions of the NEIIPP, 2007 had requisite incentives as well as an enabling environment to speed up industrialization of the region. The highlights of the incentives for all industrial units, new as well as existing units & on their substantial expansion, located anywhere in NER included excise duty exemption, subsidy on capital investment, subsidy on plants and machinery, power subsidy and transport subsidy. The Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, Government of India, issued a circular to all the eight NER states to convey that registration under the schemes of NEIIPP, 2007 had been suspended with effect from December 1, 2014.

NEIIPP policy should be reinstated with increased budgetary allocation up to 10 times the current limit. Reinstatement of this policy will boost promotion of industries that will not only ensure higher hydrocarbon consumptions but also create jobs for local people.

15.2.2 Utilization of flared gas

Utilization of flared gas by transporting gas through cascades from flare locations to demand centers needs to be ensured in the immediate term. This will help in utilization of the gas which is being flared at present and additionally help in offsetting LPG demand by consumers around the flare locations. Feasibility analysis for modular power plants near flare gas locations also needs to be carried out subject to long term gas profile. Details of flare gas locations are provided in table below:

Location	Company	Volume (MMSCMD)	Viable monetization method	LPG demand offset (TMTPA)
Makum (Assam)	OIL	0.015	Construction of Makum CGS is in progress.	4
Habeda (Assam)	OIL	0.060	Construction of CGS is in progress. To be supplied to CGD networks	16
Kumchai (Arunachal Pradesh)	OIL	0.025	10 MW power plant planned by OIL	-
Borholla, Koraghat, Nambhar,Kasomariaon (Assam)	ONGC	0.054	To be supplied to CGD networks by pipeline or by cascading options	15
Geleki (Assam)	ONGC	0.029	To be supplied to BCPL by Compressors	8
Kharsang (AP)	Others	0.020	To be supplied to CGD networks by pipeline or by cascading options	5
Total		**0.203**		**48**

For effective utilization of flared gas, NOCs to assist long term customers like AGCL/TNGCL for off-taking of gas (by constructing small pipelines if required).

15.2.3 Increasing LPG & POL products storage capacity

(a) LPG tankage and bottling Plants (Capacity Expansion)

It is imperative to increase the LPG storage capacity in NER, to meet the demand for LPG. Hence there is a need to increase the bottling capacity and tankage of LPG in the next three years. The table below provides the details of the availability of the tankage capacity at the existing bottling plants, along with the proposed expansion, in the next three years.

Name	Existing (MT)	Additional (MT)	Total (MT)
Maulkhang	100	350	450
Bishalgarh	83	1800	1800
Kimin	100	0	100
Gopanari	1800	0	1800
Sarpara	900	0	900
Dimapur (AOD)	400	0	400
North Guwahati	1320	1200	2520
Silchar*	1800	0	1800
Sekmai	1800	0	1800
Bongaigaon	0	900	900
Refineries	5330	0	5330
TOTAL	**13,633**	**4250**	**17,800**

** Existing tankage at Silchar will be decommissioned after commissioning of new tankage of 1800 MT*

GOPANARI LPG Bottling Plant: LPG bottling capacity at Gopanari LPG Bottling Plant is being augmented by installing additional 1 x 24 point LPG Cylinder filling carousal at an estimated cost of Rs. 9.48 Crores. On completion of project the LPG cylinder bottling capacity of the plant would be 60 TMTPA as against present capacity of 30 TMTPA. The project is likely to get completed by Apr'16.

NORTH GUWAHATI LPG Bottling Plant: LPG storage capacity at the North Guwahati LPG Bottling Plant is being augmented by installing additional 2 x 600 MT Mounded Storage Vessels, at an estimated cost of Rs. 28.48 Crores. As of now, physical progress is around 52% as pile foundation work of vessels is in progress. The project is likely to get completed by March - April'17. On completion of project the LPG storage capacity of the plant would be 2520 MT as against present LPG storage capacity of 1320 MT.

(b) POL Storage facility

On similar lines, increase in tankage capacity for POL products has been planned over the next 3 years and feasibility studies have been already carried out by IOCL. The table below summarizes the planned capacity expansions and their current status.

State	New location	Product	Tankage (In KL)	Current Status	Expected Commissioning
Assam	Golai, Digboi	MS	8722	Construction activities in progress. Construction work affected pending issuance of NOC by Defence Authority for construction on 3.03 acres defence land.	Dec'16
		SKO	6626		
		LDO	Nil		
		HSD	13146		
		FO+LVFO	6626		
	Moinarband,	MS Silchar	7200	Land taken over. Estimated Cost of Construction - Rs.382 Crs. Approval in process.	Mar'19
		SKO	3200		
		HSD	16000		
		ATF	3600		
Manipur	Imphal – New	MS	5052	Construction work in progress. To be commissioned as a road fed Depot.	Mar'16
		SKO	5055		
		HSD	11796		
Arunachal Pradesh	Doimukh	MS	9192	Depot with augmented tankages and Rail receipt facilities expected to be commissioned by Mar 2019.	Mar'19
		SKO		4398	
		HSD		16158	
Total		HSD	57,100		
		MS	30,166		
		SKO	19,279		
		ATF	3,600		
		FO	6,626		

(c) Malom Depot (Imphal)

A new automated rail head terminal at Malom (Imphal) is being developed to meet the ever increasing POL demand of Manipur area. The project is in advance stages of completion and is likely to be commissioned in May 2016.

(d) Value Added Products

- Guwahati refinery Indmax unit revamp (increase of capacity by 50%) to be ready by Feb'16
- Guwahati refinery Indadept G unit (for production of BS-IV MS to meet auto fuel policy) would be commissioned by July'16

15.2.4 Setting up of a Bio-refinery at Numaligarh

NRL has planned to establish a bio-refinery at Numaligarh for production of bioethanol from bamboo. The estimated cost of the project is Rs. 790 crore and it is envisaged to be completed in 24 months after start of construction for which feasibility studies have already been carried out. This project should be taken up on an immediate basis, considering the fact that, it will improve access to clean fuel and in the process will promote bamboo cultivation which will benefit the local farmers/entrepreneurs associated with bamboo production and processing industry.

15.2.5 Developing northeast as a wax processing hub

Crude oil produced from NER has high wax content; hence, the region has been developed as a major wax producing area. NER has two paraffin wax producing units located at IOCL's Digboi refinery and at Numaligarh refinery. These units account for the bulk of wax production in the country.

Since candle manufacturing is not capital intensive and requires minimal resources, NER can be developed as a candle manufacturing hub for the country. Proximity with countries such as Bangladesh, Myanmar, Nepal and Bhutan will ensure a ready market for export for these small scale industries. State Govt. may facilitate setting up a Wax Processing park in the state with facilities like industrial shed and power etc.

15.3 Action points - Policy level initiatives

Key policy level initiatives which will benefit the oil and gas sector in NER have been listed below. These initiatives could be implemented for new PSCs that would be signed in the region.

15.3.1 Policy changes for E&P sector

- Identification of high risk areas/challenging areas in NER by DGH as per past records and experience and categorizing them as "challenging areas".
- Extension of tax holiday from 7 years to 12 years for challenging areas in future contracts to make blocks economically viable and attract bidders' interest in future.
- Timeline for exploration phase for challenging blocks to be revised to 12 years (8+4) from current 7 years (4+3) for NER blocks considering only 6-7 months are available for survey and exploration.
- Exemption of EC/FC clearances for exploratory phase
- Offering of relinquished areas to NOCs
- Offering premium on price of natural gas produced from challenging blocks in NER
- Concept of zero phase of exploration to be introduced and implemented. Zero phase of exploration provides an opportunity to the E&P Company to hold discussion and talks with the local community, clearly highlighting the impact of oil and gas exploration and production activities and the measures that would be taken by the E&P Company to mitigate any such social and environmental impact.

15.3.2 Increasing VGF limit from current 20% to 50%

Increase the VGF limit from the current 20% to 50%, since the projects in NER are highly capital intensive. VGF facility should also be made available to PSUs.

15.3.3 Facilitating stream exchange between refineries

The four North East Refineries have different configurations. Some of the refineries have better capacity for bottom upgradation of crude oil processed. These capabilities can be utilized to generate more value added product from each barrel of crude processed by way of sharing of streams between refineries. However, the stream exchange between refineries become un-economical as companies are not allowed to set-off tax on input against tax on output for petroleum products. Providing such facility will not only allow refineries to extract better value out of the crude processed but will also be revenue neutral to the state Govt. The State Govt. may consider suitable changes in policy accordingly.

15.4 Action Points – Other allied areas

The objectives which can be achieved over the immediate term in the areas allied to the hydrocarbon sector development have been discussed below:

15.4.1 Skill Development

Vocational training can be added in course curriculums in the educational institutes in NER in the immediate term to provide industry specific training to candidates.

15.4.2 Make in India

Review and feasibility analysis should be carried out towards developing industries around upstream, midstream and downstream activities in NER. Some of such industry segments have been listed below:

- Manufacturing equipment such as drilling rigs, drill pipes, nuts and bolts, casing and tubing and well head equipment could be manufactured in NER for the upstream segment.
- Industries related to pipe manufacturing/steel in NER could be promoted.
- Candle manufacturing industry to be developed in the region

15.4.3 Health/Medical services

Health camps and health facilities (including ambulances) to be provided through a joint effort between initiatives of NHM and entities operating in the hydrocarbon sector in NER.

16. Hydrocarbon Vision 2030 for NER

16.1 Vision statement

The vision statement for hydrocarbons in the Northeast region lays out the roadmap and medium-to-long term objectives. It also outlines the focus areas for achieving the desired state by 2030. For the development of a vision statement linked to the hydrocarbon industry in the NER, key objectives have been considered. These objectives highlight the macro level indicators that will link the vision statement with the desired developed state of the hydrocarbon industry in the region.

Figure 55: Guiding principles - Vision statement

OBJECTIVES	GOALS
Leverage Hydrocarbon potential	• Increase production of Oil and Natural Gas (O+OEG in MMTOE) to 2 times • Moderate PSC structure considering challenges in NER • Develop service provider hubs
Enhance access to clean fuels	• Increase LPG pipeline connectivity to ensure access and availability • Develop Gas Grid, CGD networks and CNG Highways in the region • Promote production of bio fuel in the region
Improve availability of petroleum products	• Plan for adequate refining capacity expansion in NER • Ensure connectivity for transporting POL and Crude Oil • Develop crude import infrastructure
Facilitate economic development	• Generate employment through promotion of manufacturing industry in the region • Promote trade between NER in India and neighboring SAARC countries • Focus on skill development

In keeping with the development objectives, Hydrocarbon Vision 2030 for the NER is as follows:

- Develop the region as a dominant hub at the forefront of India's energy map by utilising its hydrocarbon potential –
  - **Double oil and gas production (O+OEG in MMTOE) from the region** by employing the latest technology and equipment.
  - Provide **access to clean fuel (LPG / PNG)** to all households at affordable prices.
  - Bolster development of the hydrocarbon sector by **creating service provider hubs** and concomitantly improving infrastructure.
  - **Ensure availability** to support growth in per capita petroleum product consumption.
  - Provide pipeline connectivity by installing **new petroleum products and LPG pipelines** to connect major supply and demand centres.
  - Transition towards use of sustainable forms of energy by developing a **natural gas grid and CNG highways that not only inter-connect the states** in the region but also connect these to the national gas grid; this will increase consumption of natural gas as a fuel of choice.

- Generate **employment opportunities** through skill development, and by promoting industries in hydrocarbon and allied sectors such as power, fertilisers, and plastics and realising the region's potential as an export hub (subject to acceptable pricing) for petroleum products to neighbouring countries such as Bangladesh and Myanmar.
- Promote **manufacturing** by focusing on hydrocarbon sector-related products such as drill pipes, nuts and bolts, casing and tubing and other spare parts; facilitate consumption of petroleum products in the region through industrial development, and by improving pipeline transport infrastructure.
- Incentivize **production of bio-fuels** for providing access to clean fuels for all and to boost rural economy.
- Promote **trade** between **NER** of India and neighbouring **SAARC countries.**

17. Vision 2030 - Key initiatives planned for the states

17.1 Assam

Production of oil & gas	LPG access	POL product supply
Oil & gas production estimated to be 9.4 MMTOE in 2030	Increasing LPG availability from 267 TMTPA in 2014-15 to 700 TMTPA in 2029-30	Increasing POL availability from 1905 TMTPA in 2014-15 to 3952 TMTPA in 2029-30

Planned projects	
Oil & gas	Other infrastructure projects

▪ Service provider hub at Jorhat/Dibrugarh
▪ 3 refinery expansion projects
  ▪ Numaligarh from 3 MMTPA to 9 MMTPA
  ▪ Bongaigaon from 2.35 MMTPA to 4.5 MMTPA
  ▪ Guwahati from 1 MMTPA to 1.7 MMTPA
▪ Expansion plan of 2 bottling plants
  ▪ Gopanari LPG Bottling Plant
  ▪ North Guwahati LPG Bottling Plant
▪ Bio-refinery at Numaligarh
▪ Natural gas pipeline projects
  ▪ Duliajan-Numaligarh-Bongaigaon pipeline
  ▪ Agartala-Sichar-Shillong-Guwahati pipeline
  ▪ Barauni-Siliguri-Bongaigaon pipeline
▪ Development of CGD networks
  ▪ Morigaon, Nagaon, Guwahati, Silchar (Cachar Hills), Karimganj, hailakandi, Goalpara, Bongaigaon, Dhubri, Kokrajhar
▪ POL product pipelines
  ▪ Guwahati-Lumding-Silchar-Imphal
  ▪ Numaligarh-Dimapur-Imphal-Moreh
  ▪ Numaligarh-Itanagar (future plan)
  ▪ Numaligarh-Dimapur-Imphal-Moreh (with Numaligarh refinery expansion)
▪ LPG pipelines
  ▪ Numaligarh-Dimapur-Imphal
  ▪ Durgapur-Siliguri-Guwahati (extension to Imphal if NRL expansion does not take place) (alternative to Chittagong-Agartala pipeline)
	▪ Proposed 4-laning of NH 37
	▪ Double-laning of NH 36, 52, 61
	▪ Airport at Jorhat to be converted to civilian airport
	▪ Development of NW 2 and NW 6

17.2 Arunachal Pradesh

Production of oil & gas	LPG access	POL product supply
Oil & gas production estimated to be 0.6 MMTOE in 2030	Increasing LPG availability from 16 TMTPA in 2014-15 to 35 TMTPA in 2029-30	Increasing POL availability from TMTPA in 2014-15 to 576 TMTPA in 2029-30 178

Planned projects	
Oil & gas	Other infrastructure projects
▪ 10-MW flare gas power plant ▪ POL product pipeline from Numaligarh-Itanagar (future plan)	▪ Double-laning of NH 52 B ▪ Development of civilian airport

17.3 Manipur

Production of oil & gas	LPG access	POL product supply
Oil & gas production estimated to be 0.37 MMTOE in 2030	Increasing LPG availability from 22 TMTPA in 2014-15 to 35 TMTPA in 2029-30	Increasing POL availability from 173 TMTPA in 2014-15 to 576 TMTPA in 2029-30

Planned projects	
Oil & gas	Other infrastructure projects
▪ Natural gas pipeline: Agartala-Silchar-Shillong-Guwahati-Bongaigaon (spur line to Imphal) ▪ Development of CGD network at Imphal ▪ POL product pipeline: Guwahati-Lumding-Silchar-Imphal ▪ LPG pipeline ▪ Numaligarh-Dimapur-Imphal ▪ Durgapur-Siliguri-Guwahati (extension to Imphal if NRL expansion does take place) (alternative to Chittagong-Agartala pipeline)	▪ Black top surface and double-laning of NH 53, 150 and 102B

17.4 Meghalaya

Production of oil & gas	LPG access	POL product supply
	Increasing LPG availability from 16 TMTPA in 2014-15 to 25 TMTPA in 2029-30	Increasing POL availability from 422 TMTPA in 2014-15 to 948 TMTPA in 2029-30

Planned projects	
Oil & gas	Other infrastructure projects
▪ Natural gas pipeline: Agartala-Silchar-Shillong-Guwahati-Bongaigaon (spur line to Imphal) ▪ Development of CGD network at Shillong ▪ LPG pipeline: Durgapur-Siliguri-Guwahati (extension to Imphal if NRL expansion does not happen); alternative to Chittagong-Agartala pipeline	

17.5 Mizoram

Production of oil & gas	LPG access	POL product supply
Oil & gas production estimated to be 0.55 MMTOE in 2030	Increasing LPG availability from 21 TMTPA in 2014-15 to 31 TMTPA in 2029-30	Increasing POL availability from 107 TMTPA in 2014-15 to 301 TMTPA in 2029-30

Planned projects	
Oil & gas	Other infrastructure projects
▪ Development of CGD network at Aizawl ▪ POL product pipeline: Guwahati-Lumding-Silchar-Imphal (further to Aizawl/Agartala) ▪ LPG pipeline: Chittagong-Sabrum-Agartala (further extension to Aizawl/Silchar)	▪ Double-laning of NH 54

17.6 Nagaland

Production of oil & gas	LPG access	POL product supply
Oil & gas production estimated to be 1 MMTOE in 2030	Increasing LPG availability from 17 TMTPA in 2014-15 to 28 TMTPA in 2029-30	Increasing POL availability from 120 TMTPA in 2014-15 to 315 TMTPA in 2029-30

Planned projects	
Oil & gas	Other infrastructure projects
▪ Resolution of dispute over DAB areas and royalty sharing ▪ POL product pipeline: Numaligarh- Dimapur-Imphal-Moreh ▪ LPG pipeline: Numaligarh-Dimapur-Imphal	

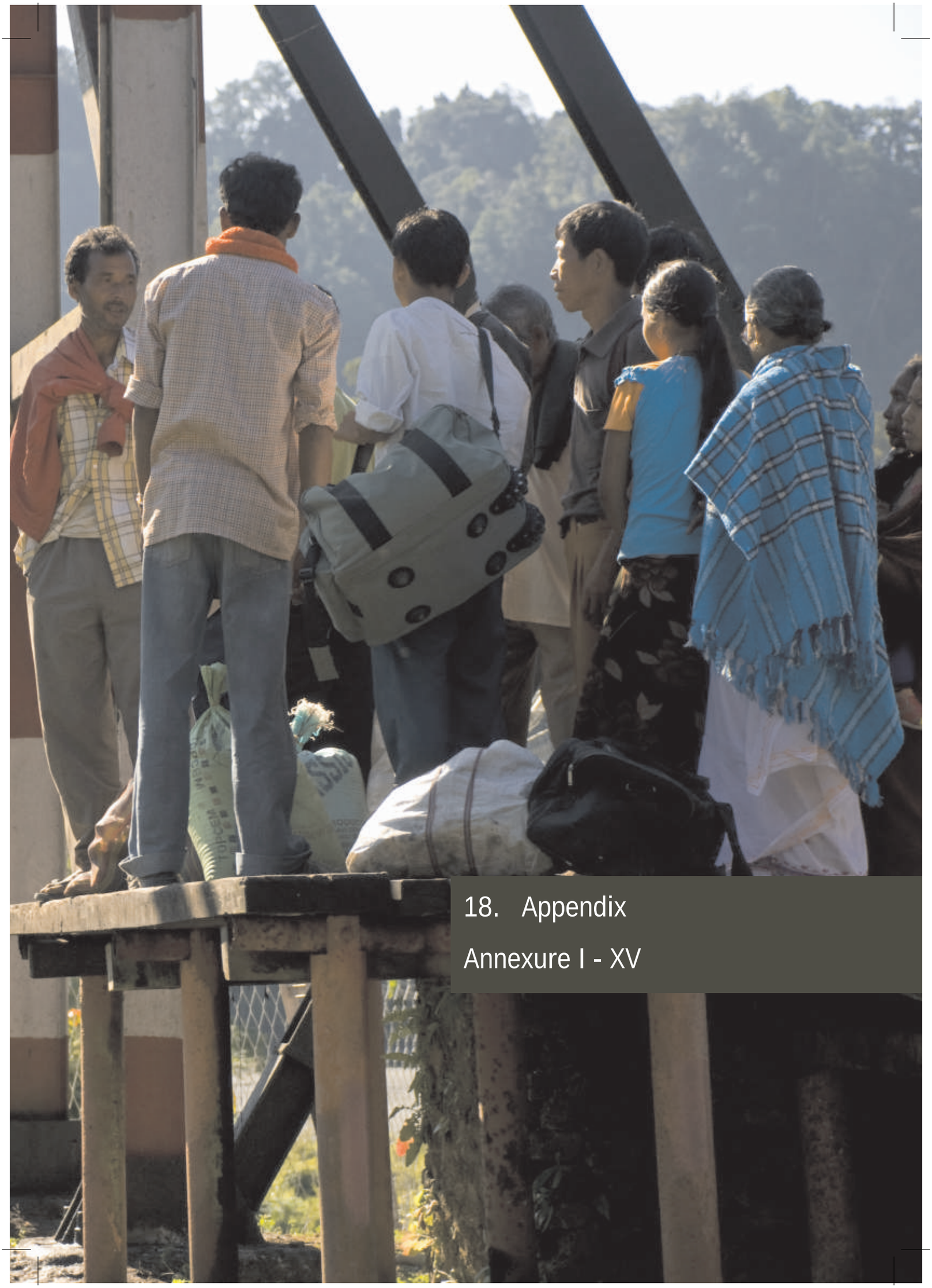
17.7 Tripura

Production of oil & gas	LPG access	POL product supply
Oil & gas production estimated to be 3.5 MMTOE in 2030	Increasing LPG availability from 32 TMTPA in 2014-15 to 84 TMTPA in 2029-30	Increasing POL availability from 190 TMTPA in 2014-15 to 408 TMTPA in 2029-30

Planned projects	
Oil & gas	Other infrastructure projects
▪ Service provider hub at Agartala ▪ Natural gas pipeline: Agartala-Silchar-Shillong-Guwahati-Bongaigaon ▪ Expansion of CGD network by TNGCL ▪ LPG pipeline: Chittagong-Sabrum-Agartala (further extension to Aizawl/Silchar)	▪ Black top surface and double laning of NH 44

17.8 Sikkim

Production of oil & gas	LPG access	POL product supply
	Increasing LPG availability from 11 TMTPA in 2014-15 to 19 TMTPA in 2029-30	Increasing POL availability from 93 TMTPA in 2014-15 to 184 TMTPA in 2029-30



18. Appendix

Annexure I - XV

18. Appendix

18.1 Power transmission infrastructure in northeast India

18.1.1 Need for power transmission network in northeast India

Northeast India faced a peak power deficit of 12.9% and energy deficit of 8.7% in 2014-15, thereby hobbling the region's economy. Power transmission constraints have also made it difficult to evacuate excess power and channel it to areas that face shortages. Projects have had to purchase power from costlier sources while others remained under-utilised. Hence, there is an urgent need to address underlying issues in the transmission sector to ensure power demand is effectively met.

18.1.2 Existing transmission infrastructure in northeast India

Only 590 circuit kilometers (ckm) of inter-regional transmission lines have been laid in the region. Further, there are only 14 substations. Due to unavailability of high voltage network, transmission losses in the region is very high.

Table 151: Existing power transmission network in northeast India

Equipment category	Units (ckm/ nos.)
Transmission lines	
400 kV	1,870
220 kV	545
132/66 kV	1,810
Inter-regional (400 kV)	430
Inter-regional (220 kV)	160
Substations	
1,445 MVA	14 nos

Source: MDONER

18.1.2.1 Proposed transmission network

A comprehensive scheme for strengthening the transmission, sub-transmission and distribution systems has been evolved by the Central Electricity Authority (CEA) in consultation with POWERGRID and states in the NER. Details of the scheme are:

- Transmission system associated with Lower Subansiri HEP (2,000 MW) and Kameng HEP (600 MW) in Arunachal Pradesh:
  - Under this scheme, POWERGRID is constructing a dedicated 400kV transmission system to interconnect the generating station to the pooling s/s at Bishwanath Chariali in Assam.
- 6,000 MW HVDC lines (800kV) from Bishwanath Chariali in NER to Agra for transmission of power from NER to NR/WR.
- Transmission system for Pallatana (726 MW) and Bongaigaon (750 MW) being constructed by NETC (JV of OTPC-35%, Tripura-10%, Assam-13%, Mizoram-10%, Manipur-6%, POWERGRID-26%) - 400 kV D/C Pallatana-Silchar line - 254 km.
- Eight 400, 220 and 132 kV new sub-stations (s/s) (Silchar & Mariani in Assam, Rowing, Tezu & Namsai in Arunachal Pr., Imphal in Manipur, Melriat in Mizoram and Mokokchung in Nagaland)
- 14 new 400, 220 and 132 kV transmission lines
- Pallatana-Surajmaninagar 400 kV D/C line charged at 132 kV (for Tripura)
- Silchar-Purba Kanchan Bari 400 kV D/C line charged at 132 kV (for Tripura)
- Silchar-Melriat (new) 400 kV D/C line charged at 132 kV (for Mizoram)
- Silchar-Imphal (new) 400 kV D/C line charged at 132 kV (for Manipur)
- Mariani (new)-Mokokchung (PG) 220 kV D/C line (for Nagaland)
- Pasighat-Roing-Tezu-Namsai 132 kV single circuit (s/c) line on D/C tower (for Arunachal Pradesh)

18.2 State-specific issues

18.2.1 Assam

Delay in getting clearances and approvals

Environmental clearances and approvals proved to be the key challenge for exploration activities. There have been significant delays in granting of clearances by the MoEF and Assam state government.

Details of blocks in which E&P activities have been postponed due to delay in providing clearances

S. no	Blocks	Issues
1	AA-ONN-2001/3	Environmental clearance/forest clearance not granted by MoEF /Govt. of Assam
2	AA-ONN-2003/1	
3	AA-ONN-2004/2	
4	AA-ONN-2004/3	
5	AA-ONN-2002/3	
6	AA-ONN-2005/1	Work held up due to border dispute with Nagaland

Disturbed Area Belt (DAB)

This area has issues related to border dispute between Nagaland and Assam. 2 blocks of ONGC are in this area. Work could not progress in these blocks due to law and order issues. The border dispute over the Assam-Nagaland border belt, called the disturbed area belt (DAB), is awaiting resolution from the Supreme Court after Assam filed a petition in 1988, seeking a settlement. The Assam government wants no change in the current border demarcation. However, Nagaland wants to follow the historical boundary which was demarcated before colonial rule.

VAT applicability and input tax credit

Presently, transaction between oil marketing companies in Assam is exempted from levy of Assam VAT at the first point of sale of products, provided the transaction is for resale. However, if the purchasing oil company uses the product for processing into value-added products, then VAT exemption is not available. Also, for petroleum products presently no input tax credit is available in Assam.

The four northeast refineries can improve their product slate by exchanging stream / intermediate products from one refinery to other refinery for further processing. One of such example of slate improvement is upgrading foots oil produced by Digboi refinery in Numaligarh to higher valued HSD with further processing. However, such inter-company stream / intermediate product exchange is not viable in view of high incidence of local VAT rate.

Hindrance in development of infrastructure

It has been observed that the development and maintenance of the national highways are being handled by National Highway Authorities of India (NHAI), public works department (PWD) and Border Road Organisation (BRO). The involvement of multiple authorities often creates different power centres, thereby delaying implementation of such works.

18.2.2 Manipur

Infrastructure gap

National highways such as NH 37, NH 53, NH 150 and NH 102 B pass through E&P blocks in Manipur, but due to the poor condition of these roads, heavy vehicles required for exploration activities are unable to ply. Around 90% of NH 53 and NH 150 run through hilly terrain, which have very poor road surface. The poor condition of the road surface can be gauged from the fact that it takes about 14 hours to drive through the 255-km long NH-37 in a normal mid-sized passenger truck, and takes four hours to travel 32 km from Barak river to Parbung (proposed well site location in south block) in a four-wheel drive mid-sized truck.

Only about one-third of the stretch on NH 53 and NH 150 has black top surface for vehicular traffic, and the remaining portions have only water bound macadam (WBM) at the formation level. Also, most part of these hilly stretches are susceptible to frequent landslides during the monsoon season (May to October), thereby leaving vehicles stranded for periods running into days until the debris is cleared by the Indian Army's Border Road Task Force (BRTF).

Delay in getting clearances and approvals

Environmental clearances and approvals from different authorities are a key challenge for exploration activities. There have been significant delays in granting of clearances by the MoEF and state government of Manipur.

Blocks in which E&P activities have been delayed due to delay in receiving clearances

Sr. No.	State	Blocks	Issues
1	Manipur	AA-ONN-2009/1	Environmental clearance/ forest clearance not granted by MoEF / Govt. of Manipur
2		AA-ONN-2009/2	

18.2.3 Nagaland

Evocation of article 371 A in Nagaland

The Nagaland state government passed the Nagaland Petroleum & Natural Gas (NPNG) regulations and the NPNG rules in 2012 under the powers of Article 371 A (1)(a)(iv) of the constitution, which states that "Ownership and transfer of land and natural resources shall apply to the state of Nagaland unless the legislative assembly of Nagaland by a resolution so decides." An NPNG board was also set up to monitor all activities related to oil and natural gas mining. The NPNG regulations stipulated a three-level committee: the first comprising state ministers; the second with senior bureaucrats; and the third with junior government officers, advisers and others.

After notification of the legislation in 2012, the government floated an expression of interest (EOI) for 11 oil and gas zones, including the Wokha oil zone in Wokha district. A ministerial group gave the permit for the oil zones at Wokha and Peren to Metropolitan Oil & Gas Pvt Ltd (MOGPL). This included the Changpang oil field in Wokha, which had to be abandoned by ONGC in 1994.

Delay in getting clearances and approvals

The environmental clearance and approvals from different authorities proved to be the key challenge for exploration activities. Nagaland has stopped giving clearances for blocks located in the region. This led to relinquishment of blocks allotted in Nagaland under the NELP round.

Details of two blocks that were relinquished by ONGC

Sr. No	Blocks	Issues
1	AA-ONN-2001/4	Exploration activites of ONGC could not be commenced
2	AA-ONN-2002/4	

18.2.4 Tripura

Infrastructure gap

Two blocks have been allocated in Tripura. While block AA-ONN-2001/1 has been awarded to ONGC under NELP III bidding, the second block, AA-ONN-2002/1, has been won by a consortium of GAIL and Jubilant Oil & Gas Pvt Ltd.

Connectivity of these blocks is through poorly constructed, single-lane roads, which even lack black top surface in some stretches. In terms of rail infrastructure, the area is still in preliminary stages of development.

Connectivity infrastructure in Tripura has been posing serious challenges to exploration activities. Further, development of the railway network needs to be implemented in a time-bound manner.

18.2.5 Mizoram

Infrastructure gap

National highways connecting the oil and gas blocks are single-lane. The nearest airport in the region is at Aizawl.

18.2.6 Arunachal Pradesh

Infrastructure gap

The Kharsang oil field is located in Arunachal Pradesh, about 50 km east of Digboi refinery, and is part of the Assam-Arakan basin. The Kharsang license covers an area of approximately 10 sq km and is operated by GeoEnpro Petroleum Ltd. Connectivity to this block is via a single-lane highway. The nearest railway station is at a distance of 32 km at Ledo in Assam, while the nearest airport is 135 km away at Mohanbari in Dibrugarh district of the neighbouring state of Assam.

The state has limited railway infrastructure, owing to which delivery of goods and services is almost entirely dependent on road.

Annexure I: Abbreviation

Acronym	Definition
AAI	Airports Authority of India
ADC	Autonomous district council
AFS	Aviation fuel stations
AGCL	Assam Gas Company Ltd
AICTE	All India Council of Technical Education
AIDCL	Assam Industrial Development Corporation Ltd
AOGO	Association of Oil and Gas Operators
ASEB	Assam State Electricity Board
ATF	Aviation turbine fuel
BCF	Billion cubic feet
BCM	Billion cubic metre
BCMA	Billion cubic metre per annum
BCPL	Brahmaputra Cracker and Polymer Ltd
BOE	Barrel of oil equivalent
BPCL	Bharat Petroleum Corporation Ltd
BRO	Border Roads Organisation
BVFCL	Brahmaputra Valley Fertilizer Corporation Ltd
CAG	Comptroller and Auditor General
CAGR	Compounded annual growth rate
CBM	Coal bed methane
CCEA	Cabinet Committee on Economic Affairs
CCGT	Combined cycle gas turbine
CCI	Cement Corporation of India
CEA	Central Electricity Authority
CGD	City gas distribution
CIWTC	Central Inland Water Corporation
CNG	Compressed natural gas
CNPC	China National Petroleum Corporation
DFR	Detailed feasibility report
DGH	Directorate General of Hydrocarbons
DIPP	Department of Industrial Policy and Promotion
DPCL	Dharma Port Company Ltd
EIL	Engineers India Ltd
EOI	Expression of interest
EOL	Essar Oil Ltd
EOR	Enhanced oil recovery
EPF	Employees Provident Fund
ERL	Eastern Refinery Ltd
ESIC	Employee's State Insurance Corporation
GAIL	GAIL India Ltd
GDP	Gross domestic product
GLK	Ground line kilometre
GSDP	Gross state domestic product
GSPC	Gujarat State Petroleum Corporation
HDPE	High density polyethylene
HEP	Hydroelectric power
HOEC	Hindustan Oil Exploration Company

Acronym	Definition
HPCL	Hindustan Petroleum Corporation Ltd
HSD	High speed diesel
HVDC	High voltage direct current
IAF	Indian Air Force
IIITAS	Indian Institute of Information Technology and Advanced Sciences
IIP	Indian Institute of Petroleum
IIPDF	Indian Infrastructure Project Development Fund
IIT	Indian Institute of Technology
IOC	Indian Oil Corporation
IOR	Improved oil recovery
ITI	Indian Technical Institute
IWAI	Inland Waterways Authority of India
IWT	Inland water transport
JOGPL	Jubilant Oil and Gas Pvt Ltd
JSPL	Jindal Steel and Power
JVC	Joint venture company
KTA	Kilo tonnes per annum
LDO	Light diesel oil
LLDPE	Linear low density polyethylene
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
LSHS	Low sulphur heavy stock
MDONER	Ministry of Development of North Eastern Region
MDP	Market driven price
MEA	Ministry of External Affairs
MHA	Ministry of Home Affairs
MMSCF	Million metric standard cubic feet
MMSCM	Million metric standard cubic metre
MMSCMD	Million metric standard cubic metres per day
MMT	Million metric tonne
MMTPA	Million metric tonnes per annum
MOEF	Ministry of Environment & Forests
MOGE	Myanmar Oil and Gas Enterprise
MOGPL	Metropolitan Oil & Gas Private Ltd
MORTH	Ministry of Road Transport and Highways
MOU	Memorandum of understanding
MSME	Micro, small and medium enterprise
MTPA	million tonnes per annum
MVA	Mega volt ampere
NAAC	National Assessment and Accreditation Council
NDR	National data repository
NEEPCO	North Eastern Electric Power Corporation
NEFTU	North East Frontier Technical University
NEIIPP	North East Industrial and Investment Promotion Policy
NELP	New Exploration Licensing Policy
NER	North Eastern Railway
NERIST	North Eastern Regional Institute of Science and Technology
NHAI	National Highway Authority of India
NIT	National Institute of Technology

Acronym	Definition
NOC	National oil companies
NPNG	Nagaland Petroleum & Natural Gas
NRL	Numaligarh Refinery Ltd
NSDC	National Skill Development Corporation India
NSDP	Net state domestic product
OALP	Open acreage licensing policy
OEG	Oil equivalent of gas
OFS	Oil field services
OIIP	Oil initial in place
OIL	Oil India Ltd
OMC	Oil marketing company
ONGC	Oil & Natural Gas Corporation
OTPC	ONGC Tripura Power Company
PCB	Pollution Control Board
PDO	Product delivery order
PEL	Petroleum exploration license
PML	Petroleum mining lease
PNGRB	Petroleum & Natural Gas Regulatory Board
POL	Petroleum, oils and lubricants
PPAC	Petroleum Planning & Analysis Cell
PPP	Public private partnership
PSC	Production sharing contract
PSU	Public sector undertaking
PTTEP	PTT Exploration and Production
PWD	Public works department
RGPIT	Rajiv Gandhi Institute of Petroleum Technology
ROFR	Right of first refusal
RSC	Revenue sharing contract
SAARC	South Asian Association for Regional Cooperation
SARDP	Special Accelerated Road Development Programme for North East
SCM	Standard cubic metre
SEZ	Special economic zone
SKM	Square kilometre
SKO	Superior kerosene oil
SPV	Special purpose vehicle
SSI	Small scale industry
TMT	Thousand metric tonne
TMTPA	Thousand metric tonnes per annum
TNGCL	Tripura Natural Gas Company Ltd
TPA	Tonnes per annum
TPD	Tonnes per day
TSECL	Tripura State Electricity Corporation Ltd
UAE	United Arab Emirates
UPES	University of Petroleum and Energy Studies
VAT	Value-added tax
VGF	Viability gap funding
WBM	Water bound macadam
YTF	Yet to find

Annexure II: Demographic and macroeconomic indicators of NER

Particulars	Assam	Arunachal	Manipur Pradesh	Meghalaya	Mizoram	Nagaland	Tripura	Sikkim
GSDP (Rs crore)	88,537	6,171	7,892	13,215	5608	10,492	18510	5,491
Per capita Income (in Rs)	24,533	37,996	23,996	42,467	40,930	46,889	42,315	75,137
Per capita state income % of per capita national income	61%	95%	60%	106%	103%	118%	106%	188%
Population (in lakh)	312	14	27	30	11	20	37	6
Literacy rate (%)	73%	67%	80%	75%	92%	80%	88%	82%
Male to female ratio (per thousand male)	954	920	987	986	975	931	961	889
Households	6,367,295	261,614	507,152	538,299	221,077	399,965	842,781	128,131
Electricity consumption (MU)	7,926	610	678	1,634	425	661	1,048	399

Annexure III: Tax structure in existing PSCs

	Onshore blocks	Shallow water	Offshore (deep water and frontier blocks)
Exploration period	7 years (4+3)	7 years (4+3)	8 years (5+3)
PEL & PML	20 years; extended by 5 years or 10 years in case of a gas discovery	20 years; extended by 5 years or 10 years in case of a gas discovery	20 years; extended by 5 years or 10 years in case of a gas discovery
Royalty	12.5% oil and 10% natural gas	12.5% oil and 10% natural gas	5% for crude oil and Natural gas both.
Tax rates	100% deduction on exploration, capital costs	100% deduction on exploration, capital costs	100% deduction on exploration, capital costs
Tax holiday	Companies with oil production get a 7 year tax holiday (section 80 IB of IT Act)	Companies with oil production get a 7 year tax holiday (section 80 IB of IT Act)	Companies with oil production get a 7 year tax holiday (section 80 IB of IT Act)

Annexure IV: Service hubs

World example: Service hub(s)

- Onne Oil and Gas Free Zone, Nigeria
- Jebel Ali Free Trade Zone, UAE
- Free zones in Malaysia and Singapore

Onne Oil and Gas Free Zone at a glance

The Onne Oil and Gas Free Zone in Nigeria officially opened in March 1997. It was set by the Nigerian government to provide the ideal infrastructure to create a hub for oilfield services to assist not only the countries onshore and offshore fields but also to provide easy access to the entire West African oilfield operating regions. It is managed by DMS International Ltd. It combines the effectiveness of the private sector with the required commitment and support of the Federal Government of Nigeria.

As a result of the various incentives offered by the Onne Oil and Gas Free Zone, it has been able to attract over 140 major companies and create in excess of 30,000 jobs (directly and indirectly). It has also resulted in the transfer of technological skills to Nigeria, increase of local content within the hydrocarbon industry and substantial revenue savings for the government.

Table 152: Advantages of Onne Oil and Gas Free Zone

Specific advantage	General advantage
▪ Customs privileges for goods consigned to Onne Oil and Gas Free Zone, including goods in transit to other West African territories. ▪ No pre-shipment inspection – goods are not consigned to Nigeria ▪ Duty-free stock, equipment, spare parts and pipes ▪ No double handling in and out of Nigeria ▪ Access to major projects onshore, offshore and regional ▪ Cost-efficient operations ▪ Sophisticated oil service centre support.	▪ Quick and simple registration procedures ▪ Easy cargo customs clearing procedures ▪ Fast track procedures at port and airports for all visiting and Free Zone expatriate personnel ▪ Easy clearing process ▪ Duty-free status for imports ▪ Pre-shipment inspection in the free zone ▪ Duties paid on goods exported to Nigeria ▪ Sea-air logistics
Free zone advantage	**Tax advantage**
▪ 100% import and export tax exemption ▪ 100% exemption from commercial levies ▪ 100% repatriation of capital and profits ▪ 100% foreign company ownership ▪ Leases available from 5-21 years ▪ No quotas for expatriate employees	▪ No corporate taxes ▪ No personal income taxes ▪ No VAT ▪ No withholding taxes ▪ No levies

Annexure V: OTPC power plant, Tripura

ONGC Tripura Power Company (OTPC) Ltd is a power project being implemented in Tripura in the Palatana district of Udaipur. The project site is located adjacent to the existing state highway connecting to Udaipur with onward connectivity to Agartala by NH-44. The project is being implemented with the objective of utilising the gas available in Tripura, and establishing a 726.6 MW (two units of 363.3 MW) combined cycle gas turbine (CCGT) power plant along with an associated power transmission system from the project site to Bongaigaon in Assam.

Holding structure of SPV

The OTPC project is being implemented via the special purpose vehicle (SPV) route. ONGC is the major shareholder and promoter of the project. The shareholding pattern of the company is shown in the table below.

Shareholder	Percentage holding (%)
ONGC	50%
Shareholder	**Percentage holding (%)**
India Infrastructure Fund – II	23.5%
Government of Tripura	0.5%

Source: OTPC website

Cost of the project

The project is being implemented at a total cost of Rs 6,929.5 crore. The generation project will cost Rs 3,429.5 crore and the transmission system Rs 1,750 crore. We have mentioned the project cost along with the capital structure for generation and transmission projects in the table below.

Generation project	Rs crore	Percentage
Debt	2,572.1	75%
Equity	857.4	25%
Project cost	3,429.5	100%
Transmission project		
Debt	1,400	80%
Equity	350	20%
Project cost	1,750	100%

Source: OTPC website

Power off-take

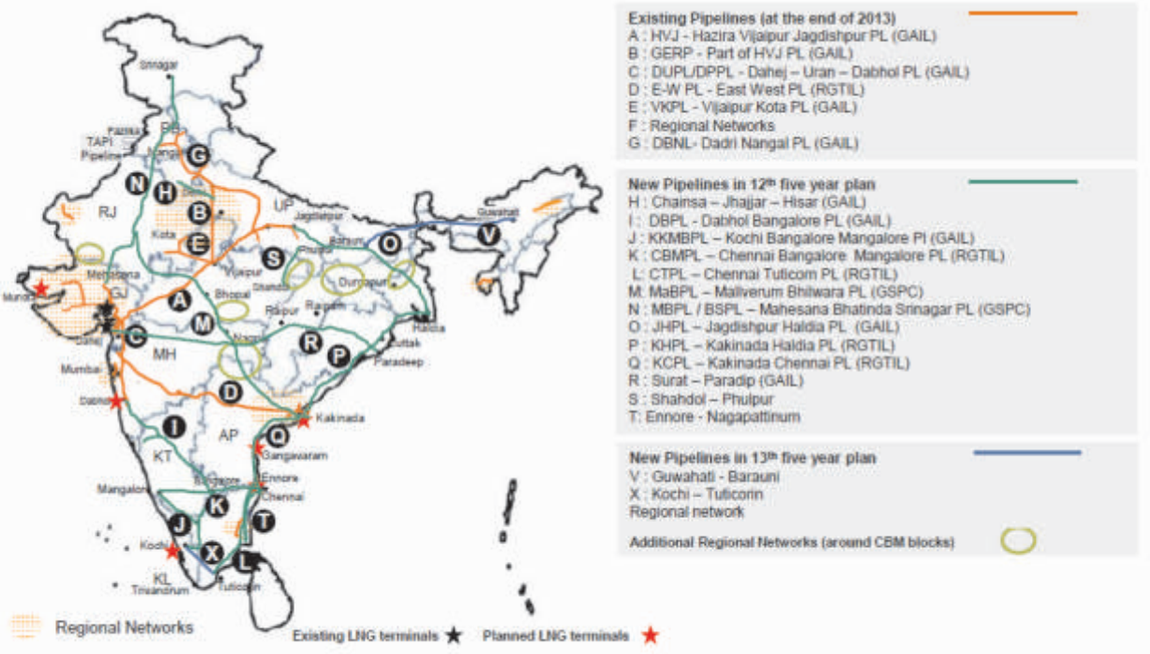
Sale of power from the power plant is based on allocation decided by the Ministry of Power. As per the allocation, out of the total capacity, 628 MW has been allocated to NER states; the balance 98 MW will be sold on merchant basis by OTPC. State-wise allocation of power is shown in the table below.

State	Allocation (MW)
Assam	240
Meghalaya	79
Manipur	42
Nagaland	27
Arunachal Pradesh	22
Mizoram	22
Tripura	196
Balance on merchant sales	98
Total	726

Source: Ministry of Power, Circular order dated November 25, 2008

Annexure VI: National gas grid

National gas grid



Annexure VII: Kharsang block

Kharsang block

Kharsang block is located in the state of Arunachal Pradesh, approximately 140 km from Dibrugarh (Assam). The block was discovered in 1976 by Oil India Ltd. Commercial production from the block commenced in 1983. The entire PML area of 11 sq km is covered by forests. GeoEnpro Petroleum Limited is the operator of the block, which is a joint venture between Geopetrol International Inc. and Jubilant Energy. Companies associated with the block are Oil India Ltd (40%), Jubilant Energy (Kharsang) Pvt. Ltd (25%), Geopetrol International Inc. (25%) and GeoEnpro Petroleum Ltd (10%, operator).

PSC for the block was signed on June 16, 1995 and is valid for a period of 20 years till June 15, 2015; it can be extended for a further period not exceeding five years; in the event of commercial production of non-associated natural gas, the PSC may be extended for a period up to but not exceeding 35 years from the effective date.

Activities carried out till date

The contractor of the block has invested around $138 million till the end of FY15 on exploration and development activities in Kharsang Field. Activities carried out till date in the block are mentioned below:

- 32 development wells (majority being directional/high-angled wells)
- 2 exploration wells
- 60 LKM of 2D Seismic (2001)
- 37 Sq. Km of 3D Seismic (2008)
- 87 Sq. Km of 3D Seismic (2012-13)
- Various G&G and reservoir engineering studies for better understanding of the complex reservoir
- Radial drilling, sand consolidation and various new production technologies have been implemented in the Kharsang field to address complexities (sanding, waxing, shallow reservoir and low pressure)

Current oil and gas production

	2014-15	2015-16 (expected)
Oil production	1,372 BOPD	1,100 BOPD
Gas production	Between 50,000 – 60,000 SCMD*	N.A.

**Out of the 50,000 to 60,000 SCMD of gas produced, 13,000 to 15,000 SCMD is used for internal consumption; 19,000 to 20,000 SCMD is unavoidable loss and 18,000 to 25,000 SCMD is flared. Till date, the contractor has not been able to monetise the produced gas.*

Till date, 12 MMBLs of oil has been extracted from the Kharsang field. As per the PSC, the field had recoverable reserves of 20.06 MMBL of crude oil; thus, the field still has around 8 MMBLs of balance recoverable crude oil.

Untapped potential from deeper plays (Girujan and Tipams)

Resources	Potential
Contingent resources	15.03 MMBbl of oil and 248.8 BCF of Gas
Unrisked prospective resources	11.0 MMBbl of oil and 127 BCF of gas with production potential up to 1.5 MMSCMD

The estimates are based on reserves and resources estimation carried out by Gaffney Cline & Associates in 2014. These are expected to undergo an upward revision based on static and dynamic modelling being carried out by Blade Energy Partners, on the strength of the new 3D Seismic data acquired in 2013.

Future investment plans

The contractor has submitted an FDP for drilling 12 'firm infill/step out' wells at a cost of $24.5 million and 23 contingent wells at a cost of ~ $46 million, a total investment of $70.5 million. In addition, the SDM study being carried out by Blade Energy is also expected to generate additional locations, warranting additional investments.

The contractor is also planning to undertake exploratory/appraisal drilling for the deeper plays that will entail an investment of $16 million per well. Once successful, the contractor will be required to invest upwards of $300 million to develop the deeper plays for both oil and gas.

Reasons for significant balance recoverable reserves and potential

Delay in grant of licences from government agencies

- Grant of Petroleum Mining Lease (PML) was delayed by 28 months, resulting in an absence of production enhancement activities including workover activities.
- Application for diversion of forest land was delayed by 57 months. The first application for diversion of forest land for drilling of five development wells was delayed by 46 months. The second application for diversion of forest land for undertaking the next set of development wells was never granted. However, the contractor based on the advice of the Management Committee (MC) went ahead and drilled deviated wells for the same. Till date, no additional location has been granted for forest diversion.

Technical challenges

- The upper Girujan reservoir in Kharsang has posed severe sand control and heavy waxing problems. Due to the pressure depletion, productivity per well has also seen a significant decline compared to the earlier wells, warranting an increase in the number of wells to be drilled to extract the same volume of reserves. Two attempts were made by the contractor (in 2005 and 2011) to drill exploration/appraisal wells targeting deeper plays; these did not succeed due to a high-pressure regime.

Uncertainty in fiscal terms

- Uncertainty in fiscal terms, such as increase in royalty, cess and profit from petroleum, has created negative sentiments among the investors. Further, extension of PSC terms should be enhanced from the present limit, especially for the Northeastern blocks, as the investors are likely to face greater hurdles compared to rest of the country due to difficult terrain and other issues.

Other concerns stated by the contractors are:

- Pending enhancement of cost recovery limit,
- Infrastructure bottlenecks and lack of viable gas monetisation options without government support

Suggestions by the contractor

- The contractor is willing to take the risk of investing significant capital in further exploration/appraisal/development activities if the fiscal terms of the extension policy balance the risk-return equation, especially considering the infrastructural challenges, remote location of the field and technical challenges. Continuing the existing PSC fiscal terms will balance the risk-return equation.
- Delays in statutory approvals were the primary reason for the contractor's inability to undertake exploration/appraisal/development activities envisaged at the time of bidding. Therefore, delays attributed to such delays should be considered for granting extension to the duration of the PSC terms.
- Fast tracking of MoEF approvals
- Monetising gas production in remote areas must be supported through funding of evacuation infrastructure and grant of freedom to market the gas to customers who can afford the import parity price.

Annexure VIII: Major projects/schemes underway

Brahmaputra Crackers and Polymer Ltd, Dibrugarh (Assam)

Brahmaputra Cracker and Polymer Limited is implementing the prestigious Assam Gas Cracker project, the first ever petrochemical project in NER. The project came as a part of the historic Assam Accord signed on August 15, 1985 with the motive of overall socio-economic development of the region. It was approved by the Cabinet Committee on Economic Affairs (CCEA) on April 18, 2006. Subsequently a joint venture company BCPL was incorporated on January 8, 2007 as a central public sector enterprise under the Department of Chemicals & Petrochemicals, Govt. of India. The project is expected to generate scope for substantial investments in setting up of downstream plastic processing industries that will generate both direct as well as indirect employment.

GAIL (India) Ltd is the main promoter with 70% of equity participation; the rest 30% is equally shared by Oil India Ltd (OIL), Numaligarh Refinery Limited (NRL) and the Government of Assam.

The complex is spread over 3,000 bighas of land at Lepetkata, and situated approximately 15 kilometres away from the tea city Dibrugarh.

The feedstock for the project will be natural gas and naphtha. OIL and ONGC will supply natural gas and naphtha shall be supplied by NRL. The principal end-products of the complex will be high-density polyethylene (HDPE) and linear low-density polyethylene (LLDPE) totaling 2,20,000 tonnes per annum (TPA) and 60,000 TPA of polypropylene (PP). The other products include raw pyrolysis gasoline and fuel oil.

The products produced at BCPL have varying uses in the manufacturing of various plastic products. The uses of principal end-products from BCPL are tabled below.

Products	Usage
LLDPE grade (MFI-0.9)	Packaging films, liners
LLDPE grade (MFI – 2.0)	Stretch films and stretch film rolls
LLDPE grade (MFI- 4.0)	High quality packaging films, bubble film packaging
HMHDPE (MFI –I21- 10)	Trash bag, carrier bags
MDPE (MFI 3.0)	Draining parts, fuel tanks etc.
MDPE (MFI 4.0)	Tanks, containers, waste bins, road dividers
HDPE (MFI – 4.5)	Dustbins, pallet boxes, fish crates, technical mouldings
HDPE (MFI – 8.4)	Crates, boxes, pallets, closures, helmets
HDPE (MFI – 21)	Housewares, buckets and baskets
HDPE (MFI – 1.0)	Fishnets, raffia bags
HDPE (MFI -0.2)	Oil containers, lube containers
HDPE (MFI – I21 - 10)	Large containers
Polypropylene	
TQ Film (MFI-12)	Textile overwraps, garments bag, snack food packaging
Raffia (MFI – 3.4)	Raffia bags, leno bags
Injection moulding (MFI -12)	Rigid packaging, furniture, house wares, closures etc.

BCPL is the only Petrochemical project of such a mega size at a single location in the entire North East region. With the setting-up of this project, it is expected to give rise to the consumption of polymer in this part of the country. The availability of raw material will facilitate the development of numerous downstream polymer industries in the region. One such plastic park has been conceptualized by Govt. of Assam at Tinsukia to facilitate entrepreneurs in setting-up of new polymer processing industries. This plastic park is expected to house around 256 downstream plastic industries and according to DFR, this has potential to generate direct and indirect employment to the tune of 77000.

At present, there are around 136 plastic processing industries in North East region consuming approximately 1.1 Lakhs TPA of polymer which is being sourced from outside the North East Region.

After BCPL project goes into production stream on consistent basis, it is expected that polymer sourcing from outside the North East Region will gradually reduce / stop. Further, as the raw material for the plastic processing industries will locally be available there will be development of new plastic processing industries in this sector and consumption of polymer will increase. BCPL has also conducted several entrepreneur development-cum-awareness programs in the NE region. With these programs BCPL has been able to successfully spread the message amongst the prospective entrepreneurs about the importance and significance of polymer business. It is expected that with such campaign, polymer business may gradually grow in North East region in the time to come.

Numaligarh Refinery expansion plan, Assam

Numaligarh Refinery Ltd (NRL) is planning to expand its refining capacity from 3 MMTPA to 9 MMTPA by 2020. The mega refinery expansion plan of NRL will call for capital expenditure to the tune of Rs 20,000 crore.

While about 70% of the products would be lifted by NRL's holding company, Bharat Petroleum (BPCL) to fulfill its existing demand for POL products, the region and its geographically contiguous neighbouring countries like Bangladesh, Nepal and Myanmar are being explored for selling the balance products.

The company has already inked two important memorandums of understanding (MoU), one with Dhamra Port Company Limited (DPCL) for import of crude oil and LPG and the other with Cement Corporation of India (CCI) for utilisation of raw petroleum coke, likely to be generated at NRL after its proposed capacity expansion. The capacity expansion of the refinery is expected to address the sub-economic size of the refinery which has been hindering the company's scalability as well as profitability. Considering the declining trend in domestic crude oil supplies from northeastern oil fields, NRL will be importing crude oil to utilise the additional refining capacity. To facilitate transportation of around 6 MMTPA imported crude oil from the Dhamra port in Orissa to Numaligarh, a new pipeline is envisaged to be constructed. As of now, there is no plan of extension for the other refineries in the region except NRL.

According to the company, additional products generated from the refinery expansion will primarily be absorbed within the region. Moreover, part of NRL's increased production is also envisaged to be exported to Bangladesh through Parbatipur (150 km from the NRL terminal at Siliguri) while part quantities are envisaged to be utilised for production of petrochemical grade naphtha for which adequate demand exists within the country.

Fertiliser plant in Tripura – ONGC and Chambal Fertilizers

ONGC, Tripura government, and Chambal Fertilizers and Chemicals had signed an MOU to set up a fertilizer plant in Unkoti district by 2016. The requirement of land is around 600-800 acres. The supply of gas to the plant site would be made available from the newly discovered Khubal well in the area. However, experts are yet to find out a regular source to bring in water to the plant site. The Tripura government — which has a 10% share in the plant — hoped that Bangladesh would grant permission for transportation of fertilisers to the rest of India through Bangladesh. The cross-border transit facility would ease the price of urea and meet demand in a short time. Production of gas in Tripura is projected at 2.8 MMSCMD. Half of the production is marked for the proposed fertiliser plant.

Plastic Park, Tinsukia, Assam

Assam Industrial Development Corporation Limited (AIDCL) is in the process of setting up a 360 acre Plastic Park in Tinsukia, north of Guwahati that will use raw material produced by Brahmaputra Crackers and Polymers Limited (BCPL) that is likely to come on-stream in around a year's time. The idea is to utilise the 200,000 tonnes per annum polymer produced at BCPL to produce finished products that can be sold in the neighbouring markets of Myanmar, Bangladesh, and Bhutan among other regions in South-East Asia.

At least six or seven plastic processing companies from the state have decided to set up units at the upcoming Tinsukia Plastic Park in Assam for a total investment close to Rs 150 crore in response to Assam Industrial Development Corporation Ltd's (AIDCL) campaign to attract investors to the Plastic Park project. It expects to attract around Rs 5,000 crore-worth investments in the park.

The hilly states are an attractive destination for small and medium companies from other regions who look forward to setting up units there to take advantage of excise and other duty incentives offered by these states. In Assam, for example, apart from the value-added tax (VAT) exemption, micro-industries would also enjoy 30% interest subsidy on term loans, apart from a 30% power subsidy.

The state accounts for nearly 60% of the country's net polymer production. India's net production capacity is around six million tonnes per annum. However, at nearly 90,000 TPA, Gujarat currently accounts for 15% of all-India polymer processing.

Once complete, the Tinsukia Plastic Park is expected to house at least 1,250 downstream plastic processing units generating over one lakh direct and indirect employments.

Brahmaputra Valley Fertilizer Corporation Ltd

The Namrup Fertilizer Complex – renamed as Brahmaputra Valley Fertilizer Corporation Limited after its bifurcation from the erstwhile Hindustan Fertilizer Corporation Limited w.e.f. 1st April 2002 – and located on the banks of the river Dilli in the south-western border of Dibrugarh District in Assam is the first factory of its kind in India to use associated natural gas as basic raw material for producing nitrogenous fertilser. Till the beginning of the sixties, Namrup, a sleepy village, was little known to the rest of the country. Discovery of oil and natural gas in the Naharkatiya region promoted serious thinking on proper utilisation of gas which had to be otherwise flared up.

Project planning for Namrup-I Group of plants was started in the middle of 1960 by Hindustan Chemicals and Fertilizers, which was merged with Fertilizer Corporation on January 1, 1961. After crossing various hurdles successfully, the foundation stone was laid on January 1, 1966 by the then Assam Chief Minister Late B P Chaliha and the factory went into stream in August 1968. Commercial production, however, commenced from January 1, 1969 with annual capacity of only 55,000 MT of urea and 100,000 MT of ammonium sulphate. Namrup-I was set up at a cost of Rs. 24.96 crore including foreign exchange of Rs.6.36 crore

it was found that surplus natural gas would be available in the adjoining Moran-Naharkatiya oil fields of M/S. Oil India Limited. The government decided to gainfully utilise this associated natural gas by putting up the 2nd unit of Namrup Fertilizer Plant at a cost of Rs. 74.60 crore including foreign exchange of Rs.23.60 crore. The Namrup-II plant went into commercial production in 1976 with annual capacity of 3, 30,000 MT of urea.

The availability of surplus natural gas in the Naharkatiya-Moran and Lakwa oil fields led to the addition of the third unit of the Namrup fertilizer plant at a cost of Rs. 285.55 crore, including Rs. 58.67 crore of foreign exchange. The plant went into commercial production in 1987 with annual capacity of 3, 85,000 MT of urea.

Annexure IX: Cash flow analysis for 7 and 12 years tax holiday

Profit & Loss statement for annual oil and gas production for 1MMT of oil and 1 MMBTU of natural gas

P&L in USD million for Oil	Year1	Year2	Year3	Year4	Year5	Year7	Year9	Year11	Year13	Year15	Year17	Year19	Year21	Year23	Year25
Revenue	402	402	402	402	402	402	402	402	402	402	402	402	402	402	402
OPEX	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
Depreciation	1,022	1,009	530	54	46	33	24	17	12	9	7	5	3	2	12
PBT	(744)	(731)	(252)	225	233	245	254	261	266	269	272	274	275	276	266

P&L in USD million for Natural Gas	Year1	Year2	Year3	Year4	Year5	Year7	Year9	Year11	Year13	Year15	Year17	Year19	Year21	Year23	Year25
Revenue	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
OPEX	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Depreciation	13.1	13.0	6.8	0.7	0.6	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.2
PBT	(9.7)	(9.5)	(3.4)	2.7	2.8	3.0	3.1	3.2	3.3	3.3	3.3	3.4	3.4	3.4	3.3

Cumulative cash flows with project NPV and IRR considering 7-year and 12-year tax holidays

Cumulative cash flow for oil and Gas with 7 year tax holiday (USD million)	Year1	Year2	Year3	Year4	Year5	Year7	Year9	Year11	Year13	Year15	Year17	Year19	Year21	Year23	Year25
Revenue	407	407	407	407	407	407	407	407	407	407	407	407	407	407	407
OPEX	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74
CAPEX	1,183	1,183	592												
Government share of Profit Petroleum	-	-	-	-	-	-	-	71	141	141	197	197	197	197	197
Depreciation	1,035	1,022	537	54	46	33	24	17	13	9	7	5	3	2	12
Tax with 7 year tax holoday	(256)	(252)	(87)	-	-	-	88	66	44	45	26	27	28	28	25
Cash flow to the company	(497)	(489)	(169)	227	235	248	170	128	85	87	51	53	54	54	48
NPV@12%	($91.16)														
IRR	**10.27%**														

Cumulative cash flow for oil and Gas with 12 year tax holiday (in USD million)	Year1	Year2	Year3	Year4	Year5	Year7	Year9	Year11	Year13	Year15	Year17	Year19	Year21	Year23	Year25
Revenue	407	407	407	407	407	407	407	407	407	407	407	407	407	407	407
OPEX	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74
CAPEX	1,183	1,183	592												
Government share of Profit Petroleum	-	-	-	-	-	-	-	71	141	141	197	197	197	197	197
Depreciation	1,035	1,022	537	54	46	33	24	17	13	9	7	5	3	2	12
Tax with 7 year tax holoday	(256)	(252)	(87)	-	-	-	-	-	44	45	26	27	28	28	25
Cash flow to the company	(497)	(489)	(169)	227	235	248	258	193	85	87	51	53	54	54	48
NPV@12%	$33.66														
IRR	**12.60%**														

Loss to exchequer for extension of tax holiday from 7 to 12 years	Calculation
Tax with 7 year holiday (Over 25 years)	179.07
Tax with 12 year holiday (Over 25 years)	(191.95)
Loss to Exchequer in USD million	371.02
Loss to exchequer in INR crore for Production of 25 MMBTU of Natural Gas and 25 MMT of crude oil	2,337

Annexure X: Details of oil & gas resource conversion in NER

Details of oil & gas resource conversion by ONGC in northeast

As a result of its exploratory efforts as on 01.04.15, ONGC has made 76 hydrocarbon discoveries which include 55 discoveries in Assam, 17 in Tripura, 3 in Nagaland and one in Mizoram. This has resulted in the establishment of 904.32 MMt (O+OEG) in place and 269.21MMt (O+OEG) ultimate reserves in Assam & Assam Arakan Basin. The state-wise distribution of established, in-place and ultimate volumes is tabled below.

In place and ultimate reserves established in A&A Basin-ONGC (as on 1-04-2015)

State	Prognosticated Resource MMTOE (O+OEG)	In place, MMT O+OEG	Ultimate, MMT (O+OEG)	Conversion % (Prognosticated to Ultimate)
(O+OEG)Assam	1615	785.21	214.34	13%
Mizoram	170	2.28	0	0%
Tripura	590	99.78	50.87	9%
Nagaland	555	17.05	4.0	1%
Assam & Assam Arakan Basin	2930	904.32	269.21	9%

Targets by ONGC for increase in in-place reserves

a. **Assam shelf:** In-place accretion realisation from 782.6 MMt to 952.6 MMt by 2030 and in terms of prognosticated resource conversion from 65 % to 80%

b. **Fold belt sector covering Cachar, Tripura, and Mizoram:** In-place accretion realisation from 101.95 MMt to 167.95 MMt by 2030 and in terms of prognosticated resource conversion from 17 % to 28%

Initiatives by ONGC:

Induction of a new rig to achieve exploratory drilling levels of 28 wells by 2016-17 from the current level of16 wells

Details of oil & gas resources in YTF areas of NER for Oil India

2P and 1P reserves of Oil India as on 01.04.2015 are tabled below.

Oil India	2P reserves	1 P reserves
Oil + Condensates (MMTOE)	83.41	31.26
Gas (BCM)	44.10	23.79
O+OEG (MMTOE)	121.31	51.76

Total prognosticated reserves estimated by Oil India from YTF areas are 1,834 MMTOE. Considering the same conversion percentage as calculated above for conversion of prognosticated to established and established to recoverable category for reserves in NER, the estimated established and recoverable reserves from YTF areas for Oil India are as such.

State	Established (MMTOE)	Recoverable (MMTOE)
Assam	1190	178
Arunachal Pradesh	15.7	1.4
Total NER	1204.7	179.4

Annexure XI: Analysis of revenue to states for increased production of oil & gas

With increased production of oil & gas from NER states, the states with blocks shall be majorly benefitted in terms of getting royalties from producers. Along with royalty, the states will get other revenues such as VAT, entry tax and sales tax. An analysis of increased production of oil & gas is given below.

Analysis of royalty to states for 1 MMTPA of crude oil

For crude oil	Calculation
Barrel to MT	7.3
Exchange rate	63
Crude price ($/bbl)	50
Production (MMT)	1
Royalty rate	12.50%
Crude price in INR/MT	22,995
Yearly royalty (INR crore)	**287**

Source: CRISIL Infrastructure Advisory Analysis

Analysis of royalty to states for 1MMSCMD of gas

For Natural Gas	Calculation
M3/BTU	39,683
Exchange rate	63
Gas price ($/MMBTU)	4.66
Production (MMSCMD)	1
Production (MMSCM)	365
Royalty rate	10.0%
Gas price INR/MSCM	11,650
Yearly royalty (INR crore)	**42.5**

Source: CRISIL Infrastructure Advisory Analysis

Thus, considering the potential of NER, additional 2 MMTPA of oil production and 10 MMSCMD of gas production can increase the income of NER states by around Rs 1,000 crore per annum. Additional revenue from VAT, sales tax and entry tax may be in the tune of another Rs 300-400 crore.

Annexure XII: Details of blocks with pending clearances and other issues

Problems/issues in exploration blocks under PSC regime in NER:

S.No.	State	Block	Operator	Bidding Round	Issues/Problem
1	Assam	AA-ONN-2002/3	OIL	NELP-IV	Drill site not approachable owing to low load capacity of bridges. NHAI intimated for replacement of bridges by December 2015, situation yet to improve.
2		AA-ONN-2001/3	ONGC	NELP-III	Operator has proposed to exit block under new government policy dated: November 10, 2014. DGH has asked operator for submission of data. The block is located in DAB area close to the Assam-Nagaland border. Some activities have been done after obtaining the clearance form MOEF. Work was stopped by the CRPF authorities for security reasons in the DAB sector.
3	Manipur	AA-ONN-2003/1	JOGPL	NELP-V	Exploration work has suspended in the block since April 25, 2011 as operators could not obtain permission for forest land division from the Assam state forest department. Operator has proposed to exit block under new government policy dated November 10, 2014. Exit from the production sharing contract (PSC), is under the DGH's consideration.
4		AA-ONN-2004/5	EOL	NELP-VI	Operator proposed for relinquishment due to delay in environment clearance. Cost of UMWP has been approved by the MoP&NG. Block status relinquished but cost of unfinished WP pending.
5		AA-ONN-2009/1	JOGPL	NELP-VIII	Environmental clearance / forest clearance is awaited from MoEF. No activities as enroute roads/bridges are not suitable to carry drilling equipments as per operator.
6		AA-ONN-2009/2	JOGPL	NELP-VIII	
7	Nagaland	AA-ONN-2001/4	ONGC	NELP-III	Operator has proposed to exit block under new government policy dated November 10, 2014. DGH has asked operator for submission of data. (MOEF and MOD clearance not granted)
8		AA-ONN-2002/4	ONGC	NELP-IV	
9	Assam/Nagaland	AA-ON/7	ACL	Pre-NELP	Operator relinquished the Assam part of the block on March 27, 2008. Whereas operator requested for time extensionfor the Nagaland part, owing to delay in obtaining PEL, the government has conveyed that this matter on the subject of execution of new PSC for the Nagaland part of the block will be taken up after resolution of the Nagaland issue. This has been communicated to operator on February 2, 2015.

Source: DGH

Blocks of ONGC where work is held up due to EC and FC clearances:

Sr. No.	Area of Activity	Issues in Detail	Pending With
1	Khoraghat ML Extn.Block,	Drilling of three development wells viz. KHDD, KHDE and KHDF. First stage of Forest clearance is awaited.	Govt. of Assam
2	Golaghat District PEL,	Exploratory locations URAA need diversion of the forest land for non- forest purposes prior to drilling. The permissions for the diversion are accorded by MoEF & CC. Awaiting clearance.	Govt. of Assam
3	Kasomarigaon & Kalyanpur PML,	Exploratory locations KSAD in Kasomarigaon PML and KSAE in Kalyanpur ML need diversion of the forest land for non- forest purposes prior to drilling. The permissions for the diversion are accorded by MoEF & CC. Awaiting clearance. Two development, three exploratory locations and construction of GGS including laying of pipeline in Kasomarigaon, Assam. Waiting for Expert Appraisal Committee (EAC) meeting.	Govt. of Assam
4	Sivsagar District PEL, Panidihing ML North-Rudrasagar-Disangmukh ML, Assam	Applied for PEL extension for part area of 87 Km2 falling in Eco-fragile limit-Panidihing Bird Sanctuary, awaiting MoEF-statutory wildlife clearance from State Govt. and National Board of Wildlife (NBWL) for 7 exploratory locations viz. DSAE, DSAD, DSAF, RJAA, DHAB, PDAH & PDAG. Out of Seven (7) locations of Sivasagar district, Two (2) locations (DSAE, DHAB) have been recommended by State Board for Wildlife (SBWL). Requested for expediting wildlife clearance from State Government and National Board of Wildlife for remaining five exploratory locations. Awaiting clearance	National Board of Wildlife (NBWL)
5	Exploration activities in Wild life Sanctuary, Assam	About 82.7% area of block Block AA-ONN-2009/3 falls in Eco-Sensitive Zone of Hollangpar Gibbon Wildlife Sanctuary-Assam. ONGC has applied to the concerned Forest Department, Govt. of Assam on 25.09.2013. Applied for National Board of Wild Life (NBWL) for clearance for 3 exploratory locations falling in Economic Sensitive Zone to Govt. of Assam on 09.06.2014. Awaiting clearance.	Govt. of Assam / NBWL
6	A&AA Basin, Assam	Exploratory drilling of 9 locations (RPAA, RLBK-1, RBK-1, LBAA, RBK-3, RTDN-1, RJDR, RTNG-1 and RTDN-2) in Pre-NELP Block AA-ONJ/2 at district Cachar, Assam. EAC Meeting held on 20.04.2015.	MoEF & CC
7	**Exploratory/ Development activities, Tripura**	4 Locations falling in Tichna PML viz. TIAG, TIAF, TIAC and TL are pending for drilling for the want of statutory clearance from SBWL and National Board of Wildlife (NBWL) and six development locations in Tichna Field MoEF. Joint inspection in three exploratory locations Viz. TIAC, TIAG and TIAF has been carried out for resubmission of proposals to obtain clearance from Wildlife Division, Tripura Government and online submission to MoEF. Locations are integral part of the field development plan to sustain gas supply to OTPC Project in Tripura. For diversion of 15 hectares of forest land falling in Trishna Wildlife Sanctuary, online proposal for six development locations submitted on 24.07.15 and three exploratory locations & one Drill Site Accommodation on 27.07.15. Subsequent to online submission of proposal, clarifications were sought by Wildlife Division, Tripura which have been submitted on 27.08.2015. After verifications of documents, joint survey is to be carried out by Wildlife Division, Tripura.	SBWL, NWLB & Govt. of Tripura

Blocks of ONGC in which PEL and PML are awaited:

Sr. No.	Area of Activity	Issues in Detail	Pending With
1.	Grant of PEL/PML,	Golaghat district PEL (54.4 Km2): Grant awaited from State Govt.	Govt. of Assam
		Badarpur (2.3 Km2): GoI approval required in original by state Govt.	Govt. of As
		North Patharia (60 Km2): Revised application submitted on 12.08.2014. Grant awaited from State Govt.	Govt. of Assam
		Adamtila PML (4 Km2): Under DGH/MoPNG consideration. Grant awaited from State Govt.	DGH/MoPNG & Govt. of Assam
		Adamtila Extension PML (148 Km2): Grant awaited from State Govt.	Govt. of Assam
		Sector V C PML(497 Km2): Grant awaited from State Govt	Govt. of Assam
2.	Nambar PML,	ML Area falls along boundary of Disputed Area Belt between two States of Assam and Nagaland. Nambhar Extn. PML (Applied): Exploratory location KHAR and CJAA pending. Nambhar PML (Applied): Exploratory location NRAD pending.	Govt. of Assam and Nagaland.
3.	Geleki ML, Geleki Extension ML,Namti ML, South East Geleki ML, Assam	ML Areas falls along boundary of Disputed Area Belt between Assam and Nagaland. Exploratory works postponed due to pending of approval from both Assam & Nagaland State Governments. Exploratory released locations like BSAA, GKBD and GKBI fall in this area could not be taken up for drilling. Disputed Area Belt (DAB), Approval from both Assam and Nagaland Govt. is awaited.	

Details of statewise issues faced by OIL India in its blocks are given below:

State	Block	Issue
Assam	Mechaki Block	Stage (I) Forest Clearance pending since June 14, 2010 for Locations- MKD and MKE, located in the Mechaki RF, under the Doomdooma Forest Div, for which OIL already obtained Environment Clearance on November 2, 2011. Proposal for one Location-MKD was forwarded by the Assam state government's Environment & Forests ministry to the R.O, MoEF&CC, and Shillong on 21.08.2015 for approval under FC Act-1980. But the same has been returned by the Nodal Officer, Assam state government on October 15, 2015 advising OIL to start the process afresh by loading the proposal online, when the proposal submitted earlier to August 2014, does not require on-line submission by the project proponents.
Assam	Doomdooma PML Block	Stage-I forest clearance pending since 07.12.2012 for Locations- DGT & DGR in the Doomdooma PML Block, located in the Jorajan RF, under Digboi Forest Div, for which OIL has already got Environment Clearance on November 1, 2011
Assam	Khagarijan & East Khagarijan block	Drilling of 27 exploratory wells in the non-forest land in ecologically sensitive area is pending since 14.12.2013 for grant of Wildlife Clearance for the 675 Km2 Khagarijan & East Khagarijan block in Tinsukia & Dibrugarh Dist, Assam.
Assam	Naharkatiya – Deohal – Bagapani – Nagajan block	Drilling of 17 exploratory wells in non-forest land in ecologically sensitive area is pending since 29.05.2013 for grant of Wildlife Clearance for the Naharkatiya – Deohal – Bagapani – Nagajan block in Tinsukia & Dibrugarh Dist, Assam.
Assam	Karbi Anglong (New), Assam	Forest Clearance for seismic survey pending since June 30, 2012 for block AA-ONN-2010/2 (NELP-IX): Karbi Anglong (New), Assam.
Arunachal Pradesh	Namchik PEL Block	Stage (I) Forest Clearance pending since September 12, 2008 for Location NCK-1 in Namchik PEL Block, Arunachal Pradesh, for which OIL already got Environment Clearance on 23.11.2010.
Arunachal Pradesh	Deomali PEL Block	Stage (I) Forest Clearance pending since 05.07.2011 for Deomali PEL Block, Arunachal Pradesh. Regarding Environmental Clearance, public hearings completed on July 2015 – yet to receive final minutes from AP State Pollution Control Board.

State	Block	Issue
Arunachal Pradesh	Jairampur Extn PEL Block	Stage (I) Forest Clearance pending since December 8, 2007 for Location- JRB in Jairampur Extn PEL Block.
Arunachal Pradesh	Ningru PML Block	Stage (I) Forest Clearance pending since November,2007 for Location- NMA in Ningru PML Block in Arunachal Pradesh
Other Issues		
Assam		Pending Notification for Site Specific ecologically sensitive area for Dibru-Saikhowa National Park (340 Km^2) , [Bherjan (1.06 Km^2) – Borajan (4.39 Km^2) – Padumoni (1.76 Km^2)] Wildlife Sanctuary, Dihinh Patkai (119.9 Km^2) Wildlife Sanctuary, OIL's most promising fields areat stake, : Baghjan , Barekuri , Borhapjan, Hugrijan, Naharkatiya, Naharkatiya Extension, Tinsukia, Tinsukia Extension & Dumduma, as for all these cases, a distance of 10 km non-forestry land is considered as the ecologically sensitive area January 21, 2002, followed with an order from Hon'ble Supreme Court dtd December 4, 2006. Consideration of 10-km Ecologically Sensitive Zone (ESZ) distance is presently include the entire Township of Tinsukia and part of Dibrugarh District.
Assam		257 Km2 Prospective PEL area of Baghjan Extension PML had to be relinquished by OIL in 2002-03, as per directives from the Assam state government, vide letter dated 5.12.2003, since the Dibru/Saikhowa Reserved Forest is designated as Dibru-Saikhowa National Park in 1999, where E&P activities are restricted as per the Supreme Court's order: OIL proposes to drill 7 wells using horizontal sub-surface directional drilling at a depth of 3,900-4,000 metres, using advanced Horizontal Deviation Directional Drilling Technology such as ERD (Extended Reach Drilling) & Multilaterals, without affecting any forest surface of the Dibru Saikhowa National Park for which the surface drilling pads will be placed outside the forest area at a distance of 1-1.5 Km from the boundary of the Dibru Saikhowa National Park- an Interlocutory Application (IA) in this regard has been filed with the Supreme Court of India on May 9, 2014, appealing for grant of permission against which hearing in the Green Bench of the apex court yet to take place.
Assam		Repeated public hearings for the two operating districts of OIL- Tinsukia & Dibrugarh, Assam have delayed grant of environment clearances due to presence of various interest groups dominating in the region –This needs a re-look by MoEF&CC
Arunachal Pradesh		Payment of NPV for the entire PML area under provision of FC Act-1980, had forced OIL to keep its E&P activities in abeyance since November, 2003 for the 615.668 Km2 PML area of Ningru (540.668 sq km) and Ningru Ext. (75 sq km) PMLs in Arunachal Pradesh, as the payment of NPV for total 615.668 Km2 PML area was a few thousand crores. However OIL took up the matter with the Supreme Court of India by filing an IA in on April 26, 2013 seeking relaxation on the NPV payment, on the basis of which the apex court passed its judgment on August 8, 2014 for payment of NPV of 2% only for the total 615.668 Km2 PML area. OIL has paid Rs 74 crore on this account and the Renewal of the PML is likely to happen after a held-up of more than a decade.
General		Mandatory payment of NPV @ 2% for the entire forest land falling under allotted PML area involves huge financial outgo for OIL as most of its operating blocks are either falling in the forest lands or in the vicinity of protected areas. Such has been directed vide MoEF& CC's guidelines dated 01.02.2013, 17.11.2014 , 01.04.2015 and last one vide F.No 8-118/2006-FC dated June 24, 2015, with specific reference to the petroleum mining lease under FC Act-1980, according to which such payments are to be made by June,2016, pending which the mining lease will be revoked. Such regulations do not affect the other E&P Operators who are not operating in NE Region, like OIL.

Annexure XIII: Capital Investment by PSUs in the last 5 years

Sr. No.	PSU	Capex of last 5 years (Rs Cr)
1	ONGC	13,676
2	Oil India Ltd	8,172
3	GAIL ltd	613
4	Indian Oil Company Ltd	3,700
5	NRL	1,292
	TOTAL	**27,453**

Annexure XIV: Days Coverage of petroleum products

State	Location	Product	Tankage (KL)	Present Days Coverage
Assam	Tinsukia	MS	9669	29.31
		SKO	6837	37.98
		HSD	26452	24.36
		LDO	4571	20.00
		FO + LVFO	22433	112.17
	Betkuchi	MS	8742	13.19
		SKO	3712	13.79
		HSD	11648	5.76
	Lumding	MS	3800	87.26
		SKO	6800	31.63
		HSD	7800	55.54
		FO	7000	Being converted ATF
	Ramnagar	MS	1855	19.05
		SKO	5190	39.28
		HSD	8695	31.80
	Missamari	MS	1580	94.37
		SKO	8155	375.64
		HSD	7158	77.26
		ATF	1988	308.14
Tripura	Dharamnagar	MS	698	4.40
		SKO	2607	25.26
		HSD	2707	8.39
Manipur	Imphal	MS	840	5.40
		SKO	2528	39.38
		HSD	3341	11.61
Arunachal Pradesh	Doimukh	MS	1051	20.73
		SKO	1398	78.65
		HSD	3909	18.85
Nagaland	Dimapur	MS	1580	23.71
		SKO	2990	66.49
		HSD	6280	32.16
Mizoram	Vairangte	MS	283	3.00
		SKO	233	9.00
		HSD	758	4.00

Annexure XV: Expected tankage and coverage of POL Products

Location	Product	Expected Tankage Addition upto 2030	No. of Days coverage after tankage additions
Digboi(Resitement of Tinsukia)	MS	24159	16
	SKO	6626	58
	HSD	29140	14
	FO	6626	25
Betkuchi	MS	32813	16
	SKO	3712	31
	HSD	47713	14
Lumding	MS	3800	28
	SKO	7000	98
	HSD	7800	28
	ATF	6800	30
Moinarband (Resitement of Ramnagar)	MS	7200	12
	SKO	3200	42
	HSD	16000	22
Missamari	MS	1580	23
	SKO	1000	90
	HSD	4000	25
	ATF	2000	30
Dharmanagar (Resited)	MS	10668	16
	SKO	3200	48
	HSD	12000	24
Imphal(Resited)	MS	5052	14
	SKO	5055	120
	HSD	11796	22
Doimukh	MS	9000	46
	SKO	4000	362
	HSD	16500	43
Dimapur	MS	1580	10
	SKO	2990	102
	HSD	6280	21
Vairangte	MS	283	
	SKO	233	
	HSD	758	