

GS - ECONOMY

Energy

Energy is a vital input for production and rapid growth of GDP will need to be supported by an increase in energy consumption. This is especially so in India, where large sections of the population are still without adequate access to energy. Here, we examine the likely energy requirement of 9.0 per cent growth and make an assessment of its feasibility and the implications for various aspects of energy policy including energy pricing.

Projected Energy Demand

The extent of the increase in energy requirement over the Twelfth Five Year Plan depends on the elasticity of energy demand with respect to GDP, which has been falling over time and is currently around 0.80. Allowing for some further decline in the elasticity, a GDP growth rate of 9.0 per cent per year over the Twelfth Plan will require energy supply to grow at around 6.5 per cent per year. The ability to meet this energy demand depends on our ability to expand domestic production in critical energy sub sectors, notably petroleum, gas and coal, and meeting the balance requirement through imports.

The total energy requirement (in terms of million tonnes of oil equivalent) is projected to grow at 6.5 per cent per year between 2010-11 and 2016-17. This is based on the assumption that the energy elasticity will decline over time. It is worth noting that import dependence on oil is expected to increase from 76.0 per cent in 2010-11 to 80.0 per cent by the end of the Twelfth Plan. Import dependence on natural gas is projected to increase from 19.0 per cent in 2010-11 to 28.4 per cent in 2016-17. In the case of coal, it will increase from 19.8 per cent in 2010-11 to about 22.1 per cent in 2016-17.

If energy were plentifully available in global markets at affordable prices, large energy imports may not present serious problems, although even in those circumstances problems of energy security would remain. In fact of course, energy prices are rising globally and imports will be expensive. This underscores the need for moderating the growth of energy demand by achieving higher levels of energy efficiency while also increasing domestic supplies of energy as much as possible. Energy prices have a crucial role to play in achieving both objectives.

Energy Efficiency

Increased energy efficiency is the only way to contain energy demand without jeopardizing growth and it must therefore receive high priority in the Twelfth Plan. Increasing energy efficiency requires action on two fronts: rationalizing energy prices to incentivize energy efficiency and taking non-price initiatives to push the economy towards greater energy efficiency. The role of energy pricing is discussed in the next section.

There is considerable scope for non-price initiatives to promote energy efficiency. Several of these are included in the National Mission on Enhanced Energy Efficiency which was launched in 2008 as one of the eight missions in the National Action Plan for Climate Change. The measures include labeling of consumer durables for energy efficiency, imposing targets for reducing energy use in energy intensive industries, introducing energy efficiency in buildings, etc.

Promoting Energy Efficiency

The following are the main components of the Energy efficiency Mission. These programmes have resulted in avoided generation capacity of over 7,500 MW during the first four years of the Eleventh Plan.

- ❖ **Standards and Labelling of Equipment & Appliances:** Labelling has been introduced for 16 major energy-consuming appliances, providing users with information on the energy use of a model, and its relative efficiency as compared to others. It has been made mandatory for airconditioners,

refrigerators, distribution transformers and tube lights.

- ❖ **Energy Efficiency in Buildings:** A national Energy Conservation Building Code (ECBC) has been prepared for the design of new commercial buildings. Over 700 ECBC-compliant buildings are at various stages of construction. Two States have adopted ECBC, making it mandatory for all new, large-commercial buildings to comply with the Code. Performance contracting through Energy Service Companies (ESCOs) is being promoted to enable the retrofit of existing buildings so as to reduce their energy consumption.
- ❖ **Energy Efficiency in Industry:** 467 industrial units from 8 sectors have been declared as Designated Consumers. Together they account for about 35 per cent of the total energy consumption in India. Each designated consumer has been prescribed a target per centage reduction in its specific energy consumption to be achieved by 2014-15. Those who exceed their targets would receive tradable Energy Saving Certificates for their excess savings, which could be used for compliance by other designated consumers, who find it expensive to meet their targets through their own actions. A major programme to enhance energy efficiency of small and medium enterprises is also being launched, focusing on SME clusters, and the development of local consultants, equipment vendors, and financial institutions through replicable pilot projects.
- ❖ **Residential Lighting:** The penetration of energy-efficient compact fluorescent lamps (CFLs) in the domestic sector has been relatively limited because of the high costs of CFLs. The Bachat Lamp Yojana (BLY) provides CFLs to households at the cost of incandescent bulbs. Distribution Companies select qualified investors to sell high quality CFLs in their region. The investors earn carbon credits due to the lower energy use by the CFLs. The BEE has registered a country-wide Programme of Activities (POA) under the Clean Development Mechanism (CDM) which enables the quick registration of each investor-led project as a CDM project under the POAs. Currently over 20 million CFLs have already been distributed under the BLY programme.
- ❖ **Energy Efficiency in Agricultural Pumping:** Replacement of inefficient agricultural pumps by efficient pumps is enabled through the performance contracting mode. Pumps on designated feeders (which have no other loads) are evaluated for their current energy consumption, and then the existing pumps are replaced with efficient pumps by an ESCO. The resultant energy savings are evaluated, and the ESCO is paid a share of the savings. Six pilots have been launched to assess the viability of this model.

The use of super critical and ultra-super critical technologies in power generation can reduce the coal requirement of electricity production. Domestic capacities for building such power plants are being established. We should try to ensure that a much larger part of the capacities initiated in the Twelfth Plan will be of the super critical variety and we should prescribe that from the Thirteenth Plan onwards all new capacities must be super critical or ultra-super critical.

Shift in modes of transport from roads towards railways in the case of freights, greater use of public transport in cities, and use of inland water transport can also make a big difference to total energy use. The scope for affecting such a shift depends upon our ability to increase the competitiveness of the Railways as a freight carrier and also on urban transport policies which emphasise Rapid Mass Transport (RMT).

New technologies like IGCC and energy efficient use of gas plants through facilitating distributed generation in CHP mode by developing network of gas pipe lines must be encouraged. Development in technology for Carbon Capture and Storage (CCS) need to be carefully monitored to assess the suitability and cost effectiveness of this technology for Indian conditions. A major effort must be made to expand energy from clean energy sources. The share of new renewable energy in total commercial energy use at this juncture is around 10.0 per cent with conventional hydro-electricity accounting for another 22.0 per cent. The share of new and renewable energy could go up to 15.0 per cent by 2020.

With improved capacity utilisation, this may result in a higher share of clean energy in the overall energy basket. The twin measures of energy efficiency, and larger share of clean energy, will help in reducing greenhouse gas emissions further.

An Expert Group on Low Carbon Strategies for Inclusive Growth, in its Interim Report, has estimated that emissions intensity of our GDP could go down by 23.0 to 33.0 per cent over 2005 levels by 2020, depending upon the intensity of the mitigation effort, while achieving the target 9.0 per cent GDP growth.

Energy Pricing

Energy prices have a key role to play both in promoting energy efficiency and in ensuring expansion of domestic supply. They promote energy efficiency by providing an economic incentive to shift to more energy efficient technologies, an objective that is helped by the various non-price actions discussed above.

Rational energy prices are also necessary to ensure expanded energy supply because otherwise energy producers will not generate the investible surpluses needed to fund the costs of exploration and production. Unfortunately, the structure of energy prices at present is very different from what it should be.

An integrated energy policy was approved by Cabinet in 2009 under which fuels that are tradable (i.e. imported or exported) would be priced in line with global prices. This alignment has yet to be achieved.

Pricing of Petroleum Products

The position regarding petroleum products, where we are importing around 80.0 per cent of our requirement is that petrol prices are aligned with world prices (and indeed bear an extra burden of taxation) but diesel prices are at least 20.0 per cent lower than they should be if they are to be fully aligned.

Kerosene prices are as much as 70.0 per cent lower and LPG prices 50.0 per cent lower. This misalignment is not only imposing a burden on the exchequer and the oil companies, it also causes serious distortions.

The massive under-pricing of kerosene is leading to large scale diversion for adulteration with diesel and PDS actually reaches the consumer. The LPG subsidy is completely untargeted, and for the most part benefits people in the middle and upper income classes.

Natural gas pricing presents special problems since international pricing of natural gas is not as easily implemented as it is for oil. At present, natural gas from the KG basin and other domestic sources is priced at \$4.2–5.7 per mmbtu whereas imported LNG ranges from \$13–14 mmbtu. Part of the problem with discovering a domestic market price for natural gas is that the first priority for natural gas is fertiliser, where the final price being controlled, the cost of gas is simply passed on into a higher subsidy.

This problem would not arise if the system of fertiliser subsidy is shifted to a fixed subsidy with market determine pricing.

Coal Prices

Coal prices are theoretically decontrolled, but in fact they are adjusted only in consultation with the Ministry. Indian coal has high mineral content and a lower calorific value as against imported coal, but even accounting for this difference, the price of domestic coal is 30.0 to 50.0 per cent lower than imported coal. The expected demand for coal from the power sector cannot be met except through a significant increase in imports, which poses two problems. First Indian power plants are not designed to take more than 10.0 to 15.0 per cent of imported coal. Besides, power producers are not willing to accept higher cost fuel because that puts them at a disadvantage compared with producer using domestic coal. It is essential to develop some mechanism of providing power producers with a mix of domestic and imported coal consistent with their technical constraints so that the higher cost of imported coal is averaged with the lower cost of domestic coal.

Electricity Prices

Electricity to the consumer is also under-priced. Electricity prices are set by State regulators but most regulators have shown a tendency to hold back tariff adjustments, typically under political pressure. At

times, the discoms are also discouraged from seeking tariff revisions. The result is that electricity tariffs are not only very low (and in some places zero) for agriculture, but also lower than they should be for many other categories of consumers. This jeopardises the financial position of the discoms.

A transition to more rational energy pricing requires upward adjustment in all these prices. Since different Ministries are involved, a coordinated view is necessary based on a holistic understanding of the rationale of the move. The adjustment needed cannot be achieved in one go, but the process must begin so that a full adjustment occurs over two or three years. Increasing prices is never easy, but it is also true that our ability to grow rapidly in a world of high energy prices depends crucially on our ability to adjust these prices. Suppressing energy prices will not help. There is a case for insulating the poor from these price increases by a targeted subsidy, but what we have at present is a much more general subsidy

Oil & Gas Production

India is heavily dependent on imports for supplies of both oil and gas. As shown in Table 3.1, the import component of domestic oil consumption is about 76.0 per cent (after adjusting for export of refined petroleum products) and in the case of natural gas, it is about 19.0 per cent. These per centages are projected to rise to 80.0 per cent and 28.0 per cent respectively, by 2016-17.

Exploration and production (E&P) activities in oil and natural gas therefore, have to been given special emphasis. 3.20 Oil and gas exploration policies under NELP were designed to achieve rapid expansion of domestic production with the involvement of private investors. So far 235 blocks have been awarded. However, the results achieved thus far are disappointing. There has been some increase in crude oil production and a significant expansion of domestic gas output. However domestic production of both oil and gas needs to be significantly improved. ONGC's performance in increasing production, despite the allocation of a large number of blocks, has been disappointing.

The international response to the recent NELP offers has been poor. It is necessary to re-examine whether the current policy provides a sufficiently attractive framework which can attract investors to this area. There is need for a stable long-term regime of fiscal incentives which is comparable to what exists elsewhere. The issue of pricing of natural gas and its linkage with international prices also need to be clarified if investors are to be attracted to this sector.

Non-conventional gas resources, particularly Shale Gas and also Coal Bed Methane (CBM), have dramatically changed the supply scenario in the US. Similar developments are taking place elsewhere. A major thrust needs to be given to the identification of shale gas resources in India and the determination of the feasibility of exploiting them, which depends on several technical factors. Expansion of CBM should also receive priority attention. An effort to map available Shale gas resources is currently underway and is expected to be completed by the end of 2011.

Expanded usage of natural gas will continue to be dependent on imported LNG, an expensive proposition at present. As against the domestic natural gas price of \$4.2–5.7 mmbtu from K.G. Basin, prices of imported LNG are \$13–14 mmbtu which is equivalent to \$78–85 per barrel of oil. It is important that we develop strategies which will permit the expansion of gas usage, including LNG, so that the portfolio of hydrocarbons is more evenly spaced out. This should take into account the greater likelihood of gas discovery in India's economic zones, as well as the possibility of gas assets abroad including assured forms of contractual supply.

The Twelfth Plan must therefore, focus on further expansion of NELP, development of shale gas exploration, new coal bed methane blocks and expansion of gas pipeline network. A major focus will have to be on aligning oil and gas prices to market conditions. With oil prices expected to remain firm in global oil markets, this will be a major challenge to meet.

As part of the focus on clean fuel approach, ethanol blending of 5.0 per cent in petrol was initiated during the Eleventh Plan and currently about 3–5.0 per cent of ethanol is blended in petrol. There is a need to expand the supply of bio-fuels, including bio-diesel, to reduce the dependence on imported oil. The share of bio-fuels, including bio-diesel and ethanol, needs to be increased during the Twelfth Plan.

Considerations of energy security justify a policy of acquiring energy assets abroad. ONGC Videsh has already invested \$11 billion in such assets. Similar investment should be undertaken in coal and also in uranium to have access to energy assets in other resource rich countries which would enable us to meet domestic demand.

Power

Power generation (utilities + captive) has grown at 5.8 per cent per annum during the period 1990-91 to 2010-11 and the implicit elasticity with respect to GDP is 0.87. This is much lower than 1.09 per cent recorded in the period 1993-94 to 2003-04. It is estimated that, in order to sustain GDP growth at 9.0 per cent, the demand for grid power will grow by 6.0 per cent per annum to 1,200 billion units (Bu) by the end of the Twelfth Plan. If diesel/FO based captive generation is to be curtailed, as it should be for energy efficiency, we have to plan for grid supply of at least 1,350 Bu.

Capacity Creation

The Eleventh Plan had targeted creation of 78.7 GW of additional capacity for grid power. Actual realization may not exceed 50 GW, largely on account of slippages in public sector projects. The shortfall in achieving the targets has been primarily due to poor project implementation, inadequate domestic manufacturing capacity, shortage of power equipment, and slow-down due to lack of fuel, particularly coal.

More than 80,000 MW of new power capacity is already under construction. Hence it may be reasonable to target 1,00,000 MW of new power capacity during the next Plan. This will, however, need an effective resolution of issues holding up domestic production of coal and effective measures for improving financial health of power utilities. The Twelfth Plan should, therefore, aim at capacity creation of about 100 GW, which will include 28 GW of capacity from projects which were supposed to be completed in the Eleventh Plan, but are now expected to be completed in the first two years of the Twelfth Plan. We must ensure that not only the spill-over projects from the Eleventh Plan are completed at the earliest, but that slippages in the capacity addition programme for the Twelfth Plan are minimised. In addition, we should examine whether it is possible to back additional gas-based power capacity for initiation/completion during the Twelfth Plan, given the competing demand from the fertiliser sector.

The share of the private sector in capacity expansion has gone up substantially in the Eleventh Plan and it is expected that 33.0 per cent of the total incremental capacity will come from the private sector. In the Twelfth Plan, this share is expected to increase further to about 50.0 per cent. Since most of the new power capacity will consist of thermal plants, it is essential to ensure that coal availability does not become a constraint.

India has a substantial potential for creating hydropower capacity, especially in the North Eastern region. The pace of capacity creation in this area has been slow and it is vital that special emphasis be given to expedite environmental and other clearances, so that the pace of work on these hydro-electric power projects can be stepped up. Early completion of these projects will also generate an income stream for the North Eastern States which will enable them to accelerate the pace of development.

It is also necessary to take measures to increase the share of gas based power and also of nuclear power. Safeguards in respect of the latter will be further reviewed and additional measures taken as required. Both these are areas with great potential and will need investments.

Transmission

In order to support the large expansion in production and consumption of electricity, the transmission and distribution network will have to be significantly expanded and strengthened. Some private sector investments have been made in transmission in the Eleventh Plan and it is important to build a policy framework within which more private sector investments will be forthcoming in the Twelfth Plan.

A special project on power evacuation from the North-East will have to be undertaken. The possibility of such lines passing through Bangladesh could be considered reflecting our mutually beneficial interdependence. Technological development for transmission lines of 765 KV and over 1,000/1,200 KV is of great relevance in order to reduce land requirement and also transmission losses.

Distribution

The distribution segment in the power sector is clearly the weakest link in the power system. The current losses of distribution utilities before accounting for State subsidy are approximately Rs. 70,000 crore. Continuing losses on this scale is simply not viable. There are three elements that explain these large losses. First, State power regulators have, in most cases, lagged in setting power tariffs annually as they were supposed to. This is largely a reflection of political pressure on the regulators and in some cases also of political pressure on the utilities themselves to ensure that they do not ask for tariff revision. Second, the supply of free or virtually free power to the farm sector, and its mostly un-metered nature, is leading to considerable leakage. Finally, State-owned power utilities have tolerated large losses, often reflecting collusion between the distribution staff and consumer. They have not made investments needed on the transmission side to reduce losses and have also not fully used the meters that have been installed under the meterization programme, to identify and rectify power leakage.

Since the financial viability of the power sector as a whole depends upon the revenues collected at the distribution end, it is absolutely vital that the distribution system is made financially viable during the Twelfth Plan. This can be done within the existing system of publicly owned distribution system by bringing in modern systems of management, use of IT and enforcement of accountability. Another way is to go in for privatisation as some States have done. For example, Delhi has privatised the distribution segment with good results in the term of reduction in AT&C losses. Other states have resorted to 'franchising' in which a private company takes over the management of the distribution system and collection of revenues on the basis of a predetermined revenue sharing model. Franchising has given good results in several areas, and the experiment is being replicated.

Since distribution is entirely in the domain of the States, action to improve distribution has to be taken by the State government. States should give this issue high priority. The Central Government can at best incentivise action in a manner which allows the States room for experimenting with different ways of obtaining better results.

With new capacities being set up in different States, it is essential that we move to operationalise the Open Access policy. Although the introduction of Open Access has been mandated in the Electricity Act, 2003, there has been reluctance in the States to give freedom to customers having requirement of 1 MVA and above to choose their own sources of supply. This should be expedited so that power markets are widened and deepened.

Rural Electrification

Access to power has been particularly poor in rural habitations and the Rajiv Gandhi Grameen Vidhyutikaran Yojana (RGGVY) was devised to remedy this problem by providing connections to all villages and free connections to BPL families. There are, however, still a large number of habitations left uncovered and a very large population that has no connectivity. It is desirable to try and universalize access of power during the Twelfth Plan and this requires dealing with the large backlog in the States of Uttar Pradesh, Bihar, Orissa and Assam and some of the other North East States. However for effective universal access the RGGVY programme has to be restructured. Connectivity by itself is only part of the problem, since in many States there is also a real shortage of power. Besides RGGVY focuses only on household supply and does not address the need for providing electricity for agriculture, which needs three phase supply. This in turn requires strengthening of the rural network, and not just last mile connectivity to households, which is what RGGVY covers.

There are other schemes which provide electrical connectivity to people below poverty line. Solar lanterns have been distributed at subsidized rates. There is also an initiative for developing other resources of clean energy for both rural and urban consumption. These programmes need to be widened and strengthened.

Total Installed Capacity (October 2012)

Source	Total Capacity (MW)	Percentage
Coal	120,103.38	57.38
Hydroelectricity	39,291.40	18.77
Renewable energy source	24,998.46	11.94
Gas	18,903.05	9.03
Nuclear	4780	2.28
Oil	1,199.75	0.57
Total	2,09,276.04	

Sector	Total Capacity (MW)	Percentage
State Sector	86,881.40	41.51
Central Sector	62,373.63	29.66
Private Sector	60,321.28	28.82
Total	2,09,276.04	

Coal

The demand for coal has risen by about 8.0 per cent per annum during the Eleventh Plan and may rise by about the same magnitude during the Twelfth Plan. Coal output expanded at about 7.0 per cent per year in the five-year period of 2004-05 to 2009-10, with especially strong growth in both 2008-09 and 2009-10. However, in 2010-11 coal production remained stagnant.

Domestic coal production was originally targeted to reach 680 mt in the Eleventh Plan. This was scaled down to 630 mt in the Mid Term Appraisal and it is now expected to be only 554 mt. Of the 208 captive coal blocks allotted with 49 billion tonnes of reserves and a production potential of 657 mt per annum, the estimated annual production by the end of the Eleventh Plan is only 37 mt.

Given the strong growth in thermal generation projected in the Twelfth Plan, the aggregate demand for coal at the end of the Twelfth Plan is likely to be between 900 and 1,000 million tonnes depending upon the pace of implementation of power capacity. As against the projected demand of 900–1,000 million metric tonnes (mt) by the end of the Twelfth Plan, the domestic output is unlikely to exceed 750 mt leaving more than 200 mt shortfall to be met from imports. Even this assumes that domestic output will be able to increase by over 200 mt from current levels.

Fuel Supply Agreements

Uncertainties in coal supply are already affecting the establishment of generating capacity. Coal India is not entering into Fuel Supply Arrangements for more than 50.0 per cent of the requirement of thermal plants, and that too only for five years. Private sector investors in power generation are unlikely to be able to access financing from banks if there is uncertainty about coal supplies. Although coal is importable, coal imports are much more expensive and power producers are reluctant to accept a fuel supply arrangement based on imported coal which would put them at a disadvantage. If domestic coal prices were aligned with world prices this problem would not arise. However, such a large adjustment may not be easy to achieve in a short period. CIL should explore the possibility of developing a mechanism to enable power producers procure a mix of domestic and imported coal consistent with their technical constraints.

It is necessary to introduce a system of pooling domestic and imported coal prices for power producers so that the price they are charged does not depend upon whether they receive domestic or imported coal.

Environment Constraints

An important reason for low production in domestic production of coal is the inadequate incentive with the States to increase coal production. In addition, there have been, in the recent years, constraints due to tighter environmental regulations, problems in Resettlement & Rehabilitation (R&R), and also problems in land acquisition. The Ministry of Environment & Forests had adopted a policy of 'Go-No Go' in which coal mining was completely banned in 'No Go' areas. However, as large coal bearing areas were suddenly declared 'No Go' areas, this would have severely limited the ability to expand domestic production of coal. Further, Comprehensive Environmental Pollution Index (CEPI) norms were introduced which prohibited mining in areas with a high pollution index, even if the pollution was due to other industrial sources. Coal being 'location specific', there is clearly a need to review this approach.

A Group of Ministers is working on resolution of these issues and it is essential that an appropriate balance be struck between the need to protect the environment and the need for energy security.

Underground coal mining has the potential of greatly reducing the disturbance caused to the environment. However, current output levels from underground mining at 60 mt is very low and these mines are predominantly old. There has been very little fresh investment in underground mining. It may be necessary to sharply increase the scope and share of underground coal mining and this will involve much greater mechanization and investment by private players.

Washeries

The quality of Indian coal is poor and needs to be improved through coal washeries which calls for an expansion in washery capacity. It would improve the quality of the coal and efficiency of the consuming industries. There has been a very marginal increase in the coal washery capacities. One reason for this is that the system of coal pricing does not contain a sufficient premium for higher quality coal. Coal India must move towards a pricing mechanism in which coal of higher calorific value is priced with an appropriate premium. It is also necessary to promote productive use of the large volume of washery rejects which contain large quantities of sensible heat.

Prospecting of coal in new areas must be energetically undertaken. It is planned that the exploration of all known coal bearing areas be completed during the Twelfth Plan. This will result in expansion of the inferred/proven category and thereby the overall availability. Environmental concerns regarding these, particularly limitations in undertaking this work effectively in forest areas, will be addressed.

Coal Imports

Even with the best effort at increasing domestic production it will not be possible to meet the increased demand for coal from domestic production. Coal imports are expected to rise from about 90 million tonnes at present to over 200 million tonne from 2016-17. The necessary infrastructure including ports and railways to service these projected import volumes will have to be in place.

Given the importance of expanding supply and the indifferent performance of Coal India in increasing production, there is need for inducting private sector investment in coal. It is already allowed for captive mining. There is no reason why it should not be opened up generally. In this context there is a case for reconsidering the merit of nationalization of the industry.

Renewable Energy

Continued emphasis has to be placed on other renewable resources, especially on expanding wind power generation and in the emerging area of solar thermal and solar photovoltaic. While a National Solar Mission plans for a capacity of 22,000 MW by 2022, C-WET estimated a technically feasible wind potential of 49,000 MW. A fresh assessment of wind power, a potential by some agencies has mentioned a higher figure which needs realistic review by the Ministry of New and Renewable Energy (MNRE) based on scientific norms. These areas will need further study. The potential for such generation is clearly higher than current estimates of about 50 GW.

It is also necessary that scientific and technological (S&T) developments, especially in the solar energy field, are sufficiently internalized to keep the country abreast of international developments. In order to make solar power a success in the coming decades, it is vital that we develop the necessary domestic S&T capacity such that we can collaborate as peers with the rest of the global community.

A basic problem with most renewable energy sources is that they are significantly more expensive than conventional power. However, technological developments are reducing the cost of renewable generation and it is widely predicted that by 2019 the cost of solar electricity generation, which is currently six times higher than coal based electricity will come down to be approximately equal to the latter. However, this equalization is expected to occur partly because the cost of conventional fuels is expected to rise significantly. In other words, technological developments in the field of renewable energy will help overcome energy constraints, but only at significantly higher energy prices.

This underscores the fact that in the medium term, energy prices in India must rise to correspond more closely with world energy prices.

The overview of energy related issues presented in this chapter shows that a workable energy strategy for the Twelfth Plan requires a large number of actions by different Ministries in the Central Government plus action by State Governments in several areas. The success of the Twelfth Plan depends critically on our being able to ensure that all or most of these actions are taken within a reasonable period of time. Unless this can be done, energy constraints will limit the ability of the economy to reach 9.0 percent growth.

Indias demand for energy will continuously expand rapidly, but the domestic supply will be constrained by: price distortions and many hindrances. This will result into increased demand for fossil-fuel import.

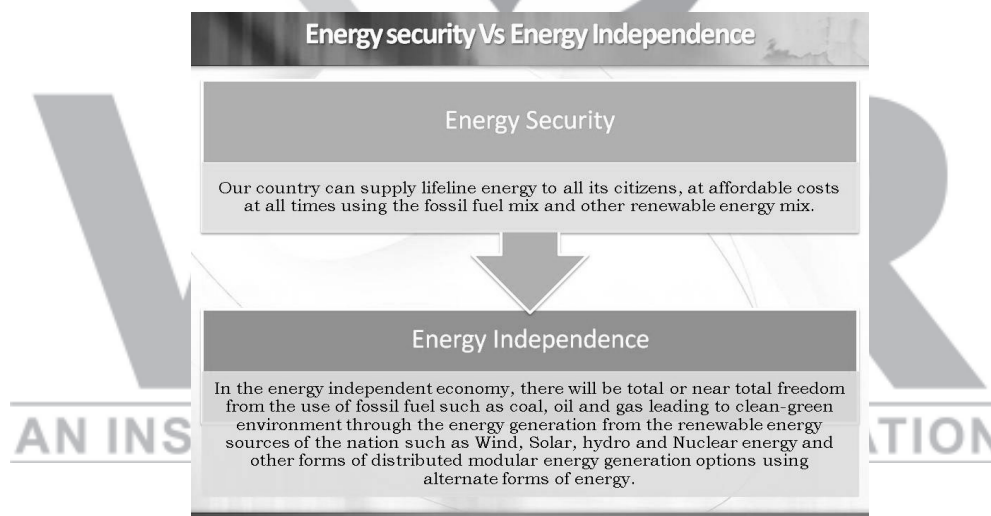
Over the years, in all the three dimensions of the trilemma such as Energy security, equitable energy access and environmental impact mitigation, Indias performance is declining. This will need formulation of holistic, medium and long term policies for investment in energy infrastructure, creation of strategic energy mix and coordination between central and state governments. Power sector is hobbled with inefficiencies and bad pricing policies and have left the state utilities (state electricity boards) bankrupt. Net effect will be, India will continue to depend on fossil fuel as a large part of energy mix leading to large scale import of coal, oil and gas. Renewable energy can provide some relief, but nuclear could be energy of the future. Manufacturing industries have great challenges in procuring energy for expansion. It may lead to three types of situations; Firstly, ignore the problem with the risk that limited energy supplies will cap the growth and investment. The second is, internalize it, by securing captive energy sources - which might skew governance and retard the adoption of cleaner fuels. Thirdly, innovate policies and practices across the energy supply chain and manage demand for ensuring sustainable energy future. The potential of Renewable Sources is undeniable. In 5 years they could account for 18% of capacity - if only about 6% of generation comes from wind and solar alone. Simultaneously, resolve the scaling up challenges arising from volatile supply, grid integration, geographic dispersion and un-competitiveness. Both state and central governments have to work with a common goal for its generation.

For empowering the growth of any nation, it is essential to evolve right perspectives on realizing the Energy Independence vision by 2030 graduating from Energy Security. The basic foundation for achieving energy independence has to be built on the principles of environmental impact mitigation, selecting the right energy mix directly linked to the sustainable economic growth of the nation keeping the democratic dimensions in mind and the use of 5th fuel namely constantly improving energy efficiency

in an integrated way.



Energy security Vs Energy Independence Just like India has a concern for the development of renewable energy from various angles, recently US President has also put a target to minimize the fossils fuel import progressively through the development and large scale production of renewable energy. The climate of the globe as a whole is changing and we have to collectively work towards building a habitable planet earth.



Energy Security, means ensuring that our country can supply lifeline energy to all its citizens, at affordable costs at all times using the fossil fuel mix and other renewable energy mix. Whereas it must be considered only as a transition strategy to eventually achieve **Energy independence**. In the energy independent economy, there will be total or near total freedom from the use of fossil fuel such as coal, oil and gas leading to clean-green environment through the energy generation from the renewable energy sources of the nation such as Wind, Solar, hydro and Nuclear energy and other forms of distributed modular energy generation options using alternate forms of energy

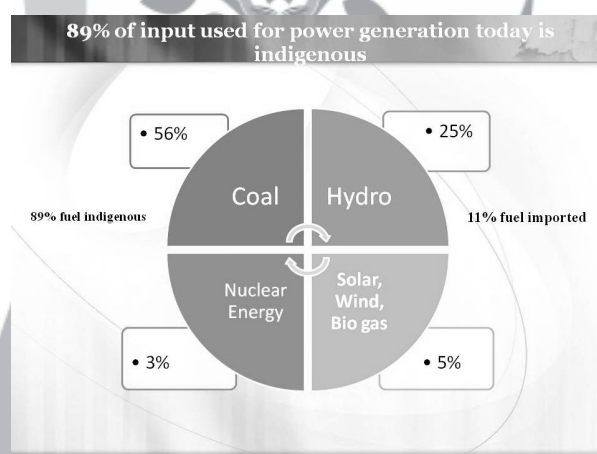
Hence, **Energy Independence** is our highest priority. We are determined to achieve this within the next 18 years, which means, by the year 2030. For achieving this mission proper policy must be formulated, funds guaranteed, and the missions have to be entrusted to the younger generation as

public-private partnerships missions for driving the sustainable development of the nation towards and beyond the pre-economic turbulence regime.

Independence in electric power generation sector. At present, we have an installed capacity of about 205,000 MW of electricity.

Forecasts of our Energy requirements by 2030, when our population may touch 1.4 billion people, indicate that demand from power sector will increase from the existing 205,000 MW to about 400,000 MW. This assumes an energy growth rate of 5% per annum. In addition, we have to cater for additional power for meeting volatile supply arising from the use of renewable energy. For example; today India has 30,000 MWs of captive power with the industry which can be fed by the private companies and used for national purposes for meeting volatile supply. Today, the problem is, this captive power is costly and environmentally unfriendly. To make it affordable with consistent environmental impact reduction, our scientists are working on emulsification model which uses 50% diesel and 50% water in the diesel generating sets.

Prime electric power generation in India today now accesses four basic energy sources: Fossil fuels such as oil, natural gas and coal; Hydroelectricity; Nuclear power; and Renewable energy sources such as bio-fuels, solar, biomass, wind and ocean. The **89% of input used for power generation today is indigeneous**, from coal (55%), diesel and gas (11%), hydroelectricity (21%), nuclear power (2%) and Renewable (11%). Solar energy segment contributes just 0.5% of our energy production today.



Indian Energy problem

In coal India has something as abundant as people. As more Indians enjoy the trappings of middle-class life and the country industrialises, demand for coal-fired electricity will continue to rise smartly, roughly in line with economic growth. India may not have much oil or gas to call its own but it has the world's fifth-largest coal reserves. And it has successfully raised a mountain of the other raw material needed to turn carbon into sparks: capital. Some \$130 billion has been ploughed into the power industry in the past five years. Of that, \$60 billion or so has come from the private sector—probably the largest-ever private-sector investment India has seen.

Possessing coal and capital is no guarantee that India's energy boiler will work properly, however. It also involves multiple states, government ministries, regulators, mandarins, politicians, tycoons, environmentalists, villagers, activists, crooks and bandits. There are the usual gripes of an emerging economy: blackouts (during peak hours the system delivers 10% less electricity than customers want) and an inadequate grid that does not reach some 300m people (although it has improved a lot in recent years).

There is also a risk that India cannot deliver the long-term increase in electricity generation that its economy needs to fulfil its potential. On January 18th a group of influential businessmen gathered

in Delhi to bend the prime minister's ear on this very matter.



The problem is partly one of design. Coal is dug up by a state-monopolist that has failed to boost output significantly in recent years, unlike China (see chart 1), and so cannot keep up with demand. Power is distributed to homes and firms by publicly owned grid companies that are often bankrupt, their tariffs kept too low by local politicians. Trapped in the middle are the firms that run power stations. In desperation they are importing pricier foreign coal, but the grid companies cannot afford the power it produces. With too little coal and wobbly customers, the private firms that have built new power stations are in financial trouble. Another wave of private investment looks unlikely.

In India, though, no one expects perfect design. The economy sits somewhere between the old command-and-control approach and the new ways of markets and private capital. What is worrying is that India's talent for improvisation—a collective ability to muddle through—has deserted it when it comes to providing electricity.

The problem has been clear for ages. A circuitous blame game is taking place. Ministries squabble but no one knocks heads together. If you trawl round the offices of industry bosses the livid letters they brandish trace their incandescent correspondence with each other. Power, so vital for growth, is India's biggest bottleneck. The danger is that it becomes a metaphor for the whole economy: many fear that the muddle-through approach of the past two decades of boom has diminishing returns.

One dam thing after another

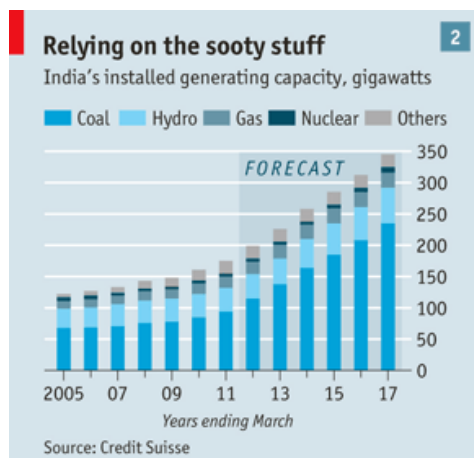
It wasn't always all about coal. Jawaharlal Nehru, the country's first prime minister after independence, was obsessed with hydroelectric dams, calling them the "temples of modern India". It would have been good for India's environment, and the world's, had many more temples been raised. The fad for hydro trickled away and it now provides only 14% of India's power compared with up to a half in the 1960s.

That seems unlikely to change—India is too chaotic and free a place to manage the feats of national machismo that allowed China to build the Three Gorges dam. Although new projects are planned in places such as Kashmir and neighbouring Bhutan, harnessing Himalayan rivers to power all of India is for now a dream, not a policy.

The subcontinent has plenty of sun and wind, and states including Gujarat and Tamil Nadu are keen to encourage investments in renewable energy. These are likely to be niche sources of power, thanks to problems getting land and their high cost.

As for nuclear power, India's attitude has long been hyperbolic on paper and ambivalent in practice, despite striking a civilian nuclear deal with America in 2005. Foreign companies are put off by the prospect of unlimited liability in the event of an accident. Nuclear plants face opposition from hostile state governments and protesters. Events in Japan have not helped. "By the time people forgot

Chernobyl, along came Fukushima,” says one industry bigwig.



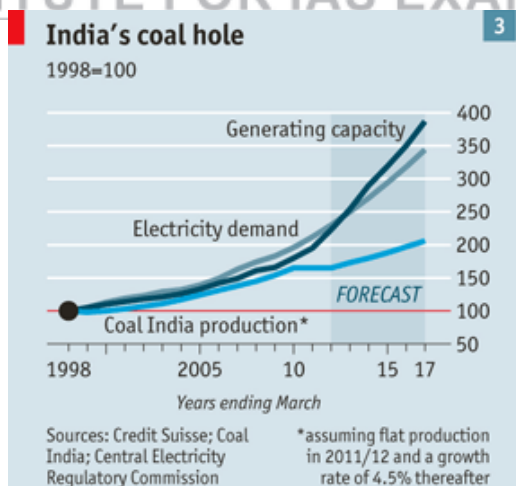
The result is that, as in China, fossil fuels will dominate the energy mix (see chart 2). Carbon emissions will rise in tandem, by about two-and-a-half times between 2010 and 2030 according to McKinsey, a consultancy. The growth of India's power industry—assuming it is built and largely fired by fossil fuels—would contribute about a tenth of the total global rise in emissions over the period. Most Indians do not feel too guilty, arguing that dirtier rich countries, not poor ones, should show restraint. India's emissions will remain far below those from America and China both in absolute terms and per head.

Fossil hunting

India has some oil and gas, mainly offshore and in Rajasthan, although production has been faltering. It lags China in developing pipelines from energy-rich Central Asia. Coal, then, is key. India's is not of a high quality—it contains too much ash—but there is lots of it. The British started swinging picks in earnest in the mid-19th century, to meet the demand of a burgeoning railway system, and undertook geological surveys in Bengal. Today east India remains coal's heartland and control of the sooty stuff lies with one of the most important companies that most people have never heard of: Coal India.

It is a mighty odd beast. Its blood is of the public sector, with modest buildings, 375,000 staff, an empire of largely opencast mines and company towns, and even its own song. Its managers are proud scientists and engineers. And prices are fixed by the state, at far below international levels. Yet its brain has some capitalist cells.

After privatisation in 2010, a tenth of its shares are listed (the rest are owned by the state) making it India's third-most-valuable firm, worth \$44 billion. It makes a huge return on equity of over 35%, has \$11 billion of unused net cash and reinvests only a fifth of its gross cashflow. It even has a financial gnat on its hide in the form of TCI, a London-based activist hedge fund famed for its stagy belligerence.



What is beyond doubt, though, is that Coal India is not digging fast enough (see chart 3). Output has been flat for the past two years—a dire result. India's ratio of production to reserves is middling by global standards and is well below China's. Assuming production picks up and grows in line with the long-term average, a vast shortfall in production will still stunt growth in power generation.

From his office in Kolkata, outside which street vendors boil vats of soup on coal stoves, the firm's outgoing chairman, N.C. Jha, says that Coal India is being made a scapegoat. The lag in production partly reflects one-off factors, such as bad weather, but is mainly the result of a deliberate clampdown by the central government on new permits for buying and clearing land, and an explosion of red tape. "Give me land, and I will give you coal," says Mr Jha.

This complaint is reasonable. At Gondagaon, a vast opencast mine in the Nagpur field, engineers need more space to dump the earth and rock that is dug up with coal. A map shows the pit hemmed in by villages and scrub land. Acquiring the land, compensating the villagers and making sure they shift poses a challenge harder than geology, says the company. "We do not have a magic wand in our hand to increase production," says D.C. Garg, boss of the Coal India unit responsible for the area. In east India the firm faces another problem: most reserves are in remote areas where Maoist guerrillas operate.

Yet for all the hurdles it faces, many say Coal India is part of the problem. A senior government official says it is riddled with trade unionism and gangs who steal coal—something the private sector would resolve by sending in "the toughest son of a bitch" they could find. The boss of one smallish state-owned electricity generator details how local Coal India employees collude with middlemen to steal his fuel. He says that its local chief is "hugely compromised" by corruption.

And no one really knows what Coal India's mission is, thanks to its hybrid status. Should it maximise profits and the dividend it pays to a cash-strapped government, despite the fact it is a near-monopoly and unregulated? Or is its job to deliver cheap fuel for the nation and accept lower returns by investing more on new mines?

Let's burn Australia instead

Private generating firms are not waiting to find out the answer to this identity crisis. Instead they have assumed that the state will not deliver enough and are prepared to import vast amounts of coal to fire their plants, either by acquiring it from wholesalers or by buying foreign coal mines. Some \$7 billion has been spent in the past six years on pits in Australia, Indonesia and Africa. Gautam Adani, a Gujarat-based tycoon, is building a private network of mines abroad that feeds ports and power stations in India.

Amish Shah of Credit Suisse reckons that by the year to March 2017 domestic coal production will meet only 73% of demand, leaving a gap of some 230m tonnes, almost five times the level of 2012. Include other industries that use coal, such as steel, and some analysts calculate that India's total imports by 2017 could reach some 300m tonnes. That is on a par with the current exports of Australia, or those of Indonesia, South Africa and Canada combined.

Even if India could improve its ports and already stretched railways, and adapt its power plants to burn alien coal, can it afford to import so much? Coal prices have soared in recent years (the benchmark price is some 50% above its average in 2009), partly due to Chinese demand. Indonesia has imposed new rules that hamper foreign mine owners from exporting coal at below market rates. So, adjusted for quality, foreign coal is perhaps four times pricier than the local stuff. The cost of shopping abroad could be as much as \$20 billion by 2017—or 1% of today's GDP.

That would swell India's overall annual energy-import bill. Include coal used for purposes other than power, liquefied natural gas and oil and it could rise by \$65 billion or so by 2017, compared with the year to March 2011, according to Sanjeev Prasad of Kotak, a broker. That would put a huge strain on the balance of payments. Even if India can afford to import all this coal, the next question is whether it can persuade its population to fork out for the electricity it produces.

Torture boards

Electricity meters are installed in unexpected places. Power in Dharavi, a giant Mumbai slum, is now largely tolled, with meters nestling next to curing factories piled with goat skins and people melting down used plastic cutlery. But the city, where power is distributed mainly by two private firms, is an

exception: almost everywhere else state electricity boards operate the grid, usually badly. They typically lose about a third of the power they buy through theft or inefficient kit, and one executive reckons that up to another third is delivered legally to rural customers who pay subsidised prices or get it free. The result is that a small proportion of customers foot the bills.

Although tariffs are notionally set by regulators, local politicians often hold sway and keep them low to win votes. The legislation that governs power is reasonable but unenforced. The electricity boards haemorrhage cash as a result. They lost \$11 billion, excluding any subsidies, in the 12 months to March 2010—the last year for which reliable figures are available.

The consequences are twofold. First, there is not enough money to upgrade the network: up to \$200 billion of capital investment is required. And second, if the cost of the power rises because of the expense of imported coal, these outfits are neither strong enough to absorb the financial hit themselves nor capable of easily passing it through by raising prices to customers. That means it is their suppliers, the generating companies, that get squashed.

“I can see if someone is sleeping on the job,” boasts Arup Roy Choudhury, the chairman of NTPC, the country’s biggest electricity generator. In the floor above his office in Delhi a CCTV studio allows him to spy on his empire. He can zoom in on a giant construction site in Mouda, near those mines in Nagpur, where in March a new plant will fire up, fuelled by coal produced by Coal India. NTPC is likely to get the coal it needs partly because it is state-owned and big.

Another power firm in the same state with a new plant coming on line in March expects to get only half the fuel originally promised by Coal India. Private-sector firms with plants coming on line often assume they will be last in the queue for domestic fuel. If they substitute imported coal for domestic coal they worry that they may not be allowed to pass on the costs and that if they are, the electricity boards won’t be able to pay.

Generation should be a success story. After a false start in the 1990s, during which even Enron was briefly and disastrously tempted in, mainly local firms, including Tata Sons and Reliance Group, have piled in once more. Special rules were created to fast-track “ultra-mega power plants”, among the largest in the world, with their own captive coal supply and exemptions from some red tape. Total capital investment (including NTPC) has been perhaps \$60 billion in the past five years. Yet now share prices have slumped and the central bank has been forced to reassure financial markets that a wave of defaults in the sector will not hurt the banks, which have about 7% of their loans to the power industry, mainly to generation firms.

The true cost to the country is not a few bad debts but a reduction in long-term investment plans as confidence wanes. Across the industry “projects are taking a hit, due to a lack of fuel among other things,” says J.P. Chalasani, the chief executive of Reliance Power, a generation firm. For the economy to expand at 8-9% it will need to add large amounts of generation, consistently. “We are nowhere near that unless immediate action is taken. At some point all this will hit our GDP growth.”

In theory there are two solutions to the looming power problem. One is to privatise the electricity boards, end Coal India’s de facto monopoly or break it up, create new regulators and give teeth to existing ones, and then hope that market forces raise standards, tariffs and production. The other is to resort to command-and-control, with a single authority breaking heads.

Either of these approaches might be better than today’s squabbling and passivity. Unfortunately, neither is likely. Privatisation is too politically sensitive, as is allowing private firms, let alone foreigners, to run riot over India’s coal beds. And the mesh of states, law courts, ministries and coalition politics means iron fists come out only in a crisis.

Watch while we juggle

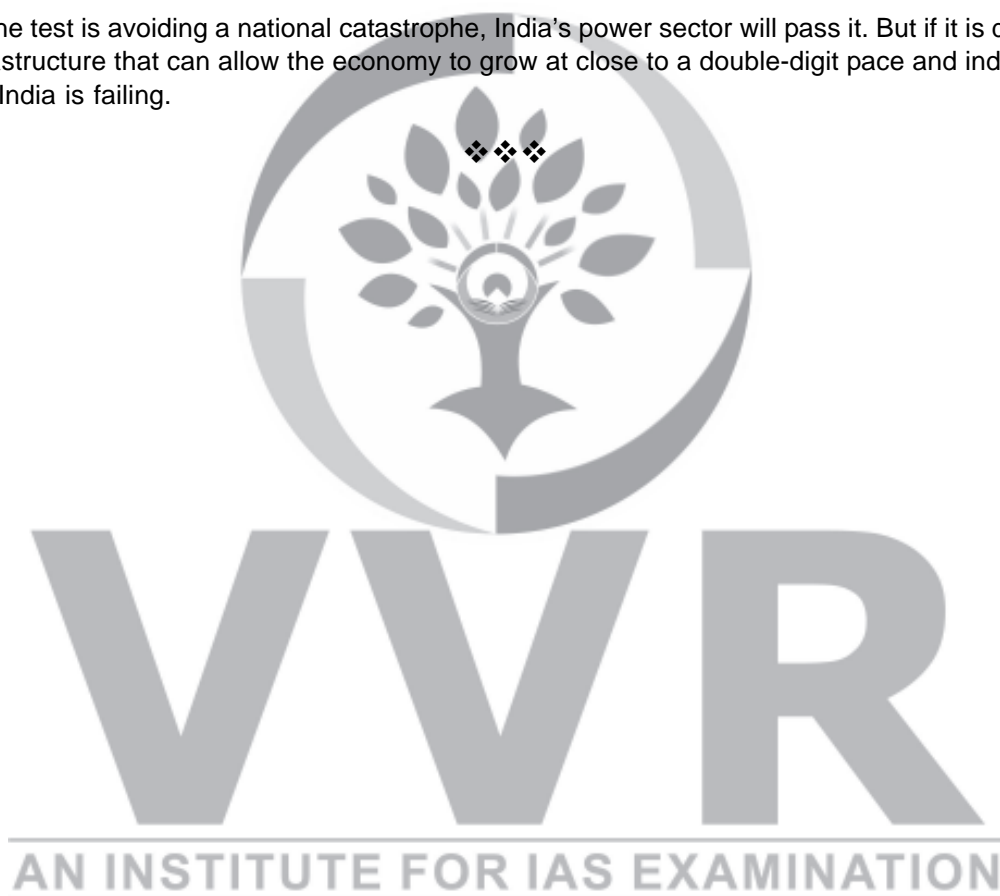
That leaves an alternative approach of administrative fiat and improvisation. It hasn’t worked so far but there are some grounds for hope. A recent court ruling has prodded many electricity boards to raise tariffs. Crafty ways are being cooked up to allow private miners to do the digging while Coal India retains its notional title to the coal, and to grant permission for more “captive” mines where a private generator digs up its own fuel.

In need of untangling

Banks seem to have been given the nod by the central bank to ease the terms of their loans to power firms without booking losses. Government officials talk of spreading the cost of imported coal across all firms, so it is not borne by a few, and dream of open access where a power station could bypass the state grid operators and plug into customers directly.

It is a safe bet that India's skills of improvisation will recover—helped by stern words from the prime minister. The lights will not go out anywhere for long enough to annoy voters unduly, and by historical standards there will be decent improvements in the reach and availability of electricity. Companies which need reliable power supplies, including India's technology giants, will carry on building their own generators just to be sure. Those states that can guarantee power supply, such as Gujarat, will attract the majority of energy-intensive investment, such as car factories.

If the test is avoiding a national catastrophe, India's power sector will pass it. But if it is delivering the infrastructure that can allow the economy to grow at close to a double-digit pace and industrialise rapidly, India is failing.



Questions on Energy (Prelims)

1. Which of the following pairs in respect of correct Power generation in India is/are correctly matched? **(2008)**
1. Installed electricity: 100000 MW generation capacity
 2. Electricity generation 660 billion kWh
- Select the correct answer using the code given below:
- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2
2. Where are Tapovan and Vishnugarh Hydro-electric Projects located ? **(2008)**
- (a) Madhya Pradesh
(b) Uttar Pradesh
(c) Uttarakhand
(d) Rajasthan
3. Which one of the following brings out the publication called "Energy Statistics" from time to time ? **(2009)**
- (a) Central Power Research Institute
(b) Planning Commission
(c) Power Finance Corporation Ltd.
(d) Central Statistical Organization
4. Other than Venezuela, which one among the following from South America is a member of OPEC? **(2009)**
- (a) Argentina (b) Brazil
(c) Ecuador (d) Bolivia
5. Consider the following statements: **(2003)**
1. India's import of crude and petroleum products during the year 2001-02 accounted for about 27% of India's total imports
 2. During the year 2001-02, India's exports had increased by 10% as compared to the previous year
- Which of these statements is/are correct?
- (a) Only 1 (b) Only 2
(c) Both 1 and 2 (d) Neither 1 nor 2



Questions on Energy (Mains)

- Question 1.** Briefly review India's Energy resources. In the context of the world shortage of petroleum, how would you plan for meeting our rural energy needs? Discuss the relative merits of centralized generation, supply and distribution of energy vis-a-vis generation of energy at consumer points or centres. **(1979)**
- Question 2.** What is the global energy crisis and what is its impact on India ? Having regard to our situation, environment, resources and problems, what would be the profile of an appropriate energy policy for India? Examine critically the available alternative options. **(1980)**
- Question 3.** "20th century was century of oil, 21st century would be the century of natural gas." Comment **(1997)**
- Question 4.** Comment on the salient features of the Integrated Energy Policy recently approved by the Government and its implications on the energy security needs of the country. **(2009)**



ANSWERS (PRELIMS)

Answer 1: (c)

Answer 2: (c) Both of the hydel power projects are located in Uttarakhand (Now Uttaranchal).

Answer 3: (d) 'Energy Statistics' is a publication of the Central Statistical Organization (CSO) under the Ministry of Statistics and Programme Implementation (MOSPI), Government of India.

Answer 4: (c) It is Ecuador.

Answer 5: (a)

