Appendix I

Action Agenda of India Hydrocarbon Vision: 2025

a. Focus on oil security through intensification of exploration efforts and achievement of 100 Percent coverage of unexplored basins in a time bound manner to enhance domestic availability of oil and gas.
b. Secure acreages in identified countries having high attractiveness for ensuring sustainable long- term supplies.
c. Pursue projects to met the deficit in demand and supply of natural gas, and facilitate availability of LNG.
d. Maintain adequate levels of self-sufficiency in refining (90 percent of consumption of middle distillates).
e. Establish adequate strategic storage of crude and petroleum products in different locations.
f. Create additional infrastructure for distribution and marketing of oil and gas.
g. Open up the hydrocarbon market so that there is free and fair competition between public sector enterprises, private companies and other international players.
h. Create a policy framework for cleaner and greener fuels.
i. Have a rational tariff and pricing policy, which would ensure the consumer getting the petroleum products at the most reasonable prices and requisite quality, eliminating adulteration.
j. Announce a long-term fiscal policy to attract required investments in the hydrocarbon sector.
k. Restructure the oil sector PSUs with the objective of enhancing shareholder value and disinvest in a phased manner in all the oil sector PSUs.
l. To develop regulatory and legislative framework for providing oil/gas security for the country.

Source: *India Hydrocarbon Vision: 2025*, Planning commission, Government of India
Appendix II


India faces formidable challenges in meeting its energy needs and providing adequate energy of desired quality in various forms to users in a sustainable manner and at reasonable costs. India needs to sustain a 8% to 10% economic growth to eradicate poverty and meet its economic & human development goals. Such economic growth would call for increased demand for energy and ensuring access to clean, convenient and reliable energy for all to address human development. To deliver a sustained growth of 8% through 2031, India would, in the very least, need to grow its primary energy supply by 3 to 4 times and electricity supply by 5 to 7 times of today’s consumption. By 2031-32, power generation capacity would have to increase to 778095 MW and annual coal requirement would be 2040 mt, if we don’t take any measures to reduce requirement. Along with quantity the quality of energy supply has to also improve. The energy challenge is of fundamental importance to India’s economic growth imperatives.

The broad vision behind the energy policy is to reliably meet the demand for energy services of all sectors including the lifeline energy needs of vulnerable households, in all parts of the country, with safe and convenient energy at the least cost in a technically efficient, economically viable and environmentally sustainable manner. Assured supply of such energy and technologies at all times considering the shocks and disruption that can be reasonably expected is essential to providing energy security to all. Meeting this vision would require that India pursues all available fuel options and forms of energy, both conventional and non-conventional, as well as new and emerging technologies and energy sources. Coal shall remain India’s most important energy source till 2031-32 and possibly beyond. India will need to take a lead in seeking clean coal technologies and, given its growing demand, new coal extraction technologies such as in-situ gasification
to tap its vast coal reserves that are difficult to extract economically using conventional technologies.

The approach of the Committee is directed to realise cost-effective energy system. For this the following are needed:

(I) Markets that promote competition.
(ii) Pricing and resource allocation to take place under market forces under an effective and credible regulatory oversight, as far as possible.
(iii) Subsidies to be transparent and targeted.
(iv) Improved efficiencies across the energy chain.
(v) Policies that reflect externalities of energy consumption.
(vi) Policies that rely on incentives and which are implementable.

A competitive market without any entry barriers is theoretically the most efficient way to realise optimal fuel and technology choices for extraction, conversion, transportation, distribution and end use of energy. The tax structure and regulation across energy sub-sectors should be consistent and institutional arrangements should provide a level playing field to all players. Social objectives should be ideally met through direct transfers. Environmental externalities should be treated uniformly and internalised, as far as possible, under the polluter pays principle. An energy market with the foregoing features would minimise market distortions and maximise efficiency gains. An integrated energy policy is needed to ensure that energy availability does not become a constraint on India’s economic growth and competitiveness.

While the medium to long-term challenges of ensuring competitive energy supplies are formidable, the immediate problem of power and coal shortages also require policy actions. The policy recommendations have addressed the immediate as well as the medium to long-term issues.

Some key recommendations are summarised below:

(i) **Coal Shall Remain India’s Primary Energy Source till 2031-32, Current shortages are a concern:**
(a) Coal accounts for over 50% of India’s commercial energy consumption and some 78% of domestic coal production is dedicated to power generation. Since prices were de-controlled, the sector has become profitable primarily as a result of price increases and the rising share of open cast production. The present shortage can be addressed by encouraging imports which are also needed from a longer-term perspective. Thus we need to facilitate coal imports and create the needed infrastructure. Imports also put a competitive pressure on domestic coal industry to be efficient.

(b) The Committee has concluded that imported coal is far more cost competitive to imported gas for power generation especially along the western & southern coasts of India. Such a cost advantage is likely to continue.

(c) At the same time domestic coal production should be stepped up by allotting coal blocks to central and state public sector units and for captive mines to notified end users. Coal blocks held by Coal India Limited (CIL) which CIL cannot bring into production by 2016-17, either directly or through joint ventures, should be made available to other eligible candidates for development and bringing into production by 2011-12.

(d) Ideally, the Coal Mines (Nationalisation) Act, 1973 should be amended to facilitate (a) private participation in coal mining for purposes other than those specified and (b) offering of future coal blocks to potential entrepreneurs.

(ii) Power Sector Reforms must focus on control over aggregate technical and commercial losses of state power utilities. Only financially healthy state power utilities can sustain the growing Central and State Public Sector Units (PSUs) and provide the needed comfort on payment security to attract private investment in the power sector at internationally competitive tariffs. To control AT&C losses the Committee recommends that the existing Accelerated Power Development and Reform Programme (APDRP) be restructured to ensure energy flow auditing at the distribution transformer level through automated meter reading, geographical information system (GIS) mapping of the network and consumers and separation of feeders for agricultural pumps. Investment in developing the MIS that can
support full energy audit for each distribution transformer is essential to reform and reduction in AT&C losses. This will fix accountability and provide a baseline which is an essential prerequisite to privatisation. The revised APDRP would provide incentives to SEBs linked to performance outcomes and would also include incentives to staff for reduction in AT&C losses.

The Committee also recommends that a liberal captive and group captive regime foreseen under the Electricity Act 2003 be realised on the ground. India’s liberal captive regime would not only derive economic benefits from availability of distributed generation but also set competitive wheeling charges to supply power to group captive consumers. This will pave the way for open access to distribution networks. This will facilitate private generation that limits its interface with the host utility to merely use of the distribution network for a fee and thus can be realised even before AT&C losses are reduced. However, to achieve these objectives, the Committee feels that it is essential to separate the cost of the pure wires business (carriage) from the energy business (content) in both transmission & distribution. Electricity Act 2003 recognises such separation for the transmission sub-segment. Separation of content from carriage in the distribution sub-segment, however, is foreseen only through the provision of open access. The wires business within the distribution sub-segment is also a natural monopoly and must be regulated as proposed under (iii) (e) below. Further, introduction of ABT and the upgrading of State Load Despatch Centres to the technological level of Regional Load Despatch Centres will have to be realised.

(iii) Reduce Cost of Power: In terms of purchasing power parity, power tariffs in India for industry, commerce & large households are among the highest in the world. A number of measures are suggested to reduce cost of power.

(a) The Government Policy should seek to ensure that all generation & transmission projects started in the 11th Plan & beyond should be competitively built on the basis of tariff based bidding under a prescribed price cap.

(b) Where a cost plus regime cannot be avoided and the payments are guaranteed by the Government of India (GOI) the internal rate of return on total capital employed should bear a reasonable relationship to the long-term government bond coupon at the time of the approval.
c) Government should seed the capital markets to develop market based instruments that effectively extend the tenure of debt available to power projects to say 20 years. This will reduce the capacity charge in the earlier years and spread it more evenly over the life of the project.

(d) Standardise the unit size and invite global tenders for 20 to 30 units to get substantial bulk discount.

(e) Distribution should be bid out on the basis of a distribution margin or paid for by a regulated distribution charge determined on a cost plus basis including a profit mark up similar to that paid under (b) above.

(iv) Rationalise Fuel Prices: Relative prices play the most important role in choice of fuel and energy form. They are thus the most vital aspect of Integrated Energy Policy that promotes efficient fuel choices and facilitates appropriate substitution. In a competitive set up, the marginal use value of different fuels, which are substitutes, is equal at a given place and time and the prices of different fuels at different places do not differ by more than the cost of transporting the fuels. Then the resulting inter-fuel choices would be economically efficient.

Prices of different fuels should not be set independently of each other. As a general rule, all commercial primary energy sources must be priced at trade parity prices at the point of sale. This means FOB price for products for which the country is a net exporter and CIF price for which it is a net importer. This principle is extremely relevant for the petroleum sector wherein bulk of the crude is imported and India is fast becoming a net exporter of petroleum products. The only legitimate alternative to trade parity prices in the petroleum sector is to permit full price competition at the refinery gate and the retail level. To provide a cushion against the volatility of prices on the international market, FOB or CIF prices, can be set on the basis of median prices over a month or three months.

Coal prices should ideally be left to the market and trading of coal, nationally and internationally, should be free. Only a competitive free market can do an efficient job of price determination. A competitive market requires that there are multiple
producers and that there are no entry barriers to new producers or to imports. Steps to achieve these objectives for the coal market are summarised in paragraph (i) above. Pending the creation of such a competitive market independent regulation of coal prices becomes essential.

Natural Gas is a non-tradable commodity in the absence of significant investments in pipelines or, alternatively, in liquification, cryogenic shipping & regasification. Thus the natural gas price can be determined through competition among different producers (this presumes multiple sources and a competitive supply-demand balance) or independently regulated on a cost plus basis including reasonable returns (where competing supply sources are absent and/or demand exceeds available supply). Another option could be to price gas on a net-back-basis. Should a scenario wherein gas becomes 15%-20% of India’s energy mix materialise by 2031-32; some 60% to 80% of the gas supply would be used for power generation. This would mean that beyond the level of gas consumption in the fertiliser, petrochemical, automotive and domestic sectors gas must compete with coal, the key alternative for power generation. A competitive coal market is thus important for setting a proper price of natural gas on a net-back-basis. An alternative to pricing domestic gas could be the net realisation of the domestic natural gas producer after investing and getting a return on the infrastructure needed to make the natural gas tradable across borders.

Central and State taxes on commercial energy supplies need to be rationalized to yield optimal fuel choices and investment decisions. Relative prices of fuels can be distorted if taxes and subsidies are not equivalent across fuels. The equivalence should be in terms of effective calorie: In other words they should be such that producer and consumer choices as to which fuel and which technology to use are not affected by the taxes and subsidies.

Environmental taxes and subsidies, however, are levied to affect choices. Differential taxes can be justified here if they appropriately reflect environmental externalities. A consistent application of polluter pays principle or consumer pays principle should be made to attain environmental objectives at least cost.
v) **Energy Efficiency and Demand Side Management**: Lowering energy intensity of GDP growth through higher energy efficiency is key to meeting India’s energy challenge & ensuring its energy security. India’s energy intensity of growth has been falling and is about half what it used to be in the early seventies. Currently India consumes 0.19 kilogram of oil equivalent per dollar of GDP expressed in purchasing power parity terms.

This is equal to the energy intensity of the OECD and better than the 0.21 kilograms of China, 0.22 kilograms of the US and a World average of 0.21. However, there are several countries in Europe at or below 0.12 with Brazil at 0.14 and Japan at 0.15. Thus, clearly there is room to improve and energy intensity can be brought down significantly in India with current commercially available technologies.

India would need to and must succeed in achieving much lower energy intensity compared to its current level. Lowering energy intensity through higher efficiency is like creating a virtual source of untapped domestic energy. It may be noted that a unit of energy saved by a user is greater than a unit produced, as it saves on production losses, as well as transport, transmission and distribution losses. Thus a “Negawatt”, produced by reducing energy need saves more than a Megawatt generated. The Committee feels that up to 25 percent reduction in India’s energy intensity is possible over current levels.

Efficiency can be increased in energy extraction, energy conversion, energy transportation, as well as in energy consumption. Further, the same level of service can be provided by alternate means requiring less energy. The major areas where efficiency in energy use can make a substantial impact are mining, electricity generation, electricity transmission, electricity distribution, pumping water, industrial production processes, haulage, mass transport, building design, construction, heating ventilation & air conditioning, lighting and household appliances. As the Indian economy opens up to international competition, it would have to become more energy efficient. This is well demonstrated by India’s steel & cement industry. However, the Committee recommends the following policies, some of which can
be implemented through voluntary targets undertaken by industry associations as opposed to through external dictates and enforcement.

(a) The Petroleum Conservation Research Association (PCRA) should be merged with Bureau of Energy Efficiency (BEE) that is seen as an autonomous statutory body under the Energy Conservation Act. The merged entity should endeavour to achieve financial independence through energy savings it helps generate & may also tap financial support from key industry players with an interest in India’s energy sector.

(b) Increase coal use efficiency in power generation from the current average of 30.5 percent to 39 percent for all new plants.

(c) Require a least cost planning approach providing level playing field, in the very least, to Negawatts and Megawatts so that regulators permit same return on a watt saved as on the investment needed to supply an additional watt.

(d) Promote urban mass transport, freight movement by railways, and energy efficient vehicles. Enforce minimum fuel efficiency, standards for all vehicles.

(e) Force the pace of energy efficiency improvement in energy using appliances and equipment and incentivise through golden carrots which give substantial rewards to the firm which first commercialises equipment that exceeds energy efficiency target.

(f) Enforce truthful labelling with major financial repercussions if equipment fails to deliver stated efficiencies. In extreme cases resort to black listing of errant suppliers at consumer information web sites and for government procurement.

(g) Promote minimum life cycle cost purchase instead of minimum initial cost procurement by government and public sector.

(h) Annual audits must include energy audits for all specified energy intensive industries and industries with a turnover exceeding say Rs.100 crores.

(i) Establish benchmarks of energy consumption for all energy intensive sectors.
(j) Disseminate information, support training and reward best practices with national level honours in energy efficiency & energy conservation.

(k) Institute specialisations in energy efficiency/energy conservation in all technical colleges and commence certification of such experts.

(vi) **Augmenting Resources:** India’s energy resources can be augmented till 2031-32 by exploration to find more of coal, oil and gas, or by recovering a higher percentage of the in-place reserves. Developing the thorium cycle for nuclear power and exploiting non-conventional energy, especially solar, offer possibilities for India’s energy independence beyond 2050.

At a growth rate of 5% in domestic production, currently extractable coal resources will be exhausted in about 40 years. However, only about 45% of the potential coal bearing area has currently been covered by regional surveys. Further, it is felt that both regional as well as detailed drilling can be made more comprehensive. Covering all coal bearing areas with comprehensive regional & detailed drilling could make a significant difference to the estimated life of India’s coal reserves. Finally, India’s extractable coal resources can be augmented through in-situ coal gasification which permits using coal deposits which are at greater depth or not easily extracted by conventional methods. Similarly extracting coal bed methane before and during mining can augment the country’s energy resources. Again, enhanced oil recovery and incremental oil recovery technologies can improve the proportion of in-place reserves that can be economically recovered from abandoned/depleted fields. Finally, isolated deposits of all hydro carbons including coal may be tapped economically through sub leases to the private sector.

(vii) **Role of Hydro and Nuclear:** It is seen that even if India succeeds in exploiting its full hydro potential of 150,000 MW, the contribution of hydro to the energy mix would be around 5-6%. Similarly, even if a 20-fold increase takes place in India’s nuclear power capacity by 2031-32, the contribution of nuclear energy to India’s energy mix is also, at best, expected to be 5-6%.

Though its contribution to energy requirement is small, hydro electricity’s flexibility and suitability as a peaking power make it valuable. Moreover, hydro
development especially storage schemes are critical for India as India’s per capita water storage is the lowest among all its comparators. Creating such storages is critical to India’s water security, flood control and drought control.

Nuclear, on the other hand, theoretically offers India the most potent means to long-term energy security. India has to succeed in realising the three-stage development process described in the main report and thereby tap its vast thorium resource to become truly energy independent beyond 2050. Continuing support to the three-stage development of India’s nuclear potential is considered essential.

(viii) Role of Renewables: From a longer-term perspective and the need to maximally develop domestic supply options as well as the need to diversify energy sources, renewables remain important to India’s energy sector. It would not be out of place to mention that solar power could be an important player in India attaining energy independence in the long run. Even with a concerted push of 20-fold increase in capacity, renewables can account for around 5-7% of India’s energy mix by 2031-32. While this is small, the distributed nature of renewables can provide many social benefits.

Subsidy for renewables may be justified on several grounds. A renewable energy source may be environmentally benign. It may be locally available making it possible to supply energy earlier than a centralized system. Grid connected renewables could improve the quality of supply and provide system benefits by generating energy at the ends of the grid where otherwise supply would have been lax. Further, renewables may provide employment and livelihood to the poor. However, the subsidies should be given for a well-defined period or upto a well-defined limit and should be linked to outcomes (energy generated), and not just outlays (capacity installed).

The Committee’s approach to policy for promoting renewables is to link incentives to outcomes as far as possible. Even when a capital subsidy is needed, it should be linked to outcomes. Power Regulators must create alternative incentive structures such as mandated feed-in-laws or differential tariffs to encourage utilities to integrate wind, small hydro, cogeneration etc. into their systems. A subsidy could
also be given in the form of a Tradable Tax Rebate Certificates (TTRC) based on energy generated. The rebate claim becomes payable depending upon the amount of electricity/energy actually certified as having been supplied.

An annual renewable energy report should be published providing details of actual performance of different renewable technologies at the state and national level. This would include actual energy supplied from different renewable options, availability, actual costs, operating and maintenance problems etc. It should also report on social benefits, employment created, women participation and empowerment.

Policies for promoting many specific alternatives are suggested in the main text. These include fuel wood plantations, bio-gas plants, wood gasifier based power plants, solar thermal, solar water heaters, solar photo voltaics, bio-diesel and ethanol.

It is also recommended that Indian Renewable Energy Development Agency Ltd (IREDA) be converted into a national refinancing institution on the lines of NABARD/National Housing Bank (NHB) for the Renewable Energy Sector. IREDA’s own equity base can be expanded by the financial institutions of the country instead of continuing the current system of GOI support.

(ix) Ensuring Energy Security: India’s energy security, at its broadest level, has to do with the continuous availability of primary commercial energy at an affordable price. Reducing energy requirement and increasing energy use efficiency are the most important measures to increase energy security. However, it is still necessary to recognise that India’s growing dependence on energy imports increases uncertainty regarding availability of energy at affordable prices.

How do we deal with this supply risk? The threat to energy security arises not just from the uncertainty of availability and price of imported energy, but also from the possible disruption or shortfalls in domestic production. Supply risk from domestic sources, such as from a strike in Coal India or Railways, also needs to be addressed. Even if there is no disruption of supply there can be the market risk of a
sudden increase in oil price. Again, even when the country has adequate energy resources, technical failures may disrupt the supply of energy to some people. Generators fail, transmission lines trip or oil pipeline may spring a leak. One needs to provide security against such technical risks. Risks can be reduced by reducing the requirement of energy by increasing efficiency in production and use of energy; by substituting imported fuels by domestic fuels; by diversifying fuel choices (gas, ethanol, orimulsion tar sands etc.) and supply sources; and by expanding domestic energy resource base. Risks can also be dealt with by increasing ability to withstand supply shocks; ability to import energy and face market risk; and providing redundancy to address technical risks.

The policy recommendation include maintaining a strategic reserve for 90 days of oil imports and/or buying options for emergency supplies from neighbouring large storages such as those available in Singapore. The Committee, however, felt that obtaining equity oil, coal and gas abroad, do not represent adequate strategies for enhancing energy security beyond the fact that they help diversify supply sources. In contrast, pipelines for importing gas do enhance security of supply if the supplying country makes a major investment in the pipeline. The most critical elements of our energy security, however, remain the measures suggested herein to increase efficiency, reduce requirements and augment the domestic energy resource base.

(x) Boosting Energy Related R&D: India would find it increasingly harder to import the required commercial energy as India’s share of the incremental world supply of oil & gas could be as high as 20% since its demand is growing faster than that of industrialised nations. Research and Development (R&D) in the energy sector is critical to augment our energy resources, to meet India’s long-term energy needs, to attain energy independence, to promote energy efficiency and to enhance our energy security. R&D requires sustained and continued support over a long period of time.

Energy related R&D has not got the resources that it needs. India needs to substantially augment the resources for energy related R&D and to allocate these strategically. To take an innovative idea to a commercial application involves
many steps. Basic research leading to a fundamental breakthrough may open up possibilities of applications. R&D is needed to develop the concept and to prove its feasibility. This needs to be followed up by a working model at laboratory scale. Scaling up to a pilot project follows if the economic potential looks attractive keeping in mind cost reductions that could be achieved through better engineering and mass production. Demonstration project, economic assessment and further R&D to make the new technology acceptable and attractive to customers is required before commercialisation and diffusion can take place. Some key policy initiatives relevant to energy related R&D are detailed below:

(a) A National Energy Fund (NEF) should be set up by levying a cess of 0.1% of the turnover of all companies engaged in the field of primary/secondary energy production whose annual turnover exceeds Rs.100 crores. At 2004-05 turnover levels, this should collect Rs.500 to Rs.600 crores per year. In order to encourage the firms to do their own R&D a rebate of upto 80% of this cess may be given to firms for R&D carried out in-house. The R&D priorities have to be based on a strategic vision which is frequently updated. The NEF should periodically commission and fund such studies.

(b) A number of technology missions should be mounted for developing near commercial technologies and rolling out new technologies in a time bound manner. These include coal technologies (wherein India should take a lead) for efficiency improvement; in-situ gasification; IGCC and carbon sequestration; solar technologies for thermal and photo voltaics; bio-fuels such as bio-diesel and ethanol; bio-mass plantation and wood gasification and community based bio-gas plants.

(c) Coordinated research and development of all stages of the innovation chain to reach a targeted goal such as in the departments of atomic energy and space research are suggested for more efficient industrial plant, machinery & processes, efficient appliances, hybrid cars, super batteries, nuclear technologies related to thorium and fusion, gas hydrates, and hydrogen production, storage transport and distribution.

(d) The NEF could provide R&D funding in support of applications, innovative new ideas, fundamental research etc. to researchers in different
institutions, universities, organisations and even individuals working independently.

(x) Household Energy Security - Electricity and Clean Fuels for All: One of the toughest challenges is to provide electricity and clean fuels to all, particularly rural populations; considering the poor paying capacity, the limited availability of local resources for clean cooking energy and the size of the country and its population. Yet, given the fact that women and the girl child carry most of the burden of the drudgery of gathering fuel wood, agricultural wastes and animal dung and also bear the brunt of the indoor air pollution; the urgency to meet the challenge should be high, if we are to achieve universal primary education for girls, promote gender equality and empower women. The considerable effort spent on gathering the biomass and the cow-dung & preparing the same for use is not priced into the cost of such energy. These fuels create smoke and indoor air pollution and are inconvenient to use. They have adverse impact on the health of people, particularly women and children. Easy availability of a certain amount of clean energy, required to maintain life, should be considered as a basic necessity. Energy security at the individual level means to ensure supply of such lifeline energy need. India cannot be energy secure if her people remain without secure supply of energy at affordable cost.

Even if one assumes that some 30% of India's households are unable to pay for a lifeline electricity consumption of 30 units/month and a loss level of about 40% in delivering these 30 units, the total need for free electricity is about 7% of the current generation. At zero cost to the consumer, this translates into a subsidy burden of about Rs.9,500 crores a year assuming the infrastructure is built under RGGVY. This burden would reduce over time as 8% GDP growth is expected to reduce poverty at a rate that exceeds population growth. Similarly, if one assumes that the same 30% of Indian households cannot pay for a lifeline consumption of 8 cylinders of gas per annum while another 20% can only pay for 25% of the cost of supply of such lifeline consumption of gas; the subsidy burden amounts to about Rs.34,000 crores annually at Rs.450/cylinder. Again, this subsidy burden would reduce over time with economic growth.
The foregoing demonstrates that a well-directed subsidy programme targeted at the intended beneficiary is not unaffordable for a resurgent India. The benefits in empowerment, health, environment and reduced pressure on deforestation and hence the water table and soil erosion are well worth the cost – even without considering the benefits from the likely increase in productivity of rural India. The top 5% of India's households could pay for this subsidy through a cess on their incomes or a more widely distributed cess on consumption could fund this subsidy burden.

It is pointed out that even currently over 60% of the estimated subsidy burden is being funded, although the benefits do not reach the intended beneficiaries due to poor targeting. The real issue is to target the subsidy programme well and ensure that those falling outside the subsidy net pay the full cost of supply. A well-targeted subsidy regime may only marginally raise the current subsidy burden. A system of lifeline tradable entitlements delivered through smart debit cards could potentially be the answer.

In addition to the above subsidy other actions are also needed.

(a) Finance a large scale socio-economic experiment to operate community sized bio-gas plants as a commercial enterprise either by a community cooperative or by a commercial entrepreneur, as such bio-gas plants can meet the need for clean cooking energy of a sizable segment of the rural population.

(b) Even with subsidies for clean fuel, it may not be easy to reach clean fuels to the poor and they may continue to use fuel wood. As part of the above programme, improve the efficiency of domestic chullahs & lanterns from the prevailing 10-12% to 20-25% which is easily attainable. Couple this to improving ventilation in the cooking area of the dwellings.

(c) To reduce drudgery of those who still need to gather fuel, village woodlots within one kilometer should be developed. To develop sustainable energy supply, Women's groups can form co-operatives for developing and managing fuel wood or oil seed plantations with the same efforts that they put in searching and gathering fuel wood today. Provide finance through self-help groups to transform women, who are today
energy gatherers into micro-entrepreneurs engaged in rural energy markets and energy management.

(d) Generate electricity through wood gasifiers or burning surplus biogas from the community bio-gas plants. Such distributed generators may be able to reach electricity to villages sooner than the grid and may be connected to the grid with a feed-in tariff as and when it reaches the villages. This will encourage such local generation, as people would not wait for the grid. Cover such distributed generation together with the local grid under the subsidy scheme of RGGVY. Formulate a tariff policy for such distributed generation for both household and productive use including agriculture. (e) For setting up of off-grid generation facilities in rural areas, organised sector can be encouraged to adopt rural Community /communities in their areas of operation.

(xii) Enabling an Environment for Competitive Efficiency: Apart from pricing policies, an environment that allows multiple players in each element of the energy value chain to compete under transparent & level terms is essential to realising efficiency gains within the energy sector. Currently the Energy Sector is dominated by large Public Sector Companies and some sub-sectors have natural monopoly characteristics potentially offering economies of scale. Given this ground reality, independent & informed regulation becomes essential to realising competitive efficiency at least till markets develop and mature. Such regulation must in the very last ensure that:

(a) The regulatory responsibility/functions of the State are separated from the Ministries that control the Public Sector Units that dominate the energy sector; and
(b) Till competitive markets emerge, independent regulators should fix prices or price caps to mimic competitive markets based on principles summarized in para (iv) above.

(xiii) Climate Change Concerns: Concern for the threat of climate change has been an important issue in formulating the energy policy. Even though India is not required to contain its GHG emissions, as a signatory to the UN Framework Convention on Climate Change and a country where the impact on its poor due to
climate change could be serious, this policy has suggested a number of initiatives that will reduce the greenhouse gas intensity of the economy. These are—

- Energy efficiency in all sectors
- Emphasis on mass transport
- Active policy on renewable energy including bio-fuels and fuel plantations
- Accelerated development of nuclear and hydro-electricity
- Technology Missions for clean coal technologies
- Focussed R&D on many climate friendly technologies

With the recommendations of the Committee, India can meet her energy requirements in an efficient, cost effective way and be on a path of sustainable energy security.

Source: Planning Commission, Government of India.
Appendix III


Executive Summary

1.1 Economy & Energy

1.1.1 Efficient, reliable and competitively priced energy supplies are prerequisites for accelerating economic growth. For any developing country, the strategy for energy development is an integral part of the overall economic strategy. Efficient use of resources and long-term sustainability remains core objective of economic planning. Sustainability would take into account not only available natural resources and issues related to ecological balance but also established delivery mechanisms, the technological constraints that are prevalent in the system and immediate compulsion to meet the priority needs of the economy, economic equity and self-reliance. Simultaneous and concurrent action is, therefore, necessary to ensure that the short-term concerns do not detract the economy away from the long-term goals.

1.1.2 Realisation of high economic growth aspirations by the country in the coming decades, calls for rapid development of the energy market. The energy resources available indigenously are limited and may not be sufficient in the long run to sustain the process of economic development translating into increased energy import dependence. The base of the country’s energy supply system is tilted towards fossil fuels, which are finite. This has serious long-term implications as the emerging patterns of energy consumption, which is heavily skewed towards oil and gas, bring to focus many ecological and environmental issues.

1.1.3 India meets nearly 30 percent of its total energy requirements through imports. With the increase in share of hydrocarbons in the energy
supply/use, this share of imported energy is expected to increase. The challenge, therefore, is to secure adequate energy supplies at the least possible cost. Although growth of the energy sector is moderate and has, to some extent, served the country’s social needs, it has put tremendous pressure on the Government’s budget.

1.2 International Scenario

1.2.1 Projected global oil consumption is expected to register a substantial growth over the present levels. Recently published energy reports project incremental demand of about 38 million barrels per day (mbpd) in 2030 over 80 mbpd level in 2003. Most of this incremental demand will emanate from developing countries including China and India where oil consumption is expected to grow at the rate of 3.8 and 2.4 percent respectively as against the world average of 1.4 percent. Non-OPEC (Organisation of Petroleum Exporting Countries) production, though showing an upward trend, will not be sufficient to service this incremental demand emphasising, once again, the continued dependence of the world on OPEC oil for its energy requirements.

1.2.2 High oil and gas prices have prompted increased investments in the exploration and production (E&P) sector posing new challenges for the sector in the form of increased cost of operations due to high service costs, exposure to logistically difficult terrain and shortage of technical manpower. Global refining scenario indicates very little to negligible addition in capacities in major developed consuming markets like the USA and the European countries. Developing countries like the Middle East, China and India are fast emerging as refining hubs. Needless to say that capacity augmentation in these regions would also result into possible integration of both the refining and petrochemicals business.

1.2.3 Natural gas has been rightly termed as the fuel of the 21st century. Natural gas, the third largest contributor to the global energy basket, is projected to increase at a rate faster than any other energy source. In the global context, natural gas market era has truly begun during the
last 5 years. The global gas markets are fast integrating, commercial models are undergoing rapid changes, and the market structures are evolving and fast changing. Leading this growth in global gas sector are the Asian markets with special investment focus on countries like China and India.

1.2.4 It is indeed difficult to predict what will happen to oil prices over a five year period but current assessments indicate that oil prices will remain high. This will exert downward pressure on the economy, both directly and also through their impact on world economic growth. Currently, the impact of high oil prices on the world economy has somewhat been offset because the industrialised countries have adjusted to these higher oil prices. Sustained conditions of high oil prices, however, will eventually create macro-imbalances in the world economy making it vulnerable to any future ‘oil shock’. Simulations with macro-models suggest that if oil prices increase sharply in future, growth rate could be compromised by between 0.5 and 1.0 percentage points below the levels projected with present levels of oil prices.

1.3 Indian Scenario

1.3.1 India is and shall remain heavily dependent on coal for about half of its primary commercial energy requirements with the other half being dominated by oil and gas put together. The Indian hydrocarbon industry is currently passing through a challenging phase. Increasing concern for energy security, increasingly stringent environmental regulations, emergence of natural gas and soaring crude oil and natural gas prices have thrown up both challenges and opportunities to the Indian oil and gas industry.

1.3.2 Projected high domestic demand for petroleum products is expected to push investments into the refining sector. India, with 18 refineries, currently has a surplus refining capacity which has placed India amongst net petroleum product exporter countries. Increasingly stringent fuel specifications have put pressure on the old and non-
compliant refineries to upgrade their refinery configurations to produce compliant fuels. The Government is seriously considering promoting India as a competitive refining destination to service export market for petroleum products as also integrating it with the petrochemical and chemicals businesses to produce and export higher revenue generating value added products.

1.3.3 Exceptionally high crude oil prices in the international market and an almost stagnant domestic crude oil production has caused a drain on country's foreign exchange reserves. The Government is committed to mitigating these challenges and has, in fact, met with accelerated domestic exploration through its New Exploration Licensing Policy (NELP) policy initiative. Some of the world class oil discoveries have recently been reported from blocks offered under the NELP regime. Five NELP rounds have resulted into 110 PSCs being signed and the Sixth round offering 55 exploration blocks is still underway. Besides augmenting domestic reserves, India has successfully ventured overseas to acquire oil and gas assets and entered into long-term Liquefied Natural Gas (LNG) contracts as measures for enhancing energy security.

1.3.4 Creating sustainable transportation system through cross-country crude oil and petroleum product pipelines in the next few decades, with the objective of preserving environment and protecting human health and safety would be a real challenge for the petroleum industry.

1.3.5 Persistence of high oil prices and dependence on imported oil leaves India with some difficult choices to make. The choice is between (a) passing on the price increase to the consumer; (b) rationalising taxes and other levies on petroleum products; and (c) making the National Oil Companies (NOCs) bear the burden. Although the Government has resorted to a combination of all above three options in the past, each of these options has its own drawbacks. In the long run, the only viable policy to deal with high international oil prices is to rationalise the tax burden on oil products over time, remove anomaly, if any, in
the existing pricing mechanism, realize efficiency gains through competition at the refinery gate and retail prices of petroleum products, and pass on the rest of the international oil price increase to consumers, while compensating targeted groups below the poverty line as much as possible.

1.3.6 With the advent of LNG and progressive de-control of gas prices, the natural gas sector in India has progressed and achieved some degree of maturity. It has managed to receive progressively growing attention from global companies and has made rapid strides during the last five years. Current natural gas policy dispensations have created numerous challenges for the gas sector. Major among them are the demands of competing consumer industries, ensuring competition and open access in the pipeline transportation and distribution networks, reducing the supply demand gap that exists today.

1.4 Thrust Areas for the Petroleum and Natural Gas Sector

1.4.1 The following thrust points, discussed under respective industry segment, merit consideration for the healthy overall development of the oil and gas industry.

**Exploration & Production**

- Increasing domestic production by attracting investments, both private and public, in the upstream sector. This needs to be attempted by involving industry participants in formulating an investor friendly E&P investment regime.
- Taking all steps to increase the production from ONGC’s (Oil and Natural Gas Corporation) assets including their maturing field.

**Refining**

- Equipping domestic refining industry both existing and planned to successfully meet the challenge of producing fuels complying with prescribed environment friendly specifications which are increasingly
becoming stringent.

- Promoting India as a competitive and economically viable refining destination to service both the domestic as well as the export market.

**Pipelines**

- Increasing the coverage of pipelines throughout the country.
- Leveraging the inherent advantages of using pipelines to transport products and enhancing the pipeline infrastructure in product pipelines.
- Building a sound gas transportation infrastructure to support the projected growth of the gas market. Setting up of a regulator under the Petroleum and Natural Gas Regulatory Board Act, 2006 (PNGRB Act 2006) to regulate the downstream oil and gas sector, including gas infrastructure, is expected to provide clarity and comfort to investors interested in India’s gas transportation sector.

**Marketing**

- Steps need to be undertaken by all stakeholders to curb adulteration.
- Maintaining viability of retail outlets by synergy among public sector oil marketing companies in setting up of new retail outlets.
- Introduction of automation of retail outlets throughout the country.

**Alternate Fuels**

- Promoting use of ethanol-blended petrol and bio-diesel throughout the country.
- Exploring and exploiting country’s CBM resource.

**Research and Development**

- Promoting Research and Development (R&D) activities through provision of incentives and funds.

**Energy Conservation**
• Encouraging energy conservation through campaigns aimed at sensitising the people about the significance of efficient use of energy.

Addressing Workforce Challenges

• Proactive planning for sustained availability of knowledge workers for the entire oil and gas industry.

1.5 Acknowledgements

1.5.1 The Working Group thanks all the Members from the Government, public and private sector, autonomous/industry bodies and their representatives of the Working Group on Petroleum and Natural Gas for the XI Plan for their contribution, cooperation and support throughout the preparation of this report. Thanks are due to Shri Anil Razdan, Additional Secretary, Shri Prabh Das, Shri Ajay Tyagi, Shri Narsimha Raju, concerned Joint Secretaries in the Ministry, Shri P K Sinha, Joint Secretary & Financial Adviser, Shri C.B. Singh, Joint Adviser (F) and their teams for giving valuable inputs to the Working Group from time to time. The Working Group thanks the officials of Petroleum Planning and Analysis Cell (PPAC), Petroleum Conservation and Research Association (PCRA) and Petroleum Federation of India (PetroFed) and their team members for their inputs and support. Thanks also to the members of the various working Sub Groups for timely preparation of the Working Sub Group Reports.

1.5.2 To summarise, the task of achieving an average growth rate in Gross Domestic Product (GDP) between 8 and 9 percent as being projected by the Government for the XI Plan could be feasible, provided necessary policy interventions are made in one of the important sectors like oil and gas which is the back bone of the economy. Keeping the above points in view the Report of the Working Group on Petroleum and Natural Gas Sector for the XI Plan has analysed the emerging trends and factors influencing the oil and gas sector and outlined the action plan for the aforesaid period 2007-2012. Terms of Reference
(TOR) of the Working Group are at Annexure - I. The report is the outcome of various deliberations held by various Working Sub Groups constituted for the purpose, which comprise members from the private as well as public sector. The terms of reference of the various Working Sub Groups are at Annexure – II (a) to II (c).

Source: Ministry of Petroleum and Natural Gas, Government of India
# APENDIX IV

Main Conversions Used in Petroleum Industry

<table>
<thead>
<tr>
<th>ITEM</th>
<th>CONVERSION FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crude Oil</strong></td>
<td></td>
</tr>
<tr>
<td>1 Metric Tonne</td>
<td>= 7.33 Barrels</td>
</tr>
<tr>
<td></td>
<td>= 1.165 Cubic Metres (Kilolites)</td>
</tr>
<tr>
<td>1 Barrel</td>
<td>= 0.136 Tonnes</td>
</tr>
<tr>
<td></td>
<td>= 0.159 Cubic Metres (Kilolitres)</td>
</tr>
<tr>
<td>1 Cubic Metre</td>
<td>= 0.858 Tonnes</td>
</tr>
<tr>
<td></td>
<td>= 6.289 Barrels</td>
</tr>
<tr>
<td>1 Million Tonne</td>
<td>= 1.111 Billion Cubic Metres</td>
</tr>
<tr>
<td>Natural Gas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>= 39.2 billion Cubic Feet</td>
</tr>
<tr>
<td></td>
<td>= 0.805 Million Tonnes LNG</td>
</tr>
<tr>
<td></td>
<td>= 40.4 Trillion British thermal Units</td>
</tr>
<tr>
<td><strong>Natural Gas</strong></td>
<td></td>
</tr>
<tr>
<td>1 Billion Cubic Metre</td>
<td>= 35.3 Billion Cubic Feet</td>
</tr>
<tr>
<td></td>
<td>= 0.90 million Tonnes Crude Oil</td>
</tr>
<tr>
<td></td>
<td>= 0.73 million tonnes LNG</td>
</tr>
<tr>
<td></td>
<td>= 36 Trillion British Thermal Units</td>
</tr>
<tr>
<td></td>
<td>= 6.29 Million Barrels of Oil Equiv.</td>
</tr>
</tbody>
</table>
### APENDIX V

**Conversion Factors for Petroleum Products**

<table>
<thead>
<tr>
<th>Products</th>
<th>TOE/Tonne</th>
<th>Barrels/Tonne</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refinery Gas</td>
<td>1.150</td>
<td>8.00</td>
</tr>
<tr>
<td>Ethane</td>
<td>1.130</td>
<td>16.85</td>
</tr>
<tr>
<td>LPG</td>
<td>1.130</td>
<td>11.60</td>
</tr>
<tr>
<td>Aviation Gasoline</td>
<td>1.070</td>
<td>8.90</td>
</tr>
<tr>
<td>Motor Gasoline</td>
<td>1.070</td>
<td>8.53</td>
</tr>
<tr>
<td>Jet Gasoline</td>
<td>1.070</td>
<td>7.93</td>
</tr>
<tr>
<td>Jet Kerosene</td>
<td>1.065</td>
<td>7.93</td>
</tr>
<tr>
<td>Other Kerosene</td>
<td>1.045</td>
<td>7.74</td>
</tr>
<tr>
<td>Naphtha</td>
<td>1.075</td>
<td>8.50</td>
</tr>
<tr>
<td>Gas/Diesel Oil</td>
<td>1.035</td>
<td>7.46</td>
</tr>
<tr>
<td>Heavy Fuel Oil</td>
<td>0.960</td>
<td>6.66</td>
</tr>
<tr>
<td>Petroleum Coke</td>
<td>0.740</td>
<td>5.50</td>
</tr>
<tr>
<td>White Spirit</td>
<td>0.960</td>
<td>7.00</td>
</tr>
<tr>
<td>Lubricants</td>
<td>0.960</td>
<td>7.09</td>
</tr>
<tr>
<td>Bitumen</td>
<td>0.960</td>
<td>6.08</td>
</tr>
<tr>
<td>Paraffin waxes</td>
<td>0.960</td>
<td>7.00</td>
</tr>
<tr>
<td>Non specified products</td>
<td>0.960</td>
<td>7.00</td>
</tr>
</tbody>
</table>

Source: International Energy Agency, Paris