Executive Summary and Recommendations

Why did we select this subject for audit?

India supports around 17 *per cent* of the world's population but its energy and electricity consumption is only around five *per cent* of the world's consumption. Its per capita consumption of energy and electricity is less than one-third of the world average.

In order to sustain a growth rate of over eight *per cent* through the next two decades, India would need to grow its primary energy supply by three to four times and electricity supply by at least five to seven times of its current consumption. The country might need to import over 90 *per cent* of its requirement of oil and over 45 *per cent* of its requirement of coal. Energy shortages are currently at an average of 8.7 *per cent* with peak deficit at nine *per cent.*

Fossil fuels, though cost effective and efficient, are depleting. They pollute the environment and contribute to the greenhouse effect and global warming. Renewable Energy is environment friendly and can provide energy security and offers distributed solutions. It is derived from natural processes that are replenished constantly.

India has made voluntary commitment at the United Nations Framework Convention for Climate Change to reduce its carbon emissions intensity by 20-25 *per cent* by 2020 in comparison with the 2005 levels. It is also envisaged that Renewable Energy would constitute 15 *per cent* of the energy mix of India by 2020.

India is endowed with vast Renewable Energy (RE) potential of 8,89,508 MW. The Planning Commission in the 12th Five Year Plan document had stated that the supply from renewables is expected to increase rapidly from 24,503 MW by the end of the 11th Five Year Plan to 54,503 MW by the end of the 12th Five Year Plan, and underlined the need for investments in RE.

Considering the significance of RE as an alternative to meet the ever growing energy demand of India, we decided to take up Performance Audit of Renewable Energy Sector in India for the period 2007-14. Apart from auditing the Ministry of New and Renewable Energy and institutions under it, audit was also conducted in 24 selected States.

What were our audit objectives?

The objectives of the Performance Audit of Renewable Energy Sector were to examine the progress made in:

(i) Increasing the contribution of RE resources in India's energy mix/electricity mix;
(ii) Increasing access to electricity/ lighting needs in remote and rural areas; and
(iii) Promoting research, design, development and demonstration.

What did our Performance Audit reveal?

Compliance with Renewable Purchase Obligation and availing of benefits of Clean Development Mechanism

As per the National Action Plan on Climate Change (NAPCC) announced in June 2008, a target of five *per cent* for purchase of electricity generated from RE sources was set for 2009-10 against the then existing level of around 3.5 *per cent*. This target was to increase by one *per cent* per year for next 10 years i.e. the NAPCC envisaged that RE would constitute 15 *per cent* of the energy mix of India by 2020. It was observed that as against the National Action Plan on Climate Change target of eight and nine *per cent* for the years 2012-13 and 2013-14, the national achievement was only 4.28 and 4.51 *per cent,* respectively.

(Chapter II, Paras 1 and 2.1)

In none of the 24 sampled States, except Himachal Pradesh and Tamil Nadu, Renewable Purchase Obligations (RPO) were fixed in sync with the norms set under the National Action Plan on Climate Change.

(Chapter II, Para 2.2)

Direct purchase of electricity generated from RE sources was still the preferred option to meet RPO. Between 2010 and 2014, only 4.77 *per cent* of RPO compliance was through Renewable Energy Certificate (REC) mode, whereas 95.23 *per cent* was through direct purchase of electricity from RE sources.

(Chapter II, Para 2.4)

Uncertain policy environment and poor RPO enforcement led to a situation, where as of August 2014, 93,64,699 RECs, each valuing at least ₹ 1,500 were lying unredeemed, affecting the planned cash flow of the generators.

(Chapter II, Para 3.2)

The Ministry of New and Renewable Energy (MNRE) had not devised any mechanism for claiming of Clean Development Mechanism (CDM) benefits for the grid connected and off-grid RE projects. There was lack of awareness with respect to claiming CDM benefits.

(Chapter II, Para 4.2)

Recommendations

1. *MNRE needs to pursue with the State Electricity Regulatory Commissions for the adoption of Renewable Purchase Obligation targets in alignment with National Action Plan on Climate Change targets. These targets should be enforced, with due monitoring and collection of penalties for default in compliance.*
2. *MNRE, being the nodal Ministry should ensure firming up of clear guidelines on the life of Renewable Energy Certificates and management of unredeemed Certificates, in a time bound manner.*
3. *MNRE should introduce a comprehensive framework for creating awareness of Clean Development Mechanism and availing benefits under it.*

Grid Connected Renewable Power

Solar Power

The installed capacity of grid interactive solar power in the country at the beginning of the 11th Five Year Plan period was `Nil'. This rose to 2,656 MW by March 2014, which was 0.35 *per cent* of the country's solar energy potential of 7,48,990 MW.

In the ten States endowed with 78 *per cent* of the National solar potential, the exploited potential varied from zero to 2.56 *per cent*. Gujarat and Rajasthan alone created more than 50 *per cent* of the capacity installed in the country but had exploited only 2.56 *per cent* and 0.51 *per cent* of their respective potentials. Jammu & Kashmir and Himachal Pradesh with potentials of 1,11,050 MW and 33,840 MW respectively, had not set up any grid connected solar project.

(Chapter III, Para 2)

As per the Solar Power Policy 2009 of the Government of Gujarat the tariff was fixed in a phased manner and in alignment with the decreasing capital cost of the systems. However, there were anomalies in the schemes introduced by MNRE between 2008 and 2010. The tariff assured and the period of commitment of the Government of India was increased during this period. Immediately thereafter, between 2011 and 2014, the Central Electricity Regulatory Commission tariffs and the reverse bidding rates decreased. Hence, while designing the schemes, MNRE had not provided for any flexibility to review the tariff being assured.

(Chapter III, Para 3.4)

Under Demonstration Programme, Solar Photovoltaic power project developers availing Generation Based Incentive (GBI) were not eligible to avail Accelerated Depreciation (AD) benefit under the Income Tax Act 1961. This was not ensured by MNRE/Indian Renewable Energy Development Agency (IREDA) before releasing GBI claims of ₹ 22.49 crore to Reliance Industries Ltd (RIL). This resulted in both GBI and AD being claimed by RIL in the period August 2010 to December 2012.

(Chapter III, Para 4.1.1)

MNRE had not formulated guidelines for net metering to provide an enabling environment for solar technology penetration in the country at a decentralized level.

(Chapter III, Para 4.3)

Against the target of 500 MW of Solar Thermal projects, projects of 447.50 MW (approximately 90 *per cent*) had not been commissioned (February 2015). Government land of 3,404 acres in Rajasthan leased to six Solar Thermal project developers had not been put to intended use so far. In Demonstration Programme, in one case, 345 acres of land had been leased in excess of requirement for a Solar Photovoltaic power plant.

(Chapter III, Para 4.4.2)

Lack of coordination between NTPC Vidyut Vyapar Nigam Limited, Power Grid Corporation of India Limited and State Agencies led to instances of delay in supply of thermal based

power for bundling arrangement and non availability of Long Term Access for inter-State transmission system to the State Agencies, resulting in disputed claims with distribution companies.

(Chapter III, Paras 4.4.6 and 4.4.7)

Recommendations

4. *MNRE should focus on development of solar energy in the States endowed with high solar energy potential.*
5. *MNRE, while formulating schemes that commit the Government to long term liability for incentives like Generation Based Incentives, must ensure that these are kept flexible to match changes in tariffs and costing structure to avoid unwarranted burden on public exchequer or developers.*
6. *MNRE must formulate guidelines for net metering so as to provide an enabling environment for solar technology penetration in the country at a decentralized level.*
7. *MNRE must ensure that the solar projects are completed as per schedule. In case of delays, the Central/ State Governments must review the status of the public resources like land allotted to the solar power developers and take necessary corrective measures.*
8. *MNRE, in coordination with other Central Government agencies, should ensure timely arrangement for making available conventional power for bundling and Long Term Access to inter-State transmission system, for smooth operation of the schemes.*

Wind Power

The installed capacity of grid interactive wind power in the country at the beginning of the 11th Five Year Plan was 7,091 MW. This rose to 21,137 MW by March 2014, which was 21 *per cent* of the country's wind energy potential of 1,02,788 MW.

(Chapter IV, Para 3.1)

MNRE could not ensure seamless continuation of Generation Based Incentive and Accelerated Depreciation schemes in the 12th Five Year Plan. The break in incentives being provided to wind energy developers between 2012 and 2014 adversely affected the capacity addition during this period.

(Chapter IV, Para 3.2.3.1)

There was no competition in the wind energy sector either with respect to tariff fixation or allocation of sites to the developers. Thirty two stations identified as potential sites allotted to private developers for setting up wind farms were not developed within the extended time frame. These stations were not included in the normal list of potential stations as stipulated in MNRE guidelines, thus depriving potential developers who could be looking for such sites for establishing wind farms of the opportunity to develop projects.

(Chapter IV, Para 3.2.4)

In the ten States endowed with 97 *per cent* of the country's wind potential, the exploitation varied from zero to 68 *per cent* of the States' potential. Maharashtra had the highest

potential exploitation at 68 *per cent* followed by Tamil Nadu at 51 *per cent*. Jammu & Kashmir, Odisha and Uttar Pradesh had not exploited the potential at all. More significantly, of the four highest potential States, three i.e. Gujarat, Andhra Pradesh and Karnataka had very low rates of potential exploitation ranging from five to 17 *per cent*.

(Chapter IV, Para 4.1)

There were problems in evacuation of wind power generated by the States due to non-availability of sufficient transmission infrastructure and non-synchronization of generation. Lack of scientific techniques to predict the wind power also created problems in maintaining grid discipline. In Tamil Nadu, the quantum of wind power backed down was 6,018.43 MUs during 2007-2014, the maximum backing down being in 2012-13 (1,155.27 MU) and 2013-14 (3,419.85 MU), resulting in a loss of revenue to the extent of ₹ 2,040.25 crore during this period.

(Chapter IV, Paras 4.4.3 and 4.4.5)

Repowering of wind turbines could lead to better utilization of wind-rich sites through the installation of latest technology wind turbine models available and improve the capacity utilization factor by almost two to three times. Over 4,600 turbines rated below 500 kilo Watt with an aggregate capacity of 1.6 Giga Watt and operational for more than 10/12 years, were ideal for repowering. No progress had been made with regard to re-powering of old wind turbines.

(Chapter IV, Para 5)

Recommendations

9. *MNRE should focus on development of wind energy in the States endowed with high wind energy potential.*
10. *MNRE may work towards development of adequate transmission and distribution infrastructure, both intra-State and inter-State, to meet the needs of large scale evacuation of wind power and grid stabilization through scientific forecasting techniques.*
11. *MNRE may look into the issue of repowering the old wind turbines and formulate a policy for optimal utilization of existing capacities and their enhancement.*

Small Hydro Power

The installed capacity of grid interactive Small Hydro Power projects in the country at the beginning of the 11th Five Year Plan was 1,976 MW. This rose to 3,803 MW by March 2014, which was 19 *per cent* of the country's Small Hydro Power potential of 19,749 MW. Out of 6,474 potential sites identified by MNRE, projects had been installed on 997 sites and 254 projects were under implementation.

(Chapter V, Para 2.1)

There were delays and problems in conducting feasibility studies for identifying potential sites for setting up Small Hydro Power projects, which was a critical activity for development of Small Hydro Power. In Himachal Pradesh 37 consent letters were issued but the

Independent Power Producers did not submit any Detailed Project Report even after five years; out of 88 Detailed Project Reports submitted by Himurja to the Department of Energy for technical approval none had been approved and the Independent Power Producers had not submitted feasibility study reports for 78 projects allotted to them. Fifty two Small/Mini/Micro projects of 714.40 MW in Arunachal Pradesh and 50 Small Hydro Power projects of 612.25 MW in Chhattisgarh had not been commissioned and were still in the preliminary stages.

(Chapter V, Para 2.3)

Due to delays and problems in according technical approvals to Detailed Project Reports, allotment of projects, acquiring land for setting up projects and obtaining forest and environmental clearances, several projects could not be taken up and completed in time.

(Chapter V, Paras 3.1 to 3.3)

Approved projects could not be completed due to negligence of contractors, midway changes in design, etc. resulting in significant time and cost overruns. In Bihar 15 projects had not been commissioned even after delays of 37 to 88 months and incurring expenditure of ₹ 128.19 crore.

(Chapter V, Para 3.4)

Sixty projects in five States were shut down, under repairs and maintenance or working below capacity, resulting in loss of power generation and revenue.

(Chapter V, Para 4.1)

Recommendations

12. *MNRE must ensure that pre-requisites such as land and statutory clearances are obtained before release of Central Financial Assistance to developers, in order to avoid time and cost overruns.*
13. *MNRE should focus on reviewing Small Hydro Power projects that are held up or are under performing, to find solutions to the problems hindering the completion of these projects.*

Biomass Power

The installed capacity of grid connected biomass power in the country at the beginning of the 11th Five Year Plan period was 1,184 MW. It rose to 4,123 MW by March 2014, which was 23 *per cent* of the country's Biomass potential of 17,981 MW.

(Chapter VI, Para 2.1)

Audit observed instances of non traceable biomass plants, inoperative plants, plants working at lower capacities, plants installed with different specifications than approved and plants using non-permitted fuels. None of the developers had furnished the generation data to MNRE after the commencement of commercial generation of electricity.

(Chapter VI, Paras 5.2 and 6)

Recommendations

14. *MNRE must ensure that the Central Financial Assistance is released only after compliance with conditions and thereafter the implementation of the sanctioned biomass projects should be closely monitored.*
15. *MNRE must review the power generation from the sanctioned biomass projects to ensure that these are operating as per specifications and use approved RE fuel.*

Off-Grid Renewable Power

Solar Photovoltaic Systems

MNRE did not align its off-grid targets with the Jawaharlal Nehru National Solar Mission (JNNSM) targets and only 31 *per cent* of the JNNSM targets were achieved.

(Chapter VII, Para 2)

There were cases of irregularities in distribution of solar devices, delay in distribution, irregular purchases of solar devices, deficiencies in award of works for Solar Power Plants, irregular payments and delays in completion of projects.

(Chapter VII, Para 4)

Cases of irregular installation, non installation of solar devices and poor quality of work were noticed which indicated deficiencies in monitoring and evaluation.

(Chapter VII, Para 4.2)

Maintenance of the off-grid systems was deficient. Physical verification of sampled systems by Audit revealed that 47 *per cent* of the off-grid systems were not working, one *per cent* of the systems were found missing and five *per cent* of the systems were issued to villages already electrified.

(Chapter VII, Paras 4.3 and 4.4)

Recommendations

16. *MNRE must ensure that targets set under the programme are in alignment with Jawaharlal Nehru National Solar Mission.*
17. *MNRE may review all delayed off-grid projects, set clear timelines for completion of these projects by the State Nodal Agencies/State Governments and ensure adherence with the same.*
18. *MNRE may set up an effective mechanism, in coordination with the State agencies, to ensure that the off-grid systems are properly maintained and remain functional through their useful life.*

National Biogas and Manure Management Programme

The total estimated potential for biogas plants was 1.23 crore plants, of which 47.52 lakh biogas plants (39 *per cent*) were installed as of March 2014. However, the planning was done based on the potential assessment of the cattle census of 1981-82. The potential exploitation varied from 95 *per cent* in Mizoram and Maharashtra to 2.37 *per cent* in Jammu & Kashmir.

(Chapter VIII, Para 2.2)

Physical verification of sampled systems by Audit revealed that 26 *per cent* of the biogas plants were not working.

(Chapter VIII, Para 4.3)

Recommendation

19. *MNRE may ensure better compliance with guidelines, particularly with regard to successful functioning of the biogas plants constructed under the programme.*

Remote Village Electrification

The number of remote villages/ hamlets that had been covered under the programme of Remote Village Electrification was 3,254 at the beginning of the 11th Five Year Plan, which increased to 10,318 by March 2014, although the number of villages/ hamlets eligible for electrification was 12,392. There were instances of mismatches between the list of Remote Villages verified by Rural Electrification Corporation Limited, sanctioned by the Ministry of New and Renewable Energy and actually reported as covered by the States.

(Chapter IX, Para 2.1)

Audit also observed shortcomings in implementation of the programme in the States. There were instances of inordinate delays in completion of projects, award of contracts to ineligible contractors, irregular distribution of lighting systems and incomplete/non-installation of Remote Village Electrification systems.

(Chapter IX, Para 3)

Deficiencies in maintenance of systems were noticed across the sampled States due to under collection of user charges and deficiencies in maintenance arrangements. Physical verification of sampled systems by Audit revealed that 20 *per cent* of the Remote Village Electrification systems were not working and six *per cent* of the systems were found missing.

(Chapter IX, Paras 5 and 6)

Recommendations

20. *MNRE must ensure that only eligible villages/hamlets and beneficiaries are covered in the Remote Village Electrification programme.*

21. *MNRE must ensure long term operation, maintenance and sustainability of the Remote Village Electrification systems.*

Ladakh Renewable Energy Initiative

Even after four years of implementation of the Programme, none of the 17 Small and Micro Hydro Power projects sanctioned had been commissioned as of July 2015.

(Chapter X, Para 2.2)

The projects were sanctioned without conducting proper feasibility studies, allotment of land, statutory clearances such as environmental, forest, irrigation clearances and technical approvals. This was compounded by slow progress in execution of projects.

(Chapter X, Para 3)

Off-grid solar power projects were sanctioned without conducting feasibility studies. As a result, two solar plants were installed in a village that was already covered under Rajiv Gandhi Grameen Vidyutikaran Yojana and 702 Solar Home Lighting Systems were distributed to ineligible beneficiaries. There were deficiencies in implementation of the projects.

(Chapter X, Paras 4.3.2 and 4.3.5)

Recommendations

22. *MNRE must ensure that comprehensive and reliable feasibility studies of the sites are conducted before sanctioning projects.*
23. *Prior to sanctioning of the projects all statutory clearances, particularly land clearances, must be taken.*
24. *Evaluation of progress of work during implementation and post implementation must be carried out by MNRE or State Agencies or reliable third parties.*

Prime Minister's Special Package for Arunachal Pradesh

There was shortfall in achievement of Planning Commission targets, mainly on account of non-completion of nine Small Hydro Power projects (36 MW), against which expenditure of ₹ 358.46 crore had been incurred. In addition, the Department of Hydro Power Development did not complete 13 hydel projects (capacity: eight MW) and Arunachal Pradesh Energy Development Agency had not completed 25 hydel projects (capacity: one MW) due to various reasons, such as, delay in completion of projects by turnkey contractors and non-availability of funds. The delay ranged from two to three years. As of 2013-14, only 1,051 i.e. 65 *per cent* of the villages had been electrified.

(Chapter XI, Para 2)

Even after completion, some of the projects were non functioning due to defective equipment, natural calamities, lack of repair, abandoning of projects by contractors, etc. which resulted in losses in power generation.

(Chapter XI, Para 4)

Recommendation

25. *MNRE must review the work done under Prime Minister's Special Package for Arunachal Pradesh and take action in coordination with the State Agencies for completing delayed projects, ensuring operations of commissioned projects and adequate post-project maintenance thereof.*

Research, Design, Development and Demonstration Activities in the Renewable Energy Sector

MNRE sanctioned 190 projects at a cost of ₹ 545.90 crore during the period 2007-14 to various Research & Development organizations, of which 112 projects were completed and 78 projects were under progress.

(Chapter XII, Para 1)

Audit observed that although a large number of sanctioned projects were in alignment with focus areas identified under various divisions, realisation of deliverable outcome was not achieved in a majority of projects. This was partly due to the fact that industry participation could not be secured in the projects where it was envisaged, which limited the commercial exploitation of technologies developed. There were delays in implementation of projects and inability of the implementing agencies to either file patents or publish research papers as envisaged in the projects.

(Chapter XII, Para 2)

Monitoring of the projects by MNRE was lax, as in many cases, project progress reports were not submitted by the implementing agencies and project completion reports were not evaluated by MNRE or by third parties.

(Chapter XII, Para 2)

Recommendations

26. *Project Completion Reports of research projects should invariably be vetted by field experts and peer groups before their acceptance, to validate the presented output.*

27. *Emphasis should be laid on regular monitoring of ongoing projects to ensure that these are completed on time and if required, course correction introduced.*