

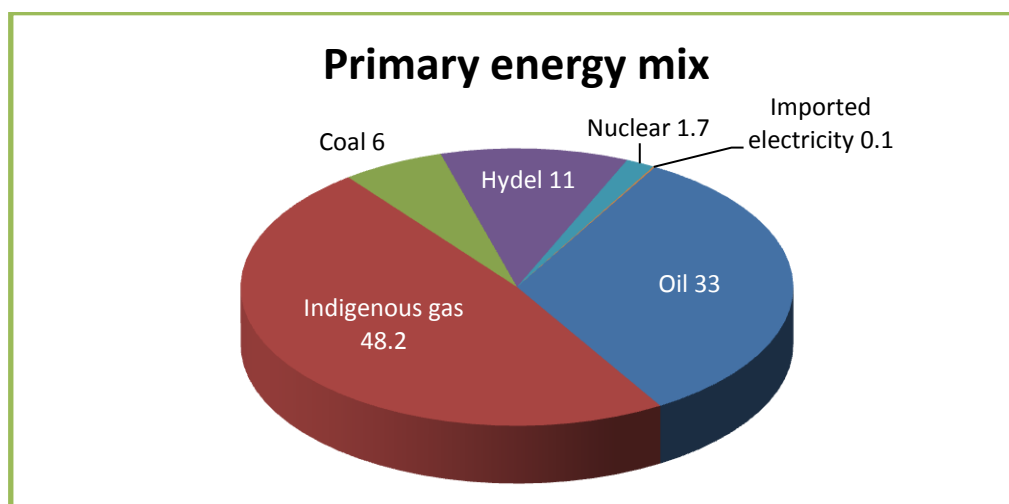
Chapter 19

ENERGY

Energy, being lifeline of socio-economic development of a country, occupies a dominant position in the Plan as ensuring energy security is one of the important themes of the Vision along with water and food. Pakistan is facing a formidable challenge of energy shortages with the demand outweighing its supply. The energy shortage has adversely affected all sectors of the economy resulting in an annual loss of up to three per cent of the GDP.

Pakistan's existing energy mix is highly dependent on expensive fuels, like oil and gas, instead of coal and hydel. In this context, gas accounts for 48 per cent, followed by oil 33 per cent, hydel 11 per cent, coal six per cent, nuclear two per cent and a small fraction from imported electricity. Disproportionate reliance on the imported oil, that is 85 per cent of the total supply, is exerting a strain on the balance of payments besides making the energy mix unfavourable.

The total commercial primary energy mix for 2012-13 was 64.59 MTOE of which 26.5 per cent was from imports and 73.5 per cent was from local indigenous resources. The current energy mix is heavily based on the subsidised indigenous gas, which is depleting and is left with useful life of 17 years at the current consumption level. The future demand of primary energy is projected to surge up to 92 MTOE during the Plan period.



Source: *Energy Year Book 2013*

Pakistan is blessed with huge resources of energy potential as mapped in the table given below. According to the resource assessment, there is a potential of 1,250 MTOE of oil and natural gas in addition to 1,540 MTOE of coal in the country. Furthermore, there is a potential of approximately 100,000 MW of renewable energy (56,721MW of hydro and 43,000 MW of wind).

Table-1: Ultimate energy resource potential estimates

| Resource category | Ultimate / Recoverable reserves | Level of production (2013) | Consumption (2013) |
|-------------------|--|--|--|
| Oil | 27.5 billion BBL/ 1.1 billion BBL (147.92 million TOE) 4% | 27.84 million BBL (3.74 million TOE) 2.5% | 19.39 million tonnes (19.78 million TOE) 81% import of oil and petroleum products |
| Natural gas | 150 TCF/ 55.63 TCF (1,100 million TOE) 37% | 1.5 TCF (4,126 MMCFD) (31.15 million TOE) 2.70% | 1.5 TCF (4,126 MMCFD) (31.15 million TOE) 0% Import |
| Shale/Tight gas | 100TCF 0TCF 0% | Not produced yet | |
| Coal | 186 billion tonnes/ 3.45 billion tonnes (1.54 billion TOE) 1.85% | 3.17 million tonnes (1.422 million TOE) 0.09% | 6.89 million tonnes (3.86 million TOE) 54% imported coal |
| Hydel | 56,721 MW (Identified potential) | 6,773 MW 29,857 GWh (7.12 million TOE) Installed capacity 12% | 96,122 GWh (23 million TOE) Total installed capacity Hydel 31% Thermal 69% |
| Wind power | 43,000 MW (Identified potential) | 106 MW 245 GWh (0.06 million TOE) 0.25% | 96,122GWh (23 million TOE) Total installed capacity Wind 0.25 % |

Source: Estimates based on scientific methods. (Ahmed. R. 1998, Hydrocarbon Resource Base of Pakistan, Pakistan Journal of Hydrocarbon Research Vol.10, p1-10), and Energy Year Book 2013

For efficient and effective exploration and exploitation of the energy resource potential, an integrated energy planning for fuels (oil, gas and coal) and renewable energy is required. It also emphasises importance of the institutional restructuring in the energy sector besides revamping policies, governance, regulation and capacity to overcome the prevailing energy crisis.

Fuel sector

Situational analysis

The fuel sector consists of oil, gas and coal. The domestic oil production has remained flat in the range of 70 to 77 BBL per day for last couple of decades whereas the demand has constantly been increasing. In 2012-13, 7.5 million tonnes of crude oil and 10.5 million tonnes petroleum products were imported to meet the domestic demand. Pakistan is expected to remain dependent on imported oil. Oil is being basically used for transport sector (49 per cent) and power generation (42 per cent). Remaining nine per cent is consumed by domestic, industrial, agriculture and other sectors. Out of the total supply of 21.3 MTOE including crude oil, petroleum products and LPG around 84 per cent are imported, and remaining 16 per cent is domestically produced.

In the upstream gas sector, seven existing large fields represent 65 per cent of the total gas production, which will start declining in the medium-term. Out of 1,267 billion CFT gas consumption, 28.6 per cent goes to the power sector, followed by domestic sector (23 per cent), general industry (22 per cent), fertilizer (14.8 per cent), transport (7.9 per cent) and commercial (3.2 per cent). At the current pace of consumption, gas deficits could climb to over 3,000 MMCFD in addition to major oil imports, which could pose energy security risk. There is a dire need to increase exploration and development activities to meet the growing needs of various sectors of the economy.

Coal is a cheap fuel for power generation compared to other fuels. Despite huge reserves of 186 billion tonnes, the consumption and exploitation of domestic coal has been negligible. Out of the total consumption of 6.88 million tonnes coal, cement industry utilises 56.1 per cent followed by brick kilns, that is, 39.1 per cent. Coal is found in almost all the four provinces. One of the basic hurdles for not developing coal is the use of rudimentary mining methods.

Challenges

The major challenges are:

- Inappropriate wellhead pricing structure of indigenous gas
- Law and order situation hampering the exploration activities
- Shortage of drilling rigs causing low exploration and development possibilities and prospect generation, whereas lack of economies of scale makes the international bidder non-competitive
- Slow exploration activities in off-shore areas due to high cost (The present on-shore exploratory drilling density is about one well per 1,000 square kilometres against the world average of 9.5 wells per 1,000 sq. km.)
- Non-development of dormant gas reserves because of slow evaluation and appraisal process, litigations, low BTU or marginal reserves
- Lack of a proper monitoring system to review the progress on blocks already awarded for exploration
- Highly volatile prices in the international oil market
- Inefficient and obsolete refining operations and sub-standard oil products

Targets

Fuel demand and supply

Demand projections of oil, gas and coal are given below, which are based on an analysis and assessment of various fuel consumption trends. These projections highlight that demand for gas is expected to continue to be higher than other fuels. Similarly, there is an increasing trend for the imported coal, which is substituting the expensive fuels.

Table-2: Demand and supply projections for fuel

| | (MTOE) | | | | |
|---|---------|---------|---------|---------|---------|
| | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
| Oil (including LPG) | 23.86 | 24.6 | 25.51 | 26.23 | 27 |
| Gas | 31.44 | 33.09 | 37.98 | 37.27 | 40.87 |
| Coal | 3.31 | 3.55 | 3.83 | 4.14 | 26.43 |
| Primary energy supply (import + domestic) | 58.61 | 61.24 | 67.32 | 67.64 | 77.16 |
| Imports as % of primary energy supplies | 36.60% | 35.94% | 43.30% | 43.86% | 48.64% |

Source: Planning Commission

In the context of heavy reliance on the gas supplies in the overall energy mix, the indigenous resource sustainability is questionable. At the current rate of production and consumption of gas, it will last only for about 17 years if no new discoveries are made in the country. This situation warrants boosting the pace of exploration and development activities of oil and gas. It is projected that the domestic fuel supplies will improve by 2017-18 due to anticipated Thar coal production, which is 10 million tonnes coal per annum.

Table-3: Domestic fuel production

| | (MTOE) | | | | |
|--------------------------------|--------------|--------------|--------------|--------------|--------------|
| | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
| Oil (including LPG) | 4.07 | 4.26 | 4.46 | 4.67 | 4.72 |
| Gas | 31.44 | 33.09 | 31.56 | 30.86 | 30.89 |
| Coal | 1.64 | 1.88 | 2.15 | 2.45 | 12.82 |
| Total indigenous supply | 37.15 | 39.23 | 38.17 | 37.98 | 48.43 |

Imports

Total imports are estimated to rise from 21.45 million TOE in 2014 to 45.87 million TOE by 2018. The higher growth is expected for the natural gas, LNG and coal as shown in the Table 4 below.

Table-4: Fuel imports

| | (MTOE) | | | | |
|----------------------|--------------|--------------|--------------|--------------|--------------|
| Description | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
| Oil (including LPG) | 19.78 | 20.34 | 21.05 | 21.56 | 22.28 |
| Imported LNG | 0 | 0 | 6.42 | 6.42 | 9.98 |
| Coal | 1.67 | 1.67 | 1.68 | 1.69 | 13.61 |
| Total imports | 21.45 | 22.01 | 29.15 | 29.67 | 45.87 |

Strategies and initiatives

Oil and gas exploration

Presently, the conventional exploration for oil and gas is reaching its maturity stage, especially in Sindh and the size of oil and gas discoveries is decreasing. Consequently, the reserves and productions are not being replenished effectively. In order to support the conventional oil and

gas resources, the exploitation of unconventional resources, especially shale oil and gas, is one of the priority areas of the government.

A shale gas study, with the USAID financial assistance of \$1.8 million, has been initiated in January 2014 and is expected to be completed by the end of 2015. The prime objective of the study is to provide basis for formulation of the shale gas policy.

Coal

Thar coal field contains 175 billion tonnes of lignite, which can be utilised for power generation. The Thar Coal Energy Board (TCEB) has been formed by the Sindh government, entrusted with the task of exploring Thar coal for power generation, is a part of the overall power generation plan. During the Plan period, the following initiatives to expedite the exploitation of the Thar coal reserves will be undertaken.

- Block-II: Sindh Engro Coal Mining Company for 600-1000 MW plant by 2017-18
- Block-III: M/s Couger Energy Company to conduct feasibility for underground coal gasification technology for establishment of 400 MW plant
- Block-IV: M/s Bin Dean Group, UAE to conduct feasibility for coal mining and power generation plant of 1,000 MW
- Block-V: Under Ground Coal Gasification Project by the Planning Commission
- Block-VI: Sindh Carbon Energy Limited for feasibility study for 300 MW plant

In addition to above, seven additional blocks in Thar field will be offered for award to interested investors for development of mines and power generation.

LNG import

In order to bridge the existing demand-supply gap of over two BCFD, projected to further increase to 1.4 BCFD by 2017-18, a three-pronged strategy envisaging – incentivising Exploration and Production (E&P) companies for enhanced domestic production, import of gas and LNG, and rationalising economic use of gas in various sectors – will be pursued during the Plan period.

An LNG terminal at the Port Qasim (Karachi) is in place (being developed) by the Engro Elengy Terminal Pakistan (Pvt) Limited. The imported LNG is expected to reach by the end of 2015. The imported LNG will be supplied to major sectors, like power, to mitigate the power shortages.

The Gwadar-Nawabshah LNG Terminal and Pipeline Project envisaging construction of 700 kilometres pipeline from Gwadar to Nawabshah, and installation of LNG regasification terminal at the Gwadar Seaport is also planned.

A project of laying an internal 42-inch diameter gas pipeline to pump the imported RLNG, TAPI and IP gas from South to North (Karachi-Lahore) will also be implemented during the Plan period.

Iran-Pakistan Gas Pipeline Project

This Project aims to bring natural gas from South Pars gas field in Iran to Pakistan. The project includes laying of 42-inch diameter 1,800 km pipeline with design capacity of 750 million cubic

feet of natural gas per day (BCFD) from Iran. 1,150-km long pipeline from the Iranian field to Iran-Pakistan border is being completed by Iran whereas the Pakistani portion of 781 kms is under active consideration for implementation. In spite of difficulties arising from geopolitical complications, the IP project will be accorded special attention and all efforts will be made to commission the project within the Plan period.

Turkmenistan-Afghanistan-Pakistan-India Gas Pipeline Project

The TAPI Project aims to bring natural gas from the Yoloten, Osman and adjacent gas fields in Turkmenistan to Afghanistan, Pakistan and India. The Project, being supported by the Asian Development Bank (ADB), envisages a 56-inch diameter 1,680 kms pipeline with design capacity of 3.2 billion cubic feet of natural gas per annum (BCFD). The first gas flow is planned by the end of 2019.

The TAPI Pipeline Company Limited (TPCL) has already been formed with MD, Interstate Gas System Ltd (ISGSL), as its Chairman. Presently, the feasibility study earlier conducted in 2008 for the project is being reviewed by the ADB.

Fuel sector reform initiatives

The Plan highlights the need to depart from the business-as-usual approach to meet difficult but doable challenges facing the energy sector and to remove impediments for ensuring sustainable energy supplies to the economy. The main recommendations and strategies are:

- The price of gas in various uses and sectors to be gradually adjusted to a level close to the prices of substitute fuels
- Developing human resources for large-scale mining operations at Thar and Lakhra coalfields
- Provincial governments to augment present facilities and establish new ones based on latest technologies
- Special attention will be made to attract investors in the offshore exploration. Director General (Petroleum Concessions), being a focal point, will put all efforts together for enhancing offshore petroleum exploration activities and target at least two wells per year (one each in public and private sector) during the Plan period.
- In order to bring efficiency and competition in gas distribution and marketing, the unbundling of gas distribution system will be examined.

Pakistan is rich in natural energy resources, but unfortunately these have been largely untapped so far. The Plan envisages a comprehensive strategy aiming at exploring and exploiting to make energy affordable for the people of Pakistan. The focus will be on enhancing share of cheap coal resource.

Power sector

Situational analysis

The overall power generation capacity of Pakistan at the end of 2012-13 was 20,849 Mega Watt (MW) on the NTDC system and 2,341 MW on K-Electric. Against this installed capacity, the power generation was 96,122 GWh, which represents 48 per cent average capacity utilisation. Seasonal variation in hydro power generation, de-rated capacity of the public sector generating

units and failure of timely supply of fuels to the IPPs are main causes of low-capacity utilisation. The power generation mix comprises 64 per cent thermal, 31 per cent hydel, 4.7 per cent nuclear and 0.1 per cent coal sources.

The peak demand for electricity in July 2013 was 17,000 MW whereas the total generation of electricity was around 12,000-14,000 MW and the shortfall was around 2,180-5,314 MW during the same period. The shortage of electricity has not only adversely affected social life, but also the national economy as the shortfall in electricity supply results in annual losses of three per cent of the Gross Domestic Product (GDP) and more than 12 per cent to 37 per cent of the industrial output, varying from sector to sector.

Furthermore, the power sector continues to be affected by the circular debt as revenues collected do not fully cover the cost of production due to high Tariff Differential Subsidy (TDS). The debt at the end of 2011 was Rs532 billion, which rose to Rs872 billion in 2012, representing about four per cent of the GDP. The issue has not yet been addressed fully, and it will continue to constrain the sector.

Under-capacity transmission and overloaded distribution networks are causing frequent power outages in main load centres. Due to the technical and administrative pitfalls, there are around 17 per cent transmission and distribution losses. Institutional capacity of the power sector is also being questioned as it has failed to show the desired level of efficiency and improvement in recovering the outstanding dues, cost of service and arrest the transmission and distribution losses.

Challenges

Power sector deficits

Load-shedding is now a common occurrence in Pakistan and it takes place both during peak and off-peak hours. Based on the planned generation schedule and forecast demand, the nationwide deficits will continue until the end of 2017-18. However, the intensity of load-shedding will be reduced approximately by 2000-3000 MW, depending upon the seasonal variation and peak demand hours.

Transmission network

The existing transmission network is sufficient only to evacuate the exiting power generation. However, with an additional power available, the transmission capacity will have to be augmented in accordance with production.

Distribution capacity

The existing distribution capacity of various DISCOs is deficient because these have not been upgraded over a period according to the changing socio-economic needs.

Project financing

Currently, the government is not in a position to provide the required funds for power projects because of its limited fiscal space, and competing needs of social and other sectors. Furthermore, due to high regulatory and security risks, local and international commercial banks offer loans on high interest rates, thus increasing the cost of financing.

Fragmented management and inefficient decision-making

There has been an inadequate focus on implementation of existing energy plans in the short-term and consolidation of energy functions in the medium and the long-term. There are more than 20 organisations engaged in developing electric power projects, for example, WAPDA (Hydroelectric), Pakistan Electric Power Company (PEPCO), the unbundled ex-WAPDA entities, Private Power Infrastructure Board (PPIB), the Alternative Energy Development Board (AEDB), Thar Coal and Energy Board, the Infrastructure Project Development Facility (IPDF) and provincial energy departments. All these entities are working on policies, but there is little or no coordination or institutional cooperation among these to formulate unified energy policy or act in unison.

Untargeted tariff subsidies

Historically, the power sector has had increasing block tariffs whereby each consumer class was getting the advantage of all the previous slabs, which meant more than half of the subsidy was allocated to consumers with consumption of more than 100 kWh. Poor consumers, also known as lifeline consumers, were benefiting the least from the subsidy because it applies to all strata of the society equally irrespective of their incomes.

Inefficient regulatory framework

There is a lack of uniform regulation, which creates distortions between the gas and electricity sectors. Inconsistent regulation between the National Electric Power Regulatory Authority (NEPRA) and Oil and Gas Regulatory Authority (OGRA) has created disharmony in pricing strategies between gas and electricity, while sending unclear signals to the potential investors of the energy sector. Moreover, operational directives from the government, overriding decisions of these regulatory authorities, have undermined their independence. Both regulatory entities also suffer from a dearth of professional capacity to properly exercise its monitoring functions to monitor operational efficiency and quality of service standards.

Circular debt

The issue of circular debt has brought considerable burden on the national exchequer, crippling most of the energy sector entities. Poor collection by the DISCOs is one of the largest contributors to the power sector's circular debt. In 2013, the average collection rate was 80 per cent as some DISCOs reported collection rate as low as 33 per cent (QESCO). Moreover, on average the DISCOs are incurring Aggregate Technical and Commercial (AT&C) losses over and above the percentage allowed by the NEPRA, thus adding to the circular debt.

Tariff differential subsidy is another significant contributor to the circular debt as the uniform rate is charged across all DISCOs despite differences in the cost of supplying electricity. The government has frozen tariffs between 2003 and 2007 at a very low level. Subsequent tariff increases did not make up for the shortfall, while crude oil and gas prices globally hiked. Between 2004 and 2008, the price of imported furnace oil, which represents about one-third of the fuel mix for power generation, increased by 76 per cent. Gas prices also saw a hike of 76 per cent between 2007 and 2008. The cost of electricity generation consequently increased with the result that notified tariffs were not able to cover the higher cost. The cost of the electricity subsidy was computed as Rs225 billion¹ in 2013. This represents a significant burden on the national exchequer, making the government unable to pay the amount to the DISCOs on time.

¹ Tariff Subsidy Cell of MOWP

Targets

Electricity demand projections

The projected electricity demand will be 31,039 MW by the end of the Plan period. The following table presents forecasts of power generation required to meet demand for both the NTDC system and KESC.

Table-6: Projected demand

| | Unit | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|---------------------|-----------|---------------|---------------|---------------|---------------|---------------|
| NTDC System | MW | 20,836 | 21,924 | 23,213 | 24,762 | 26,530 |
| KE(SC) | MW | 3,397 | 3,582 | 3,809 | 4,092 | 4,509 |
| Total Demand | MW | 24,233 | 25,505 | 27,022 | 28,855 | 31,039 |

Source: Power Market Survey, NTDC

For DISCO-wise details, Annexure C is attached.

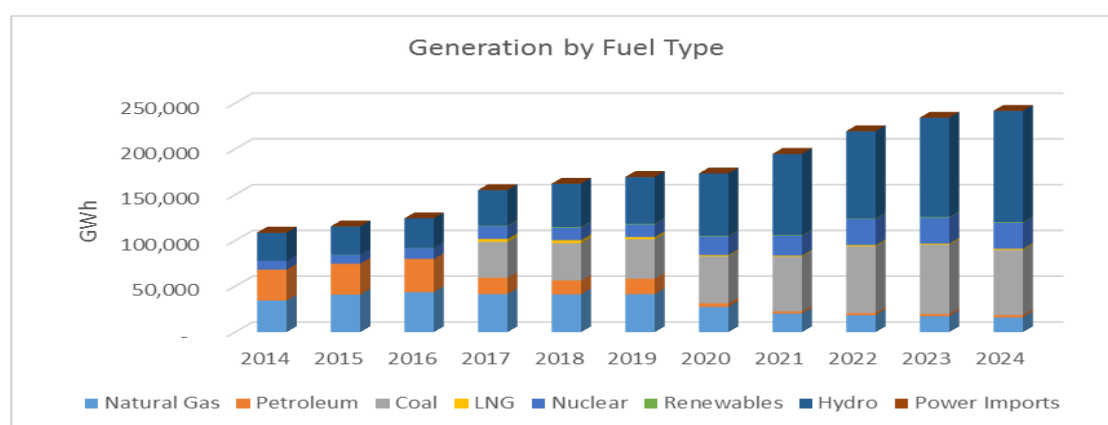
Table 7 gives the planned increase in installed capacity from 2013-14 to 2017-18. If the planned investments go according to schedule, the operating capacity will rise from almost 20,849 MW at the end of 2013-14 to 37,272 MW by the end of 2018 keeping in view the affordability and early commission of plants, the new addition of power from Hydel, LNG and Coal based plants.

Table-7: Generation capacity (MW) by 2017-18

| | Nuclear | Hydel | Solar/ Wind | Oil | Gas | Coal | Total | Cumulative |
|---------------|--------------|---------------|--------------|--------------|---------------|--------------|---------------|------------|
| Existing | 650 | 6,928 | 50 | 3,896 | 9,175 | 150 | 20,849 | 20,849 |
| Addition | | | | | | | | |
| 2015 | - | - | 250 | 425 | - | - | 675 | 21,524 |
| 2016 | 340 | - | 680 | - | - | - | 1,020 | 22,544 |
| 2017 | 340 | 2,526 | 1,720 | - | 2,400 | - | 6,986 | 29,530 |
| 2018 | - | 1,522 | - | - | 1,300 | 4,920 | 7,742 | 37,272 |
| Total: | 1,330 | 10,976 | 2,700 | 4,321 | 12,875 | 5,070 | 37,272 | |

Figure 2 presents the addition in generation capacity by fuel type. As seen from the table, most of the investments in the next 10 years are going to be in coal and hydro.

Figure-2 Generation by type



A complete list of the upcoming plant-wise generation projects and is given in Annexure-A.

Transmission expansion plan

During the Plan period, 31 new transmission projects will be undertaken by the NTDC. This will augment their present transmission capacity of 39,641 to 77,451 MVA. The table below summarises the planned addition in transmission capacity through augmentation of substations and transmission lines.

Table-8: NTDC planned capacity expansion (Cumulative)

| Year | 500 kV | | 200kV | | Total | |
|---------|----------|--------------|----------|--------------|------------------------|--------------|
| | Addition | Capacity MVA | Addition | Capacity MVA | Total period additions | Capacity MVA |
| 2013-14 | 3,150 | 18,000 | 6,277 | 21,641 | 9,427 | 39,641 |
| 2014-15 | 4,200 | 22,200 | 7,130 | 28,771 | 11,330 | 50,971 |
| 2015-16 | 1,050 | 23,250 | 3,000 | 31,771 | 4,050 | 55,021 |
| 2016-17 | 4,375 | 27,625 | 3,840 | 35,611 | 8,215 | 63,236 |
| 2017-18 | 4,375 | 32,000 | 3,840 | 39,451 | 8,215 | 71,451 |

Source: NTDC

Table-9: NTDC planned transmission line expansion

| Year | 500 kV Tls | | 220 kV Tls | | Total Tls | |
|---------|-------------|----------|-------------|----------|-------------|----------------|
| | Circuit kms | Addition | Circuit kms | Addition | Circuit kms | Total addition |
| 2013-14 | 5,180 | 103 | 9,104 | 1,738 | 14,284 | 1,841 |
| 2014-15 | 5,729 | 549 | 9,791 | 687 | 15,520 | 1,236 |
| 2015-16 | 6,595 | 866 | 10,218 | 427 | 16,813 | 1,293 |
| 2016-17 | 8,760 | 2,165 | 10,780 | 562 | 21,705 | 4,892 |
| 2017-18 | 10,925 | 2,165 | 11,342 | 600 | 26,597 | 4,892 |

Source: NTDC

Strategies and initiatives

Affordable energy for all

To make the energy affordable, generation mix is being improved by adding coal and hydro-based generations. Further, gas-based highly efficient plants have been planned in the coming years.

On-Grid projects

Keeping in view the potential of alternate energy in Pakistan, the working group on the Alternate Renewable Energy (ARE) have recommended that the overall integrated energy plan will target to commission at least 5,695 MW of power (up above current installed capacity of 341 MW) through alternative and renewable energies by 2018 under the Plan.

Alternate energy and conservation

To deal with the ongoing energy crisis, the government is taking all possible measures to ensure energy security and development in the country. The Vision 2025 strategises fast track development of renewable energy resources in order to diversify country's energy mix and reduce import dependence.

Solar power is already competitive vis-à-vis diesel-based captive power generation. Irrigation pumps are being converted to solar under both private and public investments. Rooftop electricity generation, both in residential as well as industrial and commercial sectors, will become significant after 2020. This will reduce demand of central generation and reduce load on transmission and distribution network.

Energy efficiency

Promoting energy efficiency and conservation occupies an important role in the Plan as saving and conserving one watt of energy is more valuable than producing two watt. Taking simple and sensible steps to ensure energy efficiency and conservation have been categorised as ‘triple win’ as (i) it saves money, (ii) reduces energy demand and (iii) curbs CO₂ emissions. The Vision lays special emphasis on energy efficiency and conservation.

Realising the importance of energy efficiency and conservation, all key stakeholders have been taken on board, and the following steps have been taken to ensure energy efficiency and conservation:

- Proposal to encourage use of energy efficient air conditioners
- Proposal to encourage use of energy efficient lights, that is, LEDs
- Encouragement of solar water heaters
- A target of saving 1,000 MW through conservation during the Plan period
- Improvement in transmission and distribution

The DISCOs will have to enhance their capacity and are required to prepare their respective distribution as well as performance improvement plans to smooth distribution of additional generation to the end consumers. In order to upgrade and expand the distribution network of Discos, the World Bank is financing a programme under the sixth transmission and grids improvement of all the Discos. Tranche-II for power distribution enhancement project has also been approved.

International cooperation

Under the China-Pakistan Economic Corridor (CPEC), China, being a key economic partner of Pakistan, has offered to collaborate on a number of economic projects, including power generation. During the Plan period, one of the major steps will be to start 21 power sector projects with a cumulative installed capacity of 17,000 MW, which will be carried out at a total cost of \$32.293 billion. The projects, being actively promoted under the CPEC, include seven projects having a total capacity of 6,645 MW with an estimated total cost of \$16.787 billion.

Besides funding from international financial development institutions, such as the World Bank and ADB, economic assistance from friendly countries like USA, Japan, Germany, France and Gulf countries is being lined up, which is estimated at Rs3,927 billion including Rs2,280 billion Foreign Project Assistance (FPA) in shape of loans and grants. Notably, the ADB is financing 1,200 MW coal-fired power plant at Jamshoro. Other projects include upgradation of the Transmission Grid Systems.

The ADB is also supporting in conducting the studies of coal conversion of the FO and Gas-based Thermal Power Plants and establishment of new hydel projects. China is engaged in construction of nuclear power stations at Karachi C-II and C-III for 2,200 MW.

The USAID is funding construction and rehabilitation of the Gomal Zam Dam, Satpara Dam, Mangla Dam, Kaitu Weir, and Tarbela Dam and the modernisation of Guddu, Jamshoro, and Muzaffargarh power plants. In addition, the Overseas Private Investment Corporation (OPIC) is facilitating the private sector investment in a number of wind projects to provide up to 250 megawatts of clean, renewable, grid-connected power.

Power sector reform initiatives

Undertaking reforms in the energy sector is fundamental for improving efficiency of the sector and creating the enabling environment required to attract private sector investment. The planned reform initiatives for implementation during the Plan period are summarised below:

Policy reforms

- Subsidy reforms – Adopting a balanced approach to tariff hikes and government subsidies
- Prioritising the recovery of dues from problem areas
- Improving performance of the distribution companies by signing performance contracts between the Ministry of Water and Power (MoW&P) and government-owned entities including GENCOs, NTDC and DISCOs², installing smart meters to monitor power theft, and offering differential tariffs to consumers willing to pay more for uninterrupted and high quality supply

Privatisation of the GENCOs and DISCOs – Due to problems of circular debt and financial constraints, the government has invited proposals from private investors to undertake necessary investments in these loss making entities, and to control management and operations.

Open access: During the next five years, the power sector will show transition from a single buyer market to a multi-buyer market by allowing power producers to directly sell to bulk consumers and DISCOs; thereby reducing and eliminating role of the CPPA and distribution companies.

Regulatory reforms

Considering prevailing challenges, the government has chalked out a detailed energy reform agenda. The proposal includes consideration of merger of the NEPRA and OGRA, establishment of the Energy Appellate Tribunals to avoid costly and delaying litigation, formulation of Regulatory Advisory Committees (RACs) to provide an institutional mechanism to elicit response and inputs of the stakeholders. It also proposes reorganisation of the NEPRA and OGRA along professional lines, tariff-setting reforms in the regulatory process by building technical capacity, and unbundling of gas sector to improve and ensure visibility of their performance. Other

² The objective of these Performance Contracts is to monitor and evaluate the performance of these entities on the basis of key performance indicators which have been developed after consultation with the relevant stakeholders. These performance contracts will make it a binding upon these entities to take measures to improve their performance.

proposals include standardisation of the Wheeling Contracts in both electrical and gas sector, time based Whole-sale Tariff for DISCOs and regional and DISCO-wise quotas of electricity

Addressing circular debt and subsidy

The government plans to eliminate circular debt through rationalisation of tariffs and pursuing a comprehensive energy sector reform agenda. The tariff reform includes the following:

- Determination of base revenue requirements on the principle of full cost recovery for all DISCOs for each fiscal year
- Allowing only technical line losses for assessing revenue requirements of the DISCOs
- Retail tariff for all DISCOs to be identical, that is, consumers of a particular category to pay the same retail tariff irrespective of their geographical location
- Rationalisation of the domestic sector tariffs by eliminating subsidy for high-end users
- Offering guaranteed uninterrupted supply to industrial users at a 50 per cent premium
- Implementation of a national plan to improve tariff collections (with necessary legislation for penalties)
- Implementation of programmes for loss reduction, improvement of monitoring system, pilot scale smart grid, demand management, improved metering and other initiatives for efficiency improvement

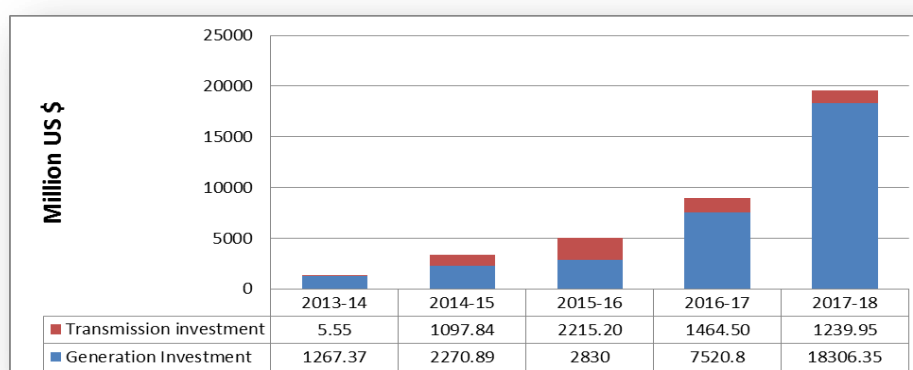
Integrated energy modelling initiatives

Considering the diverse nature of Pakistan's energy mix and its peculiar nature of challenges, importance of an integrated energy modelling and planning mechanism has been realised. A proper modelling-based integrated energy plan review and mid-course modification, therefore, will be ensured during the Plan period.

Financial outlay

The annual investments required for the planned power generation and transmission projects are given in Figure 3. The total investment requirement is estimated at \$38,215 million out of which \$6,022 million will be spent on transmission, and the remaining \$32,193 million on distribution.

Figure 3: Investment requirements for generation and transmission



A practical and sustainable planning process entails thinking ahead, thinking across and thinking again. The Plan endeavours to do the same by looking at the energy sector holistically and formulating strategies for ensuring future energy security of the country. By 2017-18, the nationwide peak shortage of power will be reduced to the range of 2,500-3000 MW, assuming timely completion of the projects in pipeline. Hydro and coal are projected to be the work-horses of the electrical sector as 90 per cent of the planned additions are based on these sources. Due to induction of cheap coal into the energy-mix (Annexure D), average cost of generating electricity is projected to come down, providing relief to the consumers and easing strain on the national exchequer. In the short-to-medium term, the LNG will fill some of the demand. The efficiency improvements in the transmission and distribution sectors are going to alleviate the circular debt issue.

Annexure-A

Summary of generation addition

| Sr. No. | Fiscal Year | Names of projects | Agency | Fuel | Location | Installed capacity (MW) |
|--|-------------|-----------------------------------|--------|---------|-------------------------------------|-------------------------|
| 1 | 2014-15 | Quaid-e-Azam Solar Park (Phase-1) | PPDB | Solar | Lal Sohnra (Cholistan), Punjab | 100 |
| 2 | | FWEL-I | AEDB | Wind | Jhampir/Gharo/Bhambore, Sindh | 150 |
| 3 | | Nandipur (Remaining Unit-CC) | GENCO | RFO | Gujranwala, Punjab | 425 |
| Total generation addition in 2014-15 | | | | | | 675 |
| 4 | 2015-16 | Sapphire Wind Power Plant | AEDB | Wind | Jhampir/Gharo/Bhambore, Sindh | 50 |
| 5 | | CHASNUPP-III | PAEC | Nuclear | Chashma, KPK | 340 |
| 6 | | Other Wind Power Plants | AEDB | Wind | Jhampir/Gharo/Bhambore, Sindh | 330 |
| 7 | | Quaid-e-Azam Solar Park (Phase-2) | PPDB | Solar | Lal Sohnra (Cholistan), Punjab | 300 |
| Total generation addition in 2015-16 | | | | | | 1,020 |
| 8 | 2016-17 | Other Wind Power Plants | AEDB | Wind | Jhampir/Gharo/Bhambore, Sindh | 1,120 |
| 9 | | Neelum Jhelum Hydel | WAPDA | Hydel | Nauseri/Muzaffarabad, AJK | 969 |
| 10 | | CHASHNUPP-IV | PAEC | Nucl | Chashma, KPK | 340 |
| 11 | | Tarbela 4th Ext. Project | WAPDA | Hydel | Tarbela, KPK | 1,410 |
| 12 | | Patrind HPP | PPIB | Hydel | Kunhar River, KPK/AJK | 147 |
| 13 | | LNG Based Plants (Phase-I) | PPIB | LNG | Bhikki and Baloki, Punjab | 2,400 |
| 14 | | Quaid-e-Azam Solar Park (Phase-3) | PPDB | Solar | Lal Sohnra (Cholistan), Punjab | 600 |
| Total generation addition in 2016-17 | | | | | | 6,986 |
| 15 | 2017-18 | Keyal Khwar | WAPDA | Hydel | Dasu District, KPK | 122 |
| 16 | | Coal Plant at Sahiwal | PPDB | Coal | Sahiwal, Punjab | 1,320 |
| 17 | | Port Qasim Power Plant | PPIB | Coal | Port Qasim Karachi, Sindh | 1,320 |
| 18 | | Engro Thar Coal (unit-1) | PPIB | Coal | Thar, Sindh | 330 |
| 19 | | Nooriabad Gas Plant | GoS | Gas | Nooriabad, Sindh | 100 |
| 20 | | Engro Thar Coal (unit-2) | PPIB | Coal | Thar, Sindh | 330 |
| 21 | | LNG Based Plants (Phase-II) | PPIB | LNG | Haveli Bahadur Shah (Jhang), Punjab | 1,200 |
| 22 | | Coal Plant at Salt Range | PPDB | Coal | Salt Range, Punjab | 300 |
| 23 | | Tarbela 5th Ext. Project | WAPDA | Hydel | Tarbela, KPK | 1,400 |
| 24 | | SSRL | TCEB | Coal | Thar, Sindh | 1,320 |
| Total generation addition in 2017-18 | | | | | | 7,742 |
| 25 | 2018-19 | Golen Gol HPP | WAPDA | Hydel | Chitral, KPK | 106 |
| 26 | | HUB Power Company Ltd. | PPIB | Coal | HUB, Baluchistan | 1,320 |
| 27 | | Siddiqsons Limited | TCEB | Coal | Port Qasim, Sindh | 350 |
| 28 | | Lucky Electric Power Company Ltd. | TCEB | Coal | Port Qasim, Sindh | 660 |
| 29 | | Grange Holding | PPIB | Coal | Arifwala, Punjab | 163 |
| 30 | | Gulpur Poonch river | PPIB | Hydel | Poonch River/Gulpur, AJK | 100 |
| Total generation addition in 2018-19 | | | | | | 2,699 |
| Total addition during the Plan period | | | | | | 19,122 |

Source: NTDC

Annexure-B

Power transmission plan

| Sr. No. | 500 kV transmission line/ 500/220 kV transformer description | Expected Year of Commissioning |
|---------|--|--------------------------------|
| 1 | Extension at Ghazi Brotha, 2nd 500/220 kV T/F | 2013-14 |
| 2 | Augmentation of 1x450 MVA T/F with 1x750 MVA capacity at Rawat 5 00 kV G/S | 2013-14 |
| 3 | Guddu – Multan 2 nd circuit In/Out at Dera Ghazi Khan | 2013-14 |
| 4 | Guddu – Multan 3rd Circuit In/Out at Rahim Yar Khan | 2013-14 |
| 5 | Guddu – R.Y. Khan single circuit In/Out at Guddu New Power Plant | 2014-15 |
| 6 | Guddu New Power Plant – M. Garh | 2014-15 |
| 7 | D.G. Khan – Multan circuit In/Out at M. Garh | 2014-15 |
| 8 | Guddu – Dadu 1st circuit In/Out at Shikarpur New | 2014-15 |
| 9 | Guddu – Dadu 2 nd circuit In/Out at Shikarpur New | 2014-15 |
| 10 | Sahiwal – Lahore single circuit In/Out at Lahore New | 2015-16 |
| 11 | Gujranwala – Lahore single circuit In/Out at Lahore New | 2015-16 |
| 12 | Neelum Jhelum HPP - Gakkhar (Gujranwala) | 2015-16 |
| 13 | M. Garh – Gatti circuit In/Out at Faisalabad West | 2016-17 |
| 14 | Multan – Gatti circuit In/Out at Faisalabad West | 2016-17 |
| 15 | Augmentation of 3x237 MVA T/Fs with 3x450 MVA capacity at Tarbela 500 kV G/S | 2016-17 |
| 16 | EngroThar Coal – Matiari | 2017-18 |
| 17 | Gaddani – Gaddani Power Park | 2017-18 |
| 18 | Gaddani – Matiari | 2017-18 |
| 19 | Gaddani – Khuzdar | 2017-18 |
| 20 | Quetta – Khuzdar | 2017-18 |
| 21 | HUBCO – Jamshoro circuit In/Out at Gaddani | 2017-18 |
| 22 | Faisalabad West –Ludewala | 2017-18 |
| 23 | Ludewala –Peshawar New | 2017-18 |
| 24 | Lahore South – Lahore North | 2017-18 |
| 25 | Lahore North – Gujranwala | 2017-18 |
| 26 | ±600 kV HVDC Bi-pole from Gaddani – Faisalabad West ± 600 kV HVDC Bi-pole from Gaddani – Lahore South | 2017-18 |
| 27 | Bin Qasim Coal Power Plant – Matiari | 2017-18 |
| 28 | Jamshoro – Moro | 2017-18 |
| 29 | Dadu – Moro | 2017-18 |
| 30 | Moro – R.Y. Khan | 2017-18 |

220 kV Transmission expansion plan

| Sr. No. | 220 kV Transmission Line/ 220/132 kV Transformer Description | Expected Year of Commissioning |
|---------|--|-----------------------------------|
| 1 | Gatti– K.S.K D/C In/Out at Bandala New | 2013-14 (T/L commissioned) |
| 2 | Foundation Power (Dharki) IPP – Rohri New D/C | 2013-14 |
| 3 | Foundation Power (Dharki) IPP – Rohri New D/C at Engro IPP | (T/Ls commissioned) |
| 4 | Rohri New – Shikarpur | |
| 5 | Ravi/K.S.K – Ghazi Raod D/C In/Out at Shalamar | 2013-14 |
| 6 | Multan – Samundri Rd D/C In/Out at T.T. Singh | 2013-14 |
| 7 | Vehari – Yousafwala D/C In/Out at Kassowal | 2013-14 (T/L commissioned) |
| 8 | Augmentation of 4x 160 MVA T/F with 4x250 MVA capacity at Sheikh Muhammadi 500 kV G/S | 2013-14 |
| 9 | Augmentation of 2 x 160 MVA T/F with 2x250 MVA capacity at Mardan 220 kV G/S | 2013-14 |
| 10 | Augmentation of 4 x 160 MVA T/F with 4x250 MVA capacity at Burhan 220 kV G/S | 2013-14 |
| 11 | Augmentation of 4x 160 MVA T/F with 4x250 MVA capacity at Bund Road 220 kV G/S | 2013-14 |
| 12 | Vehari – Chistian New | 2013-14 |
| 13 | Augmentation of 2 x 160 MVA T/F with 2x250 MVA capacity at Bahawalpur 220 kV G/S | 2013-14 |
| 14 | Augmentation of 2 x 160 MVA T/F with 2x250 MVA capacity at Quetta Industrial 220 kV G/S | 2013-14 |
| 15 | Dadu – Khuzdar | 2013-14 |
| 16 | D.G. Khan – Loralai | 2013-14 |
| 17 | Uch – Guddu S/C In/Out at D.M. Jamali | 2014-15 |
| 18 | Mangla – Gujranwala S/C & Mangla – Gakkhar S/C In/Out at Gujrat | 2014-15 |
| 19 | Uch I – Guddu S/C In/Out at Shikarpur New | 2014-15 |
| 20 | Augmentation of 2 x 160 MVA T/Fs with 2x250 MVA capacity and Extension of 1x250MVA at Rewat 500 kV G/S | 2014-15 |
| 21 | K.S. Kaku – Ravi S/C In/Out at Ghazi Road + N. Kotlakhpat – Sarfraznagar S/C In/Out at Ghazi Road | 2015-16 |
| 22 | Kot Lakhpat New – WapdaTown S/C In/Out at Lahore New | 2015-16 |
| 23 | Kot Lakhpat New – Ghazi Road S/C In/Out at Lahore New | 2015-16 |
| 24 | Uch II – Sibbi | 2015-16 |
| 25 | AllaiKhwar – ISPR double circuit In/Out at Mansehra | 2015-16 |
| 26 | G.Brotha – Shahibagh D/C In/Out at Nowshera Ind. | 2015-16 |
| 27 | In & Out of C1/C-2 – Ludewala S/C at D.I. Khan | 2015-16 |
| 28 | Gatti – Ludewala D/C In/Out at Lalian New. | 2015-16 |
| 29 | Hala Road – T.M. Khan Road | 2015-16 |
| 30 | Reconductoring of 220 kV Tarbela – ISPR D/C on twin bundled Rail conductor | 2015-16 |
| 31 | Reconductoring of 220 kV Tarbela – Burhan D/C on twin bundled Rail conductor | 2015-16 |
| 32 | In & Out of Manshera – ISPR S/C at Islamabad University | 2015-16 |
| 33 | Jhimpir – T.M. Khan Road | 2016-17 |
| 34 | Jhimpir – Garho | 2016-17 |
| 35 | Hala Road – T.M.Khan Road S/C In/Out at MirpurKhas New. | 2016-17 |
| 36 | Mardan – ShahiBagh New S/C In/Out at Chakdara New | 2016-17 |
| 37 | Mangla – Rewat S/C In/Out at Chakwal New | 2016-17 |
| 38 | Faisalabad West – T.T. Singh | 2016-17 |
| 39 | Faisalabad West – Lalian New | 2016-17 |
| 40 | Shadman – Bund Road | 2016-17 |
| 41 | In & Out of D.I.Khan – Ludewala S/C at C-3 | 2016-17 |
| 42 | Sibbi – Mastung | 2016-17 |
| 43 | C-3/C-4 to Bannu | 2017-18 |

Table-8: Demand projection DISCO-wise (MW)

| Year | LESCO | GEPSCO | FESCO | IESCO | MEPCO | PESCO | HESCO | QESCO | TESCO | SEPCO | TOTAL* |
|---------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 2013-14 | 4,148 | 2,004 | 2,500 | 2,072 | 3,178 | 2,666 | 1,251 | 1,399 | 662 | 956 | 20,836 |
| 2014-15 | 4,364 | 2,109 | 2,631 | 2,180 | 3,344 | 2,805 | 1,316 | 1,472 | 697 | 1,006 | 21,924 |
| 2015-16 | 4,621 | 2,233 | 2,786 | 2,308 | 3,540 | 2,970 | 1,394 | 1,559 | 738 | 1,065 | 23,213 |
| 2016-17 | 4,930 | 2,382 | 2,972 | 2,462 | 3,777 | 3,168 | 1,487 | 1,663 | 787 | 1,136 | 24,762 |
| 2017-18 | 5,281 | 2,552 | 3,184 | 2,638 | 4,046 | 3,395 | 1,593 | 1,781 | 843 | 1,217 | 26,530 |

Annexure-D

Power generation mix

| Description | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
|-------------------------------|---------------|----|---------------|----|---------------|----|---------------|----|---------------|----|
| | MW | % | MW | % | MW | % | MW | % | MW | % |
| Hydel | 7,097 | 29 | 7,097 | 27 | 7,097 | 26 | 9,809 | 32 | 10,163 | 24 |
| Oil | 8,417 | 34 | 8,842 | 34 | 8,842 | 33 | 8,842 | 29 | 8,842 | 21 |
| Gas | 7,757 | 32 | 8,068 | 31 | 8,068 | 30 | 8,068 | 26 | 8,068 | 19 |
| Coal | 150 | 1 | 150 | 1 | 150 | 1 | 250 | 1 | 10,480 | 25 |
| Nuclear | 802 | 3 | 802 | 3 | 802 | 3 | 1,142 | 4 | 1,482 | 4 |
| Renewable | 206 | 1 | 986 | 4 | 2,236 | 8 | 2,827 | 9 | 2,877 | 7 |
| Total power generation | 24,429 | | 25,945 | | 27,195 | | 30,938 | | 41,912 | |