Chapter 3 ⟹ Conservation of Resources

Audit Objective 2

To verify whether the resources were effectively managed by optimizing the use of renewable sources of energy

Indian Railway (IR) is the single largest user of both energy and water in the country. Conservation of energy and water is essential to avoid wastage. Efforts should be made to reduce energy consumption through adoption of energy-efficient measures. Ground water being a scarce resource should be used optimally. Various measures are being adopted for conservation of water by recycling waste water, provision of water treatment plant, rain water harvesting and monitoring wastages of water. In IR, the expenditure on energy constitutes a major portion of their working expenditure. Majority of the workshops sheds and PUs utilize ground water for their activities. The measures adopted by IR for conservation of energy and water are discussed below.

3.1 Conservation of Energy

In May and August 2008, RB advised all the ZRs to fix targets for energy conservation through use of energy efficient devices and also to identify sources of energy wastage. Accordingly, 11 areas for conservation of electrical energy were identified by Audit for this review. Review of performance of the selected units in achieving target relating to various energy conservation measures revealed the following:

I. Targets fixed by the ZRs for implementing various energy conservation measures within a definite time frame were not uniform in all the ZRs. In some workshops and sheds etc. no targets were fixed.

II. Achievement of selected units test checked in respect of implementation of energy consumption measures is indicated in the table below:

Table 1: Achievement of target on various energy conservation measures

Sl. No.	Description of works	No. of Workshops and Sheds where target was fixed			Number of Workshops and Sheds where no target was fixed
		Total	Target Achieved	Target Not Achieved	
1.	Provision of CFL Lighting	75	48	27[48] (WS-14) (Sh - 12) (CD-1)	63 (WS-18) (Sh – 34) (CD-11)
2.	Provision of T5 FL lights	97	24	73[49] (WS-26) (Sh - 38) (CD-9)	41 (WS-16) (Sh - 18) (CD-7)
3.	Replacement of 90 watt Ceiling Fans with 60 watt fans	90	50	40[50] (WS-16) (Sh - 19) (CD-5)	48 (WS-32) (Sh - 8) (CD-8)
4.	Replacement of electronic fan regulators	90	38	52[51] (WS-15) (Sh - 32) (CD-5)	48 (WS-21) (Sh - 16) (CD-11)
5.	Provision of electronic ballast	82	32	50[52] (WS-15) (Sh - 28) (CD-7)	56 (WS-20) (Sh - 26) (CD-10)
6.	Replacement of HPMV lamps	69	29	40[53] (WS-14) (Sh - 21) (CD-5)	69 (WS-26) (Sh - 28) (CD-15)
7.	Automatic Power Factor Correction Panels	59	46	13[54] (WS-3) (Sh - 7) (CD-3)	79 (WS-32) (Sh - 35) (CD-12)
8.	Provision of Timer Switches	62	41	21[55] (WS-7) (Sh - 13) (CD-1)	76 (WS-30) (Sh - 34) (CD-12)
9.	Provision of energy savers[56]	35	18	17[57] (WS-6) (Sh - 8) (CD- 3)	103 (WS-33) (Sh - 52) (CD-18)
10.	Provision of occupancy sensors for light control	30	11	19[58] (WS-07) (Sh – 10) (CD- 2)	108 (WS-27) (Sh – 61) (CD-20)

[48] CR, ECOR, ER, NCR, NER, NR, NWR, SCR, SECR, SER, WCR and WR
[49] All ZRs except NEFR.
[50] All ZRs except SWR
[51] CR, ECOR, ECR, ER, NCR, NFR, NR, NWR, SCR, SECR, SER, WCR and WR
[52] CR, ECOR, ECR, ER, NCR, NER, NR, NWR, SCR, SECR, SER, WCR and WR
[53] CR, ECOR, ECR, ER, NCR, NER, NFR, NR, NWR, SCR, SER, WCR and WR
[54] ECOR, ECR, ER, NR, NWR, SCR, SER, SWR, WCR and WR
[55] CR, ECOR, ER, NCR, NFR, NR, NWR, SCR, SER, WCR and WR
[56] For pumps, lighting circuits, air conditioning circuits and machines in workshops and sheds
[57] CR, ECR, NCR, NWR, SCR, SECR, SER, SWR, WCR and WR
[58] CR, ECOR, ER, NCR, NER, NFR, NWR, SCR, SWR, WCR and WR

11.	Use of variable voltage variable frequency in cranes, lifts and escalators	23	8	15[59] (WS-08) (Sh – 07) (CD-nil)	115 (WS-36) (Sh – 58) (CD-21)

WS represents workshops, Sh represents Sheds. CD represents coaching depot.

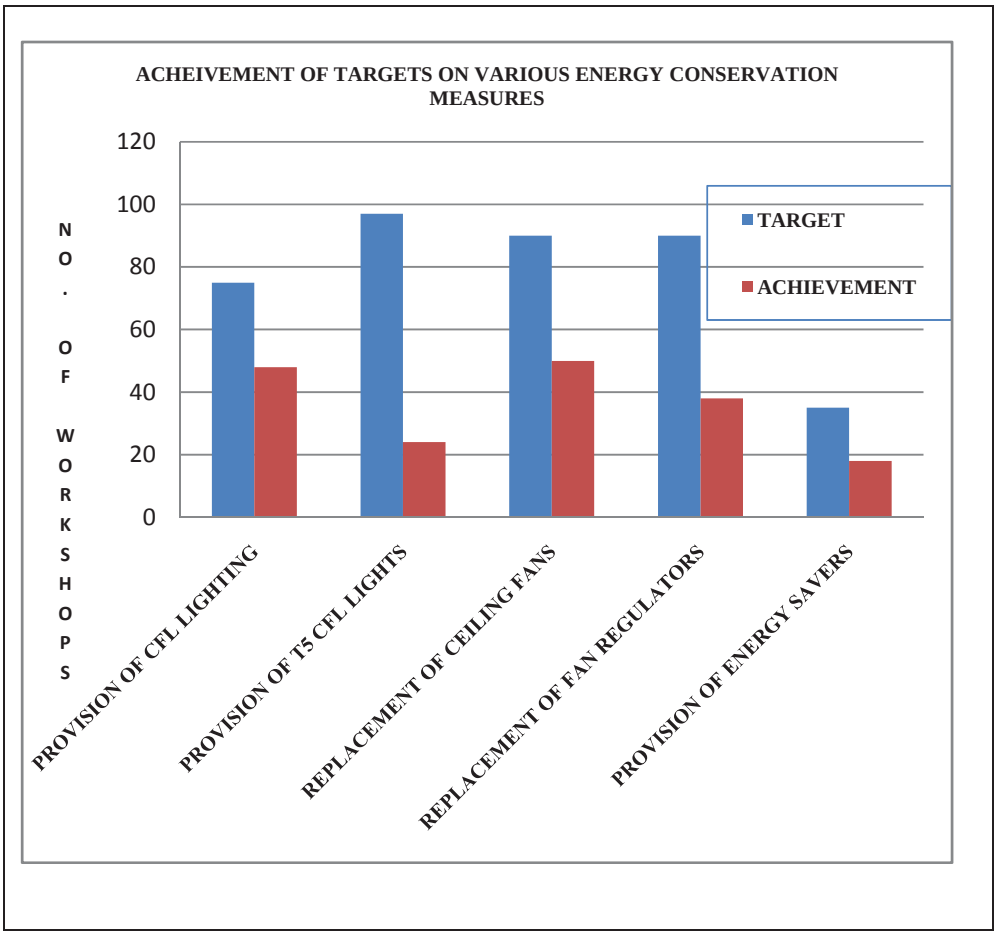

Figure: Achievement of targets on various energy conservation measures

The position tabulated above indicated that targets relating to provision of T5 FL lights, replacement of electronic fan regulators and provision of electronic ballast were not achieved by 58-75 *per cent* of workshop/sheds. The workshops and sheds where no target was fixed ranged between 30 *per cent* and 83 *per cent*. The reasons for not setting any target were not available on record.

III. Out of 22 Coaching Depot (CD) test checked, target for six energy conservation measures, as indicated against serial number 6 to 11 of the table 1, was not fixed by 12 to 21 workshop/sheds. In respect of remaining five areas of energy conservation measures mentioned against

[59] CR, NFR, NWR, SCR, WCR and WR

serial number 1 to 5 of the table above , target was not achieved by five to nine CDs[60] ;

IV. There was no system in place in RB to monitor reports received from ZRs regarding energy conservation measures and to initiate corrective actions; and

V. There is no system in place either at the field level or at RB level to quantify the financial impact of energy saving or opportunity cost of shortfall in achieving the targets.

Performance of the six production units in achieving the target for use of energy efficient fittings revealed that except RWF/Yelahanka (SWR), the implementation of various energy measures in the remaining five PUs were only partial. The areas where the PUs did not achieve the target are furnished below:

Table 2: Achievement of target on various energy conservation measures by production units

Sl No	Target in respect of	Target not achieved by
1	Use of automatic power factor correction panels in HT/LT substations	CLW, DMW
2	Replacement of old 90 watt ceiling fans by 60 watt ceiling fans	CLW, RCF,DMW
3	Use of electronic fan regulator in place of conventional fan regulators	CLW,DLW, DMW
4	Use of occupancy sensors in officers chambers and conference rooms	CLW, DMW
5	Provision of T5 FL light in place of T-12 FTL fittings	DLW, ICF, DMW
6	Timer Switches in mast towers	DLW, DMW
7	Replacement of CFL lighting in place of 60/40 Watt incandescent lamps	ICF, DMW
8	Replacement of electronic ballast in place of conventional ballast in FTL circuits	ICF, DMW
9	Provision of energy savers for pumps, lighting circuits,airconditioning circuits and machines.	ICF, DMW

[60] Except for provision of CFL lighting where only one coaching depot could not achieved the target

RB stated (December 2013) that they had been issuing policy guidelines to ZRs from time to time for implementing energy efficiency measures. RB also stated that IR achieved overall saving in energy consumption by one per cent despite increase in connected load by about 4-5 *percent.*

Audit, however, observed that in respect of four areas which involve high energy consumption viz. provision of electronic ballast, replacement of HPMV lamps, Automatic Power Factor Correction Panels and provision of Timer Switches, no target was fixed in respect of 41 *per cent* to 57 *per cent* of the workshop/sheds test checked. In PUs where substantial electrical energy is consumed, implementation of energy consumption measure was partial. The financial impact of non-implementation of energy conservation measures and shortfall in achieving the target was not evaluated either at the Zonal level or at the RB level. Though there is a system of awarding recognition for achieving target for conservation of energy, no punitive action was being taken against defaulters. There was also lack of adequate monitoring both at the Zonal and RB level of implementation of guidelines issued by the RB for energy conservation.

3.1.1 Renewable Energy

Solar energy is one of the growing sources of alternative renewable source of energy which converts sunlight directly into electricity. Similarly, power generation through wind is one of the most rapidly growing cost effective and environment friendly renewable energy technologies. "IR Vision 2020 statement" (December 2009) inter-alia envisaged use of at least 10 *per cent* of the required energy from renewable sources for reducing carbon foot print. In the budget proposal 2011-12, Minister for Railways announced setting up of 720 MW capacity Wind Mill Plants in five states[61]. However, there were no specific guidelines/instructions from the RB in this regard. Some ZRs, however, took initiatives for utilizing solar and wind power as an alternative source of energy as discussed in subsequent paragraphs.

Scrutiny of records relating to use of renewable sources of energy at selected units revealed the following:

I. Indian Railways had planned[62] to set up a total of 168 MW capacity wind mill plants across the country through capital funding and joint venture route. A new company, Railway Energy Management Company, was also set up (August 2013) to expedite harnessing green energy but the locations for

[61] Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and West Bengal

[62] Vide Pink Book item No.228 of 2010-11 (10.5 MW), 505 of 2010-11 (10.5 MW) 578 of 2012-13 (72MW), 640 of 2013-14(75MW)

installation of wind mill plants are, however, yet (June 2014) to be identified and no detailed action plan has so far been formulated in this regard;

II. At ICF/Perambur (Chennai) 10 MW capacity[63] wind mill plants were installed (March 2009) and 6.25 crore units of power was generated during the period 2009-12;


Wind Power Plant installed by ICF at Tirunelveli Dt., Tamil Nadu

III. Eighty three solar plants were installed in nine workshops and four sheds (nine *per cent*) over eight ZRs[64]. Audit observed that the saving in energy of 88075 kwh was assessed only in respect of six workshops and two sheds over five ZRs[65]. In respect of workshops and sheds in the remaining three ZRs, savings achieved as a result of use of solar plants could not be verified as the same was not assessed by the ZRs. RB stated (December 2013) that the centralized monitoring of energy saving due to solar energy plant of higher capacity had been planned through development of web based monitoring system as per Ministry of New and Renewable Energy (MNRE) guidelines. Audit, however, observed that the web based monitoring system has not been implemented till June 2014.

IV. Out of six PUs, nine solar plants were installed in three PUs[66].

Electrical Directorate of Ministry of Railways (RB) stated (December 2013) that the wind mills are provided at locations such as Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Maharashtra, Odisha, Gujarat and West Bengal having rich wind density and subject to availability of funds. Similar view was also expressed in respect of solar panel on the plea that the progress of solar panel depends upon feasibility/direction of sunlight on rooftop and other associate parameters. Scrutiny of records, however, revealed that though the states and the

[63] Windmill can generate power upto 10MW per hour depending upon the flow of wind and grid condition
[64] ER, NCR, NER, NR, SR, SWR, WCR, and WR
[65] ER, NCR, SR, SWR, and WCR
[66] ICF/Perambur/Chennai (Three), RWF/Yelahanka/SWR (Four) and DMW/Patiala (Two)

ZRs (NWR and SR) had been identified, no exercise was carried out to identify the exact locations of wind mill plants and solar panels.

Thus, the absence of any specific guidelines/instructions of the Electrical Directorate of Ministry of Railways (RB) led to inadequate initiative at the ZRs level for tapping wind and solar energy. Despite proposal in budget, the progress of installation of wind mill and solar plants was insignificant and was also not in commensurate with the policies envisaged in the Vision 2020 for use of 10 *per cent* of the energy requirement from renewable sources.

3.1.2 Energy Audit

Energy Conservation Act, 2001 classifies IR as an energy intensive industry. Ministry of Power in consultation with Bureau of Energy Efficiency (BEE)[67] notified (March 2007) workshops and PUs of Indian Railways as energy intensive establishment and specified Railways as 'Designated Consumer' (DC). Notification further specifies that every DC shall have to employ an Energy Manager who is to be certified by BEE and every DC has to get the energy audit done periodically as specified by regulation by an accredited energy auditor for which BEE conducts the certification examination.

Energy audit encompasses verification, monitoring and analysis of use of energy, including submission of recommendations for improving energy efficiency along with cost benefit analysis and action plan to reduce energy consumption.

Scrutiny of records relating to energy audit in selected units revealed the following:

I. Only 18 workshops and 10 sheds (20 *per cent*) over 13 ZRs[68] conducted energy audit during the review period and in eight workshops over eight ZRs [69] the recommendations of energy audit team were fully implemented. In the remaining 10 workshops and 10 sheds, recommendations were partially implemented. Though the energy audit report was being sent to RB, the monitoring of the progress of implementation of recommendations of energy audit was not being done at the RB level;

[67] The Government of India set up Bureau of Energy Efficiency (BEE) on 1st March 2002 under the provisions of the Energy Conservation Act, 2001. BEE co-ordinates with designated consumers, designated agencies and other organizations and recognize, identify and utilize the existing resources and infrastructure, in performing the functions assigned to it under the Energy Conservation Act.
[68] CR, ECR, ER, NCR, NER, NFR, NR, NWR, SCR, SECR, SR, WCR and WR
[69] CR, ECR, ER, NCR, NER, SCR, SR and WCR

II. Some instances are mentioned below where implementation of the recommendations would have resulted in financial savings as assessed by the ZRs:

a. In CWS/LGD/SCR, 13 recommendations of the energy auditor were not implemented though the expected savings was ₹0.14 crore per annum as against one time investment of ₹0.34 crore on the ground that the investment was more than the saving.

b. In the Manmad workshop/CR, 22 recommendations were not implemented since 2009 due to paucity of funds which could have saved energy worth ₹1.25 crore[70] during the period 2009-14 by investing ₹ 0.91 crore.

c. In the Mechanical workshop/Dibrugarh (NEFR), the recommendation of energy auditor regarding replacement of existing distilled water plant with solar distilled water plant with anticipated savings of ₹ 3.6 lakh per annum was not complied with due to paucity of funds. Similarly, in the Engineering workshop/Bongaigaon (NEFR), three recommendations of energy audit team with an annual anticipated savings of ₹2.78 lakh per annum were also not implemented during 2008-13;

d. In NWR, the recommendations of the energy audit team which projected an annual savings of ₹12.86 lakh were not implemented in five workshops and sheds[71] due to paucity of funds and non-availability of materials.

III. Out of six PUs, energy audit was conducted only in one PU (CLW/Chittaranjan).

ZRs opined that the energy audit recommendations, which were not economically feasible, were not implemented. Analysis of the economic feasibility in support of the actions of the ZRs for not implementing recommendations of the energy audit was not placed on record.

Electrical Directorate of RB stated (December 2013) that due to similar layout and pattern of energy consumption, the findings of one/two energy audit of

[70] ₹ 0.25 crore per annum

[71] DSL shed/BGKT, DSL shed/Abu road, CWS/Ajmer, Diesel Loco and wagon workshop/Ajmer, Signal workshop/Ajmer

similar type of asset is generally sufficient to make action plan for energy conservation efforts. It was also stated that the implementation of recommendations of energy audit depends upon its cost benefit analysis and the availability of funds. Scrutiny of records in the RB revealed that though the ZRs send energy audit reports to the RB, no action plan for energy conservation was framed for units based on the recommendations of Energy Audit of identical units. There exists no system at the RB level to monitor follow up action taken by the ZRs for implementation of recommendation of energy audit. The slow progress of implementation of recommendations of energy audit indicates lack of urgency of IR towards conservation of energy even though BEE classified IR as energy intensive industry.

3.2 Conservation of Water

Ground water is the primary source of water for the activities of workshops, sheds and PUs. Performance of selected units in implementation of water conservation measures revealed the following:

3.2.1 Water Recycling Plant

RB instructed (July/August 2006) the ZRs to provide Water Recycling Plant (WRP), especially at such locations (stations/sheds) where water is scarce in comparison to its demand.

Scrutiny of records relating to the implementation of RB's instruction on installation of WRP revealed the following:

i. No exercise was carried out either at the Zonal Railway level (except in WCR and SR) or at the RB level to identify requirement of WRP in workshops, sheds and PUs;
ii. There was no monitoring at the RB level to ensure compliance of its instructions on installation of WRP
iii. At coaching depot / Jabalpur (WCR), WRP with a recycling capacity of 600 kilo liters per day was provided.
iv. In view of the heavy consumption[72] of water for cleaning purposes, Southern Railway Administration proposed (2004-05) "Augmentation of water supply arrangement by installation of recycling plant and electronic monitoring system" at Coaching Depot/ Basin Bridge at an estimated cost of ₹ 3.50 crore. Though WRP was set up in December 2009, the

[72] Coaching Depot/ Basin Bridge requires 1800 KL of water for washing 500 coaches daily

same, remained idle as no over head tank for storage of recycled water was constructed. Fresh water was being used for washing coaches despite having incurred expenditure of ₹ 2.82 crore on installation of recycling plant.

Thus, there was lack of adequate efforts on the part of workshops, sheds and PUs to identify the requirement of WRP. Insignificant progress in making provision of WRP indicates the low priority attached to conservation of water despite clear instructions of RB. Moreover, RB did not monitor compliance of its own instructions.

Reply of RB was received only for S&T workshops from S&T directorate where the requirement of WRP is not necessary. No reply was given by other directorates of RB.

3.2.2 Rain Water Harvesting

Rain water harvesting (RWH) is the accumulation and storage of rainwater at surface or in sub-surface aquifers for reuse before it reaches the aquifer[73]. In February 2005, RB issued instructions to all zones to implement RWH in Railway establishments.

Scrutiny of records of selected units revealed the following:

I. RWH system was not available in 39 workshops and 73 sheds over 13 ZRs[74]; and

II. In three ZRs (SR,SWR and CR), out of ten selected workshops and 16 sheds, RWH was available only in five workshops and three sheds[75];and

III. Out of six PUs, RWH system was available at three units (RWF/Yelahanka, ICF/Chennai and RCF/Kapurthala).

Thus, the achievement in making provision of RWH in workshops and sheds was very insignificant. There was no monitoring at the RB of implementation of its instructions for making provision of RWH. This resulted in inadequate initiative on the part of ZRs towards conservation of water.

[73] An aquifer is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, or silt) from which groundwater can be extracted using a water well.
[74] ECR, ECoR, ER, NCR, NEFR, NER, NR, SCR, SECR, WR, WCR, SER and NWR (information not available)
[75] SR(5),SWR(2) and CR(1)