ix) Energy Conservation & Energy Efficiency

x) Environmental Issues

xi) Skill building and Human Resource Development

xii) Coordinated Development

xiii) Creation of Electric Vehicle Charging Infrastructure

xiv) Make in India initiative and Aatmanirbhar Bharat Abhiyan

xv) Disaster Risk Reduction

These areas are further elaborated in the following paragraphs.

5.0 OPTIMAL GENERATION MIX

5.1 The installed capacity in the country as on 31.03.2020is about 3,70,106 MW, including about 87,028MW (as on 31.03.2020) of renewable sources of energy, which comprises of 37,694 MW wind, 34,628MW solar,9,875MW biomass power(co-generation),148 MW Waste to Energy and 4,683 MW small hydro and contributes about 19% of the total installed capacity. Currently there is about 75 GW of captive generating capacity in the country. While there has been an appreciable increase in total installed capacity, the share of hydro generating capacity has reduced from 26.12% in March 2005 to 12.35% in March2020.

5.2 Adequate hydro capacity with storage or pondage including pumped storage hydro power plants /combined cycle power plants, battery storage and other emerging technologies such as Hydrogen Storage, which are capable of relatively quick ramp up and ramp down and store energy with higher efficiency for long duration, are options for meeting the peak demand in the country in an efficient manner. In future, coal based stations may have to resort to two shift operation and may have to be operated at reduced generation levels to provide flexibility to cope with variable generation from renewable energy sources. Further, to make the existing coal based plants more flexible, retrofitting of existing coal based stations and combined cycle gas stations, coupled with adoption of suitable operating practices may be explored to achieve higher degree of flexibility.

5.3 Differential tariffs between peak and off-peak hours for consumers and generating stations by CERC/SERCs, as envisaged in the Tariff Policy, should be introduced expeditiously in order to appreciate the value of peaking power. SERCs need to frame a scheme whereby consumers willing for curtailment in their demand, part or full load, get the benefit of a lower tariff.

5.4A regulatory framework for determination of adequate (national, regional and state level) primary, secondary and tertiary reserves should be developed by CEA so that demand can be met at all the times even with planned outage/tripping of generating

units, variability of generation and fluctuation of load so that the frequency is maintained at the nominal value of 50 Hz.

5.5 Along with an increase in the conventional modes of generation, there has also been a significant rise in installed capacity of renewables. While the total installed capacity through renewables was only about 3,812 MW as on 31.03.2005, the capacity has since increased to about 87,027.68 MW as on 31.03.2020. Government has set a target of 1,75,000 MW of generation capacity from renewables by the year 2022.In order to meet the variable generation from renewable energy sources, the long-term requirement of Balancing Capacity should be assessed periodically by CEA in consultation with various stakeholders. Based on the requirement of Balancing Capacity, pumped storage hydro power plants, open cycle gas power plants/ gas engines, new and viable forms of energy storage technologies need to be encouraged.

THERMAL GENERATION

5.6 While India is committed to add more capacity through non-fossil sources of generation, coal based generation capacity may still be required to be added in the country, as it continues to be the cheapest source of generation, though compliance to stricter environmental norms remain a challenge, particularly for the older stations. Therefore, endeavour should be to adopt the most efficient technology for coal-based power stations available at any point of time. All future coal based plants should only be of super critical/ultra super critical technology or other more efficient technology.

5.7 Adequate coal should be made available to meet the requirements of power plants so that generation capacity is not stranded due to shortage of coal. At the same time, coal based power plants should maintain adequate stocks in power stations to meet day to day and seasonal fluctuations of demand since coal cannot be transported instantaneously. In the past, there have been cases where shortages in coal supply and quality of indigenous coal have been constraints for generating plants. However, with the efforts made by the Government, coal shortages have been eliminated. To address concerns regarding quality of coal, third party sampling of coal has been started at loading as well as at receipt end. To reduce the margin of error in sampling, automated coal sampling and on-line quality control measurements should be encouraged.

5.8 India has the 4th largest reserves of coal in the world but still we are importing coal and thus, loosing huge amount of foreign exchange. The domestic coal production has also been augmented to fully meet the demand of power sector. Therefore, there is need to minimize use of imported coal in the power stations.

5.9 Use of natural gas as a fuel for power generation would depend upon its availability at reasonable prices. At present, about 6.74% of total installed capacity is through gas based plants and the average PLF of such plants is about 22.15% only

because of less availability of domestic gas and high landed cost of imported Re-gassified Liquefied Natural Gas. The possibility of utilizing the existing gas turbine/combined cycle gas based capacities for peaking or balancing may be explored. To facilitate this, wherever possible, the supply of gas should be made flexible with respect to time, depending on requirements, instead of constant flow. These gas stations should be compensated for reduction of efficiency and increased wear and tear due to fluctuations in generation.

HYDRO GENERATION

5.10 The share of hydro power in the country has been steadily on the decline after touching the maximum in early 1960s. Despite the fact that India has been endowed with large hydro power potential of about 1,50,000 MW, its growth has remained sluggish in the country and only about 36% of the identified potential has been developed. Though one-third of the hydro potential lies in the North-Eastern region, only 6.90% of the potential has been developed so far.

5.11 Delay in the construction of hydro projects is primarily due to the reasons like delays in environment and forest clearances, settlement of rehabilitation &resettlement issues, resolutions of inter-state issues, land acquisition, inadequate infrastructural facilities at hydro potential sites, law &order / local issues, funds constraint and contractual issues etc. causing significant time and cost overruns thereby impacting their commercial viability. Geological surprises are major contributors for delay in implementation of hydro projects. Efforts should be made to reduce geological surprise through advanced technological tools. Proper implementation of the National Policy on Rehabilitation and Resettlement (R&R) would be essential so as to ensure that concerns of project affected families are addressed adequately. For faster resolution of disputes with contractors, thereby reducing time and cost overruns, there is need to develop model contract document for award of work in hydro projects.

5.12 In light of the ambitious plan of the Government for large scale capacity addition from renewable energy sources in the coming years there would be need for huge balancing power for smooth integration of renewables in the system and for grid security and stability. Special efforts have to be made to promote more storage or pondage based hydro generation units in order to meet the peaking and balancing requirements of the country. In this regard, pumped storage power plants, assume significant importance since they are considered as one of the best sources for renewables integration and for supply of balancing power for grid stabilization. A potential of 96,524 MW of pumped storage capacity has been identified, of which just about 4,785 MW has already been developed so far. Some of the reasons which have impacted the growth of pumped storage plants in the past are continued focus on development of conventional hydro power, non-availability of adequate off-peak power for pumping, lack of differential pricing for peak and off-peak power and relatively costlier tariff vis-à-vis tariff of conventional hydro power. For faster implementation of Pumped Storage Plants, there is need to expeditiously identify and develop Pumped Storage Schemes on existing hydro stations which are likely to be cost effective as well as likely to have lesser environmental issues due to availability of one or both the

reservoirs. Apart from conventional pumped storage schemes on the rivers, 'off the river' PSPs are also now being identified. These off the river PSPs do not involve the issues like optimal development of the river basin or e-flow or inter-state issues, and do not have any complex civil structures like spillways, de-silting chambers etc. associated with conventional stations. As such, these can be accomplished in a relatively shorter time frame. Moreover, these projects, as the name suggests, are located away from the main rivers and as such involve minimal environmental and R&R issues. Further, development of hydro project wherein solar and wind power shall be integrated with stand alone pumped storage schemes, also need to be explored wherever feasible in order to have assured trajectory to power supply.

5.13 The Central Government/ State Government agencies involved in the construction of hydro projects should review their procedures in order to ensure speedy execution of hydro projects. Further, Basin-Wise Cumulative Environment Impact Assessment and Carrying Capacity Study for all the river basins in the country should be carried out expeditiously so that e-flows are known in advance to the project developers and the projects are not delayed on this account.

5.14 The Government of India had introduced the concept of land bank/ forest bank long back. Delay in identification of land for compensatory afforestation especially in the North Eastern States where most of the area is under forest cover is one of the reason for delay in processing of forest clearance. Therefore, creation of land bank should be speeded up by the State governments by developing a suitable mechanism. There is also need for greater facilitation by the State Government in the matters relating to land acquisition, maintenance of law and order etc.

5.15 Some of the measures already announced by the Government such as softer loans of longer duration, grant for enabling infrastructure and storage, pre-agreed tariff profile and Hydro Purchase obligations will help in moderating the tariff for hydro stations and thereby enhancing their viability. Further, for faster implementation of hydro projects in general and to ensure the general competitiveness of hydro power in particular, there is even greater need for tools like Standard Bidding Documents for Hydro Power in medium and long-term etc.

NUCLEAR POWER

5.16 Existing Nuclear Stations in the country are suited for operation as a base load stations. It is also a clean source of energy.The overall tariff of existing nuclear power plants is comparable with that of pithead based thermal power plants. However, tariff of new nuclear plants is projected to be high mainly due to very high capital cost.

5.17 The installed capacity, of nuclear power stations as on 31.3.2020 is about 6,780 MW, which is about 2% of our total installed capacity. Government of India plans to enhance the by 10,000 MW in the next 10 years. In order to ensure materialization of such a large capacity, efforts would have to be made to reduce the capital cost. One of the possible options could be arrangement of Longer-term loans

which would help to reduce the tariff in the initial years. The possibility of flexible operation in the existing nuclear generating stations, to the extent possible, should be explored and the future nuclear stations may be designed for flexible operation. There is also need to move towards two-part tariff consisting of fixed and variable charge.

5.18 Although safety concerns of nuclear power plants have been addressed in the country quite successfully, public engagement in the same would help allay fears to prevent delays in setting up such plants.

RENEWABLE ENERGY SOURCES AND COGENERATION

5.19 There is an urgent need to promote generation of electricity based on renewable energy sources due to its environmental benefits coupled with energy security. Hybrid renewable energy generation like wind-solar, solar-biomass, solar-mini hydel, etc. with or without energy storage system should also be encouraged. Further, hybrid operation of variable renewable source like solar and wind with conventional generation sources and energy storage systems would facilitate self-balanced portfolio with Round-the-clock power supply of acceptable profile.

5.20 All future procurement of power from new and renewable source of energy should be through tariff based competitive bidding, except from Waste to Energy plants which is still at an infant stage in order to reduce the tariff to end consumers. However, exemption to Large Hydro Power Stations from competitive bidding will be subject to conditions laid down in the Tariff Policy.(Should it be covered in Hydro section) Government has already announced vide OM dated 8th March 2019 certain measures which will inter-alia help in rationalization of tariff for Hydro Stations. Waste to Energy plants producing electricity needs hand holding and incentives commensurate with efficiency of the process because such plants free up the landfilling/dumping grounds besides avoiding pollution.

5.21 Tariffs for renewable energy sources like wind and solar power which are dependent on nature for generation are presently energy only tariffs and are thus paid only when energy is drawn by the State Distribution Companies. This gives a perverse incentive for them to not draw this power although it is in the 'must-run' category Tariff of such generators must cover the risk for any curtailment of power by the distribution licensee for reasons other than grid security or transmission constraints. Two-part tariff mechanism may be an option, particularly in case of medium/long-term procurement with hybrid operation of renewable energy source with conventional generation.

5.22 Energy intensive industrial processes such as those occurring at refineries, steel mills, glass furnaces, cement kilns, etc. release considerable amount of heat after doing the useful work in the form of hot exhaust gases. These exhaust gases, if not put into any practical use, get otherwise wasted or dumped into the environment. A system of recovering the waste heat provides efficiency gain, benefits to the concerned industry and benefits to environment. Since waste heat recovery systems

require capital investment, there is a need to give incentives to the industries which implement such systems.

5.23 'Long term growth trajectory of RPOs' for non-solar as well as solar sources has been issued by the Ministry of Power uniformly for all States/UTs up to year 2021-22. Trajectory beyond this period, if required, shall be notified by the Ministry of Power in consultation with MNRE from time to time. Large hydropower projects (with capacity more than 25 MW) shall also be treated as renewable source of energy. The Ministry of Power shall also notify a trajectory for Hydropower Purchase Obligation for a period upto2029-30 and may extend it further, if required.

5.24 In the past it has been seen that the system of Renewable Purchase Obligations (RPOs) supported by REC (Renewable Energy Certificate) mechanism have not worked satisfactorily. However, going forward there may be need for huge and unprecedented investment in the renewable generation. This can be achieved by not only protecting the interest of developers alone but also required to be funded by the end consumer via DISCOMs. There may be need to remove the short-coming of the existing RPO-REC based system and/or supplementing it with market based options. Further, the rapid pace of RE development and falling RE tariffs indicate potential for market-based mechanisms. Market-based options need to be explored, which can help to strike a desired balance between capping investor's price risk while ensuring some exposure to basic market risks of forecasting, scheduling and balancing

5.25 The intermittent renewable sources of electricity are concentrated in certain states. Therefore, power from such states is likely to flow to other states, whereas the host state would be left to bear the variability of generation. There is need to devise a pragmatic mechanism for either sharing of the cost arising due to such variability by entities concerned or sharing such costs on country wise basis. A similar mechanism may be required at intra-state level.

5.26 There are a number of advantages of distributed generation, as most of the energy generated is used at the point of consumption and, therefore, it reduces the requirement of transmission and distribution infrastructure It also helps to reduce congestion and transmission & distribution losses. Therefore, renewable distributed generation such as solar roof top need to be promoted. Central Government is promoting Off-grid solar PV applications through various schemes for use in home lighting systems, street lighting systems, solar power plants, solar pumps etc. One way of promoting solar PV systems, particularly in household applications and small industries is through net metering. The Electricity (Rights of Consumers) Rules, 2020 provide such metering for loads up to 10 kW. State Governments should consider installing solar PV system in office & school building, panchayats and other public service institutions.

MICROGRIDS

5.27 Traditionally, microgrids with distributed generation, have been used to supply electricity in areas where it is not feasible or cost effective to provide electricity to the consumers through the main grid. For example, in India, solar generation based microgrids have been used to electrify some remote villages. The distributed generation sources, should preferably be, renewable sources of energy. Micro grids are increasingly being used in cities or towns, in urban centers, on university or corporate campuses, in hospitals or at data centers having some local renewable energy generation for enhancing the reliability of power supply. Such micro grids may have to be strengthened to enhance reliability of supply and wherever feasible, these should be integrated with the main grid in accordance with the relevant Technical Standards for Connectivity to the Grid notified by the Authority.

5.28 The Discoms, in areas prone to natural disasters, should explore possibility of automatic islanding of the distribution system into multiple micro grids with their own distributed generation during storms/cyclones etc.

5.29 In view of the fact that micro grids are beneficial for the environment, power system and consumers by enabling deployment of greater quantity of renewable energy, creating efficiencies by reducing transmission and distribution losses and ensuring more reliability, respective SERCs/JERCs should make necessary enabling provisions to promote micro grids in the States/ UTs.

RENOVATION & MODERNISATION (R&M)

5.30 Traditionally, Renovation and Modernization of old thermal power stations was being done for achieving higher efficiency level with state of the art technology, life extension, raising the operative capacity with improvements in performance parameters and complying with prevailing environmental norms. Recently, CEA has issued revised guidelines for R&M to facilitate compliance to environmental norms, enhancing flexibility, facilitating biomass firing and lowering water consumption. Before undertaking any renovation and modernization exercise, a proper cost benefit analysis needs to be done to decide whether to undertake renovation and modernization of the stations or to retire it and replace it with a new generating station with more efficient supercritical units of higher size, especially in view of the revised environmental norms introduced in December, 2015by the MOEFCC. Government has, under the National Mission on Enhanced Energy Efficiency (NMEEE), introduced the PAT scheme, to incentivize efficiency improvements including that for thermal power plants. Penalties under PAT scheme would also enable the owners to take a rational economic decision.

5.31 In the case of hydroelectric power plants (HEP), the significance of R&M is even more as civil works, contributing to significant part of capital cost and considered to have a useful life of about 100 years, whereas the Electro-Mechanical (EM) works have a life of about 40 years. Therefore, the life of old HEP can be further extended by about 40 years with operational performance, the same as that of a new HEP, at a cost of about 20-30% of a new HEP. This would also obviate the need for obtaining

various statutory clearances involved in case of new HEPs i.e. Forest & Environment clearances, Resettlement & Rehabilitation (R&R) etc. besides saving a lot of time, as the civil activities take the longest time. Further, there would be no civil/geological surprises in a running plant as could be the case in new HEPs.

5.32 R&M of old wind power plants by replacing them with modern and more efficient wind generating units, results in flexibility of generating power across a higher range of wind speed and thereby generating more power at the same location with high Capacity Utilization factor. The Ministry of New and Renewable Energy, in August 2016 released a Policy for repowering of Wind Power Projects with an objective to promote optimum utilization of wind energy resources by creating a facilitative framework for repowering.

6.0 TRANSMISSION

6.1 According to Section 73 of the Electricity Act 2003, CEA is to formulate short term and perspective plans for development of electricity system. Accordingly, CEA should draw up short term plan for next 5 years and perspective plan for next 10 years period. In doing so, CEA should also coordinate activities of the planning agencies for the optimal utilisation of resources to subserve the interests of the national economy and to provide reliable and affordable electricity in accordance.

6.2 While formulating the perspective plan CEA should consult with all the relevant stakeholders such as Central Transmission Utility(CTU), State Transmission Utilities(STUs), System Operators, generating and distribution companies, industry associations and the State Governments etc. and after assessing the rate of growth in demand as well as the rates of growth of generation in different areas of country.

6.3 The CTU and the STUs should draw up implementation plans for Inter-state (ISTS) and Intra-state (Intra-STS), respectively and for up to next five (5) years period identifying specific transmission projects which are required to be taken up along with their implementation time lines, after considering the plans made by CEA and studying the progress of in generation capacity and demand. Regarding ISTS, CTU should take note of the requests made by inter-state transmission customers, congestion in any part of the ISTS and difficulties in obtaining Right of Way for development of transmission corridors. A similar approach should also be undertaken by STUs for development of the transmission system in their respective states.

6.4 The principle for planning of transmission system should be that prior agreement between buyers and seller of electricity might not be a pre-condition for network expansion. The transmission system should be available as per the requirements of transmission customers and developed matching with growth of generation and load, as far as possible. However, a system for fair compensation should be developed either through back-to-back standard agreements or through