

# Why India needs a National Electricity Council

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*India is the third largest electricity generator in the world after China and USA. India has already committed to its Nationally Determined Contributions submitted to the United Nations Framework Convention on Climate Change for the period 2021–2030, which inter alia, includes a commitment, to achieve about 40% cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030 with the help of technology transfer and low-cost international finance. However, India's power sector is facing several major challenges as it makes a transition to a more environment-friendly energy mix. Since electricity is a concurrent subject as per the Constitution of India, there is an urgent need to create an empowered National Electricity Council (NEC) with pooled sovereignty to realize the goal – 'One Nation-One Grid-One Price'. The proposed NEC will facilitate the evolution of a vibrant and self-sustaining power sector in India in a timely manner.*

**Keywords:** Coal power plants, Electricity (Amendment) Bill, energy and environment, optimal energy mix, stressed assets.

INDIA is the third largest electricity generator in the world after China and USA<sup>1</sup>. The fruits of liberalization of India's power sector from 2003 onwards are now evident<sup>2</sup>, with India's installed power generation capacity (excluding captive generation) increasing by more than 60% from 200 to 327 GW during the Twelfth Five Year Plan, ending March 2017 (ref. 2). India now has a total conventional generation capacity of 270 GW in addition to a renewable power generation capacity of 57 GW. As a result of the record growth in generation capacity during the Twelfth Plan (April 2012–March 2017), the all-India deficit in electricity supply during FY17 reduced to an all-time low of 0.7% while the deficit in meeting the peak demand of 159.5 GW reached a record low of 1.6% (ref. 2). These figures are indeed a great improvement over the all-India deficits of 10% and 11% in FY12 with respect to electricity supply and peak demand respectively<sup>3</sup>. In FY16 (ending March 2016), the per capita electricity consumption in India was 1075 kWh (ref. 2), which was approximately one-fourth that of China, and around one-third of the world average<sup>1,4</sup>. While 44 million rural households in the country are yet to be electrified, various bottlenecks to nationwide rural energy access are being addressed more vigorously today<sup>5</sup>.

In the meantime, India has ratified the Paris Agreement on 2 October 2016 and has submitted its Nationally Determined Contributions (NDCs) to the United Nations Framework Convention on Climate Change (UNFCCC)

for the period 2021–2030 (ref. 6). In its NDCs, India has indicated, 'its intention to achieve about 40% cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030 with the help of transfer of technology and low-cost international finance including from Green Climate Fund'.

In FY17, India's non-fossil fuel-based (i.e. excluding, coal, oil and gas) electricity generation capacity reached a level of 33%, of which electricity generation from Renewable Energy Sources (RES) was estimated to be 82 TWh (billion units), which amounts to 6.6% of the 1242 TWh of electrical energy generated in India<sup>2</sup>. Sixty three per cent of the generation capacity added in the 12th plan (2012–2017) was coal-based<sup>2</sup>. While RES with a combined capacity of 175 GW (33% of the projected total capacity in 2022) are expected to contribute approximately 20% of the electricity generated in India by 2022 (ref. 7), Coal Power Plants (CPPs) are still projected to generate 61% of the total electricity generated in FY27 (down from FY17 level of 76%). This is because, India is the second largest coal producer in the world and has a proven reserve of 95 billion tonnes at the end of 2016 with a reserve to production ratio (defined as the ratio of proven, economically recoverable reserves at the end of any year to the production in that year) of 137 (ref. 1). Therefore, coal will continue to be a major source of electricity in India till 2040 (ref. 8).

While India has adequate generation capacity to meet its electricity demand<sup>9</sup>, the power sector is facing several major challenges, in addition to those linked to DISCOM (Electricity Distribution Company) losses detailed by India's Ministry of Power (MOP)<sup>10</sup>. Since these challenges

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are inter-related, an integrated approach is required to develop a comprehensive, long-term solution.

### Current challenges

#### *Supply–demand mismatch and resulting financial stress*

The Government of India (GoI) has been pursuing various demand-side management and energy efficiency programmes over the last few years. The success of these programmes in the electricity sector coupled with lower than expected growth in industrial demand has led to a reduction of 8.3% in electrical energy generation in FY17 (1242 TWh) as compared to the projected generation in FY17 (1355 TWh) in the 18th Electric Power Survey (EPS) report<sup>11</sup>. More significantly, the actual peak demand of 159.5 GW in FY17 was 20% lower than that projected in the 18th EPS. However, since capacity addition projects taken up during the 12th Plan were developed to meet the demand projections in the 17th and 18th EPS, total generation capacity in India increased by a record 64% (127 GW) during the 12th Five Year Plan (2012–2017). In the 19th EPS report, Central Electricity Authority (CEA) has projected a peak demand of 235 GW and energy requirement of 1566 TWh at the end of FY22 (ref. 12), which is approximately 17% and 15.4% lower than the corresponding projections in the 18th EPS report<sup>11</sup>.

The unprecedented increase in power generation capacity during the 12th Plan coupled with lower than expected growth in power demand during the last five years is responsible for the current supply–demand mismatch in the power sector. This is also reflected in the decline in the plant load factor (PLF) of coal-fired power plants from 77% in FY10 to below the critical level of 60% in FY17 (ref. 2) as well as in the growing financial stress in the power sector<sup>13</sup>. According to a recent study by Prayas, ‘Fixed cost payments to power generators due to backing down are as high as 15% to 35% of the total fixed charges paid to the generators. In Gujarat, such payments are more than three times the agricultural power subsidy, and in other states, they amount to about 40% to 60% of power subsidies by the State Government<sup>14</sup>. Ultimately, all these idling costs due to poor planning by state utilities are borne by consumers in the form of higher tariffs, which then necessitate higher subsidies to provide ‘power for all’.

In Q4 FY17, the utilities sector (largely, power) accounted for 17% (Rs 2.47 trillion) of the total corporate debt (Rs 14.5 trillion) carried by Indian banks<sup>13</sup>. In addition, Rs 1 trillion (Rs 64 equals US\$ 1) of bad loans to India’s power sector is still un-recognized in the accounts of the lenders<sup>13</sup>. The extent of financial stress in this sector is also indicated by the fact that companies whose operating profits were not even adequate to cover

their interest costs in Q4 FY17 formed 70% of the sample of companies surveyed<sup>13</sup>.

#### *Continuing additions to CPP capacity by Government companies*

Considering the ongoing and projected addition to the capacity of RES and conventional power generation, and the projected demand during 2021–22, according to CEA<sup>7</sup>, no coal-based capacity addition is required during 2017–22. However, CPP projects with an aggregate capacity exceeding 50 GW are currently at different stages of construction, and are likely to be commissioned during the period 2017–22 (ref. 7). For example, GoI-controlled National Thermal Power Corporation (NTPC) which generated about 250 TWh of electrical energy (20% of India’s total generation in FY17) is currently executing CPP projects with a combined capacity of 20 GW, which are at various stages of construction<sup>15</sup>. As a matter of prudence, NTPC follows a consistent policy of securing Power Purchase Agreements (PPAs) before approval is given for investment<sup>15</sup>. In addition, NTPC has also executed Tripartite agreements with the RBI and each State Government to have recourse to RBI in case of any default by a state utility<sup>15</sup>. Therefore, NTPC alone will add more than 150 TWh of electrical energy from new CPPs by 2022 (assuming it will be able to maintain its current PLF of 78.6%) on account of its superior operations, competitive tariff, reliability and payment security.

As recently as FY17, Power Finance Corporation (PFC)’s three largest loans (aggregating to Rs 112 billion) were sanctioned to government-controlled CPP projects, while the top three loans granted by PFC to the private sector aggregated to only Rs 11.2 billion, i.e. only 10% of three loans sanctioned to government CPP projects<sup>16</sup>. Incidentally, the top three loans sanctioned by PFC to the private sector were all granted for renewable energy (RE) projects<sup>16</sup>. This indicates the preference of government-owned financial institutions for government-owned CPPs, since they get preferential treatment not only in terms of signing long-term PPAs, but also in terms of tariff fixation. While 18 GW of generation capacity commissioned by Independent Power Producers (IPPs) is languishing without PPAs<sup>17</sup>, several state utilities are also increasing their generation capacity through new CPPs despite the availability of surplus power at lower costs from conventional and new RES within the state as well as outside the state through the national grid.

A case in point is the RES-rich state of Tamil Nadu, which has an installed RES capacity of 10.62 GW on 31 March 2017, constituting 18.5% of the national RES capacity and 36% of the total generation capacity of 29 GW within the state<sup>2</sup>. To cater to a peak demand of 15.4 GW in FY17, the state has signed PPAs for 18 GW of conventional generation capacity in addition to RE

capacity of 9.6 GW, resulting in Tamil Nadu becoming power-surplus<sup>18</sup>. In FY22, the peak demand and gross electrical energy demand in Tamil Nadu are expected to increase to 20.3 GW (15.4 GW in FY17) and 137 TWh (106 TWh in FY17) respectively<sup>19</sup>. However, the state utility, Tamil Nadu Generation and Distribution Corporation (TANGEDCO) and GoI-controlled lignite-based power producer, Neyveli Lignite Corporation (NLC) are currently constructing CPP projects in Tamil Nadu with an aggregate capacity of 5.38 GW which will be commissioned by FY20 (ref. 18). This capacity addition itself is higher than the net increase in peak demand (4.9 GW) by FY22. On top of this, Tamil Nadu will be entitled to a major share of the incremental nuclear power generated within the state<sup>20</sup>.

In addition to drawing from IPPs and state and central generating stations (CGS) within the state, Tamil Nadu is already sourcing electricity from CGS located outside the state through the regional grid<sup>21</sup>, and from IPPs located outside the southern region through the national grid<sup>22</sup>. India's central transmission utility, Power Grid Corporation, has recently increased the inter-regional electricity transfer capacity available to the Southern Region to 9 GW (ref. 23), and is executing projects to double this capacity by 2020 (ref. 20). It is therefore likely that Tamil Nadu will either under-utilize the new CPP capacity of 8.62 GW proposed to be set up within the state<sup>18</sup> thereby leading to higher tariffs inclusive of backing-down charges, or reduce its off take from RES within the state. However, the Rural Electrification Corporation (REC) and PFC, which are both power finance corporations controlled by India's MOP continue to finance new CPP projects in Tamil Nadu<sup>24</sup>. This debt-fuelled growth in CPP capacity will saddle TANGEDCO with additional debt when it can source power from existing and/or under-construction power plants<sup>9</sup> within and outside the state to meet the demand for electricity till FY22 (ref. 18).

Further, since the new CPPs proposed to be set up by TANGEDCO<sup>18</sup> are either based on domestic coal (from coal fields 1000 km away) or on coal imports, the cost of power from these CPPs will be higher than that from RES which have the potential to add 10.5 GW of capacity within the state<sup>7</sup>. If the capacity of these new CPPs (8.62 GW) turns out to be redundant or is under-utilized, residents in Tamil Nadu will have to pay not only for the higher cost of power generated from these new CPPs but also for servicing the additional loans on the books of TANGEDCO and/or the State Government, which can be avoided/deferred with the knowledge and information available today.

In addition, setting up new CPPs in water-deficit states like, Karnataka, Maharashtra, Tamil Nadu and Telangana, will also result in temporary outages of CPPs due to raw water shortages<sup>25</sup> arising out of inadequate storage levels in the relevant water reservoirs which must meet multiple needs<sup>26,27</sup>.

### *Transmission and distribution systems*

Unfortunately, the existence of surplus power does not ensure adequate access for all citizens in India. This is mainly because the sub-distribution system (last-mile link controlled by DISCOMs) is the weak link in India's power system and poses significant challenges in India today. The distribution system has a direct impact on consumers and deserves the highest priority since efficiency, financial viability and losses in the distribution area effect the viability of the entire power sector. According to CEA<sup>7</sup>, 'investment in sub-transmission and distribution has been lacking due to resource crunch being experienced by the state transmission and distribution utilities. The break-up of the generation and transmission and distribution schemes shall normally be 50 : 50. However, more investment is taking place in generation, and investment in intra-state transmission system and distribution system has been much less than the desired proportion.'

Specifically, analysis of PFC's annual statements indicates that the loans disbursed by PFC in FY17 for generation amounted to 41% of their total disbursement, while the loans disbursed for Transmission and Distribution (T&D) summed up to only 9% of the total disbursement<sup>16</sup>. Due to this pattern of funding over the past few years, generation assets constituted 75% of loan assets on the books of PFC, while T&D assets constituted only 10% (ref. 16). Even REC, which was set up primarily to promote rural electrification has disbursed less than 50% of its loans in FY16 to T&D schemes<sup>28</sup> instead of dedicating itself to the identification, evaluation and financing of much-needed intra-state distribution projects in India.

### *Financial health of DISCOMs*

The health of Government-owned DISCOMs is detailed in the results of a rating exercise carried out by Investment Information and Credit Rating Agency (ICRA) and Credit Analysis and Research (CARE) (coordinated by MOP) to evaluate the performance of 41 DISCOMs spread across 22 states, on a range of, operational, financial, regulatory and reform parameters<sup>29</sup>. The results of this exercise indicate that, 22 of the 41 DISCOMs lack the operational and financial performance capability needed to sustain themselves on their own<sup>29</sup>. PFC has published a study of state-owned DISCOMs which indicates that their combined net worth has slipped to Rs 1.17 trillion at the end of FY15 (ref. 30).

Recognizing the criticality of DISCOM reforms, 27 states and union territories have signed onto the Ujwal DISCOM Assurance Yojana (UDAY) scheme formulated by GoI<sup>31</sup>. The UDAY scheme aims to reduce, interest burden of DISCOMs, cost of power, and power losses in distribution sector by improving the operational efficiency

of DISCOMs<sup>31</sup>. The scheme also envisages the state governments taking over 75% of the debt on the books of its DISCOMs as on 30 September 2015, for which the states are exempted from fiscal responsibility and budgetary management limits for two years<sup>31</sup>. Till now, most of the states/DISCOMs have only implemented the easier-to-do financial restructuring component of UDAY without any direct financial aid from GoI, and 15 states have directly taken over Rs 2.09 trillion of DISCOM debt under the UDAY scheme during FY 2015–16 and 2016–17 (ref. 31). Based on a study of the finances of state governments, the Reserve Bank of India has concluded that, ‘UDAY *inter alia* caused outstanding liabilities to increase by 1.5% points of GDP in 2016 over 2015 and by 0.7% point in 2017 over 2016’ (ref. 32).

The 27 government-owned DISCOMs covered by the UDAY scheme have reportedly cut their combined losses by 21.5% in FY17, mainly due to the sharp reduction in their interest burden<sup>33</sup>. However, progress in implementing the administrative and operational reforms entailed in UDAY, which also entails the state governments mustering the political will to rationalize tariffs and crack down on power theft, needs to be accelerated. Inadequate progress in implementing the identified operational improvements<sup>34</sup> in a timely manner, *viz.* upgrading the local distribution, metering, and bill collection systems, and enforcing administrative measures promptly, will inevitably burden the states and/or DISCOMs with larger deficits in the future, thereby delaying the provision of 24 × 7 affordable ‘power for all’.

This situation can be averted if the states agree to a more proactive role for MOP. For example, one of the key enablers to improve operational and billing efficiency is the installation of smart meters<sup>34</sup>. However, out of five million smart meters (for consumers billed greater than 500 kWh/month) targeted to be installed by December 2018, less than 3% have been procured between 5 November 2015 and 17 July 2017 (ref. 34). Therefore, GoI can assist the states to speed up UDAY implementation, *inter alia* by utilizing GoI-owned EESL to replicate its success in reducing the cost of procuring energy-efficient LED bulbs by more than 80% over the last 30 months<sup>35</sup>, to minimize the cost of procurement of standardized items like smart meters required in large numbers to implement UDAY<sup>34</sup>.

#### *Environmental compliance of operating coal-fired power plants*

India has only 4% of the world’s freshwater resources while it sustains 17% of the world’s population. Water availability has already become a crisis in several parts of India. Specifically, 21 CPPs located in drought-prone areas of India (e.g. Parli power plant in Maharashtra, and Raichur power plant in Karnataka), were closed tempo-

rarily in FY16 due to the lack of water to operate them in the prevailing drought situation<sup>25</sup>.

On 7 December 2015, the Ministry of Environment and Forests and Climate Change (MOEF&CC) notified the Environment (Protection) Amendment Rules, 2015 (EPAR) which is aimed at reducing emissions of particulate matter (PM10), sulphur-di-oxide (SO<sub>2</sub>), and oxides of nitrogen (NO<sub>x</sub>) from CPPs while minimizing freshwater consumption as well<sup>36</sup>. These standards are more rigorous for CPPs constructed post-2003 and are even more stringent for CPPs commissioned after January 2017.

For example, as per EPAR, existing CPPs must limit their water consumption to 3.5 m<sup>3</sup>/MWh by December 2017 from the current level of +5 m<sup>3</sup>/MWh, while CPPs installed from 2017 onwards must limit the same to 2.5 m<sup>3</sup>/MWh (ref. 36).

The operational and financial implications of complying with EPAR have already been documented by the CEA<sup>7</sup>. CPPs non-compliant with EPAR today, must upgrade and/or install additional pollution control equipment to bring down emissions and water consumption within prescribed limits to comply with law. The installation of such environmental control systems to comply with EPAR is not only capital-intensive but also involves additional operating costs<sup>7</sup>.

Complying with EPAR is a major challenge for India’s power sector, especially for +25-year old government-owned CPPs with an aggregate capacity of 35.5 GW (ref. 37) out of the total coal-fired capacity of 192 GW (ref. 2). However, some of these old CPPs may not be able to comply with EPAR by the deadline of 7 December 2017 for various reasons, such as, lack of required space for installing pollution control equipment and non-availability of suitable technology for high-ash Indian coal, and will be required to be phased out over time<sup>38</sup>. Therefore, CEA identified government-owned CPPs more than 25 years old with an aggregate capacity of 9 GW for retirement, of which, CPPs with an aggregate capacity of 3.75 GW have been retired since September 2015 (ref. 37). In addition, some government utilities have also identified a few old and inefficient CPPs (aggregate capacity 7.7 GW) for replacement with CPPs-based on super-critical technology<sup>39</sup>, since the efficiency of a CPP based on super-critical technology is 5% higher than that based on sub-critical technology<sup>40</sup>. While the timelines and funds for replacing these state-owned +25-year old CPPs (7.7 GW of aggregate capacity) with super-critical CPPs are yet to be announced, there is no visibility of the future course of action with respect to the remaining +25-year-old state government-controlled CPPs (aggregate capacity of 13 GW). The fate of these state-owned CPPs hangs in the balance, with the coming into effect of EPAR on 7 December 2017, since these CPPs are not capable of complying with EPAR in their current state<sup>36</sup>. In stark contrast, GoI-controlled NTPC has proactively decided to progressively replace its own +25-year-old plants

(aggregate capacity 11 GW) with new CPPs using super-critical technology<sup>41</sup>.

The only two alternatives available to the state utilities operating such CPPs are, to either retrofit them to comply with EPAR, or to close them down in a phased manner if the techno-economics of retrofitting these plants are unfavourable<sup>36</sup>. While the financial health of State utilities does not permit them to make the investments required to comply with EPAR, they cannot hike the tariffs to recoup investments required to comply with law. On the other hand, the Central Government has not indicated its intention<sup>42</sup> to provide financial aid to the state utilities to retrofit their CPPs to comply with the EPAR, though GoI will be collecting approximately Rs 285 billion in FY17 (ref. 43) alone by levying a cess (renamed successively, as the clean energy cess and then clean environment cess) on coal @ Rs 400 per tonne.

The stated purpose of this cess levied on coal was primarily to finance, clean energy initiatives or research into clean energy or any other scheme related to clean energy, through the National Clean Energy Fund (NCEF). However, from April 2017 onwards, this cess will be subsumed into the GST compensation fund to compensate the states for five years for potential losses during GST implementation<sup>44</sup>. A crisis is looming ahead for India's power sector since this matter is already before the National Green Tribunal. Several operating CPPs will have to be shut down in an unplanned manner, if a time-bound action plan is not in place before 7 December 2017. Therefore, environmental compliance of CPPs needs to be addressed urgently, with the help of suitable financial incentives from GoI to the state utilities operating old, inefficient, and potentially non-compliant CPPs either for retrofitting such CPPs (subject to feasibility) or for phased-out closure (in the case of CPPs with low residual life), particularly when it comes to dealing with +25-year old CPPs<sup>45</sup>.

### Future challenges

GoI has established a target of 175 GW of installed RES capacity by 2022, including 60 GW of wind and 100 GW of solar<sup>7</sup>, up from 32 GW wind and 12 GW solar at the end of March 2017 (ref. 2). This rapid growth in RES capacity has several implications, which need to be addressed by GoI along with the states in the manner suggested here.

### Grid integration

According to a recent survey of CEOs of companies involved in the solar power sector in India, the biggest concern for the renewable sector is grid integration of the growing renewable capacity followed by poor financial condition of DISCOMs, notwithstanding the progress made on the UDAY reform package<sup>46</sup>. To tackle this,

MOP has identified 'Green Energy Corridors' for connecting RES sources to the national grid, and has arranged grants and low-cost financing to construct these transmission lines<sup>7</sup>. The gestation period of RE projects is very less compared to the development of transmission systems (24–36 months) for integration with the grid. Therefore, commissioning of transmission system projects and green energy corridors should lead the connected RE generation projects. The land acquisition and construction of these inter-state and intra-state transmission lines need to be accelerated since the nine states targeted for 77% of the planned RE capacity addition of 118 GW by 2022 cannot utilize the entire quantum of intermittent RE produced<sup>7</sup>. However, prolonged delays in acquiring the right of way create impediments in strengthening the regional and national grids<sup>47</sup>, which may affect the long-term energy security not only for the state but also for the entire region. Based on certain explicitly stated premises, the National Renewable Energy Laboratory has concluded that 160 GW of solar and wind energy can be integrated into the grid by 2022, but intra-state transmission will require new planning based on projected locations of RES<sup>48</sup>.

### Grid balancing

CEA has pointed out that large scale RE integration on the scale envisaged in India would need a higher share of hydel and/or gas generation in the overall electricity mix. At present, there are two options for India to handle the intermittency of power from RES, and to ramp up power generation as per demand when solar/wind energy is not adequate. The first option is to increase gas supplies to the existing gas-based power plants (aggregate capacity of 25 GW) from 28 (FY16) to 53 million standard cubic metres per day and use the costlier, gas-based plants as peaking plants<sup>7</sup>, though gas-based power plants with an aggregate capacity of 14.3 GW are stranded due to non-availability of domestic gas<sup>44</sup>.

Another proven option for grid balancing is to use pumped storage plants (PSPs) which are cost-effective, highly efficient and operationally flexible storage devices on a large scale, suited to handle the intermittent and variable power generated by solar and wind energy sources. Operation of PSPs in areas with concentrated RES would significantly improve grid reliability, thereby acting as the best partner for the RE integration<sup>7</sup>.

PSPs improve the overall economy of power system operation and increase the capacity utilization of both CPPs and RES<sup>49</sup>. Therefore, India must develop more PSPs for which the benefits available to RE projects should also be extended to PSPs<sup>7</sup>. At present, only nine PSPs with an aggregate capacity of 4.8 GW are in operation, of which only five PSPs with an aggregate capacity of 2.6 GW are operated in pumping mode<sup>49</sup>. Since water

and hydel power are state subjects, GoI should actively encourage state governments to allocate the identified PSPs to capable developers, and to adopt a pro-active approach to resolve, statutory, land acquisition and other hurdles in the way of their expeditious implementation<sup>49</sup>. PSPs should be considered as a grid element instead of as a source of power generation and should be funded by GoI from the Power System Development Fund (PSDF)<sup>49</sup>. In addition, the Central Electricity and Regulatory Commission (CERC) must formulate pricing rules designed to fully capture the benefits of PSPs and reward such assets for the full range of services provided by them to the power system<sup>49</sup>.

### *Import dependence*

While GoI has targeted to increase solar capacity from the current level of 12 to 100 GW by 2022, India imported 5.7 GW or approximately 89% of its total solar module requirement in FY17 (almost entirely from China), at an estimated cost of about US\$ 3 billion<sup>46</sup>. Till date, GoI's sole priority in the renewable power sector has been to increase generation at lower tariffs even at the cost of hurting the prospects of domestic manufacturers who are unable to compete with Chinese imports<sup>46</sup>. In a survey of CEOs of companies involved in the solar power sector in India, 52% of the respondents indicated that there is a very high risk of poor quality equipment being dumped in India; another 39% have indicated that this is a real but manageable risk; only three CEOs stated that there is no such risk<sup>46</sup>.

Over-reliance on a single country will expose India's power sector to a risk of disruption due to any unforeseen changes in policies of a foreign government. Therefore, the aforesaid response from key stakeholders in the solar power sector should be an alarm call for GoI, which should ideally consider long-term implications for the power sector and draw up a holistic plan to promote domestic manufacturing of solar PV. While GoI has been successful in reducing coal imports for power generation by increasing domestic supplies, it must invest heavily in R&D and manufacturing facilities for renewables not only to reduce India's trade deficit of US\$ 51 billion with China in FY17 (ref. 50), but also to ensure long-term energy security for India.

### *Coordinated system operation*

Over the last three years, India has rapidly achieved adequacy in terms of availability of power. Now the time has come to shift the focus to optimal utilization of scarce and valuable resources for achieving economy and efficiency in operation. The merit order stack is a common approach to the problem of minimizing the sum of generators' operating costs while honouring the system con-

straints to supply the demand in a secure and reliable manner<sup>51</sup>.

In their recent study of India's power sector, NREL found that coordinating electricity scheduling and dispatch over a broader area is the largest driver to reduce costs, saving Rs 63 billion annually when optimized regionally vis-à-vis within a state<sup>48</sup>. For example, a study by Prayas indicates that while variable charges of 'backed down' coal-based capacity in FY16 and FY17 in six 'surplus' states was in the range of Rs 2.7/kWh to Rs 3.3/kWh, total tariff for newly contracted capacity in 'shortage' states was in the range of Rs 4/kWh to Rs 5.7/kWh (ref. 14). NTPC has indicated that the implementation of their proposed 'fixed cost' pooling mechanism, which involves the merit order operation of all NTPC stations at the national level would have resulted in saving of around 10–11 paisa/kWh in energy charges spread over NTPC's overall generation of about 250 TWh (ref. 52) (20% of the electricity generated in India in FY17 (ref. 2)). While implementation of NTPC's proposal will benefit all customers of NTPC and electricity consumers, this is still under discussion between GoI, NTPC and NTPC's utility customers in the states.

Coordinated system operations with better communications and a more effective and 'smarter' grid will not only smoothen the variability in RES utilization in the grid as well as in power demand, but will also result in lower tariffs to achieve clean and affordable 'power for all'. In addition, the proposed RE management centres equipped with centralized forecasting/scheduling system should be expedited to improve monitoring and forecasting of RES.

### **Key recommendations**

India needs an environment-friendly and self-sustaining power sector and Indians are looking forward to realizing the vision of 24 × 7 clean and affordable 'power for all', by the year 2020. The realization of these linked goals is necessary to achieve the sustainable development goals and India's NDC's submitted to the UNFCCC. During the last five years, India has progressed from being a power-starved nation to a power-surplus country. While GoI has been creating an enabling policy and regulatory environment for the orderly growth of the power sector, these measures alone are not sufficient to realize the vision of 'power for all'.

To take this momentum forward, MOP is currently drafting the official amendments in the Electricity (Amendment) Bill, 2014. Since electricity is a concurrent subject as per the Constitution of India, suitable provisions must be incorporated in this bill for the creation of a National Electricity Council (NEC) with pooled sovereignty on the pattern of the GST Council. Unlike the advisory body created by National Institution for Transforming India (NITI) Aayog to coordinate efforts related

to RE integration<sup>8</sup>, the proposed NEC must be an empowered body with representatives from the centre and the states. An empowered NEC is required to mandate all measures necessary to realize, ‘one nation-one grid-one price’, and to facilitate uniformity in the state regulators’ approach to critical issues central to the implementation of the electricity act and policies in their true spirit. NEC can consider the following recommendations to start with:

- The ‘power for all’ agreements signed off by 26 states with GoI<sup>31</sup> give a broad picture of each state’s power sector. GoI is promoting efficiency in power generation, T&D businesses and is also supporting all state utilities through various schemes, policies, and guidelines. However, there is a need to prepare a detailed, time-bound transition plan to progress towards an optimal energy mix for each state over different time horizons, which if implemented holistically, will facilitate the fulfilment of India’s growing needs for energy without compromising on the achievement of our NDCs.

- Inefficiencies in demand forecasting and capacity addition processes adopted by state utilities need to be addressed immediately, since the growth of RE in India as well as the sustainability of all stakeholders involved (financial institutions, IPPs and utilities) are affected by the growing supply–demand mismatch in the power sector. Ultimately, the people of India pay (and will continue to pay) for the gross mismatch in power supply and demand, either in the form of higher tariffs or through higher interest rates charged by commercial banks to increase provisions against loans to stressed IPPs.

- Since government companies like PFC and REC are the key financiers of new CPPs being set up by state utilities, MOP may advise them to analyse the overall power supply–demand situation in the country for the next 5–10 years before financing the creation of new CPP capacity when existing generation capacity part-financed by loans from public sector banks is grossly under-utilized. Specifically, MOP may advise REC to focus its expertise and finances to assist DISCOMs in upgrading their overloaded and archaic distribution systems, and in creating smart grids which will enable the deployment of an Aadhaar-based direct benefit transfer system to provide electricity subsidy to the deserving poor.

- The intra-state distribution system needs a major redesign inter alia to: enhance its reliability, reduce Aggregate Technical and Commercial (AT&C) losses, and include a greater portion of RE in the power mix. While several schemes are being implemented with GoI grants/loans, acquisition of land and right-of-way is creating delays in several T&D projects. Therefore, state governments must adopt a more proactive approach to ensure that T&D projects of both central and state transmission utilities are not hampered.

- RBI has noted the deterioration of fiscal position of state governments in the preceding two years due to their

participation in financial and operational restructuring of DISCOMs through UDAY. Progress made in the power sector will not last long unless effective solutions are implemented to achieve the operational improvements envisaged in the UDAY scheme as per their decided trajectory. Since the state governments have helped several DISCOMs to reduce their interest costs by taking over a major part of their debt, DISCOMs should utilize this window to implement the operational improvements envisaged in UDAY. This is also crucial to accelerate the progress of make in India.

- The deadline for compliance with the EPAR is less than six months away; yet there is no visibility on the roadmap being followed by state utilities towards compliance with the EPAR. The state utilities are unable to undertake the investments required to comply with the EPAR whose implementation is in the public interest. Therefore, GoI must incentivize the state utilities to replace their +25-year-old CPPs with more efficient and environment-friendly ultra-super-critical units with funds from the NCEF or any other source<sup>45</sup>.

- CEA has identified several infrastructural facilities like PSPs, spinning reserve, green corridors including RE management centres, and operational/policy measures like demand side management and demand response, better forecasting, as critical components of the infrastructure required to inject higher proportions of RE into the grid<sup>7</sup>. However, the state governments need to work more proactively with GoI to implement recommendations of CEA, expeditiously.

- The centre and the states must work towards a coordinated system operation of the power sector starting from the regional level and progressing towards the national level with a view to implement a national merit order dispatch system which will facilitate the achievement of ‘one nation-one grid-one price’.

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