Roadmap for Reduction in Import Dependency in the Hydrocarbon Sector by 2030

FINAL REPORT

Ministry of Petroleum and Natural Gas,
Government of India
September 2014

Roadmap for Reduction in Import Dependency in the Hydrocarbon Sector by 2030

Final Report

Ministry of Petroleum and Natural Gas, Government of India

September 2014

Preface

This Committee has been constituted by the Government of India, to prepare a roadmap for enhancing domestic oil and gas production and for sustainable reduction in import dependency by the year 2030. Energy security is a key strategic priority for India. Securing access to adequate and affordable sources of energy is fundamental to supporting our economic growth aspirations.

The country's rising import dependence puts significant pressure on the current account deficit and exposes the country to the risk of an energy crisis. The recent political turmoil in some oil producing economies and its subsequent after-effects on the Indian economy are evidence of the growing dependence on global energy supplies and highlight the need for reforms in India's oil and gas sector.

Part I of the Committee's report, which was submitted to the Ministry of Petroleum and Natural Gas in January 2014, identified a number of policy actions and measures that can be implemented immediately. The final report recommends a number of policy and institutional reforms. These policy reforms taken together will lead to significant reduction in import dependence to levels below the current and projected levels by 2030 as has been estimated in Addendum I of the Executive Summary.

The committee and sub-committees held more than 30 meetings over the last 18 months. It also held in-depth discussions with various stakeholders including private and public sector E&P companies, industry bodies and domain experts as a part of the consultation process. I wish to place on record my sincere thanks to all the committee members and special invitees, all of whom are renowned experts in their respective fields, for their valuable contributions which were crucial in making our final recommendations.

I would also like to place on record my appreciation for the efforts put in by the officers of the Directorate General of Hydrocarbons for their role in ensuring smooth conduct of the committee proceedings. I also wish to convey the committee's sincere thanks to the Boston Consulting Group, the knowledge partners of the committee, for offering their outstanding help and support on a *pro bono* basis.

We owe a special thanks to Shri B. N. Talukdar, the Director General of Hydrocarbons and the member secretary of the committee for being our friend, philosopher and guide.

Vijay Kelkar
Chairman of the committee

September 30th, 2014

Executive Summary of Recommendations

Energy security is one of the most critical issues facing the Indian economy. India today faces the daunting challenge of meeting its growing need for energy resources in a cost effective, sustainable and environment-friendly manner. However, the impact of successfully addressing this challenge is not trivial. It is possible to reduce the annual import bill by as much as USD 70-80 billion through focussed implementation of the proposed policy reforms and institutional measures.

Guiding principles

To ensure that government actions are aligned with the country's energy security goals, the committee has developed its recommendations guided by the following overarching principles:

i. The central objective of the government should be to accelerate appraisal of our sedimentary basins, maximise Exploration and Production (E&P) activity in the country, and enhance energy security.
ii. Extraction and exploitation of non-renewable energy resources including its pricing should be based on a long-term sustainable strategy that takes into account inter-generational equity.
iii. Any policy and contract between state and interested parties should reflect a balanced risk reward paradigm with due cognizance to India's prospectivity and materiality.
iv. Clear and transparent governance contract stability and sanctity are essential in order to guarantee sustained investment interest in the sector.
v. Technology, human capital, incentive structure and adequate infrastructure are the *sine qua non* for the accelerated and sustainable development of the sector.

Major recommendations of the Committee to reduce import dependence and move towards greater energy self-sufficiency are summarized below.

I. EXPEDITING APPRAISAL OF INDIAN BASINS

1. Creation of a National Data Repository

Currently half of India's 3.14 million sq. km sedimentary basin area has limited geo-scientific data. Creation of a National Data Repository (NDR), along with further appraisal of Indian basins though seismic surveys and parametric well drilling is a key priority in order to attract the interest of investors for the development of Indian basins. Availability of data for the basins will improve investor confidence by allowing them to take informed investment decisions. *The required funds (estimated at INR 7000 crore[1]) should be made available to the Directorate General of Hydrocarbons (DGH) through the OID (Oil Industry Development) cess at the earliest to expedite basin appraisal*. Furthermore, the data residing with the

[1] Directorate General of Hydrocarbons

NOCs (National Oil Companies) and private companies for relinquished fields should be made available to the NDR at the earliest.

2. Introduction of OALP at the earliest

The OALP (Open Acreage Licensing Policy) should be initiated at the earliest in parallel to the NELP (New Exploration and Licensing Policy) so as to give operators the flexibility of identifying acreages of interest, particularly those where they may have some expertise or experience. Such a measure will also enable offering of blocks round the year instead of waiting for the bidding rounds. OALP may be initiated using the data residing with NOCs, where ever possible. The committee recommends that OALP commence no later than 2016.

3. ROFR as incentive for conducting basin appraisal

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 the Right of First Refusal (ROFR) when the acreage is subsequently put up for bidding.

4. Flexibilities in completion of MWP on alternate blocks

As part of bids submitted under the NELP, operators are required to bid for a Minimum Work Programme (MWP) to be carried out–consisting of the area for 2D and 3D seismic surveys and the number of exploratory wells to be drilled. However, often during the course of the exploration activity there is limited or no incremental value of the additional wells to the operator but the MWP is carried out to avoid penalties, leading to unproductive deployment of assets. In such cases, operators must be provided with the flexibility of fulfilling the outstanding MWP on a different block with similar characteristics where the operator holds a valid exploration license. Such flexibilities should be allowed from future bidding rounds. This would not only facilitate better deployment of resources but also enable much needed additional appraisal of Indian basins.

II. ENHANCING DOMESTIC PRODUCTION OF OIL AND GAS

5. Two alternate PSC models proposed for Indian basins

Based on detailed analyses of global best practices and the suitability to the Indian geological context, the committee recommends the Production Sharing Contract (PSC) model as the preferred contractual model for Indian basins. The committee has reservations against accepting the 'biddable' Revenue Sharing Contract (RSC) model due to the inherently misaligned risk-return structure which leads either (i) to lower levels of production due to resultant reduced exploration efforts and lower recovery ratios or (ii) to high windfall gains to operators encouraging contract instability due to political economy factors. The committee has proposed two fiscal regimes either of which could be deployed:

i. **Model I:** PSC linked to Investment Multiple, with modified contract administration including self-certification of costs by the contractors
ii. **Model II:** PSC with 'biddable' supernormal profits tax

6. Administrative reforms for smoother implementation of the PSC model

The following structural changes are proposed to streamline the fiscal administration of the PSCs:

i. Prudential and fiduciary oversight of the oil and gas resources should be the primary responsibility of the Management Committee (MC) and DGH. The MC and DGH should only focus on ensuring adherence to GIPIP norms, HSE standards and best practices in reservoir health management; and not get involved in the cost assessment or fiscal oversight of the contract.

ii. Safeguarding the fiscal interest of the state through assessment of government take consisting of royalty, corporate income tax and profit oil should be the primary responsibility of the revenue agencies. Profit oil or profit gas is essentially a form of levy shared with the government which can be better assessed by the revenue authorities, whose experience, expertise and functional capability in this regard far exceed those of the DGH.

iii. The assessment of profit oil or gas should be conducted on the basis of self certification by the Operating Committee (OC), as is done for corporate income taxes. This would be a critical measure for improving the administration of the PSC as it will drastically reduce the transaction cost of the operator.

These measures will align our procedures with the best international practices.

7. Improving contract stability and administration

Proposed initiatives to create greater stability and improve administration of the contracts include:

i. *The MC should not be responsible for any financial audits or pre-approval and assessment of expenditures. Cost recovery should be executed on the basis of self-certification by the OC*, and the profit oil/gas, alongside the associated costs submitted for calculation of the share, may be audited by the revenue agencies as per standard procedures for collection of corporate income taxes.[2] Self certification of expenditures is a standard best practice all over the world, particularly in dealing with corporate liabilities. The revenue authorities would conduct audits of such corporate liabilities as per standard procedures to ensure that there is no mis-statement or tax evasion.

ii. Institution of a well defined process for contract extension with clearly identified timelines, roles and responsibilities, criteria etc.

iii. Allowing for contract extension for perpetuity or up to the end of the economic life of the asset.

iv. Institution of stabilisation clauses that allow for protection of original terms or renegotiation of contracts in a changing external environment.

[2] Under the extant PSC regime, an Operating Committee (OC) consists of the representatives of the companies that are party to the contract

8. **Maintain contract stability and sanctity and prevent retrospective contract changes**
   To improve investor confidence, it is necessary that contract stability and sanctity is maintained and no retrospective changes are made to contracts.

9. **Increasing weightage of technical criteria in bid evaluation**
   Technical criteria (excluding MWP) should be given higher weightage in bidding for blocks – at least 50% weightage for deepwater and ultra-deepwater blocks and 25% for on-land and shallow water blocks. Higher weightage should be awarded to companies bidding in consortium with Indian companies to enable technology transfer and local capability building.

10. **Removal of the subsidy burden on exploitation of mature fields**
    More than half of India's current domestic oil production is from maturing fields or fields in declining stages of production. Average recovery rates of Indian fields are 30%-40%, while recovery rates of top producing fields globally are significantly higher. Implementation of EOR (Enhanced Oil Recovery) and IOR (Improved Oil Recovery) techniques presents a low hanging fruit that can increase domestic oil production of mature fields. Currently the ability of NOCs to invest in EOR/IOR is restricted due to the share of subsidy burden allocated to upstream PSUs. Incremental production from mature fields should be exempted from subsidy sharing to ensure that investments are economically viable. The nomination blocks, which operate on quasi revenue sharing terms, should be converted to PSCs at equivalent fiscal terms in consultation with the NOC. This will ensure that the government continues to participate in the upside, brings parity with other contractors while providing the incentives for the speedy adoption of IOR and EOR measures.

11. **Empowering Boards of National Oil Companies (NOCs) for approving equity participation in nomination fields**
    Most of the mature fields in the country are currently held with the NOCs. Increasing oil production from existing mature fields would require access to advanced global expertise and technologies. Hence, the government should empower Boards of NOCs to offer equity participation by foreign and domestic private companies with access to such technologies.

12. **Encourage coal gasification – a potential game changer for achieving energy security**
    India is among the largest producers of coal in the world and accounts for one of the largest coal reserves. Coal gasification can provide an important alternate non conventional source of oil and gas to meet our growing energy needs. The following initiatives need to be taken to encourage conversion of coal to oil and gas:
    i) A suitable contract model, policies and administrative support should be developed for coal mining. This will provide the much required impetus to surface coal gasification initiatives. By adoption of an appropriate contract regime for coal blocks producing gas, vast potential exists for the country to achieve self-reliance in gas.
    ii) Demonstration plants for conversion of coal to natural gas and for underground coal gasification should be created to validate the technologies for Indian high ash coal.

iii) Coal to Liquids (CTL) presents an economic opportunity to improve our energy security. The government must not only expedite and facilitate approvals and clearances for CTL projects but also provide the required fiscal support through low interest loans, grants and equity participation.

13. Encouraging shale gas exploration by private players

Shale gas is an important potential source of energy for the future that has revolutionized the gas sector in the US. It is important to develop a robust policy framework for the exploration and development of shale gas resources in India. The current policy permits only NOCs to explore shale oil and gas resources from on-land blocks allotted to them on nomination basis. India should also put in place a policy to allow private players to explore shale oil and gas resources from nominated blocks.

III. KEY ENABLERS AND INSTITUTIONAL REFORMS

14. Institute an empowered Cabinet Committee on Energy (CCE) for policy formulation and the integration of energy related issues

In India, multiple ministries and agencies are currently involved in managing energy related issues, presenting challenges of co-ordination and optimal resource utilization, hence undermining efforts to increase energy security. An empowered Cabinet Committee on Energy (CCE) should be formed to give energy its rightful importance in the national agenda and move towards ensuring energy security. The CCE, chaired by the Prime Minister, should consist of the Union Ministers of Finance, Power, Coal and Renewable Energy, External Affairs, Environment and Forests and Petroleum and Natural Gas; Chairman, Department of Atomic Energy; National Security Advisor; Cabinet Secretary and Principal Secretary to the Prime Minister. The CCE can be serviced by the agency that is the successor to the Planning Commission.

15. DGH to become an independent regulator for the upstream oil and gas sector

At present, the multiple roles of government as policy maker, regulator and operator lead to conflicts of interest and dampen investor confidence in the sector. This creates the need for an independent and transparent regulatory mechanism. Hence, the DGH should be transitioned from its current role of being an advisor to being an independent regulator for the upstream oil and gas sector.

16. Empowerment of regulator, along the lines of SEBI

The asset base of the securities market in India, at approximately USD 1.5 trillion, is equivalent to the market value of established hydrocarbon reserves in India.[3] The comparable asset base emphasizes the need for a robust and transparent regulatory

[3] Approximate market capitalization of publicly listed companies in India is USD 1.5 trillion. As per Rystad database, estimated size of discovered oil and gas reserved in India is 15 billion BOE and oil price is assumed to be USD 100 / barrel

framework for the upstream oil and gas sector, similar to that of the securities market under the purview of Securities Exchange Board of India (SEBI). The DGH should be given, as is the case of SEBI, quasi judicial powers accompanied by an Appellate Tribunal for fast and effective dispute resolution. The status of the head of the DGH should be at par with that of other empowered regulator heads in the country, such as SEBI, TRAI etc.

17. Capability building for the effective functioning of the DGH

To ensure that the DGH can operate effectively, it should be empowered with an independent financing and staffing mechanism. The funds required for day to day operations must be made available automatically, on a formulaic basis, through the OID (Oil Industry Development) cess. The DGH should be established as a multi-member, multidisciplinary body with professional teams that have expertise in different domains such as legal, environmental, financial and technical. The DGH should further have the flexibility in its charter to access global experts, and maintain a permanent cadre at competitive remuneration rates. The DGH should also be developed as a knowledge center or knowledge hub that acts as a central repository for best practices, geo-scientific data on Indian basins (through creation and maintenance of NDR), state-of-the-art technologies available locally or globally etc. The head of the DGH must have a fixed tenure of five years and retirement age as per the norms of other similar regulators.

18. Strengthening the role of PNGRB

Initiatives to strengthen and empower the downstream regulator, PNGRB (Petroleum and Natural Gas Regulatory Board), must be taken along the lines of the initiatives for the DGH. PNGRB must be provided with an independent cadre of staff with competitive remuneration and access to professional experts. This will help in building the required capabilities for effective sector regulation.

19. Undertaking fiscal reforms

i. Including oil and gas under the proposed GST (Goods and Services Tax) framework in order to facilitate development of markets by simplifying and standardizing taxation norms and ensuring similar prices of oil and natural gas across the country.
ii. Extending definition of 'Mineral oil' as used in Oilfield Regulation and Development (ORD) Act, 1948 to the Income Tax Act, 1961.
iii. Waiving customs duty on import of LNG for all purposes.

20. Streamlining approval and clearance processes

All possible clearances should be obtained by the government before bidding of blocks to reduce E&P project delays and uncertainty for operators. The process of attaining approvals and clearances should be streamlined such that 'in-principle' approvals or clearances that are granted should be honored and not warrant 're-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.

21. Engagement with state governments

State governments play an important role in facilitating E&P activities, for both on-land and off-shore blocks. There is need to align the state government priorities with national priorities of achieving energy security through initiatives discussed below:

i. State governments should be made aware of and supported in realizing financial upsides from E&P operations that extend beyond government take and could accrue from the downstream activities undertaken within the state.
ii. Some states do not have oil and gas operations, but are important for routing of oil and gas pipelines. Therefore, there should be policy provisions to incentivize their cooperation for laying of pipelines, e.g. giving them a due share of gas.
iii. A directorate of oil and gas should be set up at the state level, housed in the Department of Industries to ensure that there is an institutional mechanism to support oil and gas exploration, and also to develop a vision for higher uptake of gas.
iv. Increasing the share of natural gas in the energy mix of India requires participation of the states. An institutional mechanism must be created whereby the Minister, MoPNG chairs a yearly conference of energy ministers to discuss the growth of oil and gas production or consumption in the states. This is similar to the power conference chaired by the Union Minister of Power with power ministers of states.

IV. FUNDING FOR DEVELOPMENT OF OIL AND GAS INDUSTRY

22. Transferring OID funds to OIDB for sector development

The Oil Industry Development (OID) cess funds should be transferred regularly to OIDB as needed and deployed for development of the oil and gas sector such as:

i. Development of oil and gas support infrastructure like natural gas pipelines, LNG terminals, gas storage facilities, 'Petroleum Clusters' for the OFS sector etc.
ii. Training and skill development for improving access to human resources.
iii. Appraisal of basins by conducting 2D and 3D seismic surveys, drilling parametric wells etc.
iv. R&D initiatives particularly development of non conventional fossil fuels.
v. Providing financial assistance to NOCs for implementation of strategic projects

V. DEVELOPMENT OF THE OIL FIELD SERVICES (OFS) INDUSTRY

23. Development of 'Petroleum Clusters' along the east and west coast

Successful exploration and production (E&P) activities depend on the existence of capable oil field services providers. To develop a domestic OFS sector, fiscal and non-fiscal incentives need to be provided through the development of a 'Petroleum Cluster' each along the eastern cost and western coast. These clusters should provide for a favorable location, developed state of the art infrastructure, reduced administrative overheads and fiscal incentives.

VI. DEVELOPMENT OF GAS INFRASTRUCTURE

24. Development of a natural gas grid for increasing share of natural gas in energy mix

India has a rapidly growing demand for energy resources. Natural gas is of strategic importance to India's energy supplies for many reasons, including its low carbon emissions, wide availability globally and higher supply reliability. It is essential for India to increase the share of gas in its energy mix from the current 10% to at-least 25%, in line with the global benchmark. This can only be achieved once gas pipeline infrastructure is in place, connecting the demand and supply centres of natural gas across the country.

25. Unbundling of gas transportation from marketing or production

In addition to the current regulatory framework, which requires the financial unbundling of gas transportation from marketing or production, legal unbundling of transportation from marketing or production roles is essential and should happen immediately. This will bring greater transparency to the system and enable complete open access to infrastructure. Over the next five years, steps should be taken to move towards complete unbundling, i.e. legal, financial and ownership, of marketing or production from distribution roles.

26. Government led creation of pipeline infrastructure through a PSE

Given the nascent and controlled nature of the gas market in India, it will be extremely challenging to attract sufficient private sector interest in the development of gas infrastructure. The onerous task of building gas pipeline infrastructure should therefore be taken up by the government though a Public Sector Enterprise (PSE) that has experience in constructing and managing gas pipelines. The PSE should be given responsibility for developing the plan or blueprint, securing funding, constructing the infrastructure by getting the appropriate partners on board and operating the pipelines.

27. Leveraging PPP models and government sources of funding

Given the significant investment involved, the pipelines should be built using a public-private partnership (PPP) or a contracting model along the lines of those used for road development or power grid development. Financial assistance should be provided by the government, as required, through tax financing, OIDB funds, Viability Gap Funding etc.

28. Encouraging use of gas for power generation in CHP/CCHP mode

CHP (Combined Heat and Power) refers to the simultaneous generation of both electricity and heat, while CCHP (Combined Heating Cooling and Power) refers to the simultaneous generation of electricity, heat and cold. CHP and CCHP are fuel efficient processes since they capture the waste heat from power generation and use it for heating or cooling. Distributed power generation in CHP/CCHP mode can achieve total system efficiencies in the range 70%–80% CHP/CCHP is a cost effective and reliable technology that has been widely used globally. Use of gas for CHP and CCHP should be encouraged in view of its

high energy efficiency and positive externalities like improved efficiency of distribution, reduced strain on the grid during peak demand period, reduced need for a T&D network and reduced probability of black-outs. Local Distribution Zones (LDZs) may be identified and developed on the basis of potential demand centres for promotion of CCHP/ CHP.

29. Project Management Committee to focus on seamless execution of projects

A Project Management Committee (PMC) consisting of the various stakeholders across the gas value chain must be in place to ensure seamless end to end development of projects. The PMC consisting of the producers, marketers, infrastructure providers, government representatives and other stakeholders will allow for close coordination and ensure timely project completion. The PMC should be in place before the start of the project.

VII. ROADMAP FOR TRANSITION TO MARKET-DETERMINED GAS PRICING

30. Transition to market-determined gas prices by 2017 or next pricing period

A rational and fair pricing policy for gas, an exhaustible resource, is vital in recognition of the principle of intergenerational equity. The principle of intergenerational equity implies that the natural resource should be priced at the highest price possible in the market, i.e. based on market-determined pricing. A gas molecule consumed by the current generation is, in effect, denied to future generations. In other words, the present generation is essentially borrowing these resources from their children and grand-children, and equity requires that future generations be fairly compensated. The question then arises, 'What is the fair and right price', or what price should 'Nana-Nani' pay to their granddaughter for such a transaction? At the very minimum, the resource price cannot be less than the maximum opportunity value of the resource. Hence, the fair price can only be the best price a gas molecule can command either in the domestic or international market, i.e. the price that is market-determined in an environment where exchange is conducted in a transparent manner on an arm's length basis.

This will encourage domestic exploration and production activities, thereby making a strong contribution to the country's energy security. At the end of the new gas pricing period, producer prices for natural gas should be unfettered of any government intervention, allowing for gas pricing by producers on a market-determined basis through transparent arms length transactions.[4] Market-determined gas pricing should apply to all forms of gas irrespective of the source. The decision for transition to market-determined producer prices should be taken and communicated by the government at the earliest, to enable operators to plan their investments upfront, given the long term planning required for E&P activity. To smoothen the adjustment, during the interim period the gas prices can be linked to the

[4] The ToRs of the committee suggest that market-determined gas pricing should commence from the end of the 12th Five Year Plan, i.e. March 2017 while the Rangarajan Committee price formulation suggests that it could commence in 2019. The Government has not taken a final decision in this regard. Hence, the suggested measures for transition to market-determined prices need to be implemented by 2017 or 2019, depending on the final government decision on this issue.

international price of liquid petroleum products such as fuel oil. The linkage could start at a lower base and be gradually increased to facilitate the transition. To ensure there is adequate support to key industries which use gas as input, government support and subsidy should be routed directly to the sector and end consumers. At the same time, the long term policy measures for subsidy reduction should be announced to enhance credibility and transparency.

31. Reforms for smooth transition to market prices

Market-determined pricing for natural gas can be implemented by the end of the 12th Five Year Plan or at the end of the new pricing policy under deliberation. In the interim period leading up to market-determined prices, the government should take the following steps to enable a smooth transition to market prices:

Supply side measures

i. Development of national pipeline infrastructure along a 'common carrier' principle for connecting demand and supply centers across the country.
ii. Development of templates and guidelines for effective regulation of gas contracts by the downstream regulator, PNGRB (Petroleum and Natural Gas Regulatory Board), to ensure that transactions are conducted on a transparent arm's length basis and contracts are at par with international best practices.
iii. Development of additional sources of gas like CBM, shale, hydrates and coal gasification
iv. Encouraging trading of spot and futures contracts for gas on the commodity exchanges in the country.
v. Gas from small and isolated fields, i.e. blocks located more than 10 km from the gas grid and producing less than 0.1 mmscmd is currently sold at market-determined prices. It is recommended that this limit of field size is periodically and gradually increased to include mid and large-sized fields so that a larger share of natural gas is traded through a price discovery process.

Demand side measures

vi. The priority sectors or end consumers may be supported by the government through transparent and targeted subsidies.
vii. Periodic and stepwise revision of consumer prices to bring them at par with market prices while educating and sensitizing consumers.
viii. Implementation of fiscal reforms, such as inclusion of gas under GST and removal of import duty on LNG to rationalize fiscal structures applicable to gas.

32. Abolition of gas allocation policy

The current gas allocation policy restricts gas market development by making it difficult to identify the 'true' gas demand. In order to promote efficient gas usage and stimulate domestic supply, the current system of gas allocation that mandates the producers to sell to a particular category of consumers should be discontinued.

VIII. BUILDING R&D CAPABILITIES IN OIL AND GAS

33. Institution of a Technology Advisory Council

A Technology Advisory Council should be instituted within the MoPNG (Ministry of Petroleum and Natural Gas) that is chaired by the Union Minister, MoPNG and headed by a prominent scientist. The Council should be responsible for the following:

i. Policy setting, identifying key thrust areas of R&D, facilitating R&D by promoting industry-wide linkages.
ii. Sourcing and allocation of funds into the critical technology thrust areas identified.
iii. Developing a robust monitoring mechanism with clear and administratively efficient guidelines and regular feedback.

34. Leveraging global partnerships

Major global R&D initiatives have been undertaken through partnerships that help to bring together complementary capabilities and resources.

i. A potential partnership model to promote basic research in the country in upstream E&P is similar to that leveraged by the JCERDC (Joint Clean Energy Research and Development Center), whereby the Indian government, the US government, industry players and academic institutions from both US and India collaborated for research along three key themes in renewable energy. The funding was obtained thorough a PPP model. A similar inter-governmental public-private partnership model should be used for the upstream oil and gas sector.
ii. Another potential partnership model that can facilitate applied research and should be undertaken by the NOCs is participation in global collaboration networks like Industry Technology Facilitator that undertake Joint Industry Projects (JIP's) in association with other major industry players to resolve the key issues or challenges facing the industry.

35. Government support for innovative R&D projects

Several Indian industry players have invested substantially in path-breaking R&D projects that have the potential to shape the future of India's energy scenario. Some of the projects that were presented to the Committee during the course of its deliberations include Coal to Liquids technology, deepwater gas pipelines and cellulosic ethanol production.[5] The government should actively scout for such innovative projects to provide the required support. The Scientific Advisory Committee in the MoPNG in association with Engineers India Limited (EIL) should objectively evaluate these and other similar projects to provide government assistance in the form of grants through OIDB, low interest rate loans, equity participation by the government and other fiscal incentives.

[5] Tata Sasol presentation to committee on 31st May 2013 , SAGE presentation to committee on 14th August 2013 , Praj Industries presentation to committee on 2nd September 2013

36. Critical thrust areas for R&D

Among the critical thrust areas for India to focus its R&D efforts for development of conventional fossil fuels are nanotechnology, water management, seismic imaging and reservoir characterization, deepwater production and deepwater pipelines. Initiatives should also be taken for development of major non conventional fuels like gas hydrates, UCG (Underground Coal Gasification) and bio-fuels.

IX. DEVELOPMENT OF HUMAN CAPITAL

37. Leveraging India's demographic dividend to become a talent hub for oil and gas

India has the unique advantage of a 'demographic dividend' in the form of it's large and educated working population. Investing in the development of a well trained and capable workforce will help India develop a competitive advantage vis-à-vis other nations in terms of human resource availability and costs. This will position India not just as a global talent hub but also benefit the domestic E&P industry substantially. For human capital in the oil and gas industry, India should aim to reach the same position of dominance that Saudi Arabia commands for the production of oil and gas. This requires the development of world class educational and skill development institutes in the country as discussed in sections below.

38. Improving quality of education to be at par with global standards

It is essential that the government work with major educational institutes in the country to improve the quality of educational and research opportunities for the upstream oil and gas sector. This can be facilitated by developing partnerships with leading global universities, re-training faculty, developing faculty and student exchange programmes to provide international exposure, providing scholarships and encouraging research by attracting world class researchers.

39. Strengthening industry-academia interface for global reach

Fostering collaboration between the industry and academia is one of the most effective ways of addressing the supply gap for manpower. Existing educational institutions in the oil and gas sector should strengthen their industry linkages. Among the avenues for improving industry collaboration are engaging retired experts as mentors, developing training modules in consultation with industry and allotting key administrative positions to industry personnel. Collaborations with international E&P players and OFS providers will improve internship and job opportunities for students.

40. Developing an institutional mechanism for skill development

The Hydrocarbon Sector Skill Council (HSSC) under the purview of the National Skill Development Council (NSDC) should be made operational at the earliest to enable development of a skilled workforce for the oil and gas sector.

X. ACQUISITION OF 'EQUITY OIL'

41. Creation of an International Sourcing Group (ISG)

Acquisition of equity oil is critical for the country since it strengthens our energy security by diversification of the supply base, enables internal capability building and international exposure for NOCs and also serves as a long term price hedge for crude oil. Among the institutional measures required to support acquisition of equity oil are:

(A) Consortium approach: A consortium approach should be the preferred mechanism for Indian companies and institutions pursuing international investments or partnership opportunities. A consortium approach increases the financial strength and bargaining power of the combined entity; enables companies to leverage their complementary skills; ensures better linkages across the value chain hence improving the probability of project success and is a more attractive proposition for the host nation since it provides a holistic turnkey solution.

(B) An International Sourcing Group (ISG) consisting of representation from various ministries like MEA, MoC, MoPNG etc. and major PSU's particularly the *Navratnas* and *Maharatnas*, and Indian companies in the private sector should be constituted. This will help devise a platform for a coordinated approach to pursue international investments and partnership opportunities. The ISG will be responsible for identifying potential nations to partner with, developing a country specific value proposition, bringing together the relevant partners and taking the investment proposal forward.

42. Institution of energy diplomats

Energy diplomats or specialists should be positioned in major cities across the world that are hubs for oil and gas transactions like Moscow, Sydney, London, Calgary, Houston and Johannesburg. These diplomats will serve as outposts of India with the objective of furthering the agenda of ensuring energy security for the country and should closely co-ordinate with the ISG. The energy diplomats should be part of the MEA (Ministry of External Affairs), which can provide the required institutional support.

43. Acquisition of stakes in oil and gas prospecting companies

Building a strong global presence requires active environment or landscape scanning. One of the commonly used avenues by several global E&P companies for acquiring 'equity oil' is to buy a stake in smaller oil and gas prospecting companies. Such companies are often listed on exchanges like the Alternative Investment Market (AIM) in London. Indian NOCs should also use a similar approach for expanding their global presence.

44. Institution of a centre for policy research on Arabian Gulf region countries

India currently imports a significant portion of its domestic oil requirements from the Arabian Gulf region countries. Hence, geo-political and economic developments in these countries have an important impact on India's energy security. A think tank should be established that undertakes quality research on the challenges and opportunities associated with the Arabian Gulf region countries. The research center should undertake multi-disciplinary research covering geo-political, economic, social cultural and other aspects with the objective of linking our energy security to the dynamics of these regions. Such a think tank may be established as part of any of the leading petroleum sector focused universities in the country.

XI. DEVELOPMENT OF TRANSNATIONAL PIPELINES

45. Expediting creation of transnational gas pipelines

Transnational pipelines can play a significant role in increasing the availability of natural gas and diversifying our supply base. The government should take concrete steps to revive and expedite creation of the proposed transnational pipeline projects like the Turkmenistan-Afghanistan-Pakistan-India (TAPI) pipeline and the Iran-Pakistan-India (IPI) pipeline. The government should also explore sub-sea pipeline projects, to secure gas from Africa or the Middle East, which can effectively address our security concerns. In association with major oil PSU's and interested private players the government should engage in constructive dialogue with the concerned nations to resolve geo-political and strategic issues, review project structures and work towards accelerating the projects. Private initiatives like SAGE and others should also be encouraged and supported.

XII. STRENGTHENING THE NATIONAL OIL COMPANIES (NOCs)

46. Empowering and strengthening the NOCs

Given that the NOCs will continue to play an important role in supplementing the country's energy security, initiatives to strengthen and empower the NOCs must be undertaken like:

i. A key milestone towards a more empowered NOC is to develop a strengthened board governance process, with greater accountability and autonomy. The board should also be strengthened through the presence of esteemed experts, both global and from the industry.
ii. Complete financial and operational autonomy in decision making must be conferred on NOCs.
iii. The current oversight and control mechanisms for NOCs by various government bodies, agencies and Parliamentary Committees require to be reviewed in order to align with international best practices.
iv. The NOCs should be positioned as global companies by encouraging them to develop an aggressive approach in identifying and pursuing global investment or partnership opportunities.
v. The NOCs must be empowered to hire and retain the best-in-line global talent.

vi. Core activities should be incentivized with active de-focusing from non-core businesses.
vii. A culture of performance and commensurate accountability must be promoted within the NOCs.

47. Allow greater autonomy for NOCs in resource allocation

In accordance with global best practices, the NOCs must be provided with greater autonomy in resource allocation and portfolio management. The board must be empowered to make farm-in and farm-out decisions while adhering to the broad principles and guidelines laid-out by the government. To address security concerns, the government may publish a 'positive list' of countries where investments can be made without prior government approval. This will expedite investment decisions, ensure optimal resource allocation and reduce lead time for approvals.

48. Divestiture of non-core businesses

To allow upstream NOCs to focus on the core activities of E&P in oil and gas, downstream projects and service functions should be reviewed and divested. This will allow for greater system efficiencies and place greater thrust on improving the E&P capabilities of upstream NOCs. This will also allow growth opportunities for in-house services and pools of expertise to grow into independent global oil field services companies.

49. Government support for sharing risks in strategic projects

For economically unviable projects of strategic importance that are undertaken by the NOCs, the government should participate in the sharing of risks by providing financial support through the OID cess.

50. Creation of a separate business unit for non-conventional fossil fuels

In line with global best practices, non conventional resources should be managed by NOCs as an independent business unit to enable speedy decision making and focus on innovation. Tapping into non conventional fossil fuels like shale gas, CBM, gas hydrates, tight gas etc. requires unique skills, capabilities and approaches since resources are in different stages of their life cycle; a decentralised business unit will enable dedicated focus. This is in line with successful strategies adopted by Statoil, Petronas among others.

51. Separation of services arm of ONGC

The technical services arm of ONGC should be spun off into a separate entity. The ONGC services arm should compete with other OFS providers for its share of business from ONGC and should be free to render technical services to other E&P providers. The transition may be done over a period of three to five years with ONGC gradually reducing the share of business that is provided exclusively to the in-house services arm. This will provide a window to the technical services arm to upgrade its technologies and capabilities for competing with global service providers.

52. Significant progress towards reduction in import dependency

If the proposed policy reforms and institutional measures are adopted, the committee envisions a significant reduction in the import dependency on account working of several mechanisms:

- Increased investment flows in E&P activity
- Shorter discovery to production cycles
- Higher recovery rates due to induction of IOR/EOR technology
- Non conventional source exploitation due to market linked gas pricing
- Higher levels of equity oil
- Promoting greater efficiency of the consuming sectors

As a result of these mechanisms, the committee estimates that India's import dependency by 2030 can be reduced by more than half as compared to the business as usual scenario. In value terms, it means that the annual imports can be steadily reduced in the coming decade leading to an annual reduction of imports of 70-80 billion USD by 2030.

Ashok Ganguly | Deepak Parekh | R S Sharma

S V Rao | Vikram Mehta | Arindam Bhattacharya

Ajit Kapadia | Anil K Jain | B N Talukdar, DGH, Member Secretary

Vijay Kelkar
Chairman of the committee

Addendum I

The potential impact of all the initiatives proposed by the Committee averaged over a 15 year period, i.e. from 2016 to 2030 implies an annual savings of USD 70-80 billion in the import bill. The overall savings for a particular year will change based on the production profiles and difference in the time periods to observe the impact of the levers discussed above.

As per the Energy Information Administration (EIA) estimates, oil consumption in India is expected to grow at 3.5% CAGR and gas consumption is set to grow at 4.6% CAGR. This implies that the oil and gas demand in India is expected to reach 3300 million BOE by 2030. In the business as usual scenario, India is expected to import almost 75% of its domestic oil and gas requirements or 2300 million BOE. However, with concerted policy efforts, Indian oil and gas imports can decrease to approximately 40% of the total requirements by 2030. This will be a significant step forward towards achieving our energy security. (Refer Exhibit below) For detailed assumptions refer to Chapter 12 of the report.

Exhibit: Summary of potential reduction in import dependence of India by 2030

Year	Oil + gas consumption (mboe)	Oil + gas domestic production (mboe)	Equity oil + gas production (mboe)	Oil + gas net import (mboe)	% import dependence
2012	1670	575	55	1040	**62%**
2030 (Business As Usual)	3275	605	145	2525	**77%**
2030 (With proposed reforms implemented)	2785	1405	300	1080	**39%**

Note: 2012 estimates as per BP Statistical Review of World Energy, 2013, BP

Table of Contents

Preface ..... **ii**
Executive Summary of Recommendations ..... **iii**
Table of Contents ..... **xx**

I Introduction and context 2
1.1 Context and objective 2
1.2 Early harvest measures 3
1.3 Committee's approach 5
II Enhancing exploration and production 8
2.1 Appraisal of Indian basins 8
2.2 Centrality of E&P contracts 10
2.3 Initiatives for improving the administration of E&P contracts 15
2.4 Increasing production from mature fields 18
2.5 Developing non conventional fossil fuels 19
III Institutional reforms 22
3.1 DGH as an independent regulator 22
3.2 Empowerment of the DGH 23
3.3 Fiscal reforms 24
3.4 Strengthening the role of PNGRB 25
3.5 Setting up an empowered Cabinet Committee on Energy (CCE) 25
3.6 Role of the Cabinet Committee on Energy 27
3.7 Streamlining the approval and clearance process 28
3.8 Engagement with state governments for E&P activities 28
IV Deployment of OID funds for the development of the oil and gas sector 31
4.1 Context and current scenario 31
4.2 Utilization of OID funds 31
V Promotion of Domestic Oil Field Services (OFS) sector 33
5.1 'Petroleum Clusters' for promotion of indigenous oil field services sector 33
5.2 Other measures for promotion of indigenous OFS sector 34
VI Building gas pipeline infrastructure 36
6.1 Introduction and context 36
6.2 Strategic importance of natural gas 36

6.3 Developing gas pipeline infrastructure 38
6.4 Structural transformation of gas markets 39
6.5 Government led development of a natural gas grid 41
6.6 Pipeline tariff mechanism....42
6.7 Network codification 42
6.8 Promoting gas usage for power generation in CHP/CCHP mode 42
6.9 Coordination between government agencies for development of ecosystem....44
VII Roadmap for transition to market determined gas pricing 46
7.1 Introduction and context 46
7.2 History of natural gas pricing....47
7.3 International experiences in gas pricing 48
7.4 Proposed approach for gas pricing in India 48
7.5 Cost-plus pricing model 50
7.6 Benefits of transition to market-determined prices 51
7.7 Roadmap for smoother transition to market prices—supply side reforms....52
7.8 Roadmap for smoother transition to market prices—demand side reforms 52
7.9 Gas allocation mechanism and required reforms 54
VIII Building R&D capabilities....56
8.1 Introduction 56
8.2 Key challenges for India in exploration and production R&D....56
8.3 Creation of a Technology Advisory Council....57
8.4 Develop global partnerships relevant for India....58
8.5 Government support for innovative R&D projects 60
8.6 Critical technology thrust areas for India to focus on 62
IX Development of human resources 66
9.1 Introduction and context 66
9.2 Opportunities in India's demographic dividend....67
X Acquisition of 'equity oil' and trans-national pipelines....73
10.1 Introduction and context 73
10.2 Strategic role of transnational pipelines 74
10.3 Strategic role of 'equity oil'....75
10.4 Institutional mechanisms for acquiring 'equity oil' 76
10.5 Revival of government-to-government interactions for transnational pipelines 78
10.6 Institution of a center for policy research on Gulf countries 79
XI Strengthening the NOCs....81
11.1 Introduction and context 81
11.2 Capability building for Indian NOCs....81
11.3 Optimization of NOC portfolios 85

11.4 Government support for sharing risks in strategic projects 85
11.5 Separate business unit focussed on non conventional fossil fuels 85
11.6 Separation of the service functions of ONGC to make them non-captive 85
XII Progress towards reduction of import dependency 87
12.1 Increased investment flows in E&P activity 88
12.2 Higher recovery rates due to induction of EOR/IOR technologies 88
12.3 Shorter discovery to production cycles 89
12.4 Higher level of 'equity oil' 89
12.5 Non conventional resource exploitation due to market based gas pricing 90
12.6 Promoting greater efficiency of the consuming sectors 90
12.7 Overall impact 91
XIII Annexure 92
13.1 Annexure A: Prospective plan prepared by DGH for appraisal of Indian basins 93
13.2 Annexure B: Note from Daniel Johnston to Kelkar Committee 93
13.3 Annexure C: Comparison of E&P fiscal regimes for Indian basins- Illustrative estimates 100
13.4 Annexure D: Prospective blueprint of demand centers (Source: GAIL) 104
13.5 Annexure E: Pipeline infrastructure in India (Source: PNGRB) 105
13.6 Annexure F: Observations of Dr. S.V.Rao and Sri B.N.Talukdar 106

Chapter I: Introduction and context

1 Introduction and context

1.1 Context and objective

The Government of India constituted this Committee under the chairmanship of Dr. Vijay Kelkar to prepare a roadmap for enhancing the domestic production of oil and gas with sustainable reduction in import dependency by 2030.

The constitution of the Committee is as follows:

1. Dr Vijay Kelkar, Chairman
2. Dr Ashok Ganguly, Member, Rajya Sabha
3. Shri Deepak Parekh, Chairman, HDFC
4. Shri R S Sharma, Ex-CMD, ONGC
5. Shri S V Rao, Ex-Director (Exploration), ONGC
6. Shri Vikram Mehta, Chairman, Brookings India
7. Dr. Arindam Bhattacharya, The Boston Consulting Group
8. Shri Ajit Kapadia, Vice Chairman, Centre for Fuel Studies and Research
9. Shri Anil K Jain, Advisor (Energy), Planning Commission
10. Shri B N Talukdar, DG, DGH-Member Secretary

The Terms of Reference (ToRs) of the Committee are as follows:

1. Steps to be taken for enhancing oil and gas production from the unconventional as well as conventional energy sources.
2. Institutional mechanism for appraisal of Indian sedimentary basins to the extent of 75% by 2015 and 100% by 2025.
3. Utilisation of Oil Industry Development Board (OIDB) cess and other innovative resource mobilisation approaches for appraising unexplored/partly explored acreages.
4. Development and promotion of the indigenous service industry in the E&P sector.
5. Review of institutional mechanisms to acquire acreages abroad for exploration and production as well as pursuit of diplomatic and political initiatives for import of gas from neighbouring and other countries with emphasis on transnational gas pipelines.
6. Steps to be taken for ensuring adequacy of finances for R&D required for building knowledge infrastructure in E&P activities.
7. Steps to be taken for development of gas transportation infrastructure for establishing a countrywide marketplace.
8. Roadmap for switching over to market determined gas pricing at the end of the 12th Plan.

1.2 Early harvest measures

Some early harvest measures were discussed in Part 1 of the report. These are highlighted for completeness and to emphasise the need to implement them at the earliest to provide the much needed thrust to the oil and gas sector in India.

1. Allow for seamless and simplified electronic transfer of data related to Indian basins using technologies like Secure File Transfer Protocol (SFTP). Beginning with data for onshore blocks, electronic data transfer practices should be extended to offshore blocks based on further consultation with the concerned departments.

2. Implement reforms in tax policies and administration to ensure that Indian firms are as competitive as their global counterparts

a. Tax reforms for domestic operations
   i. Apply an income tax holiday to all forms of hydrocarbons in line with international best practices
   ii. Continue with the income tax holiday for petroleum E&P activities and extend it to 12 years (from the current seven years) from the date of first production for assets where production is inherently slow due to weather (e.g. monsoons) and other logistical issues (e.g. deepwater, ultra-deepwater, North East region acreages, high temperature high pressure assets).
   iii. Relax social security and provident fund norms for expatriates to help Indian companies provide oil field services that require expatriate personnel in a cost effective manner and to reduce the expense burden on companies
   iv. Issue clarification reiterating the non-applicability of service tax levied on cash calls made by the operator to other partners in a consortium
   v. PSC should come into effect and with all conditions applicable as soon as it is signed and not till it is tabled in Parliament

b. Tax reforms for international acreage acquisition and operations
   i. Reduce the rate of dividend tax paid on income earned internationally by subsidiaries of Indian oil and gas companies. Under current Indian tax laws, the remittance of dividends by an overseas subsidiary to its holding company is effectively taxed at a rate of 16.99% (including surcharge and cess).
   ii. Revise the tax regime to ensure that Indian firms are not disadvantaged when operating in host countries, particularly in cases where the host countries do not impose taxes on international players as the underlying contract accounts for the government's proceeds.

3. Implement reforms related to administration of existing contracts

a. Streamline the approval process and bring in transparency
   i. Adopt a concurrent approach for statutory approvals to minimise the total time taken.
   ii. Establish IT based workflow system and move to e-governance.

b. Establish an inter-ministerial panel to which the MoPNG may entrust the dispute resolution mechanism for a flexible dispensation depending on the circumstances to ensure timely resolution of issues concerning E&P contracts.

4. Streamline the financial audit process with clearly defined policies

a. Any financial audits relating to E&P contracts should be carried out based on accounting records and financial statements prepared under the provisions of the contract in accordance with the Accounting Standards and Audit Standards of the Institute of Chartered Accountants of India (ICAI).
b. The government may conduct the audit through firms of chartered accountants, the Comptroller and Auditor General (CAG), or through international auditors with assistance from management consultants and other experts with relevant experience in auditing oil and gas operations. Such an audit–whether conducted by the CAG or others–should not include performance or efficiency audits.
c. In the event of any report of irregularities, the government may determine the need for a forensic or investigative audit in addition to the annual audit.
d. The government should make all efforts to complete the audit procedure in accordance with the timelines set in the accounting procedure of contracts.

5. Encourage NOCs to adopt progressive policies for the rapid development of small and marginal fields.

a. NOCs should be allowed to put small and marginal fields out to global tender and enter into contracts with interested parties for the same.
b. Small and marginal field projects should not be subjected to contribution towards downstream under-recoveries.

6. Encourage development of unconventional oil and gas resources

a. Put in place a policy to allow private players to explore shale oil and gas resources under the PSC regime. The current policy permits NOCs to explore shale oil and gas resources from on-land blocks that were allotted to them on a nomination basis.
b. Coal India Limited (CIL) should seek to engage with private players and NOCs to develop capabilities in gas extraction to exploit gas from CBM.

7. Reduce the under-recovery burden of upstream oil companies. To make rapid progress towards easing of the under-recovery burden of upstream companies, possible solutions are:

a. Phase out regulation of diesel, LPG and kerosene prices in line with the recommendations of the committee on 'Roadmap for Fiscal Consolidation' to reduce the overall subsidy burden.
b. If the government decides against deregulation, a higher proportion of the subsidies should be financed from the government's revenue receipts.
c. Adopt the Parikh Committee recommendations at the earliest for calculation of under-recoveries.

1.3 Committee's approach

1.3.1 Stakeholder interactions

The committee interacted with a comprehensive set of stakeholders, representing different parts of the value chain. Representatives of the following companies, industry associations, scholars and government bodies were invited to share their views with the Committee.

i. Association of Oil and Gas Operators (AOGO) (3rd May 2013 and 17th April 2014)
ii. ONGC Videsh Ltd. (OVL) (3rd May 2013 and 15th Aril 2014)
iii. Shri Atul Chandra, Ex-MD, OVL (3rd May 2013)
iv. Tata-Sasol (31st May 2013)
v. Reliance Industries Ltd (RIL) (31st May 2013)
vi. Shell (31st May 2013)
vii. British Petroleum (BP) (20th July 2013)
viii. Dr Rabi Bastia, President E&P, Oilmax Energy (20th July 2013)
ix. Shri R. N. Choubey, Directorate General of Hydrocarbons (DGH) (20th July 2013)
x. Oil and Natural Gas Corporation Limited (ONGC) (20th July 2013 and 9th May 2014)
xi. The Energy and Research Institute (TERI) (14th August 2013)
xii. South Asia Gas Enterprise (SAGE) (14th August 2013)
xiii. Observer Research Foundation (ORF) (14th August 2013)
xiv. Dr Avinash Chandra, Ex-Director General, DGH (14th August 2013)
xv. Cairn India Limited (CIL) (2nd September 2013 and 14th June 2014)
xvi. ASSOCHAM (2nd September 2013)
xvii. Confederation of Indian Industries (CII) (2nd September 2013)
xviii. Praj Industries Limited. (2nd September 2013)
xix. Shri Vivek Rae, Secretary, P&N (5th October 2013)
xx. Federation of Indian Chambers of Commerce and Industry (FICCI) (5th October 2013)
xxi. Shri R. S. Pandey, former Petroleum Secretary (5th October 2013)
xxii. Shri G. C. Chaturvedi, former Petroleum Secretary (5th October 2013)
xxiii. GAIL (30th January 2014)
xxiv. Petronet LNG Ltd (30th January 2014)
xxv. AF Mercados (20th March 2014)
xxvi. Ms Sujata Mehta, Special Secretary (ER& DPA), Ministry of External Affairs (20th March 2014)
xxvii. FICCI on 'Development of indigenous service industry in E&P sector' (7th April 2014)
xxviii. Gujarat Gas Company Limited (15th May 2014)
xxix. Shri Baroruchi Mishra, VP Engineering- East Projects and Tech., Shell (16th May 2014)
xxx. Tom Albanese, CEO, Vedanta Resources; Sudhir Mathur, CEO, Cairn India Ltd.
xxxi. Shri Satish Pai, ex-Advisor to CEO, Schlumberger Limited (16th May 2014)
xxxii. Shri S. Krishnan, Chairperson-PNGRB (28th August 2014)
xxxiii. Dr Anirbid Sircar, Director – School of Petroleum Technology, Pandit Deendayal Petroleum University (17th September 2014)

The Committee would like to thank all the stakeholders who presented their views.

1.3.2 Formation of sub-committees

The following four sub groups were formed to work on the specific ToRs of the Committee:

i. Sub-committee I on Gas related TORs- chaired by Shri Vikram Mehta
ii. Sub-committee II on E&P Contract Structure- chaired by Dr Vijay Kelkar
iii. Sub-committee III on Regulatory Reforms- chaired by Shri RS Sharma
iv. Sub-committee IV on Technology and R&D policy reforms - chaired by Dr. Ashok Ganguly

The recommendations of the sub groups were further taken up for discussion in the Committee meetings.

The Committee put up a consultation paper titled 'Towards a New E&P Regime and Roadmap for Market Determined Pricing of Natural Gas' to solicit the views of stakeholders, including representatives from the oil industry, analysts and the public at large, on two critical issues that will determine the progress of India's domestic exploration and production (E&P) activity in the coming years, namely, E&P contract regime and roadmap for transition to market determined gas pricing. Industry organization and several experts responded to the consultation paper. These were taken into account by the committee while formulating the recommendations.

1.3.3 Committee meetings

Meetings of the committee/sub-committees were held on the following dates;

i. 13th March 2013
ii. 9th April 2013
iii. 3rd and 31st May 2013
iv. 20th June 2013
v. 14th August 2013
vi. 2nd September 2013
vii. 5th and 30th October 2013
viii. 25th November 2013
ix. 13th December 2013
x. 30th January 2014
xi. 27th February 2014
xii. 12th and 20th March 2014
xiii. 2nd, 7th, 8th, 15th, 17th and 29th April 2014
xiv. 9th, 15th,16th and 27th May 2014
xv. 4th, 10th and 14th June 2014
xvi. 28th August 2014
xvii. 20th and 29th September 2014

Chapter II: Enhancing domestic exploration and production

2 Enhancing exploration and production

2.1 Appraisal of Indian basins

2.1.1 One of the major challenges facing the Indian E&P sector is the lack of adequate geo-scientific data for Indian basins. Access to sufficient and reliable data is a pre-requisite for operators to take informed investment decisions. Appraisal of basins refers to the collection of geo-scientific data that indicates the potential availability of oil and gas in a particular area, through seismic surveys and parametric wells.

2.1.2 In India, 1.502 million square kilometres (sq km) out of a total sedimentary basin area of 3.14 million sq km has scanty or little exploration data. Appraising these basin areas requires immediate attention and should be prioritized by the government.

2.1.3 Given the current state of appraisal of Indian basins, the Committee believes that a realistic target for appraisal of Indian basins to the extent of 75% is the year 2020 instead of 2015 as stated in the Terms of Reference of the Committee. The targeted 75% basin appraisal up to the year 2020 is however subject to immediate approval of funding.

2.1.4 **Creation of a National Data Repository (NDR)**

2.1.4.1 Collection of data for Indian basins is the first step forward in attracting companies with advanced capabilities and technologies to invest in Indian basins. The non-availability of high quality data for Indian basins significantly hampers the ability of interested investors to make informed bids for blocks. A large proportion of India's undiscovered resources lie in difficult terrains such as frontier on-land areas and ultra-deepwater areas, increasing the business risk for the industry. Therefore, completion of a world-class National Data Repository (NDR) is a vital step in improving the attractiveness of Indian basins. The NDR may be housed within the Directorate General of Hydrocarbons (DGH). (Refer to Annexure A for prospective plan prepared by the DGH on appraisal of Indian basins)

2.1.4.2 The critical enablers for expediting creation of the NDR are:

i. **Aggregation of existing data:** A large quantity of data for relinquished fields that have not been re-awarded resides with NOCs such as ONGC and OIL, and should be made available to the NDR for the use of interested parties. Existing non-proprietary data with private players should also be made available to the NDR for future use.

ii. **Encouraging new data collection**: In line with global best practices, a participating company should be given a sufficient exclusivity period for its data, to enable it to benefit from data

sales. The government should play no role in determining the price for the sale of the data to interested third parties so that providing data to the NDR becomes a more attractive proposition for companies. The government should also promote multi-client speculative surveys.

iii. **Funding the data collection process:** The government should make available the required funds to DGH (estimated at approximately INR 7000 crore) at the earliest through the OID (Oil Industry Development) funds to enable collection of seismic data and drilling of exploratory parametric wells for prospective basin areas that are not appraised.

2.1.5 **Adoption of the Open Acreage Licensing Policy (OALP)**

2.1.5.1 In line with global best practices, the government should initiate the OALP (Open Acreage Licensing Policy) with immediate effect for bidding of blocks in parallel to NELP (New Exploration and Licensing Policy). OALP may be initiated using the data residing with NOCs, where ever possible. The Committee recommends that the OALP commences no later than 2016.

2.1.5.2 The salient features of OALP are:

i. Acreages for the exploration of hydrocarbons should be on offer throughout the year. Companies interested in a particular area can seek an exploration license for that area.
ii. The sedimentary area, which is presently not under E&P activity, should be offered for open acreage. The area already under Mining Lease (ML), Petroleum Exploration License (PEL) and NELP-X should be excluded from the open acreage offer.
iii. The government should divide Indian territory (the land area up to the international boundary and the offshore area up to the Exclusive Economic Zone) into small zones and sectors that will form the basic units for bidding.
iv. The periodicity of opening OALP bids could initially be six months, which will give bidders enough time to select the OALP area and prepare their bids. This periodicity should be regularly reviewed based on the interest of the bidders.
v. In areas where no seismic data is available, the government should institute a mechanism to incentivize operators to participate in the appraisal of basins. This can be done by granting operators a licence to conduct seismic surveys in chosen acreages and then granting them a Right of First Refusal (ROFR) as an incentive when the block is put up for bidding.

2.1.5.3 The advantages of OALP are:

i. A prospective investor can express interest for E&P activity in any unallocated area at any time of the year as opposed to the NELP policy, where pre-determined blocks are put up for periodic bids by the government.
ii. It allows companies to invest and specialise in certain geographies where they may be experts.

2.1.6 **Introducing flexibilities in MWP**

2.1.6.1 As part of bids submitted for oil and gas acreages, operators are required to bid for the MWP (Minimum Work Programme) to be carried out. The MWP consists of the area planned to be covered for 2D and 3D seismic surveys and the number of exploratory wells that are planned to be drilled. Penalties are levied on operators for non-completion of the MWP as detailed in the submitted bids. However, often during the course of the exploration activity, there is limited or no incremental value of the additional wells to the operator. Hence, operators drill additional wells only to adhere to the submitted MWP and avoid penalties. This non productive deployment of resources implies an economic loss not just for the operator but also for the nation.

2.1.6.2 Similar to practices followed in countries like Australia, operators must be provided with the flexibility of fulfilling the outstanding MWP commitment on a different block or field with similar characteristics where the operator holds a valid licence, so as to enable incremental access to information to the benefit of both the operator and the country. Such flexibilities should be allowed from future rounds of bidding.

2.2 Centrality of E&P contracts

2.2.1 Need for review of contract structure

2.2.1.1 The E&P contract structure is central to incentivising national and international companies to invest in the exploration and development of the hydrocarbon resources of India. The fiscal regime in the contract is the core of the risk-reward paradigm that India offers to potential investors.

2.2.1.2 Given the paucity of adequate data for a vast majority of Indian basins, investors, domestic or global, do not have a clear view of the country's prospectivity. This lack of clarity negatively impacts the risk-reward perception associated with the exploration of the Indian basins. Therefore, it is essential to develop a contract regime that aligns risk-reward terms with the Indian paradigm to attract investors to invest effectively in E&P activity in the country.

2.2.1.3 The New Exploration and Licensing Policy (NELP), since its inception in 1999, has undoubtedly ushered in a new era of E&P activity in the country. However, the performance (ability to attract investors) of the more recent NELP rounds has raised questions related to the effectiveness of the policy. Blocks offered for bidding under NELP have received limited interest from international oil companies or global oil majors. One of the key reasons cited for such indifference towards the later NELP rounds is the administrative and management inefficiencies associated with the implementation of the Production Sharing Contract (PSC) in the Indian context. These systemic inefficiencies have affected the development and delivery across blocks awarded under the NELP regime and impacted investor perception and consequently their interest in Indian basins.

2.2.1.4 Retrospective taxation and changes in contract terms have added to the adverse perception. By levying retrospective taxes and effecting ad hoc contractual changes, India has managed to

score “own goals”, as these measures have created uncertainty and instability, deterring long-term investors from investing further in the E&P sector.

2.2.1.5 The central objective of the contractual regime should be to accelerate appraisal of our sedimentary basins and maximise E&P activity in the country, rather than to maximize government take. The recommendations of the Committee also address the twin requisites of India's energy security: maximising the availability of hydrocarbon resources; and ensuring affordability of supplies.

2.2.1.6 India must develop a fiscal system that (i) offers globally competitive fiscal terms with commensurate risk and reward, (ii) reduces transaction costs for investors and (iii) is stable and transparent. This is critical to attract interest from players with the requisite technological and managerial capabilities to engage in E&P activities for optimal exploitation of India's basins.

2.2.1.7 The proposals presented in this section draw upon international best practices in contract regimes. No major oil importing country presently follows a purely 'biddable' Revenue Share Contract (RSC) regime, due to its inherent shortcomings with respect to encouraging exploration activity or maximising output from producing fields. In his communication to the committee, Daniel Johnston, a leading global expert in the sector, has concurred with this view regarding the inadequacies of the RSC[6]. (Refer Annexure B for note from Daniel Johnston)

2.2.1.8 Various quantitative and qualitative analyses demonstrate that the Production Sharing Contract (PSC) is the preferred contractual regime for the Indian context given the risk and materiality associated with Indian basins.[7] The PSC model with its inherent cost recovery provides offers a more balanced risk-reward equation as compared to other models such as the Revenue Share Contract (RSC) and better aligns operator interest with public interests. (Refer to Annexure C for details of illustrative analyses to compare E&P contract regimes)

- Analyses have demonstrated that the PSC regime is likely to achieve a larger number of NPV positive fields as compared to the RSC regime, for similar levels of government take. In other words under the PSC energy security will be higher as compared to the RSC
- Given India's large share of maturing fields, the PSC model is better suited to incentivize investment in new technologies such as Enhanced Oil Recovery (EOR) and Improved Oil Recovery (IOR)

2.2.1.9 An additional downside of the RSC model is that it can be against the spirit of cooperative federalism. The revenue share collected under this model will not be shared with the state governments, a practice similar to the one adopted for the telecom sector. While, the profit oil and gas under the extant PSC is being shared with the state governments.

[6] Daniel Johnston is a renowned scholar and presented his views in a note to the Committee on the subject under discussion.
[7] Discussed in detail in the committee report on Roadmap for Reduction in Import Dependency in Hydrocarbon Sector by 2030 - Part I

2.2.1.10 However, it has been observed that in recent years, the administration of PSCs in India has been fraught with issues. The key issues include (i) the high administrative burden on the Directorate General of Hydrocarbons (DGH) for assessing the efficiency of expenditures, (ii) the high involvement of the government in operational decision making, and (iii) several disputes on the fiscal elements of cost recovery. These issues lead to significant delays and consequent financial losses to operators. To address these concerns and others, the Committee has proposed alternative contract models.

2.2.2 **Model I: PSC linked to Investment Multiple (IM) model with modified contract administration**

2.2.2.1 The PSC linked to the Investment Multiple is similar in its fiscal construct to the extant PSC model. The model employs the basic elements of the prevalent PSC model—a biddable cost recovery cap (up to 100%) and biddable share of profit petroleum/gas, based on the Pre-Tax Investment Multiple (PTIM). However, variations in the administration are introduced to address the operational constraints in the Indian context.

2.2.2.2 Ownership of the oil and gas hydrocarbon resources of the country rests with the state. The government has two central roles in protecting the interests of the owner: prudential and fiduciary oversight of the resources; and protecting the fiscal interests of the state.

2.2.2.3 The primary role of the government - prudential and fiduciary oversight of the natural resources of the country - should be carried out through the Directorate General of Hydrocarbons (DGH) and the Management Committee (MC) as detailed below:[8]

i. The DGH and the MC are responsible for prudential and fiduciary oversight of the natural resources of the country, i.e. the need to ensure that accelerated exploration, optimal exploitation, development and utilisation of the exhaustible hydrocarbon resources are carried out in an environmentally sustainable manner.
ii. In line with international best practices, the DGH and the MC should focus primarily on ensuring adherence to Good International Petroleum Industry Practices (GIPIP) norms, health and safety norms and effective reservoir management practices. In effect, the government should dissociate itself from micromanagement, i.e. operational and investment decision-making.

2.2.2.4 The fiscal role of the government is to protect the fiscal interest of the state as the owner of the resource**.** Here it is argued that the fiscal interests of the state specific to the PSC, namely royalty, corporate income taxes and profit oil/gas, are no different in nature from other general fiscal interests like corporate tax. Thus, assessment of all fiscal commitments arising from the PSC should uniformly be the responsibility of the government revenue agencies that have the requisite expertise and mandate, as is further highlighted below:

[8] Under the extant PSC regime, a Management Committee is formed, consisting of representatives from the operator and the government – DGH and Ministry of Petroleum and Natural Gas

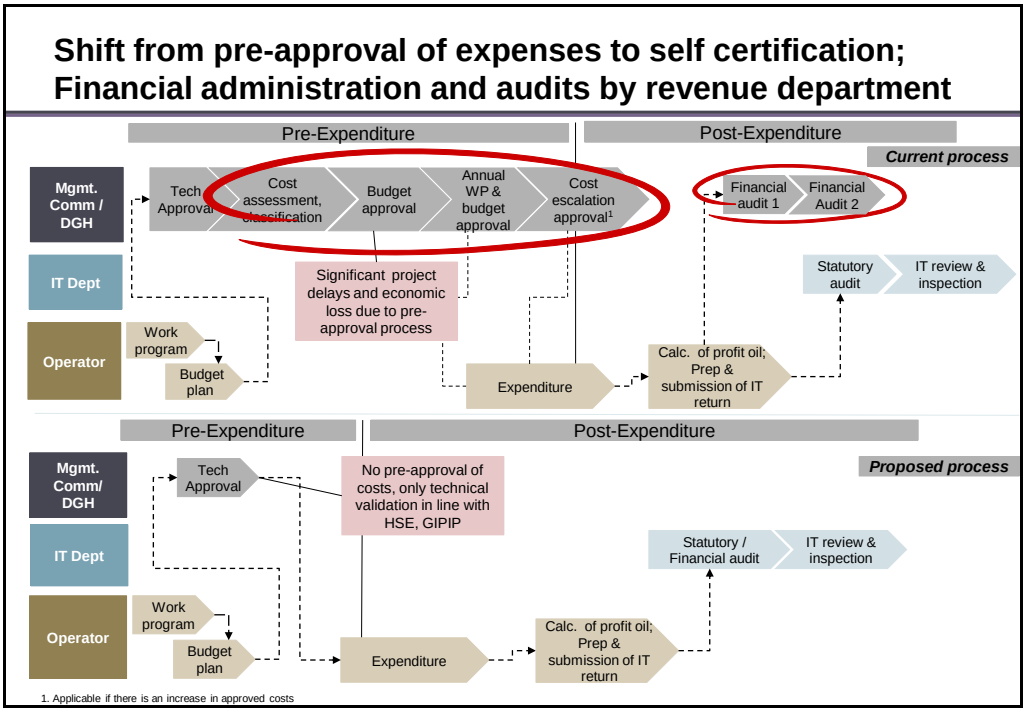
i. In the year 2012-13, the income tax authorities collected INR 3.5 lakh crore worth of corporate taxes under the Income Tax Act 1961. In the year 2013-14, they are expected to collect INR 3.9 lakh crore of corporate income taxes. This compares to just INR 9,000 crore of profit oil/gas collected from oil and gas companies in 2013-14.[9] Thus the collective profit oil/gas represents less than half percent of the corporate income tax collected and should be well be brought under the purview of the revenue authorities for effective implementation.
ii. Assessment of profit oil/gas by the revenue authorities will also bring them under the scope of financial audits conducted under the purview of the Revenue Department, and in turn subject them to the same rigorous level of scrutiny and inspection that is regularly applied to the assessment of corporate taxes.
iii. Corporate income taxes are levied on profits accruing from the operations of all commercial entities in the country. Similarly, in PSCs the government extracts a share of the profits accruing from oil and gas operations. Hence in principle the assessment of profit sharing in PSCs is in line with that of corporate income tax. The Revenue Department has the requisite manpower and capabilities to carry out fiscal contract administration and to ensure that companies do not mis-report their filings.
iv. The initiatives proposed by the Tax Administration Reform Commission (TARC) are expected to simplify tax administration norms, thereby improving the efficiency and effectiveness of the tax collection process.

2.2.2.5 The MC should not be responsible for any financial audits or pre-approval and assessment of expenditures. Cost recovery should be executed on the basis of self-certification by the Operating Committee (OC), and the profit oil/gas, alongside the associated costs submitted for calculation of the share, may be audited by the revenue agencies as per standard procedures for collection of corporate income taxes.[10] (Refer to Exhibit 1 below)

2.2.2.6 Self certification of expenditures is a standard best practice all over the world, particularly in dealing with corporate liabilities. The revenue authorities would conduct audits of such corporate liabilities as per standard procedures to ensure that there is no mis-statement or tax evasion.

[9] Directorate General of Hydrocarbons
[10] Under the extant PSC regime, an Operating Committee (OC) consists of the representatives of the companies that are party to the contract

Exhibit 1: Proposed mechanism for fiscal administration of contracts



2.2.3 **Model II: Modified PSC with supernormal profit tax model**

2.2.3.1 In the modified PSC with supernormal profit tax model, government take comprises only of royalty payments and corporate income taxes until supernormal profits are triggered This would serve the dual purpose of further increasing the investor attractiveness of the PSC, and at the same time reduce the administrative burden associated with the extant Investment Multiple based PSC model.

2.2.3.2 However, global examples indicate that in the case of windfall gains to operators under such fiscal regimes, governments are under pressure to re-negotiate or unilaterally change contracts to gain a larger share in the upside. This leads to uncertainty for investors by creating an unstable regime. To overcome this, the model proposes the imposition of a biddable supernormal profit tax in the case of unforeseen and significant gains. Such a levy would be triggered when a pre-determined threshold of investor return has been crossed. This would afford predictability and stability of the contract, while ensuring a fair share of profits to the state in the case of windfall gains.

2.2.3.3 The supernormal profit tax would be triggered annually in cases where the overall Return on Average Capital Employed (RoACE) to the investor exceeds a pre-determined threshold.[11] The

[11] The RoACE would be measured as the post tax net income adjusted for interest expenses divided by the average capital employed.

threshold may be set at a reasonable level, to reflect the risk-reward equation: for example, two to three times the prevailing risk-free rate in the country. The risk-free rate may be determined based on the yield of the 10 year government treasury bill. This would ensure that the changing market scenario and cost of capital are taken into account. Upon reaching the threshold, the operator would be required to pay the government a share of the incremental profits that are over and above the threshold. This is in addition to the regular corporate income taxes and royalties paid by the operator. The share would be a biddable parameter, and would be the only commercial parameter for assessing bids. The Committee welcomes suggestions on the determinants of the threshold.

2.2.3.4 The fiscal administration of the contract including assessment of the super normal profit tax would be handled in totality by the revenue agencies as has been discussed in detail for Model I.

2.2.3.5 Potential challenges associated with the supernormal profit tax are discussed below:

i. Initial challenges may arise when implementing a completely new contract regime as compared to adapting the existing regime, which has been well tested over many years.
ii. Government take may be lower in the initial years of operation of the fields. Typically, it is expected that the RoACE threshold may be breached post a few years of operations. For certain fields, the threshold RoACE limit may never be reached, leading to lower government take.
iii. The methodology for setting of a threshold RoACE is not "simplistic". It is difficult to create alignment on what the industry would consider as average returns and consequently what are supernormal returns for the oil and gas sector globally. There is potential for ambiguity or subjectivity, requiring a clearly defined and robust mechanism for calculation of RoACE at a block/field level.

Given our context, the committee is of the view that either of these models can be potentially deployed to achieve greater E&P activities in India.

2.3 Initiatives for improving the administration of E&P contracts

The following section discusses initiatives for streamlining E&P contract administration and management.

2.3.1 Improving E&P bid evaluation

2.3.1.1 The current bid evaluation criteria under NELP consist of three components: technical criterion, commercial criterion and a biddable work programme. However, the bid evaluation varies according to the nature of the block, as discussed in the following sections.

2.3.1.2 **Criteria for on-land and shallow blocks:** As per the bidding criteria under NELP IX for on-land and shallow blocks, there is no technical evaluation. Bid evaluation is based on the proposed Minimum Work Programme (MWP) and the commercial terms submitted by the investor, with equal

weightage given to each. While 50% weightage is allotted to the MWP, the remaining 50% weightage is allotted to the commercial bid.

2.3.1.3 **Criteria for deepwater and ultra-deepwater blocks:** As per the bidding criteia under NELP IX for deepwater and ultra-deepwater blocks, the bid evaluation is based on the technical criterion, commercial criterion and biddable work programme. The commercial criterion carries a 50% weightage, the MWP carries 25% weightage and the technical criterion carries a 25% weightage.

2.3.1.4 In order to encourage operators with advanced technological capabilities to invest in the development of Indian basins, it essential to strengthen the technical evaluation through the following initiatives:

i. The weightage of the technical criterion must be increased to at least 50% for deepwater and ultra-deepwater blocks.
ii. The technical criterion for onshore and shallow water blocks may be awarded a 25% weightage. It is noted that advanced technical expertise, such as geology-specific experience or marginal and mature field technologies are ever more critical for the optimal exploitation of on-land and shallow water blocks as well. In countries such as Norway and the UK, technical evaluation is used as a criterion for awarding all petroleum licenses, to ensure that the operator with the right technical capability and performance record is awarded the rights.
iii. A higher weightage should be allotted to bids submitted as a consortium or Joint Venture (JV) with Indian companies, since this will encourage knowledge transfer and foster indigenous capability building.
iv. Additional technical parameters that may be considered include safety records, environmental records and geological expertise.

2.3.2 Reforms related to Operating Committee and Management Committee

2.3.2.1 Under the extant PSC regime, a Management Committee (MC) is formed, consisting of representatives from the DGH, the Ministry of Petroleum and Natural Gas (MoPNG) and the operator. To reduce government involvement in day-to-day operational decision-making, it is recommended that the MoPNG should not directly be a part of the Management Committee. The DGH, as the technical advisor of the MoPNG and the de-facto regulator, should be given the responsibility of carrying out the fiduciary and prudential oversight of the nations resources on behalf of the MoPNG. The MC should be chaired by the Director General, DGH.

2.3.2.2 The Operating Committee (OC) is equivalent to the Board of Directors of a company. Hence, minutes of the meetings of the OC should be maintained meticulously and shared with the Management Committee (MC) to enable greater transparency and streamlined communication.

2.3.3 **Contract tenure and extension**: The following initiatives may be taken to streamline the contract extension process for both new and existing contracts:

i. **Well defined contract extension process and criteria**: The current PSC does not explicitly lay out the policy or procedure for extension of contracts beyond the fixed initial tenure. This leads to uncertainty and deters investment decisions by operators in critical Enhanced Oil Recovery (EOR) and Improved Oil Recovery (IOR) initiatives required towards the stages with declining production. The requirements for contract extension - including timelines, documentation required, evaluation criteria and approval processes - must be laid out clearly to give operators the certainty that will allow them to plan their investments in advance.

ii. **Contract extension up to the end of the asset's economic life**: In most countries, original contract tenures range from 15 to 30 years. On completion of the initial contract period, extensions are granted through an objective and structured process. Different countries follow different extension models suited to their respective conditions, and range from extensions granted for a fixed time period to those granted for perpetuity i.e. up to the end of the economic life of the asset. India could explore a model that allows for contract extension up to the end of the economic life of the asset. Similar models have been followed in countries such as Australia, Colombia, USA (Gulf of Mexico) etc. Extension of the contract tenure up to the end of the economic life of the asset would create incentives for operators to focus on long-term investments such as EOR/IOR techniques or optimisation of reservoir health rather than on short-term gains. The contract could also allow for cancellation of the production license if there is no or insignificant production for five consecutive years.

2.3.4 **Stabilisation clauses**: Fiscal and regulatory stability is a key factor influencing investor sentiments and decisions. Contract stabilisation clauses are usually included to address operator concerns regarding adverse changes in the policy environment after the contract has been signed.

i. **Protection of original bargain:** The contract should include a clause that protects investor interest and national interest in the event of changes to the political or macroeconomic environment. In the case of any change in laws, regulations, policies or economic environment, both parties to the contract would be free to renegotiate and amend the contract so that no party is adversely affected. Such clauses have been introduced in contract structures of Brazil and Kazakhstan.

ii. **No retrospective changes**: Several contract structures have clauses against the introduction of regulations or policies with retrospective effect on contract fiscal terms. In the event of changes in fiscal conditions, such as new applicable tax rates, the previous licenses remain unaffected by the change, unless agreed to by the licensee. To boost investor confidence and provide a stable and predictable regime, India should introduce a similar clause to prevent retrospective changes in contract fiscal terms. Such clauses have been introduced in contract structures of Norway and the Netherlands.

2.3.5 **Operators' freedom to market gas at arm's length market prices:** The NELP contract terms should be honoured in full and gas producers should be allowed to sell gas at competitive arm's length market-determined prices in line with the terms of the contract. From an investor point

of view, there is no difference between oil production and gas production in terms of the risk profile, time for exploration or development and investment required. At the time of undertaking the exploration, investors do not know whether the discovery will be that of oil or gas. While producers are allowed international import parity prices for oil, they are offered administered prices for gas - this presents an inherent bias against gas discoveries. Chapter 7 discusses this aspect and related issues in detail.

2.4 Increasing production from mature fields

2.4.1 Mature fields are defined as those where the production has reached its peak or has started declining. More than half of India's current oil production is from maturing fields and is expected to decline in the coming years. Average recovery factors for oil fields globally are in the range of 30%-40%, with similar recovery rates for most Indian fields. However, with the application of advanced technologies recovery rates of up to 60%-70% have been achieved for some fields like Stratfjord in North Sea, unlocking a significant potential for increasing oil supply globally.[12] Increasing recovery factors of existing fields under production through the following initiatives is a low hanging fruit and can help reap significant benefits for the Indian economy.

2.4.2 **Empower Boards to allow equity participation in nomination blocks of NOCs**: Most of the mature fields in the country are currently held with the NOCs (National Oil Companies). The first step forward for increasing the recovery factors of producing fields is to enable access to advanced global technologies referred to as Enhanced Oil Recovery or Increased Oil Recovery (EOR/IOR) techniques. However, access to such technologies requires allowing equity partnerships with IOCs (International Oil Companies), other major NOCs, OFS companies and others. The government should empower NOC boards to allow equity participation by foreign and domestic private players in nomination blocks. This would bring in the much required existing global technologies, expertise and best practices for increasing oil and gas supply from the existing fields.

2.4.3 **Remove subsidy burden on mature fields**: One of the major factors hindering the application of EOR/IOR techniques in the blocks held with Indian NOCs is the under-recoveries due to the significant subsidy burden borne by them. With application of EOR/IOR techniques, the cost of production per incremental barrel of oil is more than the subsidy adjusted revenue per barrel of oil, making the application of such technologies economically unviable. Incremental production from mature fields should be exempted from subsidy sharing to ensure that investments are economically viable. The nomination blocks, which operate on quasi revenue sharing terms, should be converted to PSCs at equivalent fiscal terms in consultation with the NOC. This will ensure that the government continues to participate in the upside, brings parity with other contractors while providing the incentives for the speedy adoption of IOR and EOR measures.

[12] 'Statoil extends production life from Stratfjord A platform', November 2013, Oil and Gas Journal

2.5 Developing non conventional fossil fuels

2.5.1 Coal gasification – A game changer for enhancing energy security

2.5.1.1 India is endowed with abundant reserves of coal. Coal accounts for more than 50% of the total primary energy demand in the country.[13] With an annual production of 605 million tonnes in 2012, India ranks third globally in terms of coal production.[14] Given the domestic abundance of coal, coal gasification technologies could be an important non-conventional source of oil and gas for India.

2.5.1.2 Mined coal can be gasified in surface facilitates. Surface coal gasification (CG) technologies, which convert coal to synthesis gas which can then be converted to chemicals, fertilizer, petroleum liquids and natural gas, are well established. China alone has almost 65 such manufacturing facilitates. Synthesis gas is also used worldwide to generate power in integrated combined gas turbine (ICGT) cycle, with an efficiency of more than 50%. A suitable contract model, policies and administrative support should be developed for coal mining. By adoption of an appropriate contract regime for coal blocks producing gas, vast potential exists for India to achieve self-reliance in gas.

2.5.1.3 Technology has recently been developed to convert coal directly to natural gas. The process is proven at pilot plant scale and a demonstration plant is being erected in China. It is suggested that a demonstration plant based on the said technology be created for the high ash Indian coal.

2.5.1.4 Coal to Liquids (CTL) presents an important opportunity to improve India's energy security. CTL is a clean and environment friendly technology for conversion of coal to clean transportation fuels. The centre and the state governments should facilitate CTL projects by expediting the approvals and clearances process. The government should also provide fiscal incentives to CTL projects through low interest rate loans, grants, equity investments etc.

2.5.1.5 Underground Coal Gasification (UCG) refers to the process of converting coal, especially reserves below mineable range or thin seams to gas through injection of air and water into coal seams. UCG can capture up to 80% by converting inaccessible coal resources into coal reserves. To exploit underground coal resources, it would be necessary to deploy in-situ gasification. While a few pilot/demo facilitates are created worldwide, India needs to set up demo units to validate available technology for adoption for Indian coal. According to some estimates if 5% of India’s non-mineable coal reserves are successfully utilized for gasification, it could yield three-trillion cubic metres of gas equivalent.[15]

[13] BP Statistical Review of World Energy, 2013, BP
[14] BP Statistical Review of World Energy, 2013, BP
[15] 'India seeks collaboration with SA on coal gasification technology' 2013- Mining Weekly, 2013

2.5.2 Shale gas resources

2.5.2.1 Shale gas refers to natural gas trapped in shale formations. In the USA, the successful extraction of shale gas reserves has lead to a significant increase in gas supplies and a decline in gas prices. In less than a decade, the USA is soon likely to transition from being a gas deficient nation to a gas surplus nation. Given the remarkable success of shale gas extraction in the USA, many countries have taken initiatives to tap into shale gas resources. According to some industry estimates, shale gas may account for more than 75% of India's untapped yet-to-find potential of hydrocarbons.[16] It is therefore important to develop a robust policy framework for the exploration and development of shale gas resources. The current policy permits only NOCs to explore shale oil and gas resources from on-land blocks allotted to them on nomination basis. India should also put in place a policy to allow private players to explore shale oil and gas resources from nominated blocks.

2.5.3 Other non conventional fossil fuels

2.5.3.1 Initiatives for development of other non conventional fossil fuels like bio-fuels and gas hydrates have been discussed in chapter 8 on 'Building R&D Capabilities'.

[16] Rystad Database

Chapter III: Institutional reforms

3 Institutional reforms

Several institutional and administrative reforms need to be undertaken in order to facilitate E&P activity in the country. These are discussed below.

3.1 DGH as an independent regulator

3.1.1 One of the foremost requirements for sustainable growth of any industry or sector is an effective regulation mechanism for protecting the interests of consumers and investors. The present set up, with no independent regulation mechanism for the upstream oil and gas sector, leads to several inherent conflicts of interest and dampens investor confidence.

3.1.2 The Ministry of Petroleum and Natural Gas (MoPNG) currently plays multiple roles of policy maker, regulator and operator for India's upstream oil and gas sector. The government's majority stake in India's National Oil Companies (NOCs), implies that MoPNG has an interest in the NOCs, creating a conflict of interest with its role as a regulator. The Directorate General of Hydrocarbons (DGH) acts as a technical advisor to the MoPNG and is only a 'recommendatory' body.

3.1.3 Staff members of the DGH are appointed from the NOCs on deputation and return to their firms after completion of their tenure, potentially creating additional conflicts of interest.

3.1.4 In addition to its central function as a policy maker, the MoPNG is also required to participate in operational decisions related to E&P activities that are not strategic in nature, such as granting extensions, reviewing the MWP (Minimum Work Programme), determining development areas etc. This also results in execution delays since the requests of E&P operators are first evaluated by the DGH and then taken up by the Ministry for consideration.

3.1.5 One of the foremost examples of an empowered independent regulator in India is SEBI (Securities Exchange Board of India), the securities market regulator. The asset base of the securities market in India, at approximately USD 1.5 trillion, is equivalent to the market value of established hydrocarbon reserves in India.[17] The comparable asset base emphasizes the need for a similar robust and transparent regulatory framework for the upstream oil and gas sector.

3.1.6 An independent and empowered regulator for the upstream oil and gas sector would allay investor fears and provide the much required impetus to further investment in the sector. Hence, there is a pressing need for transitioning the DGH to become an independent regulator to oversee the governance of the upstream oil and gas sector in India.

3.1.7 The need for an independent regulator has also been highlighted previously by other expert Committees. The Ashok Chawla Committee on Allocation of Natural Resources in 2011 had advised

[17] Approximate market capitalization of publicly listed companies in India is USD 1.5 trillion. As per Rystad database, estimated size of discovered oil and gas reserved in India is 15 billion BOE and oil price is assumed to be USD 100 / barrel

on reorientation of the role of the DGH to become an in independent regulator. Earlier, the Naresh Narad Committee in 2001 had proposed setting up of an Upstream Hydrocarbon Regulatory Board for regulation of upstream activities.

3.1.8 The DGH should function as the custodian of India's hydrocarbon resources. The primary role of the DGH is prudential and fiduciary oversight of the nation's hydrocarbon resources i.e. ensuring that accelerated exploration, optimal exploitation, development and utilization of hydrocarbon resources is carried out in an environmentally sustainable manner. The DGH should be a techno-economic regulator responsible for the following:

3.1.8.1 **Prudential and fiduciary oversight of hydrocarbon resources**

i. Regulation of technical aspects of E&P contracts, including licensing and exploration periods, MWP, transfers and farm-outs, abandonment, relinquishment, site restoration etc.
ii. Approval of the DOC (Declaration of Commerciality) and FDP (Field Development Plan).
iii. Facilitating the approvals processes and representing investors' interests where appropriate
iv. Laying down Good International Petroleum Industry Practices (GIPIP) norms in the Indian context and ensuring compliance with these norms.
v. Laying down Health Safety and Environmental (HSE) norms in the Indian context and ensuring compliance with these norms.

3.1.8.2 **Economic administration**

i. Selection of blocks for auctioning; conducting and evaluating bids.
ii. Providing required contract documents to Revenue Department for calculation of the government take and resolving queries of Revenue Department if any.

3.1.8.3 **Knowledge hub for the E&P sector**

i. Serving as a knowledge hub for dissemination and sharing of global best practices.
ii. Tracking latest technology innovations locally and globally to serve as a facilitator for partnership opportunities and knowledge sharing.
iii. Collecting and maintaining geological information for the National Data Repository (NDR).

3.2 Empowerment of the DGH

3.2.1 Development of appropriate funding and manpower models for the DGH, as discussed below, is essential to ensure that it is independent and effective.

3.2.2 **Independent source of funding**: To ensure that the DGH is impartial in its functioning and decision making, it should have an independent source of funds along the lines of SEBI. Financial independence is critical in enabling SEBI to function as an effective regulator. The funding for DGH may be obtained through an uninterrupted transfer of a predetermined proportion of the Oil Industry Development (OID) cess fund to the DGH for day to day functioning. For special projects of strategic

importance undertaken by the DGH, allocation of funds from the OID cess may be approved on a needs basis.

3.2.3 **Multidisciplinary multi-member body**: The DGH should be set up as a high-powered multi-member, multi-disciplinary body with professional teams that have expertise in several domains, including technical, legal, financial and environmental areas. This will ensure that it is equipped to take informed decisions and to act as a facilitator for the development of India's oil and gas sector. Through a model similar to that of SEBI, the DGH should also be able to set up internal sub-committees to deliberate and provide expertise on specific topics. The systems and processes of the DGH should be at par with the global best practices.

3.2.4 **Access to professional global experts**: The DGH should serve as repository of independent technical knowledge for the industry and government. Given the technical complexities involved and the industry's rapid evolution, the DGH should have the freedom to recruit and engage subject experts from within India or from abroad, as and when required.

3.2.5 **Independent staffing mechanism with competitive remuneration:** To ensure that it is protected from undue influence and remains fair and impartial in decision making, the DGH should have an independent cadre of staff members. These employees should be on permanent payrolls, as opposed to the current mechanism which involves appointing personnel on deputation from the NOCs. At the same time the flexibility to maintain temporary staff should be maintained to cater to cyclic manpower requirements. The DGH should be empowered to offer attractive and competitive remuneration to ensure that it can attract the best talent from the industry.

3.2.6 **High status of the regulator**: The status of the DGH should be equivalent to that of the country's other established regulators, such as SEBI.The status and rank of the head of the DGH should be at par with other empowered regulators in the country like TRAI, CCI, SEBI and others. The terms offered to the head must be competitive and attractive. Also, the head must have a fixed tenure of five years and retirement at the age of 65 years, whichever is earlier.

3.2.7 **Appellate tribunal in DGH:** In view of the strategic importance of the oil and gas sector for the Indian economy and the large resource base under the purview of the DGH, an effective and transparent dispute resolution process is critical. Similar to the Securities Appellate Tribunal in SEBI, an appellate tribunal should be formed as a part of DGH. This will enable speedy and efficient dispute resolution by giving the regulator quasi judicial powers.

3.3 Fiscal reforms

3.3.1 **Adopt same 'Mineral Oil' definition in Income Tax Act as ORD Act**: Currently there are discrepancies in the definitions of 'Mineral Oil' used in several clauses of the Income Tax Act, 1961, leading to confusion and disputes. Hence, the Income Tax Act should be modified to adopt the

same definition for 'Mineral Oil' as has been laid out in the Oilfields Regulation and Development (ORD) Act, 1948.

3.3.2 **Include oil and gas in GST**: In the current taxation regime, differential taxes are levied by different states on natural gas and crude oil. The VAT (Value Added Tax) on gas varies from 0% to 25% in different states while that on crude oil varies from 4% to 5%. Some states allow for a VAT credit while others do not. Apart from leading to a significant variation in prices across the country, it also leads to double taxation in case of gas swaps. Oil and gas should be included under the GST (Goods and Services Tax) to enable moving towards a uniform structure of pricing across the country, simplifying the process of gas pooling and preventing double taxation in gas swap arrangements.

3.3.3 **Remove customs duty on LNG**: Currently, a 5% customs duty is levied on imported LNG (Liquefied Natural Gas). However, LNG imports for power generation are exempt from the customs duty. The import duty waiver should be extended to all LNG imports to encourage usage of natural gas, a clean and environment-friendly fuel.

3.4 Strengthening the role of PNGRB

3.4.1 Initiatives to strengthen and empower the downstream regulator PNGRB (Petroleum and Natural Gas Regulatory Board) must be taken along the lines of the initiatives for DGH. PNGRB must be provided with an independent cadre of staff with competitive remuneration and access to professional experts. This will help in building the required capabilities for effective sector regulation.

3.5 Setting up an empowered Cabinet Committee on Energy (CCE)

3.5.1 In India, multiple ministries and government bodies were responsible for formulating and implementing energy policies, namely:

i. The Ministry of Power is responsible for the complete value chain of the power sector
ii. The Ministry of Coal is responsible for the exploration and development of coal reserves
iii. The Ministry of New and Renewable Energy is responsible for increasing the use of renewable sources, like wind, solar and small hydro
iv. The Ministry of Petroleum and Natural Gas is responsible for oil and natural gas, including exploration, production, marketing and import/export
v. The Department of Atomic Energy under the direct charge of the Prime Minister, is responsible for India's nuclear policy[18]

3.5.2 This structure has several weaknesses, including:

i. Lack of a high-level executive body for the formulation and implementation of a coordinated and integrated energy policy that is streamlined across different energy resources. This also results in lack of authority and accountability.

[18] Understanding Energy Challenges in India, 2012, International Energy Association

ii. Lack of inter-ministerial and inter-departmental coordination between the energy-related bodies for policy making, managing conflicts and optimizing resources.
iii. Lack of coordination between energy-related bodies and other ministerial bodies such as the Ministry of Environment and Forests and the Ministry of Defense, which hampers the approval process for projects of national importance.
iv. Lack of a holistic view in maximizing efficiency of existing resources and managing demand.

3.5.3 The recent move to integrate the Ministries of Power, Coal and New and Renewable Energy is a step in the right direction and will help enable, better co-ordination and a comprehensive planning.

3.5.4 Apart from multiple energy related ministries, India's progress towards energy security is limited by the presence of multiple energy related policies–the Integrated Energy Policy, the Five Year Plans and the National Action Plan on Climate Change. While these are designed to address the growing challenges in the energy sector and to establish a workable path towards achieving India's energy objective, they need to be brought under a single umbrella.

3.5.5 To give energy its rightful importance in the national agenda, an empowered Cabinet Committee on Energy (CCE) should be set up, with the objective of formulating a coordinated policy cutting across ministries so as to improve the overall energy scenario in the country while addressing energy security concerns.

3.5.6 The CCE, chaired by the Prime Minister, should consist of the Union Ministers of Finance, Power, Coal and Renewable Energy, External Affairs, Environment and Forests and Petroleum and Natural Gas; Chairman, Department of Atomic Energy; National Security Advisor; Cabinet Secretary and Principal Secretary to the Prime Minister. The CCE may be serviced by the agency in succession to the Planning Commission.

3.5.7 The involvement of the Ministry of External Affairs is important from the perspective of international energy policies-imports, transnational pipelines and acquisition of 'equity oil'. Membership of the Ministry of Environment and Forests is important to streamline approvals and clearances.

3.5.8 Global best practices also indicate that most countries have a single ministry or department to handle all energy related policies and issues for greater coordination and integration:

i. **USA:** The US Department of Energy, a cabinet-level department, is responsible for addressing energy, environmental and nuclear challenges.
ii. **UK:** The Department of Energy and Climate change, a ministerial department, works to secure clean and affordable energy supplies and promote action on climate change.
iii. **Brazil**: The Ministry of Mines and Energy fosters investments in mining and energy-related activities, funds research and sets government policies.
iv. **Australia**: The Department of Innovation, Industry, Science and Research provides advisory services and policy support regarding resources and energy.

3.6 Role of the Cabinet Committee on Energy

3.6.1 **Formulation of an integrated national energy policy**: It is essential to develop a comprehensive and integrated energy policy incorporating issues of national importance such as promoting energy security, creating an appropriate energy mix and combating climate change. The Integrated Energy Policy (IEP) launched in 2008 was the first comprehensive energy policy that the government established to oversee all aspects of energy use and supply.[19] However, it has not been revised since 2008. This policy needs to be renewed and updated continually in line with the changing energy scenario.

3.6.2 **Formulation of an international energy policy:** Countries are increasingly expanding their global footprint to secure energy supplies. Several bilateral and multilateral initiatives are under way for acquisition of 'equity oil', development of transnational gas pipelines, and diversification of the supply base for oil and gas imports. These are complex issues that are central to ensuring India's energy security and require centralized management and collaboration between energy related ministries and the Ministry of External Affairs.

3.6.3 **Promoting R&D and innovation in energy:** Technological innovation underpins the successful exploration and consumption of domestic energy resources. However, in India, R&D efforts currently lack focus and are dispersed across multiple agencies. To prevent duplication of effort and ensure that funds are directed towards the relevant initiatives, it is essential to put in place appropriate governance mechanisms.

3.6.4 **Promoting energy efficiency, conservation and supply and demand management:** Given India's sizeable and increasing consumption of energy, an integrated view of supply and demand is essential, as is the creation of incentives for industry to use efficient technologies and the raising of consumer awareness for reducing wastage of existing resources. The executive Committee can lay out guidelines and propose policy measures that promote the development of energy efficient technologies for energy conservation.

3.6.5 **Inter-ministerial coordination and single window clearances:** Lack of inter-ministerial coordination in awarding clearances or approvals has lead to delays and financial losses in several projects of national or strategic interest. Hence, the Committee should take initiatives to streamline the approvals processes.

3.6.6 **Submission of an annual report on energy**: Given the importance of energy in our national agenda and the criticality of energy in supporting our growth targets, the succession agency of the Planning Commission should submit an annual report on the energy scenario to the Parliament, covering critical issues like status of implementation of energy policies, energy security, demand management, conservation, energy mix etc.

[19] Understanding Energy Challenges in India, 2012, International Energy Association

3.7 Streamlining the approval and clearance process

3.7.1 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 the investor sentiment, but also results in significant project delays and financial losses for operators.

3.7.2 The government must endeavour to secure all possible clearances before the award of blocks, based on the experiences of approvals required in other similar projects. This will increase confidence of operators and reduce project delays. Also, 'in-principle' clearances or approvals awarded before award of blocks must be honoured and should not warrant a re-approval. 'In-principle clearances must be carefully evaluated prior to award and may highlight 'exceptions' or 'no-go' areas. Clearances not awarded within the stipulated time frames should be deemed approved.

3.8 Engagement with state governments for E&P activities

3.8.1 State governments play an important role in facilitating E&P activities, for both on-land and off-shore blocks. 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. indicating the criticality of support from state governments to E&P activities. 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. Given the mutuality of interests, relations between the center and state governments must be strengthened.

3.8.2 The external dimensions, due to large oil import dependence have led to the states becoming aloof from pro-active support to this industry. The placement of oil and gas in the Union List has also not helped matters. The growth of large CPSUs in this sector has further enforced the view, that the states have perhaps no role to play other than tax oil and gas to shore up their revenues.

3.8.3 Opportunities which could potentially be harnessed by the state from hydrocarbon operations have not been realised. There is need to align state priorities with national priorities of energy security through the following initiatives:

i. Often states do not fully appreciate the financial gains accruing from oil and gas as has been witnessed in Rajasthan. 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- that extend beyond royalty, profit share and sales tax receipts, and could arise from the downstream activities undertaken within the state. The NELP/CBM contracts provide for ad valorem rates of royalty, which offer a large potential for the state governments. The possibility of setting up a Rajasthan Refinery indicates the potential which exists in local oil and gas success.

ii. Several states hold a grievance that while major pipelines cross or are planned through their state, no preference is given to them in gas allocation. Some states do not have oil and gas operations but are important for routing of oil and gas pipelines, and policy provisions are required to incentivize their cooperation, e.g. giving a due share of the gas to the states through which the pipelines pass.

iii. Some states like Gujarat, Andhra Pradesh and Assam have instituted departments of petroleum, and state owned PSUs to undertake oil and gas related activities both in the state and outside. GSPC is a good example for such an endeavour. If the state governments are to actively participate in exploration, production, value addition and related activities, they must develop technical competency within the states. The state governments should set up a directorate of oil and gas, housed in the Department of Industries. The above directorate may have deputationists from the Directorate of Geology as well as urban administration to oversee exploratory and CGD related aspects of this business. This would ensure that there is an institutional mechanism to support E&P activities, and also to develop a vision for higher uptake of gas in the state.

iv. Increasing the share of natural gas in the energy mix of India requires participation of the states. The adoption of CNG in urban transport, PNG in the domestic sector and LNG in industries; development of gas pipelines and storage facilities and expediting E&P activity- all need a friendly ecosystem. An institutional mechanism must be created whereby the Minister, MoPNG chairs a yearly conference of energy ministers, to discuss the growth of oil and gas production/consumption in the states. This is similar to the power conference chaired by the Union Minister of Power with power ministers of states.

3.8.4 Achieving India's energy security objectives requires providing adequate incentivize to the states, by creating local interest for them in the growth of this industry. In the light of the rapid strides made by shale gas in the US and likely success in many emerging countries like Argentina, Mexico and China, India will have to exploit this resource in the years to come. Access to land and water will be the most critical elements of a shale gas exploration drive, which will not succeed unless there is an active role and opportunity for the state governments.

Chapter IV: Deployment of OID funds

4 Deployment of OID funds for the development of the oil and gas sector

4.1 Context and current scenario

4.1.1 The Oil Industry (Development) Act 1974 provides for the collection of cess as an excise duty on indigenous crude oil and natural gas consumption. It was enacted following successive and steep increases in the international price of crude oil and was designed to collect funds for the development of the domestic oil and gas sector to shore up India's energy security.

4.1.2 The proceeds of the cess levied under the Act are credited to the Consolidated Fund of India under the purview of the government and paid to the Oil Industry Development Board (OIDB) from time to time. However, from the cess amount of more than INR 104,034 crore collected between its inception and 31st March 2012, the government has paid only INR 902.4 crore to the OIDB. Also, no allocation was made to the OIDB after 1991-92.[20] While the government may also pay the OIDB by way of grants or loans as required, no loan or grant has so far been given to the OIDB.

4.2 Utilization of OID funds

4.2.1 It is critical to deploy the OIDB funds for the development of India's oil and gas sector and hence reduce import dependence. The OID cess funds, which should be transferred to the OIDB on a needs basis, may be used for purposes that include:

i. Appraisal of unexplored or partly explored acreages by carrying out seismic surveys and drilling of exploratory parametric wells for creating a credible database.
ii. Development of infrastructure for common use, including gas pipelines, gas distribution centres, LNG terminals and storage tanks
iii. Collection of data and the creation of a National Data Repository (NDR).
iv. Development of the oil field equipment and services sector like setting up of 'Petroleum Clusters'.
v. Development of skilled manpower for the oil and gas sector.
vi. R&D programmes executed by academic and/or state-funded research institutes.
vii. Any other projects designed to increase energy security.
viii. Supporting NOCs with financial assistance in strategic projects that are economically unviable.

[20] OIDB Annual Report, 2012

Chapter V: Development of OFS sector

5 Promotion of Domestic Oil Field Services (OFS) sector

5.1 'Petroleum Clusters' for promotion of indigenous oil field services sector

5.1.1 India currently imports approximately 90% of its E&P service requirements.[21] Indian Oil Field Services (OFS) companies tend to lag behind their global peers in terms of technology and manpower capabilities. Underdevelopment of the local market for OFS has several drawbacks for India including its inability to participate in the global market for OFS, a market estimated to be USD 300 billion in size.[22] Additionally, reliance on imported services leads to higher costs, restricted competition and poor service quality for Indian E&P players.

5.1.2 All stakeholders, the government, E&P companies and service providers stand to benefit substantially if steps are taken to develop OFS sector in India. Establishing two petroleum clusters - one along the eastern coast and the other along the western coast – could kick-start the development of the OFS sector in India. Through fiscal and non-fiscal incentives, an economic zone or cluster would help to attract the interest of foreign E&P service providers. Over time, this zone could act as a medium for knowledge sharing and transfer of technologies and skills to local players. After reaching considerable scale, the zone could also act as an export hub for servicing other active E&P regions like the Middle East and Asia Pacific.

5.1.3 Dedicated geographical regions could be demarcated along the western coastline (for example at Dahej, which could service onshore and offshore assets in the Arabian Sea and Middle East) and along the eastern coastline (for example, at Kakinada, which could service south east Asian countries with a focus on deep water or ultra-deepwater assets).

5.1.4 The value proposition of a petroleum cluster lies in its proximity to different stakeholders across the oil and gas value chain, presence of state-of-the art infrastructure facilities, fiscal benefits and simplification of approvals and other administrative processes as discussed below:

i. **Favourable location for servicing domestic as well as regional requirements:** The cluster should be located so as to provide easy access and proximity to active E&P locations within India (KG Basin) and to be able to serve the region (neighbouring countries in South and South East Asia)

ii. **State-of-the-art infrastructure facilities:** Access to robust infrastructure facilities should be provided. These include transportation facilities, communication facilities and logistics facilities, including warehousing and material handling services.

[21] FICCI presentation to Committee
[22] FICCI presentation to Committee

iii. **Fiscal incentives:** Fiscal and taxation incentives should be provided in line with the extant policies of other Special Economic Zones (SEZs) in the country.

iv. **Reduction of administrative overheads**: Administrative overheads should be reduced by providing fast-track approvals, single window clearances and by minimizing administrative overheads for activities such as imports, exports and equipment movement.

5.1.5 Several countries, including Singapore, Malaysia, UAE and Nigeria have leveraged similar petroleum economic zone models to develop the local oil field services industry. In Nigeria, the free zone has attracted more than 140 major companies and created more than 30,000 jobs (directly and indirectly), also resulting in the transfer of technological skills, an increase in local participation and substantial revenue savings for the government.[23]

5.1.6 The need for development of petroleum clusters has also been emphasized in the Report of the National Working Committee on 'Developing Strategy to Encourage Global E&P Technology and Oilfield Service Providers to Consider India as a Hub' under the leadership of Sanjay Burman Roy in 2005. The report highlights that 'The E&P industry is already facing the bottleneck of services on cost, quality and timeliness front. Unless India is prepared to facilitate growth of service industry to be able to address to the above described growth in service requirement, the development of E&P industry and energy security would be compromised. Oilfield service providers specific SEZ or PEZ may be considered to represent the future of E&P service industry development strategy, especially since all the services are most suited to be located together in near vicinity of the upstream industry. PEZ model is expected to attract international companies' investments in India.' The Petroleum Clusters may be developed in-line with the best practices laid out in the aforementioned report.

5.2 Other measures for promotion of indigenous OFS sector

5.2.1 To promote a local oil field services sector, the government can also explore the provision of tax incentives to E&P companies that employ the services of Indian providers or mandate that all services must be provided by companies that have a majority ownership by Indian nationals.

5.2.2 A variety of clauses designed to increase use of local providers has also been used by other countries including Brazil, Norway, Indonesia and Malaysia. In Norway, government initiatives have included establishing regulations, encouraging local enterprises and building local capabilities through R&D, education and training. These have enabled Norway to transition from having almost no local content in the 1960s to becoming home to several leading global OFS providers. Similarly, in Brazil, government initiatives and regulations helped increase local content from about 25% in 2000 to about 60% in 2005.

5.2.3 However, given that Indian OFS providers are in the nascent stages of development, measures to increase local content should be implemented after a period of three to five years, during which Indian OFS providers can work towards upgrading their skills, technologies and

[23] FICCI presentation to Committee

systems. Concurrently, the price preference clauses included in current contracts must be done away with.

Chapter VI: Building gas pipeline infrastructure

6 Building gas pipeline infrastructure

6.1 Introduction and context

6.1.1 Natural gas is cited as the fuel of the 21st century and is expected to play an important role in economies globally.[24] India faces a significant challenge in providing access to adequate, affordable and clean sources of energy to a rapidly growing population. Given the supply uncertainty and the price fluctuations in crude oil, natural gas is an important alternative energy resource that the country needs to tap into. Natural gas can play an instrumental role in helping meet the growing demand for energy and ensuring India's energy security.

6.1.2 Natural gas accounted for 24% of the world's total primary energy consumption in 2012 and is likely to play an even greater role in the global energy scenario.[25] The share of natural gas in India's energy mix, at the current level of 9%, lags behind the global average.[26] However, India's share of natural gas is expected to increase to 20% by 2025.[27] The Committee believes that the share of natural gas should be further increased to 25% in the same time period with careful planning and implementation of gas infrastructure projects and pricing policies.

6.1.3 One of the greatest success stories of natural gas utilization is the extraction of shale gas in the United States, which has revolutionized that country's energy scenario and contributed to economic growth. The extraction of shale gas has lead to a significant increase in gas supply and hence a decline in gas prices in the US, making gas a more affordable source of energy. The US is transitioning from being an energy deficient nation to being an exporter of energy. It is believed that the shale gas 'revolution' in the US offers the country the opportunity to strengthen its economic and geopolitical position by responding to the global demand for energy, while bolstering its long-term competitive position in the global market.[28]

6.2 Strategic importance of natural gas

6.2.1 Natural gas has several advantages that need to be considered carefully when formulating a long-term strategy and outlook for natural gas in India. These are discussed below.

6.2.2 **Environmentally friendly fuel with low carbon emissions:** Natural gas is the cleanest fossil fuel and is considered to be a potential bridge fuel to a low carbon economy, particularly by replacing coal based power plants. To produce the same amount of heat, natural gas emits 30% less carbon dioxide than oil and 45% less carbon dioxide than coal, thereby improving air quality

[24] 'India's Oil Policy for the Next Century', Third Lovraj Kumar Memorial Lecture, 1996, Dr. Vijay Kelkar
[25] BP Statistical Review of World Energy 2013, BP
[26] BP Statistical Review of World Energy 2013, BP
[27] India Hydrocarbon Vision- 2025
[28] 'Energy and Climate: Black to Gold to Green' by C. Ebinger and K. Massy, 2013, Brookings Institution

and contributing to greenhouse gas reduction. Natural gas combustion also emits less particulate matter, sulphur dioxide and nitrogen oxide than coal or oil.[29] Global warming and carbon emission reduction are among the most critical challenges facing the world and are increasingly becoming a priority for governments. India too, under the Copenhagen Accord, has committed to emission reduction targets of 20-25% relative to 2005 levels by 2020.

6.2.3 **Vast and globally dispersed resource base:** According to estimates, worldwide proven gas reserves (discovered volumes that can be produced economically with existing technology at current gas prices) are approximately 190 trillion cubic metres (tcm) or about 56 times current annual global gas production levels. However, recoverable gas resources (volumes that analysts are confident will be discovered or that technology can be developed to produce them) are much larger. Conventional recoverable gas resources are estimated to be equivalent to 120 years of current global consumption. All major regions of the world have recoverable reserves equal to at least 75 years of current consumption, implying that gas resources are not concentrated in a particular region and enhancing energy security.[30]

6.2.4 **Higher efficiency in power generation:** Natural gas is used as an input fuel for combined cycle power plants that are more energy efficient than conventional power plants. In combined cycle power plants the waste heat from power generation can be recaptured for heating or cooling. While traditional centralised coal-based power plants globally have an efficiency of 30%-35%, gas-based centralised combined cycle power plants can attain efficiencies of 40%-50% by recapturing the waste heat.[31] Since additional 25%-30% electricity is lost in grid transmission and distribution networks, an alternative to centralised power generation is distributed power generation. Distributed power generation in combined cycle mode can help achieve total system efficiencies of 70%-80%.[32] Hence, there is large potential for energy saving by use of gas for distributed combined cycle power generation.

6.2.5 **Increased convenience with fewer supply disruptions:** Natural gas is a convenient source of energy since it can be piped directly to the customer through safe and efficient pipeline systems. Unlike oil, it does not need to be stored onsite in tanks and no deliveries need to be scheduled. Also, there is potential for fewer supply disruptions since pipelines are mostly underground.

6.2.6 **High potential for syngas and natural gas from coal reserves:** India is abundantly endowed with coal reserves, creating significant potential for gasification of coal to produce syngas. Underground Coal Gasification (UCG) can increase recoverable coal reserves by 200%-250% by accessing non-mineable coal. According to some estimates, if 5% of India's non-mineable coal reserves are successfully utilized for gasification, it could yield three trillion cubic metres of gas

[29] Natural Gas in the US Economy - Opportunities for growth, 2012, Federation of American Scientists
[30] Are we Entering a Golden Age of Gas, 2011, International Energy Agency
[31] Technology Roadmap: High-Efficiency, Low-Emissions Coal-Fired Power Generation, 2012, International Energy Agency
[32] The Role of Distributed Generation and Combined Heat and Power (CHP) Systems in Data Centers, 2007, US Energy Information Administration

equivalent.[33] Recently, cost effective technologies for conversion of coal to natural gas have also been developed, which can be gainfully deployed by India.

6.3 Developing gas pipeline infrastructure

6.3.1 In view of the advantages of natural gas, concrete steps should be taken to attain the targeted 20-25% share of natural gas in India's energy mix by 2025. Increasing the use of natural gas requires initiatives for development of the ecosystem consisting of gas infrastructure, demand, and supply.

i. **Infrastructure**: Development of gas infrastructure is the most critical enabler for transition to a gas-based economy and infrastructure creation has to be spearheaded ahead of the market. This topic has been discussed at length in this chapter.
ii. **Supply:** The most important initiatives for increasing gas supply are transitioning to arm's length marked-determined gas prices, development of transnational pipelines and coal gasification. These have been discussed in-depth in various sections of the report.
iii. **Demand:** Given the several inherent advantages of natural gas, specific initiatives need to be taken by the government for the development of gas demand and education of users in the country. Potential uses of gas for power generation are discussed in the later sections.

6.3.2 India presently has a network of about 13,000 km of natural gas transmission pipelines with a design capacity of approximately 337 mmscmd (million standard cubic metres per day).[34] However, the pipeline network has been developed mostly in the northern and western regions. A large part of the country lacks distribution infrastructure, preventing the full unlocking of the large potential of gas as an efficient and reliable energy option. (Refer Annexure D for map of pipeline infrastructure in India)

Exhibit 2: Regional distribution of gas transmission infrastructure in India

Region	Approx. % of gas P/L network	% of consumption	States with pipeline infrastructure	States lacking pipeline infrastructure
Western	40%	53%	Gujarat, Maharashtra	Goa
Northern	20%	26%	Delhi, UP, Haryana, Rajasthan	Punjab, J&K, HP, Uttarakhand
Central	13%	3%	MP	Chhattisgarh
Southern	16%	14%	TN, Andhra Pradesh	Kerala, Karnataka
Eastern	0	NIL		Bihar, WB, Jharkhand, Orissa
North Eastern	10%	4%	Assam, Tripura	Meghalaya, Sikkim, AP, Mizoram, Manipur, Nagaland

Source: Vision 2030, Natural gas Infrastructure in India, PNGRB

[33] 'India seeks collaboration with SA on coal gasification technology' 2013- Mining Weekly, 2013
[34] Vision 2030, Natural Gas Infrastructure in India, 2013, PNGRB

6.3.3 An analysis of developed gas markets where natural gas accounts for a significant portion of energy consumption indicates that gas pipeline infrastructure is critical for market development.

i. In the United States, where gas accounted for 30% of the primary energy mix in 2012, an extensive and integrated pipeline network that can transport natural gas to and from almost any location has been developed.[35] The natural gas pipeline grid comprises more than 210 pipeline systems with 491,000 km of transmission pipelines. In addition, several underground storage facilities, delivery, receipt and interconnection points have facilitated the evolution of a competitive and active natural gas market.[36]
ii. In the United Kingdom, where gas accounted for approximately 35% of the primary energy mix in 2012, gas transportation infrastructure consists of the National Transmission System, similar to a national grid of gas pipelines.[37] The network spanning 7600 km connects production through terminals to distribution systems.[38]

6.3.4 In order to encourage the development of gas markets in India, it is critical to put in place gas pipeline infrastructure to connect gas supply and demand centres. The pipeline infrastructure should be created 'ahead of the market' to act as a facilitator for market development. This would ensure wider availability across all regions and would contribute to uniform economic and social development. Adequate pipeline infrastructure will increase the use and availability of natural gas in India by providing a vital link between gas sources and markets.

6.3.5 The gas infrastructure – transmission pipelines, CGD network, LNG terminals etc. should operate on a common carrier principle to allow transparent and non discriminatory access to pipeline infrastructure. Such open access norms will prevent monopolization of the market.

6.3.6 The pipelines should be used for transporting gas from both conventional and unconventional sources to encourage development of additional sources of gas like coal gasification, coal bed methane, shale, hydrates etc.

6.4 Structural transformation of gas markets

6.4.1 Multiple stakeholders with clear responsibilities are involved along the gas value chain:

i. Producers carry out gas exploration and production activities.
ii. Marketers connect buyers and sellers and earn margins by buying and selling gas
iii. Transporters and distributors are responsible for the delivery of gas to end users; they handle both the transportation and storage networks needed to supply natural gas.

6.4.2 In India, production, marketing and distribution are often vertically integrated and undertaken by the same entity. This leads to market distortion, since the producer can monopolize the market by restricting access to pipeline infrastructure, which it controls. Current rules mandate only financial and accounting unbundling of distribution roles from production and marketing roles.

[35] BP Statistical Review of World Energy, 2013, BP
[36] About US Natural Gas Pipelines, US Energy Information Administration (Based on 2007/08 data)
[37] BP Statistical Review of World Energy, 2013, BP
[38] National Grid Annual Report and Accounts, 2013-14

6.4.3 International best practices indicate that unbundling is crucial for the creation of a competitive market and protection of consumer interests by preventing monopolization.

i. In the United Kingdom, gas transportation services are unbundled from marketing and production. National Grid is the sole owner and operator of gas transmission infrastructure in the UK. Gas producers supply gas to the National Transmission System (NTS) through reception terminals. Gas from the import terminals is injected into the NTS after undertaking quality checks.
ii. In the United States complete unbundling of transportation and marketing roles (i.e. financial, legal and ownership unbundling) exists. Pipeline capacity is traded in the on electronic systems in the secondary market to ensure that all transactions are transparent.

6.4.4 India should also undertake reforms to bring about not only financial but also legal unbundling of gas distribution. India should mandate both financial and legal unbundling of gas transportation from production or marketing activities. Unbundling will help prevent monopolization of the market and enable open access to pipeline infrastructure. This is in line with the current PNGRB mandate for legal and financial unbundling of transporter roles from marketing or production by 2017.

6.4.5 Over the next few years, steps should be taken to move towards complete ownership unbundling of gas transportation from marketing or production. Ownership unbundling will enable complete open access to pipeline infrastructure and should be initiated once the market is developed with adequate producers and consumers of natural gas.

6.4.6 Here, learning points can be drawn from the pioneering policy reforms initiated in the power sector in India under The Electricity Act of 2003. Salient features of the Act that led to the restructuring of the industry are:

i. Unbundling of the vertically integrated State Electricity Boards (SEBs) into separate companies for power generation, transmission and distribution. This led to greater efficiency by streamlining operations and promoting greater transparency and accountability.
ii. Enabling open access to transmission infrastructure and the development of a free market by allowing any consumer to buy power from any generator. This encouraged greater competition in the sector.
iii. Institution of the Central Electricity Regulatory Commission (CERC) and the State Electricity Regulatory Commission (SERC) for tariff regulation.

6.5 Government led development of a natural gas grid

6.5.1 Pipeline infrastructure consists of trunk pipelines, branch or spur-lines and city gas networks. Trunk pipelines connect producing and consuming centres, and are meant for long distance transmission. Spur-lines interconnect pipeline networks, while city gas networks draw gas from trunk or spur-lines at the city gate and are responsible for city wide distribution.

6.5.2 It is expected that India's existing trunk pipeline network will be expanded to around 28,000 km, with a total design capacity of around 721 mmscmd in the next five-to-six years.[39] However, no centralized plan for a development of a long-term national grid is in place. The development of new pipeline networks is market driven (i.e. it can be initiated by any interested public or private entity) and bid based. While the initial proposal has been finalised through a public consultation process, it lacks detailed techno-economic viability assessment.

6.5.3 Considering the centrality and strategic importance of natural gas in meeting India's growing energy needs, the onerous task of building a natural gas grid or trunk pipelines should be taken up by the government. It is recommended that the government develop the country's trunk pipeline infrastructure through a Public Sector Unit (PSU) or Public Sector Enterprise (PSE) that has some experience in developing gas infrastructure. The arm responsible for creation of pipeline infrastructure should be unbundled from production or marketing arms. This will allow the entity to place dedicated focus on creation of pipeline infrastructure. The funding for trunk pipeline development should be provided through tax financing and through the OID cess funds.

6.5.4 The state-owned enterprise will be responsible for end-to-end development, from planning to execution and operation of trunk pipeline infrastructure. The central responsibilities are:

i. **Preparing the blueprint for the development of pipeline infrastructure:** The blueprint for developing gas pipeline infrastructure or a natural gas grid across the country should be prepared by mapping the entire ecosystem, including major potential demand and supply centres. (Refer Annexure E for prospective blueprint of pipeline network from GAIL)
ii. **Securing the required funds:** Securing the required funds for infrastructure development, through tax financing by state, private investment, and through other government sources like OID cess or Viability Gap Funding (VGF).
iii. **Identifying partners and partnership models:** Identifying potential partners and developing partnership models within the regulatory framework for execution of projects.
iv. **Operation of the gas pipeline:** Day-to-day operations and maintenance of pipelines, capacity allocation to gas producers/marketers and pipeline tariff fixation in line with policies set by the regulator.

6.5.5 Given the magnitude of investment involved, Public-Private Partnerships (PPPs) routed through the PSE may be leveraged to develop gas pipeline infrastructure. Any ownership model –

[39] Vision 2030, Natural Gas Infrastructure in India, 2013, PNGRB

either via a JV or an independent private company – may be used for the PPP project. However, the central responsibility for development of the natural gas grid will lie with the government. India's current PPP models can be further evaluated in detail and used for development of the gas infrastructure on a case-by-case basis, depending on the situation and investor interest.

6.5.6 PNGRB, as the independent regulator would be responsible for ensuring adherence to technical, environmental and safety norms during construction of gas pipeline infrastructure.

6.6 Pipeline tariff mechanism

6.6.1 Transmission tariff or the cost of transporting gas using pipelines is an important component of gas pricing. To provide adequate incentive for development of pipeline infrastructure, it is recommended to follow a cost-plus model for setting pipeline tariffs so that investors can make regulated returns on their investment. Given the nascent stage of pipeline development in India, cost-plus pipeline tariffs will provide investors with the required visibility for investments.

6.6.2 In a cost-plus pricing mechanism, the tariff is fixed along the entire length of a gas pipeline and charges are levied per unit of gas consumption. Hence all consumers along a gas pipeline pay the same tariff per unit gas consumed. A similar cost plus based approach has been used to set pipeline tariffs in the initial phase of gas market development in several North American and OECD (Organization for Economic Cooperation and Development) member countries.

6.6.3 PNGRB as the regulator would be authorized to finalize pipeline tariffs based on incurred costs and a set rate of return on investment, to ensure that the projects are economically viable for investors and tariffs are economical for consumers.

6.7 Network codification

6.7.1 A well defined network code is a critical enabler for smooth operation and optimum utilization of a gas pipeline network. The network code lays down the parameters and guidelines for operation of pipeline networks. It covers a range of aspects like mechanism for capacity allocations, management of pipeline congestion, technical criterion for interoperability of pipeline networks, and terms applicable for the different stakeholders involved. In view of the thrust for pipeline development, the regulator, PNGRB should develop a comprehensive and robust pipeline network code to ensure pipeline operations with minimum disputes and disruptions.

6.8 Promoting gas usage for power generation in CHP/CCHP mode

6.8.1 Among the most efficient avenues for utilization of gas are CHP (Combined Heating and Power) or CCHP (Combined Cooling, Heating and Power) technologies. CHP refers to simultaneous generation of both electricity and heat, while CCHP refers to simultaneous generation of electricity, heat and cold. CHP and CCHP are fuel efficient processes since they capture the waste heat from power generation and use it for heating or cooling. CHP/CCHP is a cost effective

and reliable technology that has been widely used globally. As per 2008 estimates, CHP constitutes about 5% of the electricity produced in India.[40]

6.8.2 CHP/CCHP systems can be used for industrial applications, individual buildings or cities. The benefits of using gas for distributed power generation in CHP/CCHP mode are:

i. **High energy efficiency:** As discussed earlier, gas-based combined cycle power plants can attain 40-50% efficiency compared to coal based plants with 30-35% efficiency.[41] Additionally, distributed power generation in combined cycle plants can help achieve total system efficiencies of 70-80% by reducing transmission and distribution losses and create enormous savings in energy costs.[42]
ii. **Reduced carbon emissions and air pollution:** As discussed earlier, natural gas is the cleanest fossil fuel and can lead to substantial carbon emission reduction particularly by replacing coal based power plants. To produce the same amount of heat, natural gas emits 30% less carbon dioxide than oil and 45% less carbon dioxide than coal. It also emits less particulate matter, sulphur dioxide and nitrogen oxide than coal or oil.[43]
iii. **Favourable economics of power generation due to positive externalities:** Distributed power generation in CHP / CCHP mode is an economical process particularly when taking into account the associated positive externalities like improved efficiency of distribution, reduced strain on the grid during peak demand period, reduced need for a T&D network, reduced probability of black-outs and environmental and land use benefits. [44]

6.8.3 A large proportion of the gas in several countries is used for the purpose of distributed power generation in CHP/CCHP mode as demonstrated in the following examples:

i. CCHP is being used extensively by organizations in the UK to reduce costs and emissions. CHP plants helped reduce almost 10 mega tonnes of carbon dioxide emissions in 2012.[45]
ii. The global industrial CHP capacity is expected grow at a 30% CAGR (compound annual growth rate) from 2014 to 2023. This can be attributed to the government focus on increasing subsidies and other incentives for the adoption of CHP systems.[46]
iii. At the G8 summit in 2007, leaders called on countries to 'adopt instruments and measures to significantly increase the share of CHP in electricity generation.' Several countries like Russia, the Netherlands, Denmark, Finland etc. have expanded the use of CHP systems to account for 30-50% of their total power generations.[47]

[40] Cogeneration and District Energy, 2009, International Energy Agency
[41] Technology Roadmap: High-Efficiency, Low-Emissions Coal-Fired Power Generation, 2012, International Energy Agency
[42] The Role of Distributed Generation & CHP Systems in Data Centers, 2007, US Energy Information Administration
[43] Natural Gas in the US Economy - Opportunities for Growth, 2012, Federation of American Scientists
[44] Assessing the Role of Distributed Power Systems in the US Power Sector, 2011, Brookings Institution Energy Security Initiative & The Hoover Institution Shultz-Stephenson Task Force on Energy Policy
[45] 'UK CHP Map: Who Uses Combined Heat and Power?', April 2014, Energ Group Blog
[46] 'Industrial CHP for Efficiency, Emission Reduction', May 2014, Fierce Energy
[47] Cogeneration & District Energy, 2009, International Energy Agency

6.8.4 Local Distribution Zones (LDZs) may be identified and developed on the basis of potential demand centers for promotion of CCHP/ CHP. In view of the inherent advantages of power generation in CHP or CCHP mode, the government should provide incentives like accelerated depreciation, duty waiver on technology imports and educate customers for the use of gas in such technologies

6.9 Coordination between government agencies for development of ecosystem

6.9.1 In order to transition to a gas based economy, it is extremely important that there is close coordination between the multiple stakeholders' involved - regulators, policy makers, E&P companies, gas transporters and consumers. It is also important to ensure adequate coordination between the Centre and state governments. The policies and incentives for both upstream and downstream sector development need to be implemented in a phased and synchronized manner.

6.9.2 A five million tonne per annum capacity LNG terminal for import of natural gas was commissioned in August 2013 at Kochi for a cost of approximately INR 3000 crores.[48] However, 90% of the terminal capacity is still under-utilized since the pipelines required for connecting it with end user markets have not been constructed.[49] It is important that such issues arising from lack of coordination are avoided to minimize losses to the economy.

6.9.3 For every major gas project, a Project Management Committee (PMC) consisting of the various stakeholders across the gas value chain must be formed for end to end seamless development of the project. The PMC consisting of the producers, marketers, infrastructure providers, government representatives and other stakeholders will allow for close co-ordination and ensure timely project completion. The PMC should be commissioned before the start of the project.

[48] 'Petronet to Lease out Half of Kochi Terminal', February 2014, Economic Times
[49] 'Kochi LNG's 90 pc capacity lying un-utilised: Minister', July 2014, Business Standard

Chapter VII: Roadmap for transition to market-determined gas pricing

7 Roadmap for transition to market determined gas pricing

7.1 Introduction and context

7.1.1 One of the Terms of Reference (ToRs) of the Committee is to propose a roadmap for switching to market-determined natural gas pricing post the12th Plan period. It is understood that this relates only to the producer price and not the consumer price of natural gas since the ToRs and the mandate to the Committee are restricted to the upstream oil and gas sector.

7.1.2 The major sectors accounting for consumption of gas in India are fertilizer, power generation, manufacturing industries, transportation and household consumption. Consumer prices for these sectors are determined by the government or the relevant regulators to pursue sector specific public policy objectives as well as macro-economic policy objectives like inflation and balance of payments.

7.1.2 For a consumer, natural gas is a close substitute to petroleum products whether it is transportation fuels like diesel, industrial and power generation inputs like naphtha and fuel oil, or household fuels like LPG. Hence gas prices tend to have a close relationship with crude oil prices particularly in markets which are net importers. This phenomenon has an important bearing on the producer and consumer prices of natural gas.

7.1.3 From the perspective of a producer, exploration and production is an inherently risky business requiring a long-term horizon for decision making. Experience thus far indicates that domestic activities for exploration and production of natural gas have been very limited, given the high level of government involvement in setting gas prices in the country.

7.1.4 In 2012, approximately 30% of the gas consumed in India was imported.[50] If no significant actions are taken, the share of imports is expected to reach almost 70% by 2017, given the rising demand and declining domestic supply. [51] There is thus an urgent need to address domestic prices for natural gas such that they incentivize domestic production by aligning producer prices to the price of the imports that they replace.

7.1.5 The mindset that India is relatively low on gas reserves prompts the government to implement policies that attempt to meet the supply scarcity through rationing or allocation of available gas with consequent under-pricing. However, this approach aggravates the supply-demand imbalance since it reinforces the shortage by discouraging supply while enhancing demand for gas at artificially low prices. Such an approach also encourages rent-seeking behaviour and consequent poor governance.

[50] Vision 2030, Natural Gas Infrastructure in India, PNGRB
[51] Understanding Energy Challenges in India 2012, International Energy Agency

7.2 History of natural gas pricing

7.2.1 Over the last few decades, natural gas pricing policies have undergone several reforms and changes in India. Prior to1987, gas prices were fixed directly by the NOCs. Between 1987 and 2002 an Empowered Group of Ministers (EGoM) was entrusted with the responsibility of fixing natural gas prices. Prices were set taking into account long-term production costs and increased gradually to USD 0.84/MBtu in 1997.

7.2.2 In 1997, the government decided to price gas at parity with a basket of low sulphur heavy stock fuel oil prices, with the objective of achieving full parity by 2001-02. A floor and a ceiling were also introduced. As oil prices increased in the 2000s, the target of full parity was abandoned and prices stayed at the ceiling level of USD 1.76/MBtu and by 2005, natural gas prices became only 34% of fuel oil prices. [52]

7.2.3 In 2005, it was decided that gas from nominated blocks held by ONGC and OIL would be sold under the Administered Price Mechanism (APM), where prices would be fixed by the government and gas would be supplied to power producers, fertilizer companies and small-scale consumers. The APM gas price was increased to USD1.79/MBtu, except in the northeast region where gas was sold at 60% of the revised price. In 2010, APM gas prices were further increased to USD 4.2/MBtu.[53]

7.2.4 The price of gas from blocks auctioned prior to the NELP regime like the Panna Mukta Tapti (PMT) and Ravva fields is linked to the average of internationally traded fuel oil prices with a specified floor and ceiling price. The ceiling has been progressively increased over the years to USD 5.73/MBtu, USD 5.57/MBtu and USD 4.3/MBtu for Panna Mukta, Tapti and Ravva respectively.

7.2.5 Gas from the RIL KG-D6 basin which was auctioned under the NELP regime is priced according to a government-approved formula. The contractor under the PSC regime is required to sell the gas at a competitive arms-length price. In practice the price was determined by the government and set at USD 4.2/MBtu for the KG-D6 gas for the first five years of production (until 2014). To sum up, so far we have adopted three approaches for pricing domestic natural gas in India: (i) cost-plus pricing (ii) administered pricing mechanism and (iii) pricing linked to liquid hydrocarbons.

7.2.6 Imported Liquefied Natural Gas (LNG) prices are governed by long-term contracts, short-term contracts or spot prices as per the agreement with the supplying entity.

[52] Natural Gas in India, 2010, International Energy Agency
[53] Natural Gas in India, 2010, International Energy Agency

7.2.7 In 2012-13, the Rangarajan Committee took a different approach and recommended that domestic gas prices for a five year period starting 2014 be based on a formula linking domestic prices to imported LNG prices and international prices at major gas trading hubs. However, a final decision is yet to be taken in this regard.

7.3 International experiences in gas pricing [54]

7.3.1 **Administered price mechanism:** Under the administered price mechanism, prices are set by the government or a regulatory authority. Prices may be determined on the basis of socio- political considerations or on a cost-plus basis. Such a pricing regime is followed in countries such as Argentina and China. However, in China, steps have been taken to move away from administered pricing and towards oil product linked prices. In Argentina, the experience with administered prices has been negative for the sector, resulting in falling domestic production and increasing imports. Despite Argentina's gas reserves (estimated to be the second largest in Latin America), administered pricing has contributed to a decline in E&P activity in that country.

7.3.2 **Liquid fuel linked prices:** Under the liquid fuel linked / alternative fuels based pricing mechanism, gas prices are based on linkages with competing liquid fuels. Such a mechanism is followed in Brazil where the linking of gas prices to oil substitutes has encouraged both consumption and supply. Linking with oil prices implies that wellhead prices for gas keep pace with rising upstream capital and operating costs, thus facilitating gas E&P activity while generating additional government take. Relevant end users are in turn supported with subsidies to compensate for high gas prices. It is to be noted that over 50% of the gas contracts in Europe are priced based on oil linkage.

7.3.3 **Market-determined prices:** Some of the most widely known examples of countries with a market-determined pricing regime are the US and UK, where prices are determined by the market forces of supply and demand through interactions between buyers and sellers. Gas price deregulation in the US has been instrumental in facilitating the development of the gas market, increasing gas production and eventually reducing gas prices for the benefit of consumers due to increased supply. Gas prices in the US are today determined through a physical trading hub called the 'Henry Hub'. Similarly, in the UK, deregulation of gas prices has allowed the development of a liquid and transparent gas market.

7.4 Proposed approach for gas pricing in India

7.4.1 **Intergenerational equity perspective for gas pricing**: Perhaps the most useful way of thinking about natural gas pricing is to recognize that it is a finite and exhaustible resource requiring a perspective of inter-generational equity. A gas molecule consumed by the current generation is, in effect, denied to the future generation. In other words, the present generation is essentially borrowing these resources from their children and grand-children, and equity requires that the future

[54] India Gas Pricing , 2012, IHS CERA

generation be fairly compensated. The question then arises, 'What is the 'fair and right price' or what price should 'Nana-Nani' pay to their grand-daughter for such a transaction? At the very minimum, the resource price cannot be less than the maximum opportunity value of the resource. Hence, the fair price can only be the best price a gas molecule can command either in the domestic or international market place, i.e. the price that is market-determined in an environment where exchange is conducted in a transparent manner on an arm's length basis.

7.4.2 As has already been stated, gas is a close substitute to petroleum products. Consequently, presence of 'hydrocarbon to hydrocarbon' competition is adequate for efficient price discovery. As India is likely to be a net importer of hydrocarbons in the presence of a deep and transparent global market for oil and oil products, our proposed policy of market-determined pricing for natural gas can be implemented by the end of the 12th Five Year Plan, or at the end of the new pricing regime. However, the decision for a transition to market-determined producer prices of gas should be taken and communicated by the government at the earliest, so as to ensure visibility for operators and enable them to plan their investments upfront. This will ensure that exploration activity for gas gathers momentum and domestic production can be expedited.

7.4.3 In a market driven system, buyers and sellers are likely to enter into term contracts optimal to both parties. The buyers favor a contract that best mimics their substituted fuel, thus mitigating the price risk of the fuel, while the sellers look to cover their cost of supply and the volume risk. Typically, as gas markets develop, starting from a short position, some form of liquid fuel linked indexation is bound to emerge. Liquid fuel-based linkage is likely to precede gas-on-gas competition. As the market develops, with more suppliers and greater efficiency of demand, a gas-based linkage is bound to emerge. It is to be noted that both liquid indexed linkage (liquid substitution rationale) and gas-based linkage (gas to gas competition) are forms of market-determined prices. Globally, gas markets have evolved in a similar way including in Europe and Latin America.

7.4.4 For a democratic polity, political economy issues are important for policy making. Such a perspective raises an important issue related to the distribution of gains. It is possible that public or private gas producing organizations may get 'windfall profits or gains' from time to time, raising the issue of fairness. In this context it is important to recall that our PSC model is so designed that it enables the government to participate in such 'upside gains' in a substantial manner through fiscal mechanisms such as cess, ad valorem royalty, corporate tax and the instrument of 'profit oil/gas'. Since our E&P contracts are awarded on a global tender basis, the system ensures that this share in 'upside gains' is at the maximum possible level. So in case there is a sharp increase in the international price of oil leading to an increased market-determined price of natural gas, the share of government in the 'upside gains' will also increase accordingly.

7.4.5 The extant PSC in India recognizes the concept of 'value' vs. 'price' of natural gas. The Committee recommends that the 'value' of natural gas, which is used as a basis for calculation of government take should be the same as the market-determined price'.

7.4.6 The Committee recommends that all forms of natural gas irrespective of the source—shale gas, CBM, gas hydrates, gas from coal gasification etc—should be sold at arm's length market-determined prices.

7.5 Cost-plus pricing model

7.5.1 A cost-plus model for fixing natural gas prices has been proposed by a Parliamentary Committee and some downstream industry stakeholders. In a cost plus pricing model, gas prices are fixed such that they provide a pre-determined rate of return to investors. The cost-plus model aims at capping the profits to producers and therein creates a perception of 'fair' price for consumers. However, it is important to recognize that the cost-plus model has several major disadvantages:

i. There is no incentive for operators to achieve cost efficiency or to minimise costs. On the contrary, with an assured post-tax return, operators may be incentivized to gold-plate so that they can achieve higher absolute returns on a cost plus basis.
ii. There is potential for several disputes between the government and operators regarding cost estimates resulting in contract management problems.
iii. Different fields have different technical requirements and hence very different operating costs and capital expenditures. This will lead to difficulties in managing or administering the contract.
iv. Different fields have different risk profiles depending on the geology, stage of appraisal etc and hence may require different rates of return leading to greater complexity.
v. There is potential for disagreements on the set rate of return for investors particularly since E&P is a risky business and determining appropriate returns commensurate to the risk involved may be a subjective matter.
vi. There will be complex issues regarding accounting for expenditure on unsuccessful exploration efforts.

7.5.2 The deeper problems with the cost-plus pricing model are: (i) worsening of the demand-supply imbalance in the economy due to 'under-pricing' of the resources and consequent rationing; (ii) encouraging of 'rent-seeking' behaviour due to 'quantity-based allocation' of gas; and (iii) neglecting the interests of the future generations in terms of their foregone benefits, leading to gross underestimation of the true total cost of production.

7.5.3 The cost-plus model was earlier followed in China; however, initiatives have been taken to move away from the model due to its inherent limitations. Before 1987, wellhead gas prices in the US had been fixed on a cost-plus basis, but it was unsuccessful and led to several disruptions and supply shortages.[55]

[55] India Gas Pricing , 2012, IHS CERA

7.6 Benefits of transition to market-determined prices

7.6.1 Transition to market-determined producer prices of gas is essential to facilitate development of a gas market in the country by increasing the supply of domestic natural gas. Immediate action is necessary to reduce import dependence and ensure energy security for the country, given the long cycle times for exploration and production activity. Some of the benefits of transitioning to market-determined prices are discussed in the following sections.

7.6.2 **Increasing domestic production and energy security:** There will be higher incentive for domestic E&P activity given a more balanced risk-reward equation for producers. Further, a competitive price for natural gas will make viable a significant number of marginal and stranded fields. New discoveries of natural gas in India are highly likely to be in frontier onland areas, deepwater and ultra-deepwater basins, implying higher and riskier E&P expenditures that should be rewarded by transparent market-determined prices for gas allowing for informed decisions by operators.

7.6.3 **Import substitution:** As domestic gas prices rise to reflect market prices, increased domestic exploration and production will lead to direct savings in the import bill, reduction of the current account deficit and improvement of the fiscal health of the economy.

7.6.4 **Increasing government revenues:** Majority of the gas fields in India are held by NOCs, and hence the benefit of higher gas prices will directly accrue to the government. Higher domestic gas production will directly contribute to increase in government revenues in the form of royalties, profit gas, dividends and corporate income taxes. These may be ploughed back into the economy as deemed necessary by the government.

7.6.5 **Development of non-conventional sources:** To meet our growing energy needs, there is a need to tap into additional non-conventional sources of gas such as shale gas, coal bed methane, coal gasification, gas hydrates etc which require significant R&D effort. Market linked prices will incentivize investments in new and emerging technologies and non-conventional energy sources.

7.6.6 **Reduction in pollution and carbon emissions**: Natural gas is the cleanest burning fossil fuel and is considered to be a potential bridge fuel to a low carbon economy, particularly by replacing coal-fired electric power plants. To produce the same amount of heat, natural gas emits 30% less carbon dioxide than burning oil and 45% less carbon dioxide than burning coal, thereby improving air quality and reducing greenhouse gas emissions. Natural gas combustion also emits less particulate matter, sulphur dioxide, and nitrogen oxide than coal or oil.[56] Carbon emission reduction is one of the most critical challenges facing the world and is becoming a priority for governments.

7.6.7 **Efficient resource utilisation:** A rational price for gas will directly incentivize efficient utilisation of the resource and investment in energy efficient technologies.

7.6.8 **Prevention of 'rent-seeking' behaviour: '**Rent-seeking' refers to lobbying with the government for subsidies, grants, tariff protection etc to obtain economic gains. The current quantity

[56] Natural Gas in the US Economy - Opportunities for Growth, 2012, Federation of American Scientists

based gas allocation mechanism promotes 'rent-seeking' behaviour by participants. Market-determined gas pricing will promote transparency and prevent 'rent-seeking' behaviour.

7.7 Roadmap for smoother transition to market prices—supply side reforms

7.7.1 To enable a smoother transition, the interim period leading up to market-determined prices must be used by the government for reputation and credibility building and fostering learning among the various stakeholders involved along the gas value chain - end consumers, gas buyers, producers, commodity exchanges, pipeline companies, regulators etc.

7.7.1 Development of a gas market is required to facilitate a smoother transition to market-determined prices in the country. Gas pipelines that serve as a 'common carrier' are a critical enabler to connect gas demand and supply centres. It is hence essential that the government institute policies to expedite creation of gas pipeline infrastructure in the country. Pipeline infrastructure will also help dissipate regional disparities in gas prices and gas consumption.

7.7.2 It is important to ensure that gas prices are determined through a transparent process. The downstream regulator, Petroleum and Natural Gas Regulatory Board (PNGRB) must develop transparent procedures, guidelines and templates in order to verify gas contracts and confirm that transactions are based on an arm's length relationship. The Gas Supply Agreement (GSA) templates used currently need to be revised to bring them on par with international best practices.

7.7.3 Relevant policies must be instituted by the government to encourage development of additional sources of gas like shale, CBM, hydrates, coal gasification etc to help expand gas supply.

7.7.4 Adequate steps need to be taken by the exchange regulator and government for encouraging trading of gas contracts on the commodity exchanges in the country. Well functioning commodity exchanges play an important role in providing the technology platform to connect buyers and sellers and facilitating an efficient and transparent price discovery process.

7.7.5 The government currently allows gas from small and isolated fields, i.e. blocks located more than 10 km from the gas grid and producing less than 0.1 million metric standard cubic meters per day (mmscmd) to be sold at competitive market-determined prices. This accounts for approximately 3%-4% of the gas currently consumed in the country. The limit on the field size should gradually be increased upwards to include mid and large-sized fields so that a larger share of the total natural gas is traded through a competitive price discovery process.

7.8 Roadmap for smoother transition to market prices—demand side reforms

7.8.1 To prevent major shocks to the economy, several policy and fiscal reforms need to be taken in the interim period leading up to market-determined prices

7.8.2 It is often argued that a high price for natural gas may be economically unviable or unsustainable for some priority sectors like fertilizers, power etc. However, it will be unfair to supply natural gas at artificially low prices to all consumers, including those who can 'afford' to pay a higher price in order to support the priority sectors. Hence, the priority sectors may be supported by the government through relevant, transparent and targeted subsidies. It is also important to note that higher prices of gas will also result in additional revenues to the government in the form of government take through increased E&P activity in the country. Increasing domestic production will also contribute directly to savings in the import bill. These additional sources of revenues will help offset any additional subsidy burden. The subsidies may be provided in the form of producer subsidies to intermediate producers such as fertilizer companies, power producers etc or consumer subsidies directly to end consumers.

7.8.3 The relevant sectors to be subsidised, the appropriate amount of subsidy, the optimal delivery mechanisms, associated financial impact on the economy and the roadmap for gradually phasing away subsidies are important issues that require careful consideration. These issues need to be deliberated by the government in the interim period and these will need to be announced well in advance to reduce macroeconomic shocks and smoothen the adjustment. The mechanisms of consumer subsidies should be such that the allocation of subsidies to specific sectors becomes transparent to the polity and promotes open public discussions on the financial costs of subsidies to the country.

7.8.4 The interim period may be used for transparent and stepwise revision in gas prices to achieve parity with market prices. One possible methodology will be to follow the Cabinet decision of 1997 on gas pricing, which linked gas price to international fuel oil price. To smoothen the adjustment, such a linkage could start at a lower base and gradually be increased. Such a strategy will enable us to replicate the recent successful experience of de-regulating diesel prices.

7.8.5 It is important to note that contrary to popular perception, many analysts have a bearish outlook for long term gas prices because of the likely global and domestic discoveries of new conventional gas reserves and new gas sources like shale, CBM, coal gasification etc. This would mean that the recent trend of rapid increase in gas prices may well be softened in the future. Consequently the impact of market determined gas prices may not be as drastic as is currently assumed.

7.8.6 In the current taxation regime, differential taxes are levied by different states on natural gas. The VAT on gas varies from 0% to 25% in different states. Some states also allow for a VAT credit while others do not. Apart from leading to a significant variation in prices across the country, it also leads to double taxation in case of gas swaps. Gas should be included under the Goods and Services Tax (GST) to enable moving towards a uniform structure of gas pricing across the country, simplifying the process of gas pooling and preventing double taxation in gas swap arrangements.

7.8.7 Currently, a 5% customs duty is levied on imported LNG. However, LNG imports for power generation are exempt from the customs duty. The import duty waiver should be extended to all LNG imports to encourage usage of natural gas, a clean and environment-friendly fuel.

7.9 Gas allocation mechanism and required reforms

7.9.1 The current gas allocation policy has several adverse implications discussed below:

i. Preferential allocation of gas restricts market development by making it difficult to identify the 'true' gas demand.
ii. The gas allocation policy contradicts the right of producers to sell gas based on commercial terms in accordance with the New Exploration Licensing Policy (NELP). Producers should be allowed the freedom to sell to any willing buyer at an arm's length-determined price as laid down in NELP.

7.9.2 In order to promote efficient gas usage and stimulate domestic supply, the current system of gas allocation that mandates producers to sell to a particular category of consumers should be discontinued. Instead, the government can institute a policy of transparent consumer or producer subsidies to prioritize usage of gas for important sectors like fertilizer manufacturing and power generation. The subsidies may also be structured to be region specific.

Chapter VII: Building R&D capabilities

8 Building R&D capabilities

8.1 Introduction

8.1.1 Promoting a culture of innovation is at the core of supporting sustainable economic growth. India has built a strong reputation for low-cost innovation in several sectors such as healthcare, education, space research and others. The success of ISRO (Indian Space Research Organization) in launching India's Mars mission at record low costs as compared to other similar missions is recognized globally.

8.1.2 Global R&D centers set up by several leading multinational companies in India are testimony to India's potential to become an R&D hub. A few examples of global innovation centres operated by multi-national companies in India are the Shell Technology Center, John F Welch Technology Center and Xerox Research Center at Bengaluru; and the DuPont Innovation Center India in Pune.

8.1.3 However, India's success in R&D has been limited to a few sectors, companies and domains. There is an increasing need to undertake reforms that can position India as a global hub and destination for innovation in the oil and gas sector. R&D in the oil and gas sector can play an important role in a range of applications like enabling access to untapped resource bases, increasing efficiency of existing operations, managing the environmental challenges associated with E&P activities and others.

8.2 Key challenges for India in exploration and production R&D

8.2.1 **Need for a coherent policy**: There has been no cohesive thrust to drive R&D in the E&P sector due to lack of a coherent energy R&D policy in India. The ratio of India's R&D expenditure to GDP is below the international benchmark of 2-3% for major developed and developing economies and is reflective of the low R&D expenditure in upstream oil and gas. The National Integrated Policy for Energy with some focus on innovation was launched by the Prime Minister in 2008 but its implementation has been lackluster.

8.2.2 **Lack of an effective governance structure**: Several ministries oversee the various R&D initiatives, leading to a lack of coordination among different stakeholders in the governance machinery. India's current governance structure for encouraging R&D in the upstream oil and gas sector is fragmented leading to duplication of efforts and project delays. Also, there is need for a clear and transparent mechanism for channelling government funds for R&D. Three ministries contribute to the majority of public R&D funding for oil and gas in India as discussed below:

i. **Ministry of Petroleum and Natural Gas**: Provides funds for industry development initiatives through the OIDB

ii. **Ministry of Science and Technology**: Provides funds for projects at research institutes through the CSIR (Council for Scientific and Industrial Research)
iii. **Ministry of Human Resource Development**: Provides funds for public academic institutions through the University Grants Commission (UGC)

8.2.3 **Poor fund utilization**: The fund shortage is magnified by a poor R&D spend productivity. Lack of a structured technology prioritization mechanism for allocation of funds to projects and a poorly implemented monitoring mechanism have severely affected the quality of R&D in India. For example, globally the average number of citations of publications related to hydrocarbon E&P is 4.5, while the Indian average is 1.75, despite similar levels of investment per research paper.[57]

8.2.4 **Need for international partnerships**: Developing partnerships along best practice models such as JIPs (Joint Industry Projects) has helped several E&P operators bridge the technology gap. India needs to tap into international E&P expertise through industry-wide collaborations. International partnerships have been restricted due to lack of focus, resulting in limited technology transfer and local content generation.

8.3 Creation of a Technology Advisory Council

8.3.1 A Technology Advisory Council should be instituted within MoPNG that will be responsible for setting the R&D policy, identifying major thrust areas for R&D, securing the required funds and monitoring on-going projects. The council must be chaired by the Minister of Petroleum and Natural Gas to ensure that it has the requisite authority and influence. The vice chairman should be a distinguished scientist so that he brings in the required exposure and experience.

8.3.2 The primary responsibilities of the Technology Advisory Council would be split between three verticals:

i. **Policy and technical**: The policy and technical vertical would be responsible for policy setting, identifying key thrust areas of R&D, facilitating R&D by promoting industry-wide linkages.
ii. **Financial**: The financial vertical would be responsible for sourcing and allocation of funds into the critical technology thrust areas identified.
iii. **Review:** The review vertical would be responsible for developing a robust monitoring mechanism with clear, and administratively efficient guidelines, and regular feedback.

8.3.3 **Policy and technical vertical:** Given the multi-layered decision making process in India coupled with the lack of coordination among relevant agencies, a nodal Technology Advisory Council can tackle R&D in upstream oil and gas in a holistic manner, coordinate efforts and promote industry-wide collaborations. The technical or policy arm of the Advisory Council would be responsible for developing a comprehensive energy R&D policy with the following salient features:

[57] Source: National Institute of Science Technology and Development Studies (NISTADS)

i. Setting a long term objective with specific short term targets to achieve energy self sufficiency by a target year.
ii. Identifying the technological areas critical for India's energy security.
iii. Developing technological missions; structuring each technological mission into specific projects and setting the review process and conditions.
iv. Tapping diplomatic channels and other levers for strategic partnerships in E&P R&D at a national and international level. Potential partners could be countries like Japan, USA, Russia and Norway that have undertaken cutting edge R&D.
v. Creating platforms to promote dialogues among all stakeholders in oil and gas R&D, especially industry (operators, oil field service provides, ancillaries, etc.), academia, research institutions, policy makers and regulators to identify challenges and foster collaboration

8.3.4 **Financial vertical**: The Tecnology Advisory Council would be responsible for integrating efforts in energy R&D and allocating funds for projects in-line with the stated long term objectives. This will also help create avenues for interested E&P players to invest directly in relevant technology missions by increasing the transparency of fund utilisation. To improve utilisation of funds allocated for R&D, there is need to develop a technology prioritisation mechanism. The following parameters may be considered in prioritising the allocation of funds among different projects:

i. **Market attractiveness**: Evaluate the economic rationale in terms of market potential.
ii. **Technological impact**: Determine the potential impact in terms of future technological leverage.
iii. **Probability of success**: Estimate the chances of success through benchmarks and case studies of similar projects.
iv. **Resource demand**: Calculate resource intensity in terms of capital expenditure requirement and human capital involvement.

8.3.5 **Review vertical:** The Technology Advisory Council would be responsible for developing and implementing a robust review mechanism to evaluate the progress of the projects vis-a-vis targets. The mechanism should include the following features:

i. **Periodic reviews:** Reviews should be held on a periodic basis. International best practices indicate that technical reviews are held quarterly while financial reviews are held annually.[58]
ii. **Transparency:** The process must be transparent with the evaluation criteria communicated to the project teams at the beginning of the project.
iii. **Feedback orientation:** The review should also include a feedback process to highlight issues that require renewed focus.

8.4 Develop global partnerships relevant for India

8.4.1 India has a vast pool of hydrocarbon resources that has not yet been exploited. In order to develop these resources successfully, India needs to leverage existing global capabilities both in terms of technology and human skills. The potential partners may range from E&P operators, oil

[58] Subject to the specific nature and timelines of the project

field service companies, academic institutes, research institutes and others. Well crafted partnerships can facilitate advanced E&P activity. The focus of the partnerships should be both on access to existing technologies as well as cooperation to address challenges faced by the industry.

8.4.2 Research initiatives vary based on the nature of the research, its objective, project tenure, nature of participants and resource requirements. Different partnership and collaboration models may be leveraged depending upon the type of research. The two main types of research initiatives where partnerships need to be fostered are discussed below:

i. **Basic research**: Basic research refers to fundamental or pure research, directed towards greater knowledge or understanding of fundamental aspects.[59] While this phase is critical to generate incremental innovation, industry is often not incentivized to take it up due to the high degree of uncertainty and low returns on investment. Thus, public investments must focus on this phase of the innovation.
ii. **Applied research**: Applied research refers to the deployment and commercialization of the developed technologies. It focuses on practical application of existing knowledge. Since the efficacy of the new developed technologies is known with high certainty, industry is pro-active in adopting them. Thus, the government must facilitate industry to successfully drive this phase of the innovation.

8.4.3 Inter-government cooperation for basic research

8.4.3.1 Globally players in the oil and gas industry tend to face similar technological challenges and issues. It is hence useful to develop strategic partnerships and collaborations at a government-to-government level with the involvement of stakeholders from both industry and academia. This enables not just pooling of resources, but also brings together complementary skills, capabilities and strengths. This model is similar to the model that has been used by the JCERDC (Joint Clean Energy Research and Development Center) as discussed below. Such government-to-government collaborations should be developed for undertaking joint basic research in the oil and gas sector.

Case study: Joint Clean Energy Research and Development Center (JCERDC)

JCERDC was established in 2010, under the umbrella of the Indo-US Partnership to undertake joint research and development in clean energy technologies. Three priority areas have been indentified under clean energy: solar energy, second generation bio-fuels and energy efficient buildings. For each of these priority areas identified under the JCERDC, a consortium of academic institutes and industry participants from both the countries as been appointed to drive the initiative. An academic institute each from India and the US acts as the lead partner for each consortium.

The JCERDC setup consists of a Steering Committee co-chaired by the Deputy Chairman of the Planning Commission, India and the Secretary of Energy, US, which plays both a monitoring and

[59] National Science Foundation

advisory role. JCERDC creates a multi-institutional network that leverages the public-private model of funding, where funding is provided by the Indian and US governments and the consortia members–industry participants and academic institutes from both the US and India.

8.4.4 Global collaboration networks for applied research

8.4.4.1 A collaborative approach in addressing the technological challenges faced by operators globally can help in efficient deployment of resources. There are several global collaboration research networks such as the ITF (Industry Technology Facilitator) that bring together players with similar interests. ITF acts as a global non-profit platform with participation from over 30 operators and service companies. The ITF aims to identify technology needs, foster innovation and facilitate the development and implementation of new technologies in accordance with the needs of the industry. ITF has been instrumental in launching more than 190 new collaborative and revolutionary JIPs, with a portfolio of around 37 ongoing projects linked to £16 million direct member investment.[60]

8.4.4.2 Several IOCs, NOCs and service providers like BP, Exxon Mobil, Shell, Chevron, Statoil, Petronas, Qatar Petroleum, Weatherford etc. are members of ITF. However, there is no representation or participation of Indian NOCs. Indian NOCs must be empowered and facilitated to participate in such global collaboration networks and co-develop technologies relevant to India.

8.4.5 Sharing of research infrastructure with industry and academia

8.4.5.1 ONGC has several institutes in the country engaged in R&D activities for oil and gas E&P. Encouraging sharing of the infrastructure of the ONGC institutes with other academic or research institutes for the purpose of R&D activities will go a long way in creating a culture of innovation in the country. This is similar to the model followed by the National Aeronautics Laboratory.

8.5 Government support for innovative R&D projects

8.5.1 Several innovative R&D initiatives taken up by various industry players in India were presented to the Committee members during the course of its deliberations. The government should actively support and encourage similar path-breaking projects that have the potential to shape the future of India's energy scenario. The Scientific Advisory Committee in the MoPNG should objectively evaluate these and other similar projects to provide government assistance in the form of grants through OIDB, low interest rate loans, equity participation by the government, fiscal incentives etc. EIL (Engineers India Limited) may be appointed as the agency to provide assistance in evaluating and monitoring projects.

8.5.2 Some of the path-breaking R&D projects that are underway in India and were presented to the Committee are discussed in the case studies below.

[60] Industry Technology Facilitator

Case study: SAGE deepwater gas pipeline project [61]

South Asia Gas Enterprise Pvt Ltd (SAGE), is a joint venture lead by the Siddhomal group, that is actively considering building a transnational deepwater natural gas pipeline system from the Middle East to India. Given that the Middle East is abundantly endowed with hydrocarbon resources, it can be a potential partner for India to secure long term gas supplies at competitive rates and correct our domestic demand-supply imbalance for gas.

The proposed deepwater route across the Arabian Sea is the shortest secure distance between the Middle East and India, and also effectively addresses security concerns associated with land based on-shore gas pipeline projects. The project builds on the extensive study of the deep-water route of the Oman-India pipeline that was carried out in the early1990's, and has been strengthened by recent development work undertaken by SAGE and by the major body of deep-water design and pipe lay experience accumulated over the last decade.

The project with an expected investment of USD 3.5-4 billion to build a pipeline connecting India's western coast to Iran or Oman, can be a major step forward towards the country's energy security and requires significant government support through the following:

- Providing the required political and diplomatic support particularly for facilitating signing of an MOU and inter-governmental agreements with Iran and Oman
- Providing required fiscal support through low cost loans, grants etc.
- Establishing a consortium of NOCs like GAIL, IOCL to support the project

Case study: Praj Industries bio-fuel projects[62]

Praj Industries through its PACE (Praj Advanced Cellulose Ethanol) project is working on developing a second generation plant for cellulosic ethanol production. Substituting petrol and diesel with ethanol can help in substantial greenhouse gas emission reduction. Moreover, second generation bio-ethanol utilizes abundantly available agricultural residues or waste for fuel production and hence has several advantages over first generation bio-ethanol that uses food crops as an input. This also presents new revenue streams and job opportunities for India's vast agriculture dependent population.

A pilot plant for second generation bio ethanol production set up by Praj Industries, with an investment of almost INR 10 crores, has been operational since 2009. A demo plant for the same technology is planned to be commissioned by the end of 2014. The government should provide much required fiscal support through grants, tax incentives etc. and policy support through ethanol blending provisions to such projects.

Tata Sasol CTL project [63]

[61] SAGE presentation to Committee
[62] Praj Industries presentation to Committee
[63] Tata Sasol presentation to Committee

Strategic Energy Technology Systems (SETSPL), a joint venture between the Tata group companies and a South African firm Sasol, is the country's first initiative for Coal to Liquid or conversion of coal to clean transportation fuels through environment friendly technologies.

It is estimated that less than 1% of India's coal reserves can add almost 20% to India's proven oil reserves through a single CTL project. The project with a planned investment of USD 10 billion involves setting up a 30 million tone per annum opencast coal mine for the coal-to-liquid (CTL) plant. It has a planned capacity of 80,000 barrels per day and houses a captive 1,100 MW power plant. The project expected to create almost 35,000 direct and indirect jobs for the economy. The CTL technology under consideration has been commercially operating in South Africa for the last 60 years, producing almost 160,000 BOE/day and is South Africa's largest corporate tax payer.

The CTL plant can play a pivotal role in reducing our oil imports significantly. In view of their significant benefit to the economy, such CTL projects should be provided with the required government support particularly for securing the approvals and clearances and fiscal incentives like grants, low cost loans etc.

8.6 Critical technology thrust areas for India to focus on

8.6.1 In order to ensure that India's R&D efforts are channelled in the right direction and develop expertise in areas critical to India's energy security, appropriate technology thrust areas need to be identified. The following sections detail a few areas important for India to focus on. These may vary according to the changing external environment and evolving project requirements.

8.6.2 Seismic imaging and reservoir characterization

8.6.2.1 **Data processing:** The vast quantum of 3D seismic data acquired presents a significant data processing challenge. Data processing skills like new algorithms and accelerated computing can significantly reduce the time to 'first oil'. The industry must be encouraged to collaborate with R&D institutes and IT companies that can provide the required expertise.

8.6.2.2 **Data interpretation:** The capabilities of the IT industry in data interpretation and analysis can be leveraged for a variety of applications like pattern recognition in geology and geophysics; processing high density seismic acquisitions; high speed computing; simulation in geology and geophysics; production enhancement through data integration etc. Another potential application is the identification of hydrocarbon reserves from seismic data of developed fields by characterising the seismic signatures of existing pools to find similar pools.

8.6.2.3 **Digital oil fields:** Compilation of down-hole sensor data from wells to optimise oil, water and gas production while following best practices of reservoir engineering is another focus area. Other areas of focus are control and monitoring capabilities in drilling and induction of new telemetry systems to increase data transmission rates up to even a thousand times.

8.6.3 Deep water production and pipelines

8.6.3.1 Much of India's potential hydrocarbon reserves lie in the deepwater and ultra-deepwater basins. Deepwater discoveries provide a unique set of challenges, requiring new technologies and innovations. Potential technological challenges include development of subsea technologies, production facilities, gas and water separation facilities, storage facilities on the sea bed, sea floor oil management, facilities to handle the increased water production etc.

8.6.3.2 India also needs to focus on developing capabilities in deepwater gas pipeline technologies particularly for laying and maintenance of deepwater pipelines. This will enable India to secure gas supplies from the hydrocarbon-rich Middle East region while addressing security concerns.

8.6.4 Water management (conventional and non-conventional)

8.6.4.1 Both conventional and non conventional fossil fuels require and generate vast quantities of water. Sourcing water and mitigating effects of pollutants in the produced water require significant research. Identifying new resources like paleo river systems (the Gangetic plains for the proto Ganga and Yamuna and the arid lands of Rajasthan and Kutch for the paleo Saraswati) through remote sensing along with new survey technologies could help identify vast quantities of water as in Libya. Concurrently, new technologies to treat the produced water have to be developed.

8.6.5 Nanotechnology

8.6.5.1 Nanotechnology, the manipulation of the matter on an atomic, molecular, and super-molecular scale, is fast becoming popular for its applications in several fields. Nanotechnology programmes should be undertaken for the following applications:

i. Understanding and altering the physico-chemical properties of oil, gas and water at reservoir level and improving the mobility of hydrocarbons
ii. Desegregation of oil from gas and water at the reservoir level; surveillance of producer and injection wells; materials monitoring etc.

8.6.6 Development of non-conventional resources

8.6.6.1 Given the exhaustible nature of oil and gas resources, developing technological capabilities to harness additional non conventional sources of energy is extremely important for the long term energy security of the country. The important non-conventional fossil fuels are discussed below:

8.6.6.2 Gas hydrates: Gas hydrate is a crystalline solid consisting of a gas molecule surrounded by a cage of water molecules. In India, gas hydrate research is being steered by the MoPNG under NGHP (National Gas Hydrate Program) initiated in 1997. The NGHP has participation from the DGH, NOCs and national research institutes.[64] It is essential to sustain the momentum and resolve

[64] Directorate General of Hydrocarbons

bottlenecks for the gas hydrates R&D programme so that they can become a potential source of energy for the future.

8.6.6.3 Underground Coal Gasification (UCG): UCG refers to the conversion of coal to gas through injection of air and water into coal seams. Underground Coal Gasification has several economic and environmental benefits. An R&D committee on UCG was constituted in 2006. The committee was chaired by the Scientific Secretary in the office of the Principal Scientific Adviser to the Government of India, and included representation from the DGH, industry players, academic and research institutes.[65] Adequate thrust must be given by the government for R&D in this sector since India is abundantly endowed with coal resources.

8.6.6.4 Bio-fuels: Bio-fuels are liquid or gaseous fuels that are extracted from biomass. Bio fuels can be a major source of clean energy for the future. R&D initiatives need to be undertaken for economical and effective extraction of cellulosic bio-fuels and algae based bio-fuels. Alage based fuels will help us to leverage India's environmental conditions- abundant sunshine and sea-water. Several domestic and foreign companies have invested in research for commercial production of algae based and cellulosic bio-fuels. The government should support these initiatives through various policy measures.

[65] Directorate General of Hydrocarbons

Chapter IX: Development of human resources

9 Development of human resources

9.1 Introduction and context

9.1.1 One of the foremost challenges facing the Indian oil and gas sector today is the acute shortage of capable manpower. While globally the E&P sector is grappling with similar challenges, India specifically has failed to develop a critical mass of oil and gas professionals despite its demographic advantage of a large and growing working population. The dearth of talent is likely to widen without the required policy actions, the major reasons for which are discussed below.

9.1.2 **Challenges in attracting talent**: The oil and gas sector is facing challenges regarding the availability of a well-trained and capable talent pool, primarily due to lack of awareness and certain negative perceptions about the oil and gas sector among the students, parents and counsellors. The Petroleum Engineering (dual degree) course at ISM Dhanbad has recently been scrapped due to unpopularity among students stemming from lack of a well defined job market. Over the years, the inflow of talent from top tier institutes to the oil and gas sector has been dwindling due to:

i. The sporadic hiring pattern of oil and gas companies
ii. The unstructured internship process
iii. Lack of trained faculty
iv. Lack of a strong industry-academia interface

9.1.3 **Challenges in retaining talent**: A significant portion of the workforce leaves the oil and gas sector in India on an ongoing basis due to various international opportunities available to experienced employees. The lack of career opportunities in India and extreme working conditions are other reasons for attrition. Losing experienced industry professionals presents significant consequences, particularly since skill sets in the E&P industry are highly specialized and difficult to develop or acquire. The average age of personnel employed in the oil and gas sector is relatively high. Upstream companies are expected to find it difficult to replenish the talent loss due to significant retirement expected in the next few years. Around 50% of employees have more than 20 years of experience, and the majority is due to retire in the next 5–10 years.[66]

9.1.4 **Challenges in developing talent:** Lack of an institutional mechanism for training new talent presents a significant challenge particularly due to the highly technical nature of the industry. There is no structured process to leverage the experience of the existing workforce to groom the new generation.

[66] HR Challenges in Indian Oil and Gas Sector, 2010, Ernst & Young

9.2 Opportunities in India's demographic dividend

9.2.1 India has the unique advantage of being a relatively 'young nation' with a large proportion of working population as compared to its dependent population. India has the world's youngest work force with a median age significantly lower than that of China and OECD countries[67]. Half the population of India was younger than 25 years in 2010, and half the population will be younger than 28 years in 2030, making India a young country for the next 20 years.[68] Hence, India is uniquely positioned to become a talent hub for global manpower requirements.

9.2.2 Given India's demographic profile, the talent crunch of the E&P sector can be converted into an opportunity and competitive advantage with focused policy initiatives. India should aim to become the world leader for skilled human resources like geologists, geophysicists, petroleum engineers, reservoir engineers, facilities engineers and others in the oil and gas sector. For human capital in the oil and gas industry, India should aim to reach the same position of dominance that Saudi Arabia commands for production of oil and gas.

9.2.3 Investing in the development of a well trained and capable workforce will help India develop a competitive advantage vis-à-vis other nations in terms of human resource availability and costs. This will position India not just as a global talent hub but also benefit the domestic E&P industry substantially. India will be well positioned to leverage the trained manpower for developing its own internal resources like stripper wells cost effectively. Initiatives for developing human capital in the oil and gas sector in India are discussed in the subsequent sections.

9.2.4 **Improving educational opportunities at an institutional level**

9.2.4.1 India is home to several prominent academic institutes offering courses in the oil and gas sector, like the Indian Institutes of Technology, Indian School of Mines-Dhanbad, Indian Institute of Petroleum-Dehradun, Rajiv Gandhi Institute of Petroleum Technology-Rai Bareilly, Pandit Deendayal Petroleum University-Gandhinagar and others. These institutions have demonstrated that India has the potential to indigenously develop talented and skilled manpower in the oil and gas industry. However, these institutes lag behind their global peers both in terms of quality of education and quantum of opportunities. These institutes should aim to become centers of excellence and innovation at par with global standards.

9.2.4.2 It is essential that the government work with major educational institutes in the country to increase quality education and research opportunities in the country for the upstream oil and gas sector. The government must further aim to develop partnerships with leading global institutes to ensure that educational standards are at par with the best in the world. Some initiatives that can be taken in this regard are:

[67] 'Knowledge Paper on Skill Development in India', 2012, FICCI and Ernst & Young
[68] 'Knowledge paper on skill development in India', 2012, FICCI and Ernst & Young

i. **Global partnerships:** In order to recognize India as a global talent hub, Indian academic institutes must be encouraged to partner with leading global universities in developing courses to provide the best international knowledge and exposure to students. This will enable Indian institutes to improve their quality of education and expand the horizon of opportunities available for students.
ii. **Increase scholarships**: The government should increase the number of scholarships available to study upstream oil and gas related subjects at universities in India or abroad. These scholarships can be made more attractive by offering post-completion research contracts. The scholarship recipients may also be required to work in India for a required number of years after completion of their study. Similar initiatives have been introduced in Brazil under the 'Science without Borders' programme.
iii. **Enhance international exposure**: The academic institutes must be encouraged to develop exchange programmes with top international universities and research centers to increase the international exposure of both students and faculty members.
iv. **Attract world class researchers**: Initiatives should be taken to provide research grants to attract prominent foreign and NRI researchers in upstream oil and gas to India.
v. **Faculty re-training:** To improve the learning standards and techniques, faculty re-training must be undertaken with a high degree of international exposure and institutionalized incentives such as fellowships.

Case study: 'Science without Borders' programme in Brazil

The 'Science without Borders' programme was initiated by the Brazilian government in 2011 to provide scholarships to more than 100,000 students for higher studies and research in technical subjects at major universities across the world. The programme, funded both by government and corporate sponsors aims to provide students with global exposure and educational opportunities. One of the main objectives of the programme is to generate interest in science and technology and foster a culture of innovation. More than 83,000 scholarships have been granted by the Brazilian authorities to date and the programme has been extended to 2015.

9.2.5 **Improving industry-academia collaboration**

9.2.5.1 Fostering collaboration between the industry and academia is one of the most effective ways of addressing the supply gap for manpower. The government must work with the leading academic institutes in the country to promote industry-academia collaboration in the upstream oil and gas sector. The initiatives that can be taken in this regard are the following:

i. **Collaborations and associations with international E&P players**: Institutes should collaborate with international E&P players by allotting key administrative positions to industry personnel, improving educational standards to meet industry requirements and partnering for internship opportunities.

ii. **Development of training modules and course content in consultation with industry**: It is essential for academic institutions to establish apprenticeship, certification and training programmes for occupations where supply gaps exist in consultation with industry. Course content should be reviewed regularly to reflect the changing industry needs and advancements.

iii. **Focus on practical applications for students**: Institutes must explore opportunities to focus on real-world applications of curriculum and encourage practical learning. For example, post graduate students can be provided expert supervisors and access to field data to conduct research studies.

iv. **Engaging retired experts as mentors**: Initiatives must be taken for setting up mechanisms to engage retired professionals as mentors or trainers for transferring knowledge to a new generation. Under their training and guidance, a new Indian generation can be groomed in E&P technologies.

9.2.5.2 One of the major reasons for the low number of youth opting for careers in the oil and gas sector is the poor perception of the industry in India. There is a need to increase awareness, correct misconceptions and create the right environment to attract a larger number of young people to specialize in a career in the oil and gas sector. E&P players in general and NOCs in particular need to develop a strong talent acquisition strategy that communicates their value proposition to students. Some of the initiatives in this regard are development of a dedicated communication campaign highlighting various career options in the sector, disseminating information through a website, participating in career fairs and spreading awareness through career counselors.

9.2.5.3 Petrobras, the NOC of Brazil has effectively leveraged industry academia collaboration to build capabilities in R&D as highlighted in the case study below.

Case study: Industry-academia collaboration fueling innovation in Brazil [69]

Petrobras, the NOC of Brazil, is widely recognized as a pioneer and world leader in R&D, particularly given its success in developing deepwater and ultra-deepwater E&P capabilities.

One of the major underlying reasons for the success of Petrobras is that it has extensively leveraged capabilities of academic institutes for R&D initiatives. Petrobras has built close partnerships with several academic institutions in the country and heavily depends on the talent base and resources of these institutes for enhancing its own capabilities in research thus fuelling most of its innovation. The academic partners of Petrobras have four times the space and twenty times the people that Petrobras has for R&D. [70]

[69] 'Brazil Using Offshore Oil Boom to Build International R&D Center', December 2011, Journal of Petroleum Technology

[70] 'Brazil Using Offshore Oil Boom to Build International R&D Center', December 2011, Journal of Petroleum Technology

Some of the examples that highlight the central role played by universities in supporting R&D for the oil and gas sector in Brazil are:

i. The Rio Technology Park created by the Federal University of Rio De Janeiro is home to 11 R&D centers including those of leading global OFS providers like Schlumberger, Halliburton, BG, Siemens, Baker Huges etc. It is emerging as a hub of path breaking innovation and widely referred to as the Brazilian 'Silicon Valley'. The technology park is also home to a start up incubator.
ii. Tecgraf, the consulting arm of the Pontifical University of Rio De Janeiro, staffed by students and faculty members provides a host of state of the art technologies to Petrobras like complex programming applications, data analysis tools, data mining tools etc.
iii. The State University of Campinas initiated a petroleum engineering programme in association with Petrobras in the late 1980's. Many of its faculty members are engaged in consultation work for Petrobras, allowing Petrobras to operate at lower costs and flexibilities in terms of resource staffing.
iv. Close linkages between Petrobras and the universities also facilitate a culture of entrepreneurship. Research findings by students and faculty members that have potential for commercial application are evaluated and deployed by Petrobras. One such example is Oil Finder, founded by two doctoral candidates at Federal University of Rio De Janeiro, later hired by Petrobras.

Case study: Industry-academia collaboration at the Pandit Deenayal Petroleum University (PDPU), Gujarat [71]

International exposure for students and faculty members is an integral part of the curriculum at PDPU and partnerships with various foreign universities such as University of Texas, Oklahoma University, University of Houston etc. have been developed.

PDPU has built a strong industry interface to ensure practical learning for the students through workshops, conclaves, seminars, meetings etc. conducted in association with downstream and upstream oil and gas companies. These initiatives are supplemented through internships industrial training programs. The faculty is also encouraged to undertake several joint consultancy and research projects.

PDPU has established several Centres of Excellence in the fields of petroleum, geothermal engineering, solar engineering, automation and control. These Centers of Excellence, provides students with hands on experience of industrial applications and technologies.

[71] Note to committee from PDPU

The course content is reviewed time to time to ensure that PDPU is at par with any other national or international petroleum institute. Syllabus is updated as per industry requirements, with the up-gradation of technological input by the industries.

9.2.6 **Skills development at industrial level**

9.2.6.1 An important touch-point for human capital development is vocational or skill based training. The National Skill Development Council (NSDC) in India has identified 21 sector specific skill councils in partnership with industry players, of which 16 skill councils are operational.[72] The objective of these councils is to complement the existing vocational education system in meeting the industry requirements for adequate and high quality trained manpower. NSDC has set itself a target of training approximately 150 million people by year 2022.

9.2.6.2 Initiatives for the setting up of a Hydrocarbon Sector Skill Council (HSSC) have already been taken by the NSDC through the signing of an MoU between OIDB and Petrofed in January 2014. The HSSC has set an ambitious target of imparting training to about 19 lakh persons over a period of 10 years through identified training institutes.[73] Training will be granted for approximately 200 pre-identified trades based on industry feedback. This is a step in the right direction and will have substantial impact by making available a vast pool of skilled manpower for the industry. The HSSC should be made operational at the earliest to develop vocational training modules and implement them in the Industrial Training Institutes (ITIs). It is also important to ensure that the quality of training is at par with international standards.

[72] 'Details of Indian Sector Skill Councils', 2014, National Skill Development Corporation India
[73] 'Details of Indian Sector Skill Councils', 2014, National Skill Development Corporation India

Chapter X: Acquisition of equity oil and trans-national pipelines

10 Acquisition of 'equity oil' and trans-national pipelines

10.1 Introduction and context

10.1.1 All major developed and developing economies are increasingly pursuing international partnerships to secure access to energy resources. NOCs are focusing on aggressive international expansions driven by both economic and geo-political considerations. As a result of the rapid globalization of NOCs, the world energy scenario is becoming more and more competitive. Given that India is endowed with a relatively low share of hydrocarbon resources, there is need to put in place a robust strategy and mechanism for both building transnational pipeline infrastructure and acquisition of 'equity oil' though investments in oil and gas acreages abroad.

10.1.2 Transnational gas pipelines are a critical enabler for securing natural gas from gas rich nations. The recent USD 400 billion long-term gas supply deal negotiated between China and Russia highlights that securing gas supplies is becoming an important agenda and objective for governments globally. The agreement will enable supply of 38 billion cubic meters (bcm) of pipeline gas to China over a period of 30 years.[74] Chinese NOCs are investing in transnational pipelines in north, central and south-east Asia, adding new dimensions to the market and political dynamics of these regions while enhancing economic development.[75]

10.1.3 Major NOCs are looking beyond domestic operations and increasing their global footprint. A large part of the revenues of major NOCs can be attributed to international operations and NOCs of several countries like China, Norway, Malaysia and others have operations in more than 30 countries. Trends in E&P M&A indicate that NOC acquisitions reached an all time high of USD 112.6 billion in 2012 presenting a 225% growth over the previous year and constituting 45% of the total E&P M&A by value.[76] The table below indicates the proven international reserves of the various leading NOCs. It is interesting to note that 98% of the reserves portfolio of Korea National Oil Corporation (KNOC) is constituted by international reserves.

Exhibit 3: Proven international reserves for global NOCs (2013-14)

National oil company	Country	International reserves (mn BOE)	% of total reserves
ONGC	India	1339	20%
Statoil	Norway	1686	30%
KNOC	Korea	1330	99%

[74] Bloomberg
[75] Overseas Investments by Chinese NOCs, 2011, International Energy Agency
[76] Oil and Gas Reality Check- A look at the top issued facing the oil and gas sector, 2013, Deloitte

Petrochina	China	2283	10%
Petronas	Malaysia	3238	24%

Source: Company annual reports, BCG analysis

10.1.4 China has taken the lead in pursuing an aggressive international strategy as discussed in the case study below.

Case study: Overseas acquisition strategy of China

China is one of the foremost examples of a country that has pursued an aggressive overseas investments strategy. Chinese NOCs - CNOOC, Sinopec and CNPC have been playing a dominant role in the global upstream oil and gas scenario by aggressively pursuing global partnerships, M&A opportunities and gas deals. In 2010, China's National Energy Commission declared that, 'securing energy supply through international co-operation' is one of its major areas of focus, demonstrating that these goals are supported at the highest levels of government. The major drivers for such an approach are mainly concerns regarding energy security, given the high dependence of China on oil supplies from politically unstable regions. Chinese oil companies are now operating in 31 countries and have equity production in 20 countries.[77]

In pursuit of its strategy, the government allows Chinese NOCs to retain their profits as long as companies are investing them regularly. If the NOCs do not re-invest their profits early, they may be clawed back by the government. Hence Chinese NOCs expand overseas, often seeking a lower ROI for investments. Also, it is easier for Chinese NOCs to get government approvals for overseas investment plans than it is for domestic proposals. [78]

Chinese NOCs have also heavily invested in building trans-national pipelines. China has invested in gas pipelines from Central Asia (Turkmenistan and Kazakhstan), Russia and Myanmar. In addition, China has signed several long term LNG contracts with Australia, Qatar, Indonesia and Malaysia. [79]

10.1.5 Like other major countries, India should have a strategy for acquiring 'equity oil and gas' to meet its objective of long term energy security and price hedging, which also requires creation of transnational pipelines, particularly sub-sea pipelines.

10.2 Strategic role of transnational pipelines

10.2.1 **Increasing share of natural gas in energy mix**: Transnational pipelines can help secure access to gas supplies to increase the share of natural gas in the energy mix. The need for

[77] Overseas Investments by Chinese National Oil Companies, 2011, International Energy Agency
[78] India's Energy Sector: Pride & Prejudice-Fereidun Fesharaki & Praveen Kumar, The Political Economy of Energy and Growth edited by Najeeb Jung
[79] Overseas Investments by Chinese National Oil Companies, 2011, International Energy Agency

increasing the share of natural gas in the energy mix has been highlighted in the earlier sections of this report, given the wide availability of natural gas globally, the environment friendly nature of gas and want for diversification of our energy supplies.

10.2.2 **Encouraging competitive prices of natural gas**: Transnational pipelines can help encourage competitive and rational domestic gas prices by increasing the overall gas supply in the country and correcting the demand-supply imbalance.

10.2.3 **Diversification of supply base**: Currently natural gas is imported through shipping routes in the form of LNG. Hence, access to imported gas is dependent on access to international sea routes and maritime security. Transnational pipelines will play a critical role in reducing dependence of the country on international sea routes for gas supply and mitigating the associated risk.

10.2.4 **Long term relationship and risk mitigation:** Given the significant upfront investment required, pipeline infrastructure creates longer-term mutual dependencies between the buying and selling country. The improved symmetry in inter-dependencies implies greater supply certainty and supply risk mitigation for India. Sub-sea pipelines for securing gas have the additional advantage of enhancing security of supplies.

10.2.5 **Regional stability and development:** A regional or Asian pipeline network can help secure gas from several resource rich regions like Middle East, South Asia, Burma etc. Such initiatives will enhance regional cooperation, stability and boost economic development.

10.3 Strategic role of 'equity oil'

10.3.1 **Enhancing energy security**: Investments in international oil and gas assets help achieve the dual objective of diversification of our supply base and secure access to oil and gas reserves for present and future consumption.

10.3.2 **Capability building and international exposure for NOCs:** Participation in international ventures particularly through partnerships enables internal capability building for NOCs through exposure to global best practices. The learning for the NOCs both in terms of technology and employee skill-building can be leveraged to increase the efficiency of existing domestic operations and undertake E&P activity in difficult geologies.

10.3.3 **Long term price hedge for crude oil:** 'Equity oil' acquired by virtue of participation in international upstream projects will enable the country to develop a long term hedge against adverse price fluctuations of crude oil.

10.4 Institutional mechanisms for acquiring 'equity oil'

10.4.1 To enable access to energy resources in developing or under-developed countries, several nations are using a coordinated and collaborative approach whereby they invest in infrastructure and economic development of the host nation. Such a partnership model creates a symbiotic relationship. It enables the investing country to pursue its economic or geo-political interests by increasing influence and credibility in the host country. On the other hand, it enables the host country to benefit from the incoming investment in the development of the domestic economy.

10.4.2 Such a collaborative approach requires significant coordination between multiple stakeholders - E&P operators, service providers, infrastructure companies, mid-stream and downstream companies. Companies need to work together at all stages of a project, from intelligence gathering, to developing a value proposition by evaluating commercial interests, and project implementation, thus requiring a strong institutional mechanism for support.

10.4.3 Creation of an International Sourcing Group

10.4.3.1 While Oil and Natural Gas Corporation (ONGC) through its wholly owned subsidiary ONGC Videsh Limited (OVL), has taken the lead in acquiring oil and gas assets abroad, there is significant room for increasing our global footprint. Also, other major Indian NOCs are yet to place dedicated focus on pursuing international opportunities.

10.4.3.2 To provide dedicated focus to the objective of increasing international presence through a collaborative approach, an International Sourcing Group (ISG) must be set up. The ISG would serve as common platform to devise a coordinated approach for increasing investments in developing or underdeveloped countries. The following are the key features of the ISG:

i. **Inter-ministerial and industry representation**: The ISG should consist of representation from different ministries like the MoPNG, MEA (Ministry of External Affairs), Ministry of Coal (MoC), Ministry of Power (MoP) etc and major PSU's, particularly the Navratnas and Maharatnas, that can be potential partners in investments. The ISG may invite private participants based on requirements. This will enable greater coordination between concerned industry players with a common interest.

ii. **Identification of potential countries and development of a country specific proposition:** The ISG should be responsible for evaluating needs of different countries, identifying potential countries to partner with, developing a country specific value proposition, bringing together the interested parties and pursuing the opportunity in the identified nation.

10.4.3.2 One of the central roles of the ISG is to promote a consortium based approach in international projects. A consortium approach through partnerships between various PSUs and private companies in pursuing international opportunities will not only increase India's bargaining power but also improve the chances of project success. The consortium may be in the form of an

incorporated or unincorporated JV. Among the several benefits of using a consortium approach for international transactions are the following:

i. **Increased financial strength and bargaining power**

A consortium approach helps in pooling of resources and increases the financial strength of the combined entity, in turn increasing its bargaining power. It also provides an opportunity to smaller companies, which may not have the financial capability to invest in international transactions on a stand-alone basis, to build a global presence. For example: coordinated efforts for LNG imports by multiple companies can help negotiate better prices.

ii. **Pooling of complementary capabilities and related interests**

Partnerships between companies operating in different parts of the value chain will help bring together expertise and synergies by establishing linkages across the value chain. For example, a partnership between an upstream E&P company and a shipping company ensures that adequate infrastructure is in place for shipping extracted oil or gas to destination countries. Similarly a partnership between an upstream company and a refining company ensures that the extracted oil can be used as an input for the refinery. It is a win-win situation for both entities involved and the host nation.

iii. **Cohesive international strategy**

The consortium approach will help prevent internal competition with multiple PSU's competing for the same commercial opportunity or asset.

iv. **More attractive proposition for host nations**

A consortium based approach where multiple companies from the upstream, midstream, downstream or infrastructure sector partner to provide a holistic turnkey solution may further increase the value proposition and attractiveness of the project for the host nation.

10.4.4 Institution of energy diplomats

10.4.4.1 In order to build a presence in the global oil and gas market, India requires the assistance of dedicated cadre of professionals positioned as energy diplomats. The energy diplomats would be specialists positioned in 'energy capitals' of the world or major cities which are hubs for oil and gas transactions. Some of the cities that have been identified for deputation of the energy diplomats are Moscow, Sydney, London, Calgary, Houston and Johannesburg. These personnel would serve as outposts of India in global locations with the objective of furthering the agenda of ensuring energy security for the country.

10.4.4.2 The energy diplomats should be part of the MEA (Ministry of External Affairs) to provide the required institutional support. They should also be provided with a dedicated hospitality budget, with targets and accountabilities.

10.4.4.3 The primary responsibilities of the energy diplomats would include the following:

i. **Intelligence gathering and dissemination**

Intelligence gathering requires vigilance at all stages of a transaction-identifying the potential assets that could be of interest, identifying potential partnership opportunities, gathering information regarding competitor interests or actions, evaluating strategic attractiveness of opportunities and evaluating commercial terms. The energy diplomats should be on the lookout for major opportunities with commercial, geo-political or capability development interests and relay these back to the Indian institutions and allow for a strong value proposition to be tabled.

ii. **Nurturing relationships with key stakeholders**

The energy diplomats would be responsible for developing relations with the key industry personnel and government stakeholders who can influence the deal making process–businessmen, bankers, politicians, and industry representatives. This would in turn facilitate meetings and negotiations and also build credibility for Indian companies and institutions with the key stakeholders.

10.4.5 Acquisition of stakes in oil and gas prospecting companies

10.4.5.1 Building a strong global presence requires active environment or landscape scanning. One of the commonly used avenues by several global E&P companies for acquiring 'equity oil' is buying a stake in smaller oil and gas prospecting companies. Such companies are often listed on exchanges like the Alternate Investment Market (AIM) in London that are focused towards small and growing companies. Indian NOCs should also use a similar approach for expanding their global presence.

10.5 Revival of government-to-government interactions for transnational pipelines

10.5.1 In order to secure gas supplies at competitive rates, India should also focus on developing transnational pipeline infrastructure linking several gas-rich regions to India. Some of the proposed and potential pipeline projects are discussed in the sections below.

10.5.2 Two of the major transnational pipeline projects that have been pursued by the Indian government are the Turkmenistan-Afghanistan-Pakistan-India (TAPI) pipeline and the Iran-Pakistan-India (IPI) pipeline for sourcing of gas from Turkmenistan and Iran respectively. However, these projects have been delayed due to multiple economic and political reasons and dedicated efforts need to be taken to revive the projects. Initial agreements between the governments were signed for the TAPI and IPI pipeline projects in 2008 and 2009 respectively; but substantial progress is yet to be seen. In association with the major oil PSUs, the government should engage in constructive dialogue with the concerned nations to review project structures, resolve geo-political issues, and work towards accelerating the projects.

10.5.3 The Middle East is a relatively resource-rich region that can supply natural gas at competitive prices to India. Hence the government should give the sub-sea pipeline project between India and

the Middle East concentrated diplomatic attention and policy incentives. Such sub-sea pipelines have the additional advantage of enhancing security of supplies.

10.5.4 A new wave of gas discoveries has recently emerged in African nations such as Mozambique, Tanzania, Uganda, the Democratic Republic of Congo and others. India needs to take concrete steps both at a diplomatic and policy level to tap into these emerging sources of natural gas, which requires that pipeline infrastructure connecting India with Africa be put in place.

10.6 Institution of a center for policy research on Gulf countries

10.6.1 India currently imports almost 80% of its domestic oil requirements. Given the physical proximity and the abundance of hydrocarbon resources, the Arabian Gulf region plays an indispensable role in meeting India's energy requirements.[80] According to some estimates, India imports more than 65% of its crude oil from the Arabian Gulf region countries.[81] In such a scenario, geo-political and economic developments in the Gulf countries have an important impact on India's energy security.

10.6.2 It is critical to establish a think tank that undertakes quality research on the challenges and opportunities associated with the Arabian Gulf region countries. Such policy research initiatives become even more important with the political turmoil and instability in the Gulf region presenting a major risk to India's energy security.

10.6.3 The research center should undertake multi-disciplinary research covering geo-political, economic, social cultural and other aspects with the objective of linking our energy security to the internal and external dynamics of these regions. Systematic research will facilitate India to build long term mutually beneficial relationships with the Arabian Gulf countries through 'knowledge based policies'.

10.6.4 Such a think tank may be established as part of any of the leading petroleum sector focused universities in the country, like the Deen Dayal Petroleum University in Gujarat.

[80] Gulf region consists of 7 countries- Iraq, Kuwait, Bahrain, Saudi Arabia, Qatar, United Arab Emirates, Oman

[81] 'India's growing role in the Gulf- Implications for region and United States', 2009, Gulf Research Center

Chapter XI: Strengthening the NOCs

11 Strengthening the NOCs

11.1 Introduction and context

11.1.1 In India, National Oil Companies (NOCs) like ONGC, OIL, GSPC etc. have been strategic instruments for the countries energy policy and will continue to play an important role in enhancing energy security.

11.1.2 Internationally, National Oil Companies (NOCs) differ on a number of important variables, including the level of competition in the market in which they operate, their business profile, relevance to the national economy, and their degree of commercial orientation and international ambitions. However, most NOCs share one core construct: they seek to maximize shareholder returns while pursuing some 'national objective' and serving the nation's political and economic goals. Perhaps this is the single most relevant factor that explains their existence and resilience across political, social and economic environments.

11.1.3 Oil and gas sector of oil producing nations as well as major oil importing countries are characterized by the presence of a strong NOC. In a world ever more polarized by words such as 'energy security' and 'resource nationalism', a pragmatic positioning of the NOC is the crux of a national energy policy. The NOC is utilized by governments as an 'instrument' to facilitate the sustained backward and forward development of the sector, besides achieving 'national objectives' including accelerated hydrocarbon production, promoting competition and participation of private players in the sector.

11.1.4 Some of the aspects where NOCs play a key role to meet national objectives and specifically develop the domestic oil and gas sector are:

- Play a central role in developing the domestic oil and gas sector
    - Reduce information and technological asymmetry by promoting partnerships with global players and other private players (allow and mandate when appropriate)
    - Develop other sectors (e.g. oil field services) through the promotion of Joint Industrial Projects with key stakeholders
    - Lead critical initiatives related to creation and development of sector enablers, like investment in appraisal of national basins and developing indigenous technologies.
- Ensure participation in specific geologies of national and strategic importance
- Pursue energy security targets through acquisition and access to global oil and gas acreages

11.2 Capability building for Indian NOCs

11.2.1 Indian NOCs will continue to play a strategic role in both development of the economy, and furthering the geo-political and economic interests of the country. To that end, it is important to learn from successful global NOCs and leverage them to develop and transform Indian NOCs.

11.2.2 The strengthening of the NOCs in India requires a fundamental review of the corporate structure, governance, operating principles and practices of ONGC (and others), and may require a complete structural overhaul. The guiding principles for transforming ONGC and other NOCs are discussed in the following sections.

I. Strengthen board, with greater accountability

- Create greater autonomy with adequate checks and balances with government oversight exercised through the board, board level processes and board level committees, ensuring that the social agenda of the government as well as its 'national objectives' are met
- The remuneration of board members must be at par with international best practices, with accountability to shareholders for results.
- The selection procedure of independent directors must be strengthened and the board must also include international experts, industry professionals etc. as members.

II. Require NOCs to be unfettered of the restrictive policies of the public sector undertakings at all levels

- Confer complete financial and operational autonomy in decision making
- Enable greater flexibility in systems and procedures like transfers, deputations etc.
- The current oversight and control mechanisms for NOCs by various government bodies, agencies and Parliamentary Committees require to be reviewed in order to align with international best practices followed by countries such as Norway, Brazil and Malaysia.

III. Position as a global NOC

- Encourage NOCs to develop an aggressive approach in identifying and pursuing global investment or partnership opportunities - streamline the administrative processes for enabling and expediting such investments.
- Enable NOCs to hire and retain the best-in-line global talent in oil and gas, by allowing for differentiated and competitive remuneration in line with global markets.
- Enable organizational capability building and knowledge building through international exposure for employees and collaborations with leading global institutions.

IV. Build a strong commercial orientation

- Incentivize core activities with active de-focusing from non-core businesses.
- Build high accountability across the organization, with objective and clear KPIs linked to business results.

V. Promote a culture of performance and commensurate accountability

- Structure corporate HR policies based on 'domain expertise and professionalism', allowing for more performance based remuneration policies, as is the case with the public sector in countries like Singapore. [82]
- Build strong performance orientation that rewards meritocracy by instituting a tenure-based recognition process to reward and motivate high performers
- Modify PESB (Public Enterprises Selection Board) guidelines to allow for greater participation of private sector business leaders for leadership roles in PSUs
- Diversify the hiring base and focus on hiring the best quality talent at competitive remuneration.
- Enable hiring of global talent as knowledge partners or domain experts on a project or contractual basis

VI. Leveraging partnerships for capability building

- NOCs should be encouraged to undertake Joint Industry Projects (JIPs) in association with major industry stakeholders - upstream E&P operators, OFS providers, research institutes etc. to leverage their resources and expertise for R&D activities.
- NOCs to participate in global collaboration networks such as ITF (Industry Tech Facilitator) for R&D initiatives
- NOCs to be empowered to enter into partnerships like JVs or joint operator-ships with leading IOCs and NOCs to enable technology transfers
- NOCs should be mandated to participate in key strategic domestic acreages, to reduce information arbitrage, develop capability in complex geologies and evolve through active technology and knowledge sharing with partners
- Review structure and role of internal technology institutes to foster forward looking and accountability driven initiatives in R&D and capability building

11.2.3 The below reforms proposed by the Ministry of Finance to professionalize state owned banks and ensure greater accountability, should be extended to the NOCs.

i. Reputed professionals and experts to be inducted as independent directors
ii. Post of Chairman and Managing Director should be split; Chairman should be a reputed person form the industry
iii. Executive Directors should be experts on risk management
iv. Managing Director should have a fixed term of three years, extensible by two years contingent on performance

11.2.4 The success of Petronas and Petrobras, the NOCs of Malaysia and Brazil as comparable economies, and Statoil the NOC of Norway as an advanced economy, could offer key learning for reforming ONGC and other NOCs. The section below highlights important features and best practices of these successful NOCs.

[82] India's Energy Sector: Pride & Prejudice-Fereidun Fesharaki & Praveen Kumar, The Political Economy of Energy and Growth edited by Najeeb Jung

Case studies

A. Petronas - strong commercial orientation

Petronas, the NOC of Malaysia, is wholly owned by the Malaysian government and has developed into one of the leading integrated international companies in oil and gas. Much of the success of Petronas can also be attributed to its autonomous decision making powers. Though wholly owned by the state, Petronas functions like an independent commercial entity. The government does not interfere in the operations, financial or investment decision making of Petronas. Petronas has been identified by the Financial Times as one of the 'new seven sisters', or among the most influential energy companies from countries outside the OECD (Organization for Economic Cooperation and Development). Petronas has leveraged partnerships both for building an international presence and for internal capability building. Since establishment, Petronas has leveraged PSC's with leading IOC's like Exxon Mobil, Shell and others in order to develop the capabilities and expertise required for managing its own independent operations. Since the 1990's, Petronas has aggressively expanded operations globally. The global presence and culture of Petronas is highlighted by the fact that it currently has operations in more than 35 countries and international operations account for ~40% of its total revenues. For its global operations too, Petronas has a long history of partnerships with IOCs, Chinese NOCs and NOCs from producing countries.

B. Petrobras - innovation focus

Petrobras, the NOC of Brazil, is 46% owned by the state. Petrobras has played a central role in the expansion of the Brazilian oil and gas sector through technological innovation. Petrobras has been a pioneer in developing sub-salt offshore exploration capabilities. Petrobras is acknowledged as a world leader for its expertise in deepwater and ultra-deepwater oil production - geologies that have traditionally been considered to be technologically challenging and capital intensive. Almost 85% of the oil and gas reserves of Petrobras are in the deepwater and ultra-deepwater geologies. In view of the high risks involved, the government has facilitated and supported a culture of innovation at Petrobras by providing government funding and instituting a favorable policy framework. Petrobras also has a central business development team that reports directly to the CEO.

C. Statoil - financial autonomy

Statoil is the NOC of Norway with a 67% government stake. Statoil has evolved into a multinational company with operations in over 35 countries. One of the critical factors for the success of Statoil is its strong commercial orientation and arms length relationship with the state. It functions independently of annual state budgets. Also, Statoil has a centralized business development team that is a part of the corporate strategy team. The centralization of the business development team ensures that adequate resources are available for strategic investments. It also ensures better execution of the company's vision and leads to optimal deployment of resources by avoiding duplication of efforts or expertise.

11.3 Optimization of NOC portfolios

11.3.1 **Allow greater autonomy in resource allocation**: In accordance with global best practices, the NOCs must be provided greater autonomy in resource allocation and portfolio management. The existing process must be streamlined by empowering the board to make farm-in and farm-out decisions while adhering to broad principles and guidelines laid-out by the government. To address security concerns, the government may publish a 'positive-list' of countries where investments can be made without prior government approval. This will expedite investment decisions and reduce cycle time for approvals.

11.3.2 **Divestiture of non-core businesses**: To allow upstream NOCs to focus on the core activities of E&P in oil and gas, downstream ventures and projects should be reviewed and divested. This will allow for greater system efficiencies and place greater thrust on improving E&P capabilities of upstream NOCs.

11.4 Government support for sharing risks in strategic projects

11.4.1 For economically unviable projects of strategic importance that are undertaken by the NOCs, the government should participate in the sharing of risks by providing financial support through the IOD cess.

11.5 Separate business unit focussed on non conventional fossil fuels

11.5.1 Tapping into non conventional fossil fuels like shale gas, CBM, gas hydrates, tight gas etc. requires unique skills, capabilities and approaches since resources are in different stages of their life cycle. Given the distinctive requirements, non conventional resources are usually managed through a separate decentralised business unit to enable speedy decision making and innovation focus. In line with global best practices, non conventional resources should be managed by Indian NOCs as an independent business unit.

11.6 Separation of the service functions of ONGC to make them non-captive

11.6.1 Most of the oil field services required by ONGC, the largest NOC in India, for exploration and production are currently undertaken in-house. A Technology and Field Services (T&FS) division provides the drilling, logging, wellhead and other technical services required for all E&P projects handled by ONGC. Such vertically integrated oil companies are a legacy of the soviet era. However, today no major well performing global oil companies have such dependencies on in-house services due to the associated drawbacks such as:

i. **Lack of access to advanced technologies in a cost-efficient and timely manner**
   Given that the T&FS division is the sole provider of oil field services to ONGC, it does not have the flexibility to access the requisite technical capabilities to cater to the increasing scale and complexity of ONGC operations. Dependence on internal technical units could thus hamper the reach, effectiveness and efficiency of India's largest E&P enterprise.

ii. **Restricted in house capability development and lack of focus on core business**
Any captive business, including one that arises by virtue of being the sole service provider to the parent, could act as a strong disincentive to improve competitiveness and invest in internal capability building. In-housing of services also fragments management focus from the core operations of exploration and production activities to that of oil field services.

iii. **Restricted market development**
ONGC is the among the largest oil and gas producers in India and hence accounts for the largest share in consumption or utilization of oil field services. Due to the in-house provision of oil field services at ONGC, other professional service companies lack a sizeable market to compete in. This acts as a deterrent not only for the entry of new foreign players into the sector but also for the growth of domestic players.

11.6.2 In line with the global best practice of enhancing efficiency by reducing dependence on in-house services, drilling services within the T&FS arm of ONGC should be de-merged and spun off into an independent listed company. The transaction may be conducted through a 1:1 share split to maintain the current shareholding pattern. This may later be extended to other services. The following measures should be undertaken to ensure a smooth and successful transaction:

i. ONGC may underwrite a share of the business of the technical services arm initially, while gradually reducing the business provided exclusively to the in-house services arm over a period of three to five years. The services arm should then compete with other OFS providers for projects and transactions should be conducted on an arm's length basis.
ii. The rights of the employees in terms of salaries, healthcare facilities and other welfare benefits should be protected and safeguarded during the de-merger.
iii. The technical services arm would be free to render services to other E&P providers, domestic and regional, thus expanding its growth opportunities significantly. Hence, the interim period should be used by T&FS to upgrade its technologies and capabilities for competing with global service providers.
iv. The technical services arm may be awarded 'ratna' status in accordance with the set norms and guidelines to give it more flexibility and autonomy in decision making.

11.6.3 Separation of the oil field services division will not only generate significant efficiencies for ONGC internally but will also foster the development of a large, competitive and technologically advanced OFS sector in India.

Chapter XII: Progress towards reduction of import dependency

12 Progress towards reduction of import dependency

When the proposed policy reforms and institutional measures are adopted, the committee envisions a significant reduction in the import dependency on account of several mechanisms:

i. Increased investment flows in E&P activity
ii. Higher recovery rates due to induction of IOR/EOR technology
iii. Shorter discovery to production cycles
iv. Non conventional resource exploitation due to market linked gas pricing
v. Higher levels of equity oil
vi. Promoting greater efficiency of the consuming sectors

As a result of these mechanisms, the committee estimates that India's import dependency by 2030 can be reduced by more than half as compared to the business as usual scenario. In value terms, it means that the annual imports can be steadily reduced in the coming decade leading to an annual reduction of imports of 70-80 billion USD by 2030.

The sections below outline the estimated impact of the various recommendations on reduction of imports and the associated initiatives required to be undertaken.

12.1 Increased investment flows in E&P activity

i. Increased investments will lead to an increase in the rate of reserves accretion. This can be achieved through a favorable contract regime and streamlined contract administration, ensuring contract stability, initiation of the Open Acreage Licensing Policy, initiatives to foster R&D in oil and gas, transition to market determined gas pricing, initiatives for appraisal of Indian basins and institution of a streamlined approval and clearance process.
ii. For the purpose of estimation, It is assumed that the time to production of the 'yet to find' conventional and non conventional reserves can be reduced by 6-7 years from the current 25 years in line with international best practices. The 'yet to find' reserve base in India is estimated at 40 billion BOE. Similarly, the time to production for resources currently under exploration can be reduced by 3-4 years from the current 15 years. The resource base under exploration in India is estimated at 5 billion BOE. (Refer Exhibit 4 below) The production quantities are estimated based on the 20 year production profile of an average field.
iii. Incremental production of approximately 220 million BOE by the start of 2030 from 'yet to find' conventional and non conventional resources, and annual incremental production of 140-150 million BOE between 2025 and 2030 from resources under exploration is estimated. This translates to savings in the import bill of USD 16-20 billion annually from resources under exploration and USD 30 billion by 2030 from 'yet to find' resources. Higher recovery rates due to induction of EOR/IOR technologies

12.2 Higher recovery rates due to induction of EOR / IOR technologies

i. Recovery rates of mature fields can improved by easing the under-recovery burden on the NOCs which makes investments in EOR/IOR techniques economically viable, empowering NOC Boards to allow access to advanced global technologies and capabilities through partnerships and initiatives for strengthening of the NOCs.
ii. It is assumed that the average recovery rate of existing mature fields can be increased from current levels of approximately 30% to a modest 35-40% by application of EOR/IOR technologies bringing it to the lower band of global best practices. Production from mature fields starts in the year 2016 and ramps up in 5 years. The total EOR potential in India is 2.5 to 3 billion BOE. (Refer Exhibit 4 below)
iii. A annual incremental production in the range of 130 to 200 million BOE between 2020 and 2030 is estimated. This translates to savings in the import bill of USD 18 billion to 30 billion annually.

12.3 Shorter discovery to production cycles

i. Shorter discovery to production cycles for resources that are under development or that are discovered but not under development can be achieved through streamlined contract administration and the subsequent reduction in project delays, initiatives for strengthening of the NOCs, strengthening of the DGH to streamline approval process and timelines, expedited appraisal of Indian basins, OFS sector development initiatives to reduce procurement and delivery timelines and transition to market determined gas pricing.
ii. To estimate the impact, it is assumed that the time to production for fields that are under development or are discovered but not under development can be reduced by 4 to 5 years across stages (discovery to production) from the current 10 to 12 years bringing it in line with international practices through implementation of best in class large capex management practices. The reserve base under discovery or development is estimated at 5 billion BOE. (Refer Exhibit 4 below)
iii. An annual incremental production in the range of 65 to 120 million BOE between 2020 and 2030 is estimated. This translates to savings in the import bill of USD 9 billion to 15 billion annually. The production quantities are estimated based on the 20 year production profile of an average field.

12.4 Higher level of 'equity oil'

i. Improvement in rate of acquisition of 'equity oil' can be achieved by initiatives for strengthening the NOCs through improved governance and accountability, capability building and global exposure for NOCs and institutional support provided through the ISG (International Sourcing Group) and 'energy diplomats'.
ii. It is assumed that the CAGR for acquisition of 'equity oil' can be doubled to almost 10% as compared to 5.7% CAGR of OVL (ONGC Videsh Limited) over the last 9 years (2004-05 to 2013-14).

iii. An average annual incremental production of 55-65 million BOE between 2016 and 2030 is estimated. This translates to savings in the import bill of USD 6-8 billion annually.

12.5 Non conventional resource exploitation due to market based gas pricing

i. Initiatives that can encourage sustainable exploitation of non conventional sources of energy are development of a suitable contract model, policies and administrative support for coal mining, streamlining the approval and clearance processes and transition to market determined pricing of natural gas.

ii. It is assumed that one CTL or coal gasification project can lead to average incremental production of 36 million BOE. It is assumed that six CTL or coal gasification projects can be established between the period 2020 and 2030, i.e. a project can be launched every 2 years starting 2020.

iii. An average annual incremental production of 80-90 million BOE between 2016 and 2030 is estimated. This translates to savings in the import bill of USD 10-12 billion annually.

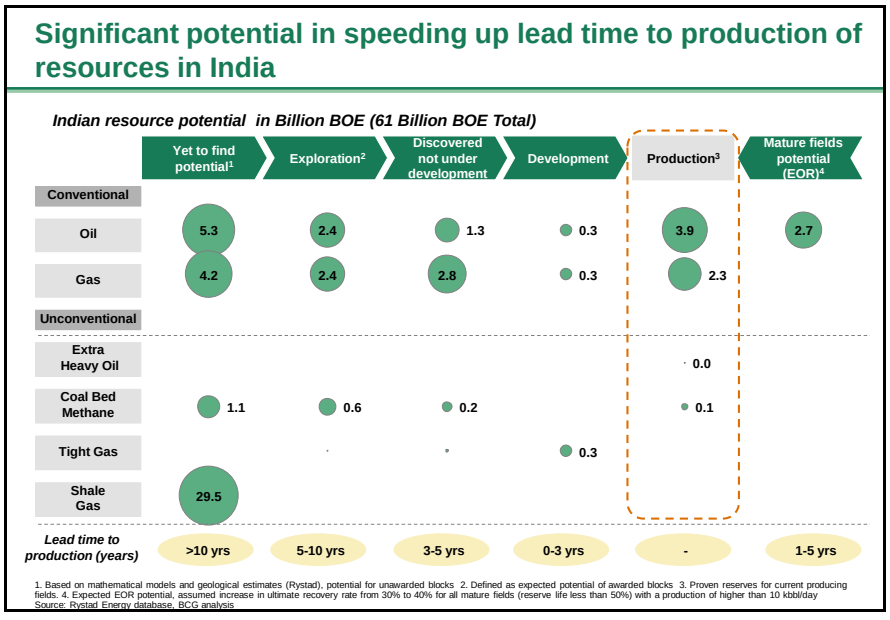
12.6 Promoting greater efficiency of the consuming sectors

i. Initiatives for improving efficiency of energy consumption are discussed in detail in the Integrated Energy Policy 2006.

ii. The overall energy demand can be reduced by up to 15% by 2030. Demand reduction targets are conservative as compared to the targeted demand reduction of 20-25% by 2030 as per the Integrated Energy Policy 2006. The demand estimates are based on forecasts of the Energy Information Administration (EIA).

iii. An average annual demand can be reduced by 140-150 million BOE between 2016 and 2030 is estimated. This translates to savings in the import bill of USD 15-20 billion annually.

Exhibit 4: India's resource potential by stage of production



Note: All the above estimates assume an inflation rate of 2% on current oil prices (approximated at USD 100/ barrel).

12.7 Overall impact

The potential impact of all the initiatives proposed by the Committee averaged over a 15 year period, i.e. from 2016 to 2030 implies an annual savings of USD 70-80 billion in the import bill. The overall savings for a particular year will change based on the production profiles and difference in the time periods to observe the impact of the levers discussed above.

As per the Energy Information Administration (EIA) estimates, oil consumption in India is expected to grow at 3.5% CAGR and gas consumption is set to grow at 4.6% CAGR. This implies that the oil and gas demand in India is expected to reach 3300 million BOE by 2030. In the business as usual scenario, India is expected to import almost 75% of its domestic oil and gas requirements or 2300 million BOE. However, with concerted policy efforts, Indian oil and gas imports can decrease to approximately 40% of the total requirements by 2030. This will be a significant step forward towards achieving our energy security. (Refer Exhibit 5 below)

Exhibit 5: Summary of potential reduction in import dependence of India by 2030

Year	Oil + gas consumption (mboe)	Oil + gas domestic production (mboe)	Equity oil + gas production (mboe)	Oil + gas net import (mboe)	% import dependence
2012	1670	575	55	1040	**62%**
2030 (Business As Usual)	3275	605	145	2525	**77%**
2030 (With proposed reforms implemented)	2785	1405	300	1080	**39%**

Note: 2012 estimates as per BP Statistical Review of World Energy, 2013, BP

Chapter XIII: Annexure

13 Annexure

13.1 Annexure A: Prospective plan prepared by DGH for appraisal of Indian basins

i. A policy for geo-scientific data generation under Non Exclusive Multi Client Model has been approved by the Government of India during February 2014. Response of 2-3 companies is received for offshore areas and no response is received for on-land areas so far. In the past also no response was received for on-land areas. Based on this experience it is planned to cover on-land areas on priority in the first three years by government's own funds.

ii. It is planned to carry out the programme in two phases.
   - Priority areas/basins are identified to be covered by 2D seismic surveys and a well in the first 3 years at an estimated cost of Rs 1878 crores for 20,707 LKM of 2D seismic and Rs 182 crores for one well. The sequence of priority areas/basins may change due to operational reasons availability of field parties.
   - Areas /basins are identified to be covered by 2D seismic surveys and wells in the next 5 years at an estimated cost of Rs 2,884 crores for 51,148 LKM of 2D seismic and Rs 1860 crores for four wells. Areas to be covered in the 2nd phase are logistically difficult, sensitive, geologically challenging and so productivity is expected to be lower.

iii. The 2D seismic surveys and drilling wells is planned to be carried out by hiring seismic parties on the basis on International As per the time lines tender documents and evaluation criteria will be prepared to hire seismic field parties.

iv. 15 seismic field parties are planned to be hired during the first year, 11 in the second year and 12 in the third year as per the planned activities respectively. If lesser number of seismic field parties are available in response to the global tendering during the first year, the plan for initial phase for 3 years will be reviewed. The above plan is estimated to cost a total of about Rs 6,804 crores (2015-2023), Rs. 4,762 crores for 2D seismic surveys (Acquisition, Processing and Interpretation) and Rs 2,042 crores for six wells.

13.2 Annexure B: Note from Daniel Johnston to Kelkar Committee

The following is the note from 'Daniel Johnston Perspective on India PSC Debate', dated 11th June 2014.

13.2.1 To Whom It May Concern

We have reviewed the current debate in India regarding petroleum fiscal regime analysis and design. Our review is based on our understanding of Indian production sharing contracts (PSCs) in the context of industry standards and best practices.

We have also reviewed the reports of the Committee on Roadmap for Reduction in Import Dependency in Hydrocarbon Sector by 2030, chaired by Dr. Vijay L. Kelkar (the 'Kelkar Committee') and the committee appointed by the former Oil Minister Jaipal Reddy, and headed by Dr. Chakravarthi Rangarajan (the Rangarajan Committee).

We also are aware of and base our views, in part, on recently published articles such as those in 'Indian Oil & Gas', 'Business Standard', 'The Hindu News' etc.

In summary, we understand that the Rangarajan Committee is recommending the government move away from PSCs and embrace revenue sharing contracts (RSCs)[83]. The impetus for these recommendations, we believe, stem in part from the controversies associated with the KG-D6 development, which generated some misperceptions about just how PSCs, and cost recovery mechanisms in particular, are designed to work.

We also believe that the disappointments associated with the Block KG-D6 development have been exacerbated and exaggerated by unfairly negative rumours and claims that often characterize disputes that land in the court of public opinion.

13.2.2 Conclusions

1. Revenue sharing systems can be somewhat easier from a government management and administrative point of view but there is more involved. RSCs can be extremely regressive and any attempt to deal with this issue efficiently quickly becomes extremely complex.
2. A 'revenue-based' system as opposed to a 'profits-based' system will be a disincentive to investment.
3. As contracts and systems worldwide have evolved and improved for the past five decades revenue-based systems have become, for all practical purposes, extinct. This is because governments have found the alternatives to be more efficient and effective. Also the alternatives such as PSCs and royalty/tax systems are more attractive to investors.
4. Governments can share in revenues once production begins and before true profits have been generated without converting to a RSC; this is what bonuses, Royalties, and cost recovery limits are designed to do.
5. It appears that early claims of 'gold-plating' have been replaced somewhat by a clarified understanding of what gold-plating is all about. Unfortunately though, this aspect of the debate appears to have devolved into claims of fraud due to 'over-invoicing' or 'transfer pricing'. This kind of potential fraud is not unique to Indian PSCs nor is it unique to the petroleum industry. Any tax-paying company or individual worldwide has an incentive to over-invoice or claim imaginary deductions.
6. A revenue sharing scheme could reduce oversight in some areas, but will not necessarily eliminate oversight requirements.

[83] In this report the term 'revenue sharing' refers to the division of *gross* revenues.

7. Dealing with the characteristically regressive nature of a revenue sharing system would be difficult. The more efficient and common mechanisms these days such as later generation 'R factors' or rate-of-return (ROR) mechanisms are based on measures of profitability (in one fashion or another).
8. We do not see credible incentives to manipulate production rates.
9. We believe the KG-D6 development costs were strongly influenced by the bullish industry-wide cost increases during development. All parties were disappointed with the results. The pain was not unique to either party.
10. We also believe the disappointingly overoptimistic reserve estimates were unintended. This sort of thing is part of the risk associated with petroleum operations.

13.2.3 The Rangarajan Committee

The terms of reference for the committee (section 1.5.4) are paraphrased as follows:

- Review existing PSCs, regarding the profit-sharing mechanism with the Pre-Tax Investment Multiple (PTIM) as the base parameter;
- Explore various contract models with a view to minimizing expenditure monitoring and oversight without compromising, firstly, future hydrocarbon output and, secondly, Government take.

Key issues associated with existing PSCs were outlined in the Rangarajan Committee's Report submitted in December 2012. Key conclusions are paraphrased as follows:

- The existing formula on sharing profit petroleum is dependent on cost recovery by the Contractor. This parameter determines the Government's and Contractor's shares of profit petroleum. However, this system encourages the Contractor to inflate costs, to the detriment of Government's share in profit petroleum.
- Other areas of concern for the Government in a PSC relate to:
    i. Adequacy of investments made, to ensure stipulated levels of production;
    ii. Ensuring correct accounting and calculation of Government's take; and
    iii. Observance of procurement procedures laid down in the PSC

We disagree that PSCs encourage companies to inflate costs. We are aware that there is almost always an incentive to 'cheat' by either over-invoicing or improperly procuring goods and services through an affiliate (i.e. transfer pricing). However, these incentives are virtually universal and go beyond PSCs as well as our industry.

13.2.4 The Kelkar Committee

The Kelkar committee is contesting the recommendation of the Rangarajan Committee to move to a revenue sharing system. In the table below we provide a snapshot, as we see it, of some of the points of contention between the two committees.

13.2.5 The Opposing Views

SNo	The Rangarajan Committee	The Kelkar Committee
1.	Proposes changing the fiscal regime to a simpler revenue sharing system.	Contests proposed changes, saying there is no need to move away from PSCs, which in their view are more investor friendly.
2.	Government to share in revenue as soon as production starts.	Contractor should recover all costs before sharing profits with the government.
3.	The cost recovery mechanism is a disincentive to reducing costs and is the root of the problems with the current fiscal regime.	There is no incentive for investors to gold-plate, spend more than they otherwise would, or curtail production.
4.	Revenue sharing systems require much less oversight.	Current audits should not include oversight of performance or efficiency.

13.2.6 Revenue sharing could be simpler in some respects, but less investor friendly

Revenue sharing systems are generally considered to be simpler to manage. The government gets their share of revenue (or production) from the first day of production regardless of costs. So in its absolute simplest form there is theoretically no need to audit, or approve expenditures. However, in its simplest form, the extremely regressive nature of a revenue sharing system would be unquestionably inappropriate and it could easily compromise government take.

By providing the government with a share of production ‘off the top’, the investor’s timely recovery of costs is dramatically reduced. This is a major disincentive to investment.

Furthermore, the only way to eliminate oversight and monitoring requirements is to eliminate taxes as well. This can be done by instituting what is called ‘taxes in lieu’ where the Contractor’s taxes are taken out of the Government’s share of production. This reduces Government flexibility with respect to its sovereign right to legislate and impose taxes.

13.2.7 Creating a ‘progressive’ regime within a revenue-based structure will be challenging.

In order to use a revenue sharing structure and at the same time maintain government take under a variety of circumstances including windfall profit situations will be extremely difficult.

A ‘progressive revenue sharing system’ is an oxymoron. Revenue-based arrangements are famously regressive. This is partly why they are so rare. The kinds of fiscal mechanisms required to neutralize the regressive nature of a revenue-based system and make it ‘progressive’ will require some new and unprecedented designs. New and unprecedented designs almost always trigger distortions, unexpected consequences, false economies or loopholes. India would effectively be

turning its back on over 50 years of contract evolution that has yielded field-proven, off-the-shelf structures and fiscal mechanisms that have withstood the test of time. There is always room for improvement but to go with a RSC is like starting from scratch.

Governments can guaranty themselves revenue each and every accounting period - without resorting to revenue sharing

The behavior of fiscal systems, how they respond to increases or decreases in oil prices, costs, field size, and various other stimuli is a function of the fiscal elements comprising the system. It is the royalties, taxes, cost recovery limits, and myriad other fiscal elements that determine just how a fiscal system works. If a government wants to share in production the day production starts, there are a number of ways to accomplish this with virtually any fiscal system type.

Royalty Tax systems typically employ royalties, and PSCs use royalties, and/or cost recovery limits, which work in conjunction with profit splits, to guaranty early governments revenue.

However, there are numerous systems that do not provide the government a guaranteed share of revenues (or production) each and every accounting period. These include the UK, Norway and Australia to mention a few. Even the Indonesian system up until the late 1980s did not have a royalty or a cost recovery limit and thus, no guarantee. It is a choice governments make.

13.2.8 The realities of gold-plating

Cost recovery mechanisms do not, in and of themselves, encourage gold-plating. The same is true of PSCs. Royalty/tax systems are not dramatically different from PSCs from a mathematical/financial point of view.

With royalty/tax systems companies are able to take ‘deductions’ (which consist of operating costs and depreciation of capital costs) in order to calculate taxable income. Thus ‘taking deductions’ for tax calculation purposes is essentially the same thing as ‘cost recovery’ in a PSC. Taxable income is equivalent to profit oil for all practical (mathematical, economic or financial) purposes. Therefore, in many respects, any claims of inefficiency or distortions (like gold-plating) could just as easily apply to nearly all systems around the world.

In most circumstances, both with PSCs as well as royalty/tax systems, increased spending only further reduces an investor’s net present value.

i. **Strategic gold-plating:** The claims of gold-plating we have seen with Indian PSCs appear to conform to what is known as ‘strategic gold-plating’. Here a system is designed so poorly and is so inefficiently there is an incentive to spend more than would otherwise be required from day one—during development planning. This kind of situation is quite rare but there were instances

in the past that were fostered by some of the early R-factor-based systems[84] or ROR-based sliding scales promoted by the World Bank[85].

ii. **Opportunistic gold-plating:** Another kind of gold-plating occurs with some of the typical older 'stair-step' R-factor or ROR-based sliding scales. As a company began to approach a threshold or 'trigger point' there were instances where economic analysis would indicate that added expenditures could be beneficial for the contractor. By increasing costs in the accounting periods prior to 'triggering' the new rate of tax or the new profit oil split and pushing it out into the future, company NPV could be improved at the expense of the government. This too is fairly rare but it can occur. It depends on the design. More modern designs have done away with the stair-step structures and have been replaced with smoother formula-based sliding scales. However, for a company to have an incentive to gold-plate is one thing, to act on it or expect to get away with it is quite another matter. Furthermore, the advantages provided by progressive mechanisms like R-factors and ROR mechanisms, if designed carefully, outweigh the risks. When oil prices increased five-fold from 2002 through 2010 government take percentages in most countries went down. This is because most systems are not designed to handle a price shock like what we saw in the early part of this century. The exceptions to this generality were the systems with R-factors or ROR features.

iii. **Over-invoicing:** Over-invoicing is a form of cheating that is unrelated to gold-plating yet understandably the line gets blurred sometimes. In our opinion this kind of larceny is not an easy thing to do. For an operator to over-invoice and submit false claims it must either delude its partners or involve them. Also, the process is difficult to hide from auditors and the risks are great. Of all the disputes (arbitrations and court cases) we have seen we have not seen any involving over-invoicing.

iv. **Transfer pricing:** This is certainly a legitimate concern for both the acquisition of goods and services as well as for oil or gas sales. However, most governments have specific laws and regulations that deal with non-arms-length purchases or sales[86]. Also, procurement laws and regulations or PSC provisions establish a framework for avoiding transfer pricing and this is the kind of thing that an audit can disclose. Transfer pricing is not such an easy thing to do, and, dealing with working interest partners only complicates matters if an operator wants to try this.

13.2.9 Revenue-sharing is also known as 'The Peruvian Model'

The revenue sharing model proposed by the Rangarajan Committee is actually a model introduced by the Peruvians years ago and often referred to as the Peruvian Model (particularly in Latin

[84] R-factors are relatively similar to the Investment Multiple in India but typically a post-tax ratio that also includes operating costs.
[85] Thus ROR systems are sometimes referred to as 'The World Bank Model' even though the concept was not invented by the World Bank.
[86] Or contract provisions that deal with this.

America). This model typically split gross production or revenue, between the government and the investor as proposed by the Rangarajan Committee. The investor covers costs out of their share of gross production. These systems in their purest form do eliminate the need to perform audits. However, they are extremely inefficient and regressive as mentioned previously, which is probably the main reason why they were rarely used in the industry and have now nearly disappeared. Peru abandoned this approach years ago as did Trinidad & Tobago which had such a system in the mid 1970s. Algeria also once had some revenue sharing arrangements but no longer uses this approach.

13.2.10 Profits-based fiscal structures foster healthy business relationships

Virtually all governments with any appreciable petroleum operations in their country rely heavily on profits-based rent extraction mechanisms such as profit oil sharing and taxes of various sorts[87]. Mexico recently launched a series of license rounds for 'fee-based' service agreements but the results were disappointing. Contrary to one of their key objectives virtually no oil companies submitted bids. The blocks went to service companies. The disappointing results of their first 3 license rounds have, in part, inspired the current Energy Reform in Mexico. One of the hallmarks of the Mexican Energy Reform is that the new constitution allows profits-based arrangements such as production sharing agreements.

Profits-based systems create an environment where the interests of all parties can be well aligned. Oil companies want to maximize profits and when they do they maximize profits for both themselves and the government. When they choose the optimal development plan it is invariably the optimal plan for all parties.

Companies also have a strong incentive to keep costs down in order to maximize profits and this too is in the best interests of all parties. As far as cheating or over-invoicing is concerned this behavior is extremely risky, difficult to conceal and the penalties are severe. This is why so few claims of such fraud exist.

Profits-based fiscal elements which consist mostly of (1) profit oil/gas shares and (2) taxes, account for the majority of revenues received by governments around the world from petroleum operations. Roughly 70-80% of government revenues come from profits-based mechanisms. The general breakdown is as follows:

	Govt. revenues from Petroleum Operations
Signature and other bonuses	**1-2%**
Royalties	**15-18%**
Profits-based mechanisms	**70-80%**
Government participation[88]	**7-10%**

[87] The unusual exceptions include Saudi Arabia and Kuwait for example.
[88] Working interest participation normally based on a *carried interest* through exploration phase.

Other **1-2%**

In virtually all of these categories of rent extraction or government revenue generation it is important to be able to monitor, oversee, audit and trust the expenditures that are claimed as either (1) netback costs (for royalty determination purposes[89]), (2) cost recovery (in the case of PSCs and service agreements) and (3) tax deductions (in potentially all systems).

Controlling costs

Governments have numerous means and opportunities to oversee, monitor and control costs which are diverse and highly evolved. These include:

i. Work program and budget process and approval rights
ii. Development plan approval rights
iii. Procurement laws and regulations
iv. Procurement rules in PSCs and/or Joint Operating Agreements
v. Auditing rights
vi. Government working interests[90]

13.2.11 Summary

Around 95% of the governments of this world use systems that are primarily based on the division of profits regardless of whether or not they use a royalty/tax system or a production sharing system. [91] Revenue sharing systems have been tried and abandoned. We believe India would be better off investigating and focusing on the fairly highly evolved, existing industry best practices instead of trying to establish a new framework based on what is essentially a failed system. The revenue-sharing foundation is weak.

13.3 Annexure C: Comparison of E&P fiscal regimes for Indian basins- Illustrative estimates

13.3.1 Introduction

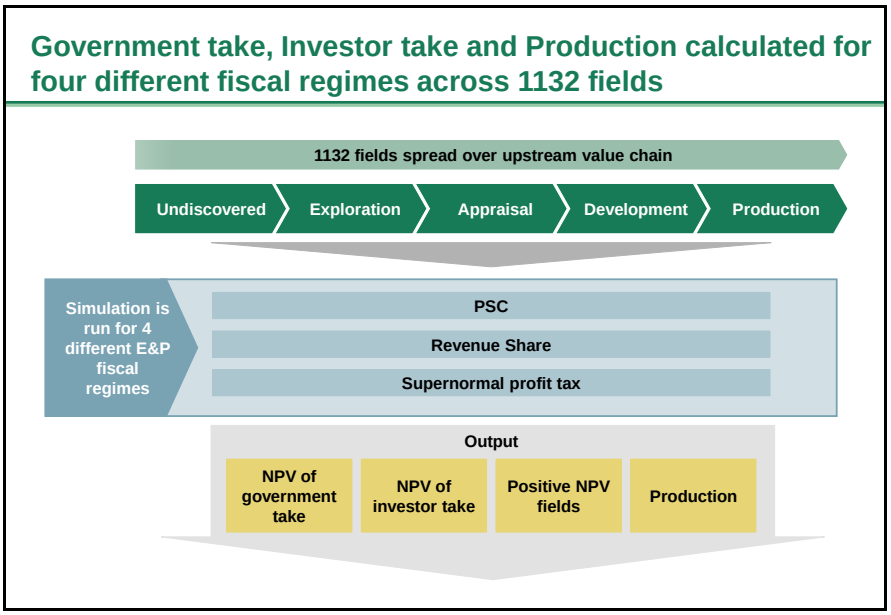
The objective of the following section is to evaluate the alternative fiscal contract regime for the same basis of India's inherent geology, materiality and prospectivity. This section discusses the results of an illustrative exercise undertaken to compare the relative outcome of four different fiscal models – Production Sharing Contract (PSC), Revenue Sharing Contract (RSC), and Supernormal profit tax when applied to the Indian fields.

[89] This is because often hydrocarbons are sold well downstream from the royalty valuation point (often the wellhead or fiscalization point).
[90] This affords government representatives an opportunity to sit in on management committee meetings as well as operating committee, technical committee, and budget meetings.
[91] These two families of petroleum fiscal/contractual arrangement compromise well over 90 percent of the systems in the world.

The primary input for the estimation is a comprehensive database of 1132 Indian fields that are in different stages of exploration, development and production. The data has been sourced from Rystad - a global E&P business intelligence provider. The data is based on best available estimates and projections of Indian fields and includes 204 fields which are currently producing, 150 fields which are in early stages of discovery or development and 778 fields which are undiscovered. The data includes estimates of both conventional and non-conventional fossil fuels. Rystad is one of the three leading databases that are used by E&P companies globally. The exercise can be replicated mutatis mutandis with other alternative credible databases.

Rystad currently houses a database of 80,000 fields for more than 3400 companies globally. While data for existing fields is extrapolated from official data published by companies, data for undiscovered acreages is based on globally recognized estimation techniques and information for nearby acreages as proxies. The Rystad database provides detailed estimates of year on year oil and gas production volumes, capital investments and operating expenses for every field for a 200 year period, i.e.1900 to 2100. Rystad also includes built in assumptions for inflation of costs.

Exhibit 1: Introduction and overview



13.3.2 Assumptions and methodology

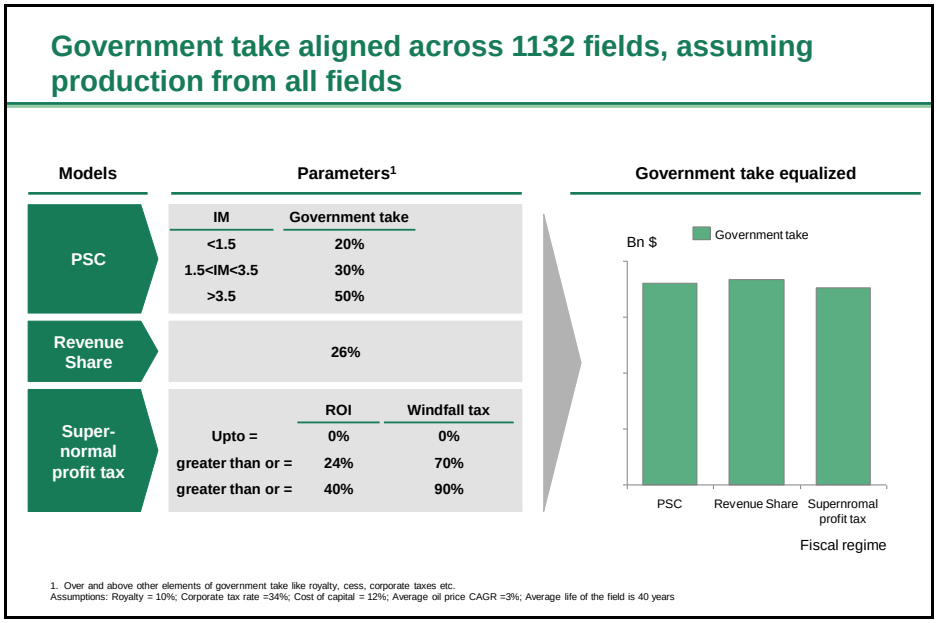
For the purpose of the estimation, a base case PSC fiscal model has been considered for the database of 1132 Indian fields. The parameters in the base case are based on commonly observed in recent PSC contracts. Consequently, the government share of profit petroleum is at 20% for an IM (Investment Multiple) tranche less than 1.5, 50% for IM tranche greater than 3.5 and pro-rated for IM tranche between 1.5 and 3.5. The analysis is essentially forward looking based on the above assumptions.

Among the other inputs of the model, corporate income tax rate is assumed to be 34%, cost of capital is assumed to be 12%, crude oil prices are assumed to increase at a CAGR of 3% from current levels, royalty rate assumed to be 10% and economic life of the field is 40 years.

The exercise indicates that the government take and investor NPV is worked out for the 1132 Indian fields, inclusive of profit petroleum, royalty, cess and corporate income taxes under the PSC contract. With this as a base case, the corresponding fiscal parameters have been derived for other contract regimes so that cumulative government take is equal (or close to equal) across all the regimes. This is to enable a rational (or an 'apple to apple') comparison of the different fiscal structures. Equalizing the government take across other fiscal regimes leads to the following fiscal parameters:

- RSC model: A revenue share of 26%, in addition to other elements of government take like corporate income tax, royalty and cess.
- Supernormal profit tax model: A windfall tax rate of 90% for ROI greater than 40% and a windfall tax rate of 70% for ROI between 24% and 40%, in addition to other elements of government take like royalty, corporate income tax and cess. The windfall tax is levied on the incremental profit that accrues over and above the set threshold.

Exhibit 2: Determining fiscal parameters



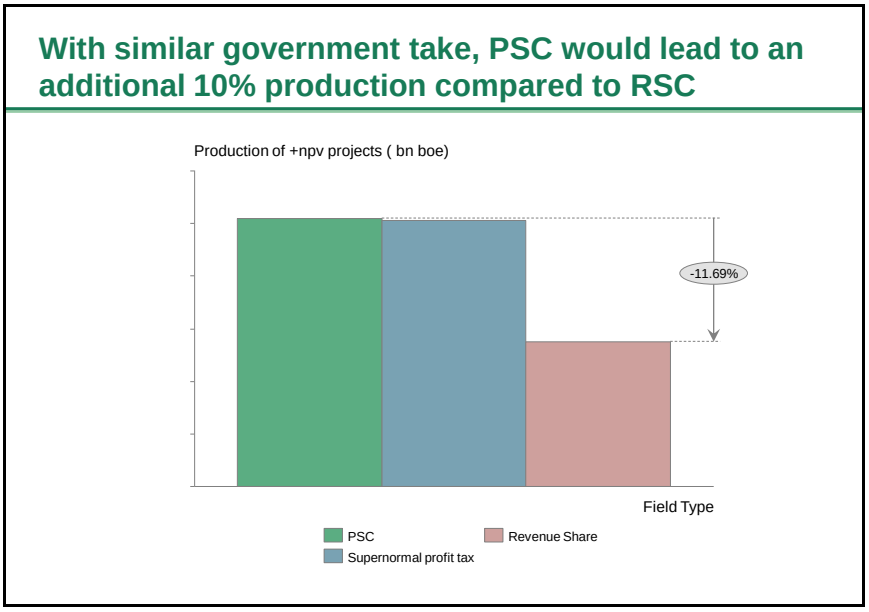
13.3.3 Results of illustrative exercise

1) A relatively larger number of fields are NPV positive under the PSC regime as compared to the RSC regime. Hence, the production from NPV positive fields under the PSC model is 11% higher as compared to the NPV positive fields under the RSC model. The increase in production is from 'yet to find' fields and EOR/IOR techniques applied to existing fields.

   Increasing production from existing producing fields requires application of new technologies like EOR and IOR. These incremental investments are economically viable under the PSC regime due to its inherent features of cost recovery. Taking these

incremental investments into account, the PSC model can lead to an incremental production, by a modest increase of the average recovery rates from 30% to 35%.

Exhibit 3: Incremental production under PSC regime is 11% higher than RSC



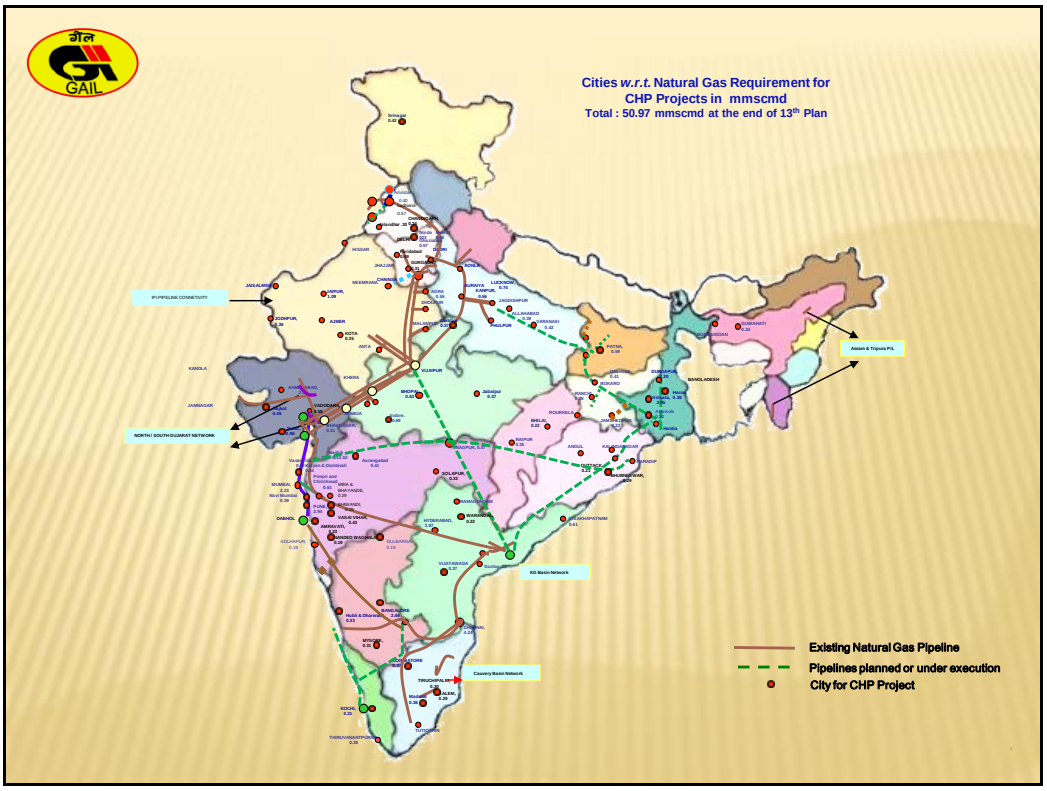
2) Based on the above results, implementing the RSC regime can lead to the following possible scenarios for India:
   - **Case A**: The forgone production from mature fields and 'yet to find fields' under the RSC regime would imply an additional import burden on the economy.
   - **Case B**: By reducing the revenue share to 10%, similar number of fields can be made NPV positive as in the discussed PSC regime. However, while the production increases in such a scenario, the government has to forego a significant amount of government take.

The above cases show that while PSC is the preferred model for an equivalent level of government take, alternate contractual regimes can also be structured to be commensurate in the risk-reward for investors and achieve similar production with reduced government take. However, in case B the loss in government take implies windfall gains to the operator. This can lead to instability by raising potential questions related to 'fair share of the government' as the owner of the hydrocarbon resources and lead to review of contract structure.

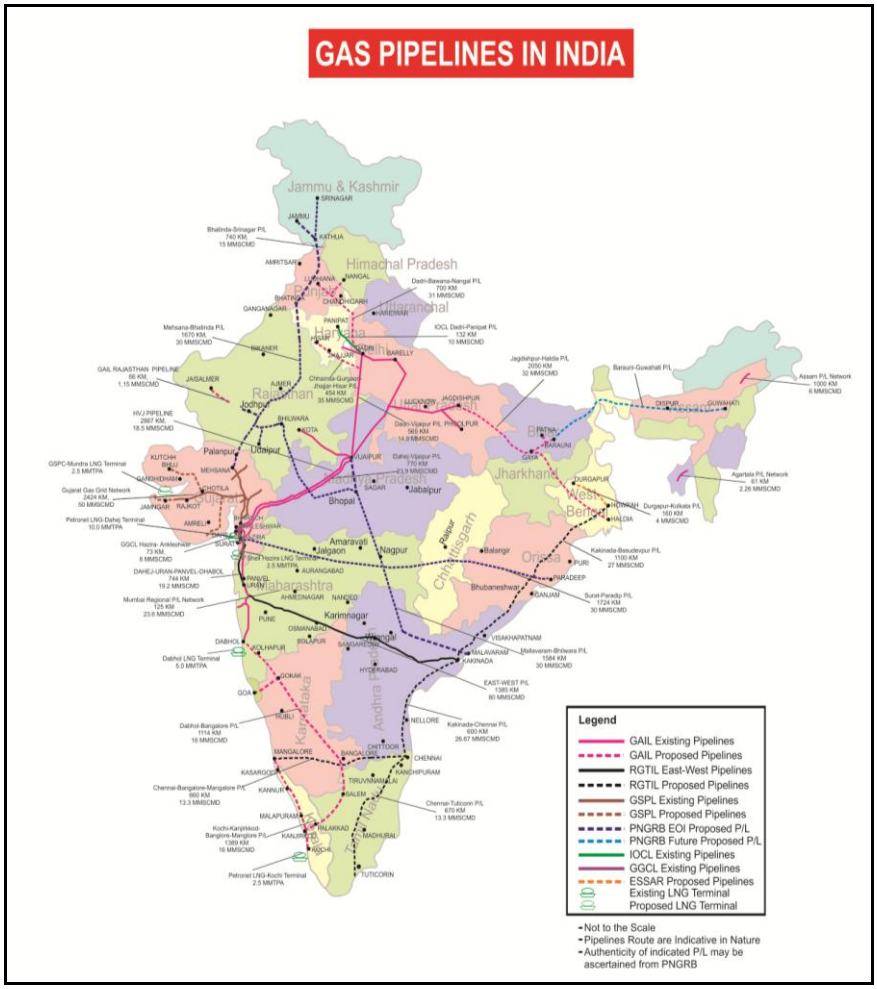
13.3.4 An illustration of downside effects of revenue share

Most of the blocks held by the NOCs were allotted to them on a nomination basis and operate on a de-facto RSC model, where revenue is shared with the government for every barrel of production for financing subsidies on oil products. This revenue sharing is over and above royalty, cess and corporate taxes paid by the NOCs. This quasi revenue sharing model is the primary reason for the inability of NOCs to monetize their discoveries as well as incremental investments in technologies likes EOR/IOR to achieve higher recovery rates. This is presently leading to a substantial loss to the economy. This point was made by ONGC in their presentation to the Committee.

13.4 Annexure D: Prospective blueprint of demand centers (Source: GAIL)



13.5 Annexure E: Pipeline infrastructure in India (Source: PNGRB)



13.6.1 Observation Note by Shri B.N. Talukdar, Director General, Directorate General of Hydrocarbons as Member-Secretary, Dr. Kelkar Committee on Committee's Views on issues regarding E & P Contract Model

The committee on "Roadmap for Reduction in import Dependency in the Hydrocarbon Sector by 2030", in its Final report has proposed the following two contract models either of which can be deployed.

Model I : PSC linked to Investment Multiple (IM), with modified contract administration including self-certification on costs by the contractors.

Model II : PSC with biddable supernormal profit tax.

There is no mention about the third model i.e. draft Revenue Sharing Contract Model which has been prepared in line with the recommendation of the Rangarajan Committee. This draft Revenue Sharing Contract is being discussed at Govt. level after obtaining various comments from the stakeholders. This alternative model could very well be the third possible model in addition to the above two.

Though the Term of Reference of the present Committee does not envisage the Committee to comment on contract models, but, as rightly pointed out in the Report, the contract structure is central to incentivizing the National and International companies to invest in exploration and production of the hydrocarbons sector for which the fiscal regime remains the core of risk reward paradigm. My overall views, without any specific recommendation on the contract models are as follows.

The Committee has rightly recognized the various constraints of the extant PSC viz. cost recovery issue, profit share calculation based on pre-tax investment multiple issue, constant and micro monitoring of the PSC by the Govt. etc. The Committee has accordingly proposed that the cost incurred by the contractors would be self-certified and the profit share to the Govt. would be collected by the Govt. Revenue Department instead of MoP&NG/DGH. While the process of collection of Profit Share is being attempted to be simplified by reducing the micro-management load on MoP&NG & DGH, there is still a possibility that DGH's involvement would be there for any technical and contractual issues raised by any agency and even by the Revenue Department.

The proposed second alternate fiscal regime i.e. 'PSC with biddable supernormal profit tax', the Committee itself has expressed concerns about its simplicity and has brought out the challenges

associated with proper calculation of the threshold Return on Average Capital Employed (RoACE). This model may lead to more ambiguity and subjectivity in contract administration.

As regards to the third alternative Model i.e. Revenue Sharing Model, the Committee has views that RSC model may lead to "lower level of production due to resultant reduced exploration efforts and lower recovery ratios". It may, however, be noted that, Government in the proposed RSC model has not prescribed any minimum Government Share in order to mitigate the risk of E&P companies so long it is non-zero share. The contractor's cost recovery will be embodied in his share of production based on which, the contractor would be free to bid. The Contractor would be required to bid the share in percentage terms payable to the Government as per the price-class and incremental production matrix. The revenue share from production for each cell of the matrix will be biddable. The NPV of Government's share in revenue, using the benchmarked production profile for the block, will be one of the deciding criteria for assessing a bid. Revenue, net of royalty, will be shared between the Contractor and the Government using a sliding scale calculation methodology. The overall bidding parameters of the Minimum Work Programme (MWP) commitment and Technical capability will remain almost the same as in the present PSC contract.

This model has the distinct advantage that all the issues related to cost recovery and profit petroleum etc. will be eliminated. However, in this model, appropriate provision has to be kept to take care of investment by the contractor on advanced technologies like IOR/EOR technologies for enhancing oil/gas recovery where accrual of benefits take relatively longer time and EOR schemes involve lot of experiments and development work prior to implementation. Additionally, it has also to be seen that the difficult oil and gas are not left out for exploitation. Both these issues may crop up to be managed by the operator after the bidding stage only which the operator might not have envisaged at the time of bidding.

Finally, it is well understood that the E & P contract model is generally country-specific based on several parameters such as geological prospectivity, geographical locations, fiscal as well as contractual and political stability, risk profile of the country, the overall perceptions of the Investors about the country and the prevailing overall Govt. governance policies. Hence, it may be appropriate for the Government to consider all such aspects and take a holistic view before finalizing the future E & P contract model best suited to Indian context.

13.6.2 OBSERVATIONS ON THE REPORT TITLED ROADMAP FOR REDUCTION IN IMPORT DEPENDENCY IN THE HYDROCARBON SECTOR BY 2030 BY Dr. S.V.RAO

It is acknowledged, in the first instance, that it was a privilege to be associated with such a distinguished committee chaired by a person of known eminence. In the large part, the report has reflected it's understanding of what 'The terms of reference' had outlined and even gone beyond it. Most of it are unhesitatingly endorsed.

A few of the 'summary of recommendations' (abbreviation-SOR), which obviously also find mention in the concerned chapters of the report, however, are at such a degree of variance with my own perception of these issues, that it would be unconscionable on my part to be associated with the same. The following is an effort to explain why:

First of all, the report has 12 chapters, 52 SOR's and 5 annexures. There are two points of divergence which are detailed at I & II below.

I - SOR 5, 6, 7, chapter 2 and Annexures b & c.

All these heads deal with the subject matter of PSC models proposed, administrative reforms for implementation of the PSC model, improving contract stability, centralization of E&P contracts, initiative for improving administration of E&P contracts, annexure notes from Daniel Johnston and that of comparison of E&P fiscal regimes for Indian basins – illustrative estimates.

Since the advent of the NELP fiscal system in 1999 till date, 360 acreages have so far been offered, 254 awarded and 1 block is so far under production, which clearly is a pointer towards the degree of success achieved over almost a decade and a half. The NELP contract administration being largely a PSC, what can be inferred beyond doubt, is that the Government and the quasi regulator on one hand and the contractor on the other, are overly engaged in administrative issues related to cost recovery of various physical programmes, which has had an impact on operations and the results thereof. This has, in fact, not just been a matter of prolonged deferment of programmes for one producing property, but for most acreages under exploration and appraisal also. It is this delay which brings out the dire need for transformation of the current PSC contract model, with its inherent cost recovery element, to an alternative system which would help avoid the huge constraints currently faced by most Operators.

The Committee's recommendation on the PSC model and its variant as a preferred choice for future exploration acreages to be offered, thus reflects a misalignment with the facts on ground. If, of all the 250 odd blocks which have so far been awarded, even a third were to move to production, the resulting chaos and deadlock would be of an unimaginable degree and something that the Indian E&P Industry would dread to confront. The reality is that it is not the expression of a choice between two different fiscal systems which is at stake, but the critical fact that Operational activities need be sustained painlessly for moving ahead on this front. It could be argued that the recommended Model II "Modified PSC with super normal profit tax model" in the report, could represent a step forward. While it is termed in the report "as a modified PSC" in essence, it is undoubtedly a Revenue Sharing Mechanism. It also addresses the undeniable problem of cost recovery issues while ensuring the administrative case of a Revenue Sharing Model. The trigger for the advent of the Super normal profit threshold however, remains foggy and could benefit from other understandings. It would be pertinent to add that there was hardly any high degree of unanimity with regard to stakeholder opinions regarding the nature of the contractual system to be implemented in the Indian E&P sector. I would recollect, for instance, Mr. Tom Albanese, the CEO Vedanta Resources, Mr. Sudhir Mathur, CEO, Cairn India besides others, who went so far as to suggest that they were comfortable with either of the systems proposed (PSC or revenue share). The over riding request from these companies was to avoid the excessive administrative hurdles that they currently face. It is therefore my firm belief that the proposed Revenue Sharing model (though constraints related to by the government opening of ESCROW account etc. still remain) should be used as a first step and put to test for one round of offer. If Operator interest wavers, as it is repeatedly assumed, a final call could be taken for Model II, after an improved mechanism for the trigger is in place.

The issues related to cost recovery can, thus, neither be wished away nor get subsumed by lowering the guard on diligence of cost recovery calculations through a process of self certification by the Operator as is being proposed by this Committee. It can also be argued that the entire issue of cost oil and profit oil and the assumption that the latter can be compared to corporate income tax, is not readily acceptable, primarily because there is need to split the latter as mutually agreeable to both parties.

In addition the assumptions and methodology which have allowed for a comparison of E&P fiscal regimes for Indian basis are illustrations of opacity. The fiscal parameters derived across contract regimes and establishment of equality of cumulative Government take, as supposedly established, are unverifiable. It is not simply a case of following a given database for the purpose of modelling the comparisons, which one could argue about, but also the crying need for buttressing the

arguments put forth by a cross verification of a few datasets of producing fields, which DGH has clear access to. The "trends" towards increased NPV's for the PSC model to be a clear clincher (irrespective of data availability) as suggested is not agreeable. Other conclusions for instance, the down size effect of revenue share, as outlined in annexure b, talks of "Revenue shared with the Government for every barrel of production for financing subsidies of oil products." This is unrelated to the facts of the case, as this is not the process for calculation of subsidies. The subsidy calculations have nothing at all to do with production and thus on the nature of the defacto RSC model.

It would thus be fair to declare, that we would gain from a reading of the summary comments by Dr. Daniel Johnston (13.2.2 – Annexure B) wherein it is stated "Around 95% of the governments of this world use systems that are primarily based on the division of profits regardless of whether or not they use a royalty tax system or a production sharing system". This goes to show that an operative hybrid of all these models (PSC, Revenue share and profit tax) would need to be in place, but without the burden of any cost recovery as part of the model, even if this calls for substitution by a new fixed tax process.

SOR 51 & Chapter 11

The committee is of the opinion as outlined at 11.6.2 that "services within the T&FS arm of ONGC should be demerged and spun off into an independent listed company. (I have underlined what I find hard to converge on). It is suggested, as an alternative model, that T&FS division be considered as a 100% subsidiary like OVL with an independent M.D. and Board of Directors for each of its services. This would allow utilization by the parent company in times of a tightness in the Indian and global market, while strengthening the argument for a business model which brings in an infusion of a strong dose of professionalism in the subsidiary. This will also help mitigate the business risks involved in testing the waters for clientele, especially as all service providers of global repute are freely available in the market in India. It will require a whole new process of learning to satisfy customers who are going to be infinitely more demanding, compared to the captive internal customers within the organization today. The inclusion of the substance of this proposition is clearly the kind of change in the company's practices which I unhesitatingly recommend. Critically it can be argued that OVL's proposal for listing has yet to find full favour both at the functional as well as the independent directors level on the board of the parent ONGC as well as the subsidiary OVL, as benefits likely to accrue to both entities are not discernible.

In conclusion it would be critical to state that the comments shared, are exclusively my own, even if it has less or no appeal with the chair and the esteemed members of the committee.