United Nations Development Programme

Government of India

Terminal Evaluation of UNDP/GEF Project: Improving Energy Efficiency in the Indian Railways System

(GEF Project ID: 3554; UNDP PIMS ID: 4044)

Terminal Evaluation Report

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SYNOPSIS

Title of UNDP supported GEF financed project: Improving Energy Efficiency in the Indian Railways System

UNDP Project ID: PIMS 4044

GEF Project ID: 3554

Evaluation time frame: September 2011 to January 2017

CEO endorsement date: April 20, 2011

Project implementation start date: April 20, 2011

Project end date: March 31, 2017

Date of evaluation report: March 31, 2017

Region and Countries included in the project: India

GEF Focal Area Objective: SP-2 (for GEF-4): Promoting energy efficiency in the industrial sector

Implementing partner and other strategic partners: Implementing partner: Indian Railways (IR), Ministry of Railways (MoR)

Evaluation team members: Mr Roland Wong, International Consultant
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EXECUTIVE SUMMARY

This report summarizes the findings of the Terminal Evaluation Mission conducted during the January 16-25, 2017 period for the UNDP-GEF Project entitled: "*Improving Energy Efficiency in the Indian Railways System*" (hereby referred to as the IEEIRS Project or the Project), that received a US$ 5.20 million grant from the Global Environmental Facility (GEF) in April 2011.

Project Summary Table

Project Title:	*Improving Energy Efficiency in the Indian Railways System* (IEEIRS Project)			
GEF Project ID:	3554		*at endorsement (Million US$)*	*at completion (Million US$)*
UNDP Project ID:	4044	GEF financing:	5.200	5.200
Country:	India	IA/EA own:	0	0.250
Region:	Asia and the Pacific	Government:	21.000	16.830
Focal Area:	Climate Change	Other:	26.200	2.900
FA Objectives, (OP/SP):	SP2 for GEF 4: Promoting energy efficiency in the industrial sector	Total co-financing:	21.000	19.980
Executing Agency:	Indian Railways and the Ministry of Railways (MoR)	Total Project Cost:	26.200	25.180
Other Partners involved:		ProDoc Signature (date project began):		September 2, 2011
		(Operational) Closing Date:	Proposed: 30 September 2014	Actual: 31 March 2017

Project Description

Indian Railways (IR) is the country's largest organization with the highest energy consumption in the country, consuming in the range of 1.9-2.4% of India's total electricity. In the FY 2014-15, the total electricity consumed by IR was 18,250 GWh with an estimated 86% and 14% for traction and non-traction usages respectively. Moreover, energy costs of the Indian Railways is over 76% of its total operating costs. To reduce its electricity related energy consumption as well as its carbon footprint, IR developed a long-term Energy Efficiency and Conservation Program that would progressively introduce energy saving technologies and measures in both the traction and non-traction systems. The IEEIRS Project sought to address the removal of a number of barriers constraining the ability of IR to achieve its objectives of energy conservation and GHG emission reductions including:

- weak institutional arrangements and institutional capacity to implement energy efficiency measures;
- lack of in-house technical information on existing EE options and opportunities as well as the technical skills to implement them;
- lack of incentives to encourage the adoption and implementation of EE measures; and
- a limited number of EE technologies and measures that have been tested and available in India.

Project Results

The Project goal and objective and overall outcomes of the IEEIRS Project are summarized on Table A against intended outcomes.

Table A: Comparison of Intended Project Outcomes from the Inception Report to Actual Outcomes

Intended Outcomes in April 2010 ProDoc	Actual Outcomes as of March 2017
Project Goal: Reduction of GHG emissions in the Indian Railways System (IRS) 0.117 million tonnes CO_2/yr by EOP	**Actual achievement of Project goal**: Only 485 tonnes of CO_2 per year of direct emission reductions were achieved by the IRS pilots. However, the interest generated by these non-traction EE pilots has catalyzed interest within the IRS to the extent that an estimated 9.6 million tonnes CO_2 are estimated as indirect emission reductions from non-traction applications alone.
Project Objective: Removal of key barriers that prevent the wide adoption of energy efficiency technologies and measures in the IRS with a target of 0.142 billion kWh/yr	**Actual achievement of Project objective:** Only 0.287 million kWh of direct energy savings generated by IRS non-traction pilots. These pilots, however, have helped raise awareness of IRS personnel that would facilitate widespread adoption of energy efficiency technologies and measures within the IRS as a means to reduce its energy-related operational costs.
Outcome 1: Strengthened IR institutional capacity (Outcome 1.2) and Improved EE management & technical capacity of IR staff (Outcome 1.2)	**Actual Outcome 1**: The institutional capacity of IR has been strengthened (actual Outcome 1a) coupled with improved EE management and technical capacity of IR staff (actual Outcome 1b).
Outcome 2: Proven EE technologies and measures in traction and non-traction operations are implemented and energy savings realized.	**Actual Outcome 2**: Non-traction related EE technologies and measures that have been proven in India have been implemented with energy savings realized. However, traction-related EE technologies and measures were not implemented under this Project.
Outcome 3: Increased confidence in the application of piloted EE technologies and practices in the IRS	**Actual Outcome 3**: IRS has increased confidence in newly developed applications of piloted EE technologies and practices.
Outcome 4: Information and knowledge on EE technologies and measures are widely available and accessible for IRS divisions and their affiliates	**Actual Outcome 4**: Information and knowledge on EE technologies and measures are now widely available and accessible for all IRS divisions and their affiliates.

Summary of Conclusions, Recommendations and Lessons

The overall rating of the IEEIRS Project is satisfactory. IEEIRS Project funds were utilized to implement pilot EE measures and technologies (that would otherwise have not received funding from Government of India) for:

- the supply and installation of "proven" EE non-traction technologies such as LED lighting and efficient fans to demonstrate their energy savings; and
- development of web based software and infrastructure for an Electrical Energy Management System (EEMS) that would improve the abilities of IRS personnel to monitor and manage energy consumption of their non-traction assets.

The pilot projects of "proven" technologies were successfully completed in 2015 for LED lighting fixtures, efficient ceiling fans, solar pumps systems, as well as SCADA and automated control systems with energy savings realized and documented for dissemination to IRS personnel. The impact of these pilots raised awareness of the benefits of energy efficiency amongst a wide section of electrical engineers within the IRS, and served as a springboard for the Ministry of Railways and IRS towards obtaining government allocations for the scaling up of these piloted "proven" EE technologies and measures. This is evident with confirmed government allocations for the retrofitting of LED lighting and energy efficient fans within the Northern Railways division and the Delhi Division of Indian Railways for all their stations and workshops and other non-traction assets.

The lack of traction-related EE measures implemented during the IEEIRS Project can be attributed to the unavailability of senior IRS personnel, in particular, those who authored the IEEIRS ProDoc and who could have initiated and undertaken traction-related EE technologies and measures within the IRS. This absence of traction-related EE initiatives is somewhat balanced by the successful demonstration of substantial energy savings from non-traction EE pilot projects implemented during the IEEIRS Project.

However, despite these successes, more efforts are still required to encourage dialogue and sharing EE success stories between railway divisions and zones. This would require the organization of events for IRS personnel to provide a forum exchanging information on energy efficiency issues for the IRS

Corrective actions for the design, implementation, monitoring and evaluation of the project:

Action 1 (to UNDP): For projects that involve building the capacity of an institution, more care is required in designing the implementation arrangements to minimize delays in the start-up of a project.

Action 2 (to UNDP): Implementation of projects where the primary beneficiary is a public organization (such as Ministry of Railways or Indian Railways) should adhere to a basic set of principles for capacity development. For UNDP projects, there is a 2010 report on "Ownership, Leadership and Transformation"[1] that provides a useful set of "default principles" in capacity development. The evaluators are of the opinion that these principles do provide a useful reminder of how best to commence and implement capacity development projects such as the IEEIRS Project in 2011.

Actions to follow up or reinforce initial benefits from the project*:*

Action 3 (to Indian Railways): Capacity building should be extended to IRS staff beyond electrical engineers to other engineers (mechanical and civil) as well as MoR finance and admin personnel.

Proposals for future directions underlining main objectives of IEEIRS Project:

Action 4 (to UNDP): Assist the Ministry of Railways to develop a donor-assistance project involving deployment of other unproven technologies that can be applied to lower the carbon footprint of Indian Railways.

[1] www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/drivers-of-change/leadership/ownership-leadership-and-transformation-full-text/ownership_leadership_and_transformation-FULL-TEXT.pdf?download

Best and worst practices in addressing issues relating to relevance, performance and success:

Best practice: Sustained and effective engagement by project management personnel is essential in building capacities of public institutions.

Poor practice: The IEEIRS Project was a climate change mitigation project that did not employ a monitoring and evaluation officer to carry out Project M&E functions, most importantly, credible estimates of energy savings and GHG reductions generated from Project activities. Energy savings and GHG emission reduction estimates are important metrics in the evaluation of almost all CCM projects in the GEF portfolio. As such, the absence of such a person on the IEEIRS Project with this technical knowledge would only lead to unreliable estimates of GHG emission reductions generated by Project activities.

Evaluation Ratings[2]

1. Monitoring and Evaluation	*Rating*	2. IA & EA Execution	*Rating*
M&E design at entry	5	Quality of Implementation Agency - UNDP	5
M&E Plan Implementation	4	Quality of Execution - Executing Entity (MoR/IR)	5
Overall quality of M&E	4	Overall quality of Implementation / Execution	5
3. Assessment of Outcomes	**Rating**	**4. Sustainability[3]**	**Rating**
Relevance[4]	2	Financial resources	4
Effectiveness	5	Socio-political	4
Efficiency	5	Institutional framework and governance	4
Overall Project Outcome Rating	5	Environmental	4
		Overall likelihood of sustainability	4

[2] Evaluation rating indices (except sustainability – see Footnote 2, and relevance – see Footnote 3): 6=*Highly Satisfactory (HS)*: The project has no shortcomings in the achievement of its objectives; 5=*Satisfactory (S)*: The project has minor shortcomings in the achievement of its objectives; 4=*Moderately Satisfactory (MS)*: The project has moderate shortcomings in the achievement of its objectives; 3=*Moderately Unsatisfactory (MU):* The project has significant shortcomings in the achievement of its objectives; 2=*Unsatisfactory (U)* The project has major shortcomings in the achievement of its objectives; 1=*Highly Unsatisfactory (HU):* The project has severe shortcomings in the achievement of its objectives.

[3] Sustainability Dimension Indices: *4 = Likely (L):* negligible risks to sustainability; *3 = Moderately Likely (ML):* moderate risks to sustainability; *2 = Moderately Unlikely (MU):* significant risks to sustainability; and *1 = Unlikely (U):* severe risks to sustainability. *Overall rating is equivalent to the lowest sustainability ranking score of the 4 dimensions.*

[4] Relevance is evaluated as follows: 2 = Relevant (R); 1 = Not relevant (NR)

ABBREVIATIONS

Acronym	Meaning
ABB	ASEA, Brown and Boveri & Cie
ASCB	Automatic-switched capacitor Bank
AC/DC	Alternating Current (AC) Electricity
APR-PIR	Annual Project Report - Project Implementation Review BEE Bureau of Energy Efficiency
BS	Building Services
CAGR	Compound annual growth rate
CDM	Clean Development Mechanism
CFL	Compact Fluorescent Lamp
COFMOW	Central Organisation for Modernisation of Workshops
CO	UNDP Country Office
CO_2	Carbon Dioxide
COE	Centre of Excellence
CP	Country Programme
CPAP	Country Programme Action Plan
CRIS	Centre for Railway Information Systems
DEA	Department of Economic Affairs
DFCC	Dedicated Freight Corridor Corporation of India Limited
DSM	Demand-side management
E&M	Energy and Management
EC	Energy Conservation
EE	Energy Efficiency
EECP	Energy Efficiency and Conservation Programme
EMS	Energy Management System
ESCO	Energy Service Company
EMU	Electric Multiple Unit
ESMON	Energy-cum-speed monitoring system
FY	Fiscal Year
FYP	Five-Year Plan
GDP	Gross Domestic Product
GEF	Global Environment Facility
GOI	Government of India
GHG	Green House gas
GPS	Global Positioning System
GPSDAS	GPS-based Driver Advice System
GTKM	Gross Tonne-Kilometre (including tare weight)
HOG	Head-on Generation
IEA	International Energy Agency
IEP	Integrated Energy Policy
IGBT	Insulated-gate bipolar transistor
INR	Indian Rupee
IR	Indian Railways
IREDA	Indian Renewable Energy Development Agency
IRIEEN	Indian Railways Institute of Electrical Engineering
IRS	Indian Railways System
KMS	Knowledge Management and Sharing
kWh	kilowatt hour
LED	Light-Emitting Diode

Acronym	Meaning
LRDSS	Long-range decision support system
M&W	Material and workmanship
MCAS	Microprocessor-controlled air-conditioning system
MEPS	Minimum Energy Performance Standard
MOEF	Ministry of Environment and Forests
MNRE	Ministry of New and Renewable Energy
MoR	Ministry of Railways
Mtoe	Million tonnes of oil equivalent
NAPCC	National Action Plan on Climate Change
NGO	Non-governmental organization
NMEEE	National Mission for Enhancing Energy Efficiency
NPC	National Project Coordinator
NPD	National Project Director
NT	Non-Traction
NTKM	Net tonne-kilometre (net: excluding tare weight)
PIMS	UNDP/GEF Project Information Management System
PMU	Project Management Unit
PMW	Pulse-Width Modulated
PPG	Project Preparatory Grant (GEF)
PSC	Project Steering Committee
PU	Production Unit
PV	Photovoltaic
R&D	Research and Development
RCU UNDP	Regional Coordination Unit
RDSO	Research, Designs and Standards Organization
REMC	Railway Energy Management Company (under the IRS)
RS	Rolling Stock
SERC	State Electricity Regulatory Commission
SME	Small and Medium-sized Enterprise
SNCF	French National Railways
tCO2	Tonne of Carbon Dioxide
TE	Terminal Evaluation
TEMS	Traction Energy Management System
TIRFAD	Technology Information Resource and Facilitation Desk
TOR	Terms of Reference
TPES	Total primary energy supply
TR	Traction
TRD	Traction power distribution
TSS	Traction substation
UIC	International Union of Railways
UN	United Nations
UNDAF	UN Development Assistance Framework
UNFCCC	UN Framework Convention on Climate Change
UNDP	UN Development Programme
US$c	United States Dollar Cent
USD	United States dollar (= 66 Indian Rupee)
VVVF	Variable voltage variable frequency
WDI	World Development Indicators
ZTC	Zonal Training Centre

1. INTRODUCTION

1. This report summarizes the findings of the Terminal Evaluation Mission conducted during the January 16-25, 2017 period for the UNDP-supported GEF-financed Project entitled: "**Improving Energy Efficiency in the Indian Railways System**" (hereby referred to as the IEEIRS Project or the Project), that received a USD 5.2 million grant from the Global Environmental Facility (GEF).

2. The Project goal was to reduce GHG emissions in the Indian Railways system (IRS), while the Project objective was to remove key barriers that prevent the wide adoption of energy efficiency technologies and measures in the IRS.

1.1 Purpose of the Evaluation

3. In accordance with UNDP and GEF M&E policies and procedures, all full and medium-sized UNDP supported GEF-financed projects are required to undergo a Terminal Evaluation (TE) upon completion of implementation of a project to *provide a comprehensive and systematic account of the performance of the completed project by evaluating its design, process of implementation and achievements vis-à-vis GEF project objectives and any agreed changes during project implementation.* As such, the TE for this Project serves to:
   - promote accountability and transparency, and to assess and disclose levels of Project accomplishments;
   - synthesize lessons that may help improve the selection, design and implementation of future GEF activities;
   - provide feedback on recurrent issues across the portfolio, attention needed, and on improvements regarding previously identified issues;
   - contribute to the GEF Evaluation Office databases for aggregation, analysis and reporting on effectiveness of GEF operations in achieving global environmental benefits and on the quality of monitoring and evaluation across the GEF system.

4. This TE was prepared to:
   - be undertaken independent of Project management to ensure independent quality assurance;
   - apply UNDP-GEF norms and standards for evaluations;
   - assess achievements of outputs and outcomes, likelihood of the sustainability of outcomes, and if the Project met the minimum M&E requirements;
   - report basic data of the evaluation and the Project, as well as provide lessons from the Project on broader applicability. This would include an outlook and guidance in charting future directions on sustaining current efforts by UNDP, the Government of India, and their donor partners to mainstreaming energy efficiency practices and measures and reducing GHG emissions from the operations of Indian Railways.

1.2 Scope and Methodology

5. The scope of the TE for the IEEIRS Project was to include all activities funded by GEF and activities from parallel-financing. The Terms of Reference (ToRs) for the TE are contained in Appendix A. Key issues addressed on this TE include:

- Design of the IEEIRS Project and its effectiveness in achieving the stated aims of reducing GHG emissions from the operations of the IRS and remove barriers that prevent widespread adoption of EE measures and technologies in the operations of IRS;
- Assessment of key financial aspects of the Project, including the extent of co-financing planned and realized;
- The effectiveness of the IEEIRS project in the piloting of EE measures and technologies for traction and non-traction applications;
- Strengths and weaknesses of the IEEIRS implementation, monitoring and adaptive management and sustainability of Project outcomes including the Project exit strategy;
- Results and impacts of the implemented Project activities including views from the IEEIRS Project focal points (and other relevant stakeholders) on the impacts of the IEEIRS Project activities implemented and their recommendations on the future activities within the IRS; and
- Recommendations, lessons learned, best practices from implementing this Project that could be used on other similar GEF projects.

6. Outputs from this TE will provide an outlook and guidance in charting future directions on sustaining current efforts by UNDP, and the Government of India, to mainstreaming energy practices and measures and reducing GHG emissions from the operations of Indian Railways.

7. The methodology adopted for this evaluation includes:
   - Review of project documentation (i.e. APR/PIRs, meeting minutes of Project Steering Committee or multipartite meetings) and pertinent background information;
   - Interviews with key project personnel including the current and former Project Managers, technical advisors, and Project developers;
   - Interviews with relevant stakeholders including other government agencies and institutes; and
   - Field visits to selected Project sites and interviews with beneficiaries.

   A detailed itinerary of the Mission is shown in Appendix B. A full list of people interviewed and documents reviewed are given in Appendix C and Appendix D respectively. The Evaluation Mission Team for the UNDP-GEF project was comprised of one international expert, and one national expert.

8. The Project was evaluated for overall results in the context of:
   - *Relevance* – the extent to which the outcome is suited to local and national development priorities and organizational policies, including changes over time;
   - *Effectiveness* – the extent to which an objective was achieved or how likely it is to be achieved;
   - *Efficiency* – the extent to which results were delivered with the least costly resources possible; and
   - *Sustainability* - The likely ability of an intervention to continue to deliver benefits for an extended period of time after completion.

9. All possible efforts have been made to minimize the limitations of this independent evaluation. Notwithstanding that 10 days were spent in New Delhi, Nashik and Lucknow by the evaluation team to collect and triangulate as much information as possible, follow-up interviews and Skype conversations by the evaluation team were also made after the New Delhi mission.

1.3 Structure of the Evaluation Report

10. This evaluation report is presented as follows:
    - An overview of Project activities from commencement of operations in September 2011 to the present activities of the IEEIRS Project;
    - An assessment of Project results based on Project objectives and outcomes through relevance, effectiveness and efficiency criteria;
    - Assessment of sustainability of Project outcomes;
    - Assessment of monitoring and evaluation systems;
    - Assessment of progress that affected Project outcomes and sustainability; and
    - Lessons learned and recommendations.

11. This evaluation report is designed to meet GEF's "Guidelines for GEF Agencies in Conducting Terminal Evaluations, Evaluation Document No. 3" of 2008: http://www.thegef.org/gef/sites/thegef.org/files/documents/Policies-TEguidelines7-31.pdf

12. The Evaluation also meets conditions set by:
    - the UNDP Document entitled "UNDP GEF – Terminal Evaluation Guideline": http://web.undp.org/evaluation/documents/guidance/GEF/UNDP-GEF-TE-Guide.pdf;
    - the UNDP Document entitled "Handbook on Planning, Monitoring and Evaluating for Development Results", 2009: http://www.undp.org/evaluation/handbook/documents/english/pme-handbook.pdf; and
    - the "Addendum June 2011 Evaluation": http://www.undp.org/evaluation/documents/HandBook/addendum/Evaluation-Addendum-June-2011.pdf

2. PROJECT DESCRIPTION AND DEVELOPMENT CONTEXT

2.1 Project Start and Duration

13. The IEEIRS Project officially commenced implementation on September 2, 2011, the date when the Indian government signature for the Project document (ProDoc) was obtained. The Project duration originally was planned for 3 years ending in October 2014. However, with poor progress during the 2011 to 2014 period of the Project, the Mid-Term Review was conducted in October-November 2014 with a recommendation in January 2015 that the Project for another 2 years, 2 months ending in December 2016. This request for Project extension was approved in May 2015. The current terminal date of the IEEIRS Project is March 31, 2017 that was approved in October 2016.

2.2 Problems that IEEIRS Project Sought to Address

14. The IEEIRS ProDoc was prepared in 2009 providing details on the problems that the Project sought to address. With the world's second largest population of more than 1.1 billion people and a sustained GDP growth rate of more than 9% over the past decade, the Government of India has been seeking the means to reduce its CO_2 emissions from increases in energy consumption, predominantly generated from the use of coal and other fossil fuels in the energy sector, and to mitigate the impacts of climate change.

15. Indian Railways (IR) is the country's largest organization with the highest energy consumption in the country, consuming in the range of 1.9-2.4% of India's total electricity. In the FY 2013-14, the electricity consumed by Indian Railways amounted to 17,665 GWh of which 86% was consumed for traction usages and 14% for non-traction usages. This compares with FY 2014-15 where total electricity consumed was 18,250 GWh (a rise of 3%) with 86% and 14% for traction and non-traction usages respectively[5]. Moreover, energy costs of the Indian Railways is over 76% of its total operating costs. For example, during FY 2007-08, its electricity costs were USD 1.071 billion and USD 0.201 billion for traction and non-traction respectively.

16. To reduce its electricity related energy consumption as well as its carbon footprint, IR developed a long-term Energy Efficiency and Conservation Program that would progressively introduce energy saving technologies and measures in both the traction and non-traction systems. The IEEIRS Project sought to address the removal of a number of barriers constraining the ability of IR to achieve its objectives of energy conservation and GHG emission reductions including:
    - weak institutional arrangements and institutional capacity to implement energy efficiency measures;
    - lack of in-house technical information on existing EE options and opportunities as well as the technical skills to implement them;
    - lack of incentives to encourage the adoption and implementation of EE measures; and
    - a limited number of EE technologies and measures that have been tested and available in India.

[5] Indian Railways Yearbooks 2013-14 and 2014-15, and the Central Electricity Authority of India

2.3 Goal and Objective of IEEIRS Project

17. The Project goal was to "reduce GHG emissions in the Indian Railways system (IRS)", while the Project objective was to "remove key barriers that prevent the wide adoption of energy efficiency technologies and measures in the IRS". The IEEIRS Project Results Framework (PRF) from April 2011 is contained in Appendix F.

2.4 Baseline Indicators Established

18. Objective-level baseline indicators of the IEEIRS Project includes:
    - cumulative direct emission reductions achieved in the IRS by the EOP (target of 1.168 million tonnes of CO_2 @ 0.117 million tonnes of CO_2 per year for 10 years);
    - total direct energy savings by EOP (target of 0.142 billion kWh per year).

    The baseline value for all these indicators at the start of the IEEIRS Project was zero.

19. Outcome-level baseline indicators for the IEEIRS Project includes:
    - Outcome 1.1: Strengthened IR institutional capacity:
        - status report of targeted EE technologies and measures that is available in India and abroad complete with gap analysis for implementation;
        - established and functioning EE Centre of Excellence (COE) in IRS by EOP;
        - established and functioning TIRFAD by EOP;
        - established and operational COE website by EOP;
        - number of training and testing institutes with capacity to provide trainings and testing EE measures and equipment respectively by Year 3 (target: 8 training institutes and to testing institutes);
        - number of training courses conducted by training institutes each year starting from year 3 (target: 64);
    - Outcome 1.2: improved EE management and technical capacity of IR staff:
        - number of managers and staff members trained on EE best practices and technologies by EOP (target: 325 managers, 675 staff);
        - number of successful EE projects implemented by trained managers and staff by EOP (target: 45);
    - Outcome 2: proven EE technologies and measures in traction and non-traction operations are implemented and energy savings realized:
        - potential energy savings from implementing EE technologies or measures by year 3 (target: 1.58 for traction, 110.44 non-traction);
        - percent savings derived from EE measures implemented allocated as incentives to EE implementers by EOP (target: at least 10%);
        - number of project proposals prepared for EE technologies and measure application projects by EOP (target: 45);
    - Outcome 3: increased confidence in the application of piloted EE technologies and practices in the IRS:
        - number of energy audits conducted in IRS units above 0.5 MW load by year 3 (target: 50);
        - number of pilot demonstrations designed and implemented by year 3 (target: at least 8);
        - total energy savings achieved from pilot projects by EOP (target: 30.4 million kWh);
        - percentage of successful pilot demonstrations adopted by IRS for replication by EOP (target: at least 25%);

  - number of EE technologies and measures identified as feasible for implementation (based on energy audits) by year 3 (target: 5);
- Outcome 4: information and knowledge on EE technologies and measures are widely available and accessible for IRS divisions and their affiliates:
  - average number of visitors visiting the web portal each year starting Year 2 (target: 24,000);
  - number of sets of knowledge sharing products developed and disseminated by EOP (target: 13);
  - number of awareness campaigns conducted per division per year starting Year 3 (target: 552);
  - number of IRS divisions actively participating in IRS EE programs by EOP (target: 68);
  - number of vendors registering with TIRFAD each year starting Year 3 (target: 3);
  - cumulative number of vendors attending TIRFAD campaigns by EOP (target: 39).

The baseline value for all these indicators at the start of the IEEIRS Project can be found in Appendix F.

2.5 Main Stakeholders

20. The main stakeholders of the IEEIRS Project are the Ministry of Railways (MoR), and the Indian Railways. There are several subsidiary departments and divisions that operate within the Ministry of Railways and Indian Railways. A complete listing of these departments and divisions who have participated on the IEEIRS Project is provided in Section 3.2.2 (Para 48).

2.6 Expected Results

21. To achieve the specific IEEIRS Project objective of "removing key barriers that prevent the wide adoption of energy efficiency technologies and measures in the IRS", the IEEIRS Project was designed for the removal of barriers with the following expected **Project outcomes**:

- Outcome 1a: Strengthened Indian Railways institutional capacity;
- Outcome 1b: Improved energy efficiency management and technical capacity of Indian Railways staff;
- Outcome 2: Proven EE technologies and measures in traction and non-traction operations are implemented and energy savings realized;
- Outcome 3: Increased confidence in the application of piloted EE technologies and practices in the Indian Railways system;
- Outcome 4: Information and knowledge on EE technologies and measures are widely available and accessible for IRS divisions and their affiliates.

3. FINDINGS

3.1 Project Design and Formulation

22. Design of the IEEIRS Project was conducted during the period of 2008-2009 with Rites Ltd.[6], a semi-autonomous consulting arm of Indian Railways that was led by senior officers of the Ministry of Railways knowledgeable on several energy efficiency topics but who unfortunately were not involved with the implementation of the IEEIRS Project. The IEEIRS ProDoc identified a number of barriers to the mainstreaming energy efficient practices and measures including:

- institutional barriers consisting of a lack of corporate policy on EE, lack of an institutional set up to promote and monitor EE measures, lack of capacities for training and testing EE equipment, and the lack of consideration of EE aspects in the specifications of material and equipment purchases;
- information and capacity barriers consisting of insufficient information and awareness amongst IR personnel on existing EE practices and measures, and a lack of proper technical skills and capacities amongst IR personnel to assess, tests, and implement EE technologies and measures;
- incentive barriers consisting of a lack of incentives to IR staff to implement EE measures, and a lack of incentives to the supply chain for EE products in India;
- technology barriers consisting of limited adoption within India of proven EE technologies abroad, and a lack of specific research and development that focuses on EE;
- financial barriers consisting of a lack of targeted budget to support the implementation of EE measures, a lack of an enabling framework to redirect savings from EE measures implemented, and high investment costs for certain EE technologies.

23. The strategy of the IEEIRS Project to overcome these barriers includes:

- Strong capacity building component to support broad technical assistance aimed at raising awareness and building confidence amongst thousands of IR staff on EE measures and international benchmarks and best practices, augmented by strengthening IR institutional capacity for testing equipment and training staff on EE technologies and measures
- increasing the availability of information and awareness on EE technologies and measures to IR personnel as well as the supply chain for EE technologies and measures, a role that could be played by a "technology information resource and facilitation desk" (TIRFAD);
- selection of a limited number of EE technologies and measures to be implemented during the Project that meet certain criteria for implementation including, amongst others, high rates of return, easy implementation, complementary to existing knowledge within IR, have proven success within India or abroad, and have high potential for replication. This would apply to EE technologies and measures categorized as non-traction and traction applications.

3.1.1 Analysis of Project Planning Matrix

24. The Project results framework (PRF) for the IEEIRS Project provides 24 indicators (2 objective level targets and 22 outcome level targets) to guide implementation of the Project towards its objective of "removing key barriers that prevent the wide adoption of energy efficiency technologies and

[6] Schedule "A" enterprise of the GoI

measures in the IRS". The wording of *IEEIRS Project indicators and targets do meet SMART criteria*[7]. Specific comments includes:

- on "*Goal and Objective level targets"*, specific targets for emission reductions and energy savings were supported with specific descriptions of various EE technologies and measures proposed as pilot measures under the IEEIRS Project. This included clear descriptions of traction and non-traction measures that had been proven within India as well as abroad;
- all outcome level targets have clear descriptions that are measurable and attainable within a defined time period during the Project;
- many of the assumptions provided in the PRF to attain a target are different from those listed in Section 7 of the ProDoc;

25. GHG emission reductions proposed on the IEEIRS Project was extensively covered within Annex D of the ProDoc. A number of EE concepts were described within the ProDoc categorized into those proven in India and those proven abroad. EE measures proven in India for implementation under the IEEIRS Project included:
    - Installation and operation of Automatic Switched Capacitor Bank to reduce electrical losses in Traction Sub Stations (ASCB for TSS);
    - Installation and use of LED lights (Light Emitting Diode) in coaches;
    - Installation and use of T5 Fluorescent tubes in place of T12 tubes for lighting for stations, workshops and railway offices;
    - CFLs replacing incandescent bulbs for service buildings and railway quarters;
    - Installation and operation of VVVF drives (Variable Voltage Variable Frequency) for machines.

26. EE measures proven abroad for implementation under the IEEIRS Project included:
    - Energy audit of rolling stock and implementation of recommendations;
    - Installation and operation of GPS based Driver Advice System (GPSDAS) and Energy Management System;
    - Installation and operation of microprocessor controlled air-conditioning systems for AC couches;
    - Installation and operation of roof mounted solar panels for electricity generation for passenger trains;
    - Energy audit of stations, workshops and railway offices;
    - Installation and operation of Building Management Systems (BMS) for stations, workshops and railway offices;
    - Installation and operation of Energy Management System (EMS) for pumping installations; and
    - The setup of energy testing and resource centres for testing energy efficiency parameters of various EE measures implemented within the IRS.

3.1.2 Risks and Assumptions

27. The primary assumptions identified in the IEEIRS ProDoc are:
    - sustained commitment to energy efficiency by decision makers within the IRS;
    - the ability of a Centre of Excellence to function independently under the IR board, and with support from other entities within the IRS such as TIRFAD.

[7] Specific, Measurable, Attainable, Relevant and Time-bound

28. The primary risks identified in the IEEIRS ProDoc are;
    - failure to secure continuous support for EE initiatives from various departments and divisions within the IRS;
    - lack of interest of supply chain stakeholders to investing in production lines for EE products;
    - poor coordination between IR divisions on implementing EE measures;
    - EE investments that decisions not given priority by IR managers;
    - competition from inefficient and cheap technologies coupled with the high cost of advanced EE technologies, thereby squeezing out reasonably costed EE technologies and measures.

    Annex A of the ProDoc provides 11 risks to be monitored by implementers of the IEEIRS Project.

3.1.3 Lessons from Other Relevant Projects Incorporated into IEEIRS Project Design

29. The ProDoc of the IEEIRS Project does not list any other relevant projects into its design.

3.1.4 Planned Stakeholder Participation

30. Since the primary purpose of IEEIRS Project was to increase the knowledge and build the capacity of IRS personnel to plan, implement and adopt energy efficient measures and activities, the Project planned to engage stakeholders within the Ministry of Railways and Indian Railways. This would also include the numerous agencies, divisions and departments under MoR with specific operational mandates within the Indian Railways system. In the ProDoc, primary stakeholders within the IRS included:
    - Indian Railways (IR) Board and important directorates (such as Electrical Engineering, Mechanical Engineering Production Units and Workshops);
    - Zonal Railways of which IR is divided into 16 zonal Railways each of which has a training centre;
    - IR Production Units that produce parts and take care of IR rolling stock including locomotives, coaching stock and axles and wheels;
    - Research, Designs and Standards organisation (RDSO) that serves as a technical advisor to the Railway Board, Zonal Railways and Production Units. RDSO would eventually serve as the TIRFAD for the IEEIRS Project;
    - Central Training Institutes of the Indian Railways. The Indian Railway Institute of Electrical Engineering (IRIEEN) at Nashik for Electrical Engineers was selected as the Centre of Excellence (COE) under Outcome 1.1;
    - Equipment manufacturers; and
    - International centres of excellence such as the International Union of Railways.

    The list of stakeholders identified in the ProDoc is both exhaustive and thorough.

3.1.5 Replication Approach

31. The Project design envisaged a replication approach by conducting well-managed pilot EE IEEIRS schemes using Project resources. These pilots would provide lessons learned on implementing EE IEEIRS schemes for replication pilots in other regions within the Indian Railways system. A criteria for the selection of an EE technology or measure to be implemented on the IEEIRS Project was its assessment of replication potential within the IRS. This approach to replication is entirely logical.

3.1.6 UNDP Comparative Advantage

32. UNDPs comparative advantage to other donor agencies is its focus on policy-based and cross-sectoral approaches as well as building local capacities through effective collaboration with a wide range of local stakeholders. This would include public and private sectors as well as technical experts, civil society and grassroots level organizations. These approaches are strongly applicable on energy efficiency projects such as this IEEIRS Project. Given UNDP's long track record on a wide variety of projects within the energy sector, UNDP is suited as an implementing agency for this project.

3.1.7 Linkages between IEEIRS Project and Other Interventions within the Sector

33. The intention of the IEEIRS Project was to derive benefits of other energy efficiency projects within India including the "Programmatic Framework Project for Energy Efficiency in India" (GEF project 3538), and 4 other EE projects under this programme including (i) the "Energy Efficiency Improvements in Commercial Buildings" project (UNDP); (ii) the "Chillers Energy Efficiency" project (World Bank); (iii) the "Financing Energy Efficiency in Small and Medium Enterprises" project (World Bank); and (iv) the "Promoting Energy Efficiency and Renewable Energy in selected SME clusters in India" project (UNIDO).

34. The Project was to establish mechanisms to communicate and coordinate with these other projects through its Project board with oversight of this process under UNDP India. The evaluation team does not fully comprehend the necessity or purpose of this programmatic framework for EE in India since energy issues within the EE are quite unique from those of the other projects. Furthermore, there is almost no overlap of energy related issues between SMEs and the IRS given the wide differences in the nature of business models between these 2 sets of stakeholders.

3.1.8 Management Arrangements

35. The implementing partner of the IEEIRS Project is the Ministry of Railways and the Indian Railways system in accordance with UNDPs National Implementation Modality (now referred to as National Execution or NEX modality). NEX modality tasks MoR with responsibility for certifying work plans and approved budgets, reporting on procurement, coordinating and tracking co-financing, terms of reference for contractors and tender documentation, and chairing the Project Steering Committee (PSC). The Chair of the PSC was to be the National Project Director (NPD) from MoR.

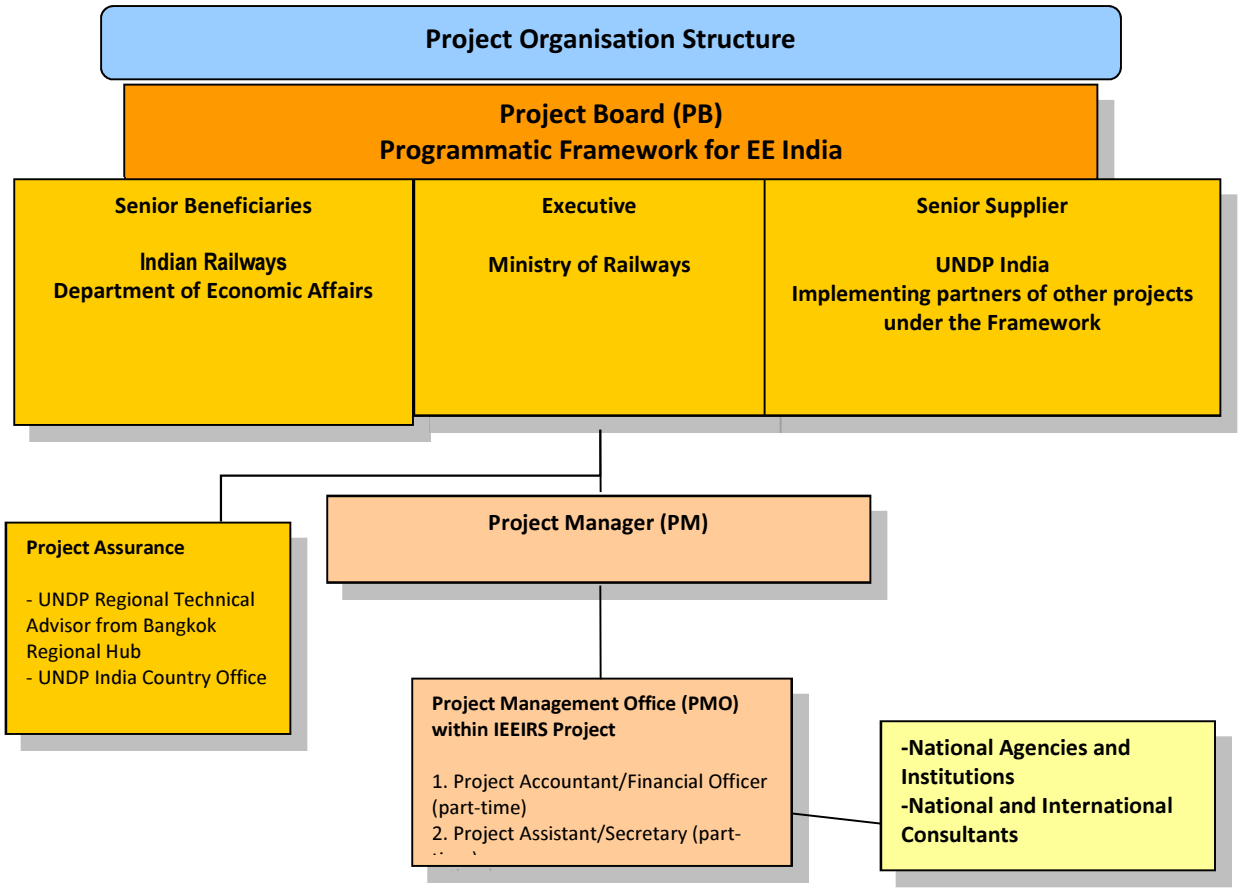
36. The NPD would be supported by a *Project Management unit (PMU)* established to implement the IEEIRS Project. The PMU under the direction of the NPD was to be responsible for implementing day-to-day activities under the lead of a *National Project Coordinator (NPC*). This would include PMU efforts to ensure the availability of experts and consultants throughout the duration of the Project. The NPC was also to be supported by administration and finance staff, and Managers for Traction (TR), Non-Traction (NT) and Energy Efficiency (EE) aspects of the IEEIRS Project. Rites Ltd was to be designated as a provider of project management and consultancy services during IEEIRS Project implementation, but only if ratified by the PSC.

37. In the ProDoc, UNDP would provide project implementation support to MoR and Indian Railways by managing the budget and project expenditures, contracting project personnel, executing actions for procurement, and implementing the day-to-day management and monitoring of Project operations. However, there is little discussion in the ProDoc of the specifics of setting up these management arrangements, in particular the integration of the flow of UNDP Project funds into the PMU which

would be under the Indian Government financial system. The lack of specific detail on this issue was carried over into implementation which caused long delays in commencing implementation of the IEEIRS Project. This issue is discussed in further detail in Para 41.

38. An organogram of the IEEIRS Project implementation arrangements is provided on Figure 1.

Figure 1: Current Management Arrangements for the UNDP-GEF Project "Improving Energy Efficiency in Indian Railways System" (IEEIRS) Project



3.2 Project Implementation

39. The following is a compilation of key events and issues of IEEIRS Project implementation in chronological order:

- The IEEIRS Project was approved by the GEF CEO on April 10, 2011;
- The ProDoc was signed on September 2, 2011, marking the official start of the Project;
- Between September 2011 and mid-2013, the IEEIRS Project experienced start-up problems related to the MoR and IR lack of familiarity in working with multilateral agencies such as UNDP,

and difficulties in resolving the issues related to UNDP fund flows into the Government of India Treasury under a NEX execution modality;

- First project developments actually commenced in June 2013 with the identification of institutions to house the Centre of Excellence, identification of EE technologies to be piloted on the project, and tendering of external services for energy auditing;
- The Project's first project manager was hired in late 2013 but was terminated in late 2014;
- The IEEIRS midterm review (MTR) was conducted in October-November 2014 with a report issued in January 2015 that observed poor progress on a number of issues including piloting of traction EE measures, and made a number of recommendations that included the need for a 2-year, 2-month extension of the IEEIRS Project from October 2014 to December 2016;
- Discussions between UNDP India and the Ministry of Railways and Indian Railways in late 2014 resulted in an agreement that the Project should be managed by UNDP India, and that the Project would utilize UNDP's procurement system and officers to acquire services and hardware for the Project. Utilization of this arrangement commenced in early 2015;
- A formal request was made in October 2016 to extend the project for 3 months to March 31, 2017. This request was granted in late 2016;
- As of January 2017, the Project is completing its activities with a planned terminal date of March 31, 2017.

3.2.1 Adaptive Management

40. Adaptive management is discussed in GEF terminal evaluations to gauge the project performance in the ability of a project to adapt to changing regulatory and environmental conditions, common occurrences that afflict the majority of GEF projects. Without adaptive management, GEF investments would not be effective in achieving their intended outcomes, outputs and targets. Unfortunately, the early stages of the IEEIRS Project were marked by difficulties in the establishment of working relationships between UNDP and its government counterparts within the Ministry of Railways and Indian Railways, for which adaptive management was required in efforts to improve the understanding of MoR and IR on the purpose of the Project as well as how best to leverage Project resources to advance mandated EE initiatives. The later stages of the IEEIRS Project, however, were marked by improved efforts to adaptively manage project activities toward achieving intended Project outcomes and objectives.

41. A summary of adaptive management initiatives by UNDP during the entire course of the IEEIRS Project includes:

- UNDP implementing changes between mid-2014 and early 2015, in an effort to more efficiently deliver Project outputs and outcomes. The need for more efficient output and outcome delivery came from difficulties experienced by UNDP to integrate the flow of UNDP funds into the GoI's financial systems in a timely manner, and to improve the efficiency in the delivery of technical services and EE technologies through "cost-sharing", where a UNDP Programme Officer manages Project finances with sign-off of expenditures from the NPD, thus avoiding the channelling of funds through the Indian government system;
- remaining flexible in terms of the EE technologies and measures to be supported by the Project given that IR personnel who authored the IEEIRS ProDoc were unavailable to the Project, the lack of readiness of IR personnel involved with the IEEIRS Project to undertake EE traction measures mentioned in the ProDoc, and the general perception amongst these IR personal that these

measures would be costly and complex in terms of implementation[8]. In place of traction measures and technologies, the Project in early 2015 did support the development of a web-based system for monitoring energy consumption of electricity consuming equipment in the IRS; and

- more dedicated approaches by UNDP to improve the effectiveness of its personnel interacting with MoR and IR personnel including improved responsiveness of UNDP to Railway Board requests for specific project assistance.

42. In conclusion, UNDP's efforts to adaptively manage this project were ***satisfactory*** in consideration of the successful outcomes of this Project.

3.2.2 Partnership Arrangements

43. The primary partnership of the IEEIRS Project was with the Ministry of Railways and Indian Railways system.

44. During the period of September 2011 to December 2014, the IEEIRS Project did not engage key stakeholders under the Ministry of Railways and the Indian Railways system to participate on the Project. However, as the work plans began to crystallize during 2014, MoR and IR identified their respective departments and agencies under which pilot EE measures could be undertaken. UNDP undertook the role of strengthening the development of EE measures by facilitating communications with other stakeholders outside the Indian Railway sector including the Bureau of Energy Efficiency (BEE) to provide advice to IR on implementing these EE measures, as well as equipment manufacturers and importers and international agencies such as the International Union of Railways (IUR), IPEEC, IEA and bilateral donors. Paras 87-89 provides more details of UNDP efforts at the November 2015 "International Summit on Energy Efficient Technologies in Railways" (in New Delhi) to provide more partnership opportunities for MoR and the IRS. Overall efforts by the IEEIRS Project to facilitate partnerships between Ministry of Railways, Indian Railways, and equipment suppliers and international centres of excellence were **satisfactory**.

3.2.3 Feedback from M&E Activities Used for Adaptive Management

45. Feedback for M&E activities was provided primarily through *PIRs from 2013 to 2016* as well as BTORs during 2014 that provided details of activities for adaptively managing the Project. In evaluating the quality of feedback provided by these reports, the evaluators noted that:
    - PIRs were not available for 2011 and 2012, likely due to the lack of activities during these years;
    - Reporting on the implementation of EE measures is poorly distinguished between "proven" and "unproven" technologies leading to some confusion over which measures would fall under the Outcomes 2 or 3. *This issue has also led to poor monitoring during the IEEIRS Project of energy savings and GHG emission reductions*. For example:
        - the pilot set up of SCADA systems and replacement of T12 and T8 lights with LEDs were reported under Outcome 2 in the 2015 PIR but switched to Outcome 3 in the 2016 PIR;

[8] A part of this fear within IR to implement EE traction measures came from the loss of the authors of the IEEIRS Project who were committed to other projects by the time the project commenced implementation in September 2011. In the estimation of the evaluation team, it is likely that these senior IR officers would have mobilized these traction initiatives given their seniority and familiarity in navigating through various departments and divisions within the IRS. However, with nearly 2 years between the completion of the IEEIRS design and the commencement of IEEIRS implementation in September 2011, the risk of losing these key personnel to implement the IEEIRS Project was high.

  - the output of the Centre of Excellence was reported under Outcomes 1.1 and 3 in the 2015 PIR but only reported under Outcome 1.1 in the 2016 PIR; and
  - LED lighting, high-efficiency fans and SCADA systems are proven technologies globally around the world and in India that should be consistently reported under Outcome 2;
  - the development of the systems for monitoring electricity consumption of IRS equipment would have fallen under Outcome 3 (since this could be categorized as an unproven measure);
- BTORs were only filed during the tenure of the project manager in 2014. No other BToRs were filed during the 2015 and 2016 periods of the project. These reports were useful to the evaluators to understand UNDP's role in the development of pilots and work plans.

46. Despite overall outcomes of the Project being satisfactory, the feedback provided by these PIRs to monitor progress of meeting set targets of the project is **moderately satisfactory** basically due to the aforementioned lack of clarity on what distinguishes proven and unproven technologies under Outcomes 2 and 3. An argument could be made (given the way the Project was managed) that there was no benefit to having Outcomes 2 and 3, and that they could have been combined. The lack of clarity distinguishing activities between Outcomes 2 and 3 may in part explain the poor performance by the Project in monitoring energy savings and GHG emission reductions of this Project.

3.2.4 Project Finance

47. The IEEIRS Project had a GEF budget of USD 5.2 million that was disbursed over a 5-year duration. Table 1 reveals:
- low rates of disbursements during the period of 2011 to 2013 that coincides with a period of very few achievements on the Project;
- an increase in IEEIRS disbursements after 2014, and at a time when adaptive management changes were undertaken by UNDP to improve Project progress;
- deviations of original ProDoc outcome expenditures including:
  - less than 20% of the US$950,000 allocated to Outcome 4 was expended on information dissemination resulting in Project savings of more than US$750,000;
  - an additional US$570,000 spent on demonstrations on Outcomes 2 and 3 that includes US$230,000 being spent on demonstrations in 2017 to the terminal date of the Project of March 31, 2017; and
  - less than 80% of the Project management budget of US$291,500, likely due to the indecision by MoR and IR on where to house the PMU, leading to savings on this budget line;

48. The expenditure profiles provided in Table 1 reveal increased expenditures after 2014 as an indication of the increased interest of MoR and the IRS of IEEIRS support to develop pilots and innovative technologies to assist the IRS in reducing its energy consumption. These expenditure profiles also indicate that the majority of Project funds were expended within a 3-year period, which was the original duration of the Project.

49. Project co-financing was USD 19.98 million, only 5% below the ProDoc estimate of USD 21.0 million but nearly 4 times the amount of the GEF grant of USD 5.2 million. Most of the co-financing was on electrical hardware related to LED lighting, EE fans, other EE equipment, and the electrical energy management system (EEMS) implemented by the Center for Railway Information Systems (CRIS). Co-financing details can be found on Table 2.

Table 1: GEF Project Budget and Expenditures for India IEEIRS Project (in USD as of December 31, 2016)

IEEIRS Outcomes	Budget (from Inception Report)	2011[21]	2012	2013	2014	2015	2016[22]	Total Disbursed	Total to be expended in 2017
OUTCOME 1: Strengthened IR institutional capacity (Outcome 1.1) and Improved EE management & technical capacity of IR staff (Outcome 1.2)	1,095,000		228,453	9,745	207,641	710,512	129,791	1,286,142	42,893
OUTCOME 2: Proven EE technologies and measures in traction and non-traction operations are implemented and energy savings realized.	1,573,500		65,250		243,369	396,256	217,107	921,982	230,000
OUTCOME 3: Increased confidence in the application of piloted EE technologies and practices in the IRS	1,290,000		192,500		1,203,738	445,641	437,742	2,279,621	
OUTCOME 4: Information and knowledge on EE technologies and measures are widely available and accessible for IRS divisions and their affiliates	950,000		1,869		16,661	146,301	35,409	200,240	
Project Management	291,500		4,000	34,454	40,352	78,446	71,870	229,122	10,000
Total (Actual)	5,200,000	0	492,071	44,199	1,711,761	1,777,157	891,919	4,917,107	282,893
Total (Cumulative Actual)	5,200,000	0	492,071	536,270	2,248,031	4,025,188	4,917,107		
Annual Planned Disbursement (from ProDoc)[23]		1,256,501	1,971,488	1,972,011	2,420,279	2,055,286	1,174,723		
% Expended of Planned Disbursement		**0%**	**25%**	**2%**	**71%**	**86%**	**76%**		

[21] From September 2011
[22] Up to December 31, 2016
[23] From planned ProDoc disbursements

Table 2: Co-Financing for India IEEIRS Project (as of December 31, 2016)

Co-financing (type/source)	UNDP own financing (million USD)		Government (million USD)		Partner Agency (million USD)		Private Sector (million USD)		Total (million USD)	
	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
Grants [24]	0.00	0.25	21.00	16.33	0.00	2.80[25]			21.00	19.38
Loans/Concessions							0.00	0.00	0.00	0.00
• In-kind support			0.00	0.50	0.00	0.10[26]			0.00	0.60
• Other									0.00	0.00
Totals	0.00	0.25	21.00	16.83	0.00	2.90	0.00	0.00	21.00	19.98

[24] Includes all cash contributions
[25] From DFCC for undertaking energy efficiency activities as guidance to Ministry of Railways
[26] From REMC for support for various Project activities

50. Overall, the cost effectiveness of the IEEIRS Project has been **satisfactory** in consideration of the catalytic impacts of the IEEIRS Project, and the replication of proven EE technologies and measures as further detailed in Sections 3.3.8 and 3.3.9.

3.2.5 M&E Design at Entry and Implementation

51. The M&E design as covered in Paras 104 to 115 in the IEEIRS Project ProDoc is robust and thorough. The design thoroughly covers all M&E activities including:

- the Project inception phase;
- quarterly reviews;
- annual Project reviews and project implementation reports (APRs/PIRs);
- independent evaluations that includes the Midterm Evaluation as well as the Final Evaluation; and
- dissemination of Project results to encourage learning and knowledge sharing.

As such, *the M&E design is rated as **satisfactory***.

52. The M&E plan implementation was affected by issues raised in Section 3.2.3 over the lack of clarity between proven and unproven EE technologies and measures. This lack of clarity makes it difficult to monitor progress of set targets as defined in the PPM of this Project. It was observed in the QPRs of 2015 and 2016 that the activities and outputs of Outcome 3 were gradually subsumed into activities of Outcome 2. This resulted in the achievement of the targets of each outcome becoming blurred. As such, *M&E plan implementation is rated as **moderately satisfactory***. Ratings according to the GEF Monitoring and Evaluation system[27] are as follows:

- *M&E design at entry - 5;*
- *M&E plan implementation - 4;*
- *Overall quality of M&E - 4.*

3.2.6 Performance of Implementing and Executing Entities

53. The performance of the implementing partner (formerly known as an Executing Agency) of the IEEIRS Project, MoR and Indian Railways, can be characterized as follows:
    - early stages of the Project were marked by poor engagement of MoR and IR personnel with Project personnel due to their lack of understanding on the purpose of the IEEIRS Project. As a result, little progress was made during the 2011 to 2014 period of the Project;

[27] 6 = HS or Highly Satisfactory: There were no shortcomings;
5 = S or Satisfactory: There were minor shortcomings,
4 = MS or Moderately Satisfactory: There were moderate shortcomings;
3 = MU or Moderately Unsatisfactory: There were significant shortcomings;
2 = U or Unsatisfactory: There were major shortcomings;
1 = HU or Highly Unsatisfactory
U/A = Unable to assess
N/A = Not applicable.

- personnel changes within MoR and IR during 2014 that had the impact of improving their interactions with UNDP, especially in the identification of new EE initiatives that had a higher likelihood of funding under the Project as opposed to GoI funding;
- recognition by key members of the Railway Board, MoR and the IRS of the benefits of the UNDP Project to their organizations that would increase access to funds for implementing innovative EE technologies and measures that would otherwise not be provided by the Government; with government agencies seemingly always short of funds, GoI funding for innovative EE measures and technologies is either highly unlikely or would be subject to a long approval process, due to perceptions that innovative proposals have a high risk of failure;
- Overall performance assessed as being **satisfactory** (with early stages being moderately satisfactory to highly satisfactory during the latter stages).

54. The performance of UNDP (the Implementing Agency) can be characterized as follows:
    - UNDP struggled during the early phases of the Project from 2011 to 2013 to understand how to more effectively provide Project assistance to MoR and IR including improving the efficiency of disbursement of UNDP funds into the Government of India Treasury and implement the Project under an NEX modality;
    - UNDP Project managers recruited under the NEX arrangement prior to 2014 were either too junior or had incompatible personalities to deal with senior IR officials, and assist them in building IR capacity;
    - Despite the difficult working relationships developed with MoR and IR up to 2014, UNDP persevered in its dialogue after 2014 with the key Project stakeholders, and made efforts to sustain engagement of these stakeholders to meet Project objectives;
    - As of January 2017, the aforementioned efforts have resulted in catalyzing the development of non-traction EE initiatives within the IRS;
    - Overall performance of UNDP on the IEEIRS Project can be assessed as being **satisfactory** (with early stages being moderately satisfactory to highly satisfactory during the latter stages).

55. A summary of ratings of the implementing and executing entities of the IEEIRS Project are as follows:
    - *Implementing Partner (MoR and Indian Railways)* – 5;
    - *Implementing Entity (UNDP)* – 5;
    - *Overall quality of implementation/execution (UNDP/MoR/Indian Railways)* – 5

3.3 Project Results

56. This section provides an overview of the overall project results and assessment of the relevance, effectiveness and efficiency, country ownership, mainstreaming, sustainability, and impact of the IEEIRS Project. In addition, evaluation ratings for overall results, effectiveness, efficiency and sustainability are also provided against the revised April 2011 Project PRF (as provided in Appendix F)[28]. For Tables 6, and 8 to 14, the "status of target achieved" is color-coded according to the following color coding scheme:

Green: Completed, indicator shows successful achievements	Yellow: Indicator shows expected completion by the EOP	Red: Indicator shows poor achievement – unlikely to be completed by project closure

[28] Evaluation ratings are on a scale of 1 to 6 as defined in Footnote 22.

3.3.1 Overall Results

57. A summary of the achievements of IEEIRS at the Project Objective level with evaluation ratings are provided on Table 3.

Table 3: Project-level achievements against IEEIRS Project targets

Intended Outcome	Performance Indicator	Baseline	Target	Status of Target Achieved	Evaluation Comments	Rating[29]
Project Goal: ***Reduction of GHG emissions in the Indian Railways System (IRS)***	Cumulative emission reductions[30] achieved in the IRS by EOP (million t CO_2)	0	0.117/yr by EOP or 1.168 (cumulative over a 10- year period)	*485 tonnes CO_2/yr of direct emissions reductions cumulative by EOP*	See para 63	2
Project Objective: ***Removal of key barriers that prevent the wide adoption of energy efficiency technologies and measures in the IRS***	Total direct energy savings[31] by EOP (billion kWh)	0	0.142/yr or 1.42 (cumulative over a 10-year period)	*0.287 million kWh of direct energy savings cumulative by EOP*	See para 63	2
Overall Rating – Project-Level Targets						**2**

58. The IEEIRS Project target for energy savings reductions was set at 1.42 billion kWh by the EOP with savings commencing in Year 3 of the Project. The direct GHG reductions were to be generated mainly from a suite of pilot projects comprising EE technologies and measures outlined in the ProDoc on pages 29 to 31 (Component 2 covering measures proven in India, and Component 3 covering measures proven abroad). Pilot projects implemented with the support of the IEEIRS Project are listed with estimates of energy savings and GHG emission reductions on Table 4.

59. The implementation of these pilot EE technologies and measures has generated direct energy savings and GHG emission reductions for the Indian Railways of 0.593 GWh per year and 455 tonnes CO_2 per year respectively. This is far below the targets of 142 GWh per year and 117,000 tonnes of CO_2 per year by the EOP, primarily due to the absence of pilot *traction-related* EE measures and technologies (with traction comprising more than 85% of the IRS energy consumption).

60. Further to traction-related EE measures, the attainability of these energy savings and GHG emission targets has been a challenge considering that senior IRS personnel (notably those who authored the IEEIRS ProDoc) who could initiate and undertake traction-related EE technologies and measures were unavailable, as mentioned in Para 41. However, successful demonstration of substantial energy savings from pilot projects in non-traction applications implemented during the IEEIRS Project has catalyzed the interest of a number of key entities within IRS including the Delhi and Northern Divisions of IRS. Their interest in EE issues has secured funds from IRS and the Government of India to replicate several EE measures and technologies within their respective divisions. This has likely or will likely generate indirect GHG emission reductions, both top-down and bottom-up. These are also estimated in Table 4.

[29] Ibid 25
[30] Total direct emission reductions in terms of tonnes CO_2 reduced per year at EOP
[31] Total direct energy savings in terms of billion kWh reduced per year at EOP

Table 4: Summary of GHG emission reductions (ERs) generated by the IEEIRS Project

EE Measure or Technology	Project Period (2011-2016)			Lifetime direct ERs (tonnes of CO_2)	Indirect ERs
	Annual energy savings (MWh/yr)	Direct ERs (tonnes of CO_2/yr)[32]	Savings as % over baseline case		
Optimal light control system over Delhi Division of IR	311.0	255	25%	2,550	0
Smart sense & smart Grid system at Baroda House, New Delhi	0	0		0	0
Provision of centralized light & fan control for New Delhi Railway Station	28.8	23	10%	230	1,077 tonnes of CO_2/yr
Provision of SCADA on New Delhi Railway Station	0	0		0	72 tonnes of CO_2/yr
Automation of pumping arrangement at Ghaziabad	0	0		0	0
LED based bay lighting in workshops & loco sheds at Ghaziabad	181.8	149	75%	1,490	0
Provision of Super energy efficient fans at New Delhi Railway Station	22.4	18	46%	180	0
Installation of Variable Voltage Variable Frequency (VVVF) drives for lifts at PK Road Railway Colony, Delhi	25.9	21	50%	210	
Provision of Solar pumps, Delhi Division, Indian Railways	23.7	19	100%	190	
Totals	**593.6 MWh/yr**	**485 tonnes of CO_2/yr**		**4,850 tonnes of CO_2**	**1,194 tonnes of CO_2/yr (bottom-up)**
Total Top-Down Indirect Emission Reductions					**9,600,000 tonnes CO_2 (see Para 62)**

61. For indirect GHG emission reductions, bottom-up reductions using any replication factor was assumed to be negligible in comparison with the magnitude of top-down indirect emission reductions. The bottom-up indirect emission reductions in Table 4 are from actual replications that took place within the IRS in other divisions.

62. These top-down emission reductions are small in comparison to the estimate for top-down indirect emission reductions which was derived as 9.6 million tonnes CO_2 over a 10-year period based on the following assumptions:
    - from Para 15, total electricity consumption by the IRS in FY 2013-14 was 17,665, rising 3% in FY 2014-15 to 18,250 GWh;
    - 14% of this electricity consumption was for non-traction purposes since only non-traction pilots completed on the IEEIRS Project;

[32] Energy savings are based on the workings done by the project team. GHG emission reductions has been computed considering a grid emission factor of 0.82 Kg CO_2 per kWh.

- a steady 3% increase of non-traction purposes electricity consumption within the IRS between the EOP of 2017 and the end of the 10-year GEF influence period ending in 2027 leading to a total electricity consumption cumulative between 2017 and 2027 of 31.9 million MWh;
- grid emissions factor for India of 0.82 tonnes CO_2/MWh leading to a cumulative GHG emissions from non-traction purposes in the IRS to be 26.2 million tonnes CO_2. The evaluation team then assumes only 12 million tonnes of CO_2 (46% of this 26.2 million tonnes of CO_2) could be saved through various energy efficient measures[33];
- a GEF causality factor of 0.8 was applied against the 10-year market potential for CO_2 reductions 12 million tonnes of CO_2 (indicating very strong effect of the Project works on the actual incremental emission reductions) for a top-down emission reduction estimate of 9.6 million tonnes of CO_2.

63. Based on the implementation of non-traction-related EE pilots and the absence of traction-related EE pilots, the IEEIRS Project-Level targets are rated as **moderately satisfactory.** Details of the GHG emission reductions from the IEEIRS Project are summarized on the GEF Tracking Tool as provided in Appendix E.

3.3.2 Component 1: Institutional capacity development and technical training

64. Activities under Component 1 were intended to "strengthen IR institutional capacity" and "improve EE management and technical capacity of the IR staff". Project resources were to be used to:
    - strengthen IR institutional capacity through the establishment of a functioning EE Centre of excellence, a technology information resource facilitation desk, the setup of an EE technology website specifically for the railway sector, and building the capacity of a number of training and testing institutes for training and testing EE measures and equipment; and
    - improve EE management and technical capacity of IR staff through training of managers and staff members on EE best practices and technologies, and facilitating the implementation of successful EE projects by these trainees.

    A summary of the actual achievements of the Component 1 with evaluation ratings are provided on Table 5.

65. The Railsaver website (https://www.railsaver.gov.in/en_con_initiatives.html) provides an update of all EE measures implemented in the IR system and is updated on a monthly basis. All the zones also report their monthly energy consumption and EE activities on this portal. Energy performance of the IRS is monitored centrally through this web based system set up by CRIS[34]. A gap analysis study was conducted by KPMG in early 2015 to how to improve IRS energy performance by adopting the latest technology on both traction and non-traction sides.

66. The evaluators observed in January 2017 training facilities and testing venues for various EE equipment that were set up with the support of the IEEIRS Project at the COE at Nashik. The testing venues were set up for testing the energy performance of air conditioners, compressors, pumps and electric motors. The presence of these testing venues significantly enhances the value of IRIEEN as a training facility.

[33] Based on the weighted average of pilot non-traction measures undertaken as summarized in Table 4.
[34] Centre for Railway Information Systems

Table 5: Outcomes 1.1 and 1.2 achievements against targets

Intended Outcome	Performance Indicator	Baseline	Target	Status of Target Achieved	Evaluation Comments	Rating [35]
Outcome 1.1: Strengthened IR institutional capacity.	Status report of targeted EE technologies / measures, its availability in India/abroad and gap analysis for its implementation	0	1	*These are regularly updated on the following link: https://www.railsaver.gov.in/en_con_initiatives.html*	*See Para 65*	5
	Established and functioning of EE Centre of Excellence (COE) in IRS by EOP	0	1[36]	*1 fully operational CoE successfully created at IRIEEN, Nasik by Year 3. Establishment of second CoE is in process at South Central Railways, Secunderabad*	*See Para 66*	6
	TIRFAD established and functioning by EOP	0	1	*Technology Information Resource and Facilitation Desk (TIRFAD) has been set up at RDSO, Lucknow and is working since October 2014*	*See Para 67*	5
	COE website established and operational by EOP	0	1	*The COE website has been established and operational on the following link: https://www.railsaver.gov.in/*	*See Para 65*	5
	Number of training and testing institutes with capacity to provide trainings and test EE measures/ equipment respectively by year 3	0	At least 8[37] At least 2[38]	*7 training centres have been set up* *2 testing institutes have been set up.*	*See Para 68*	5
	Number of training courses conducted by the training institutes each year starting from year 3	0	64[39]	*Total of 36 training courses have been completed as of mid-2016. Target of 64 training courses is expected by the EOP*	*See Para 69*	5
Outcome 1.2: Improved EE management & technical capacity of IR staff	Number of managers and staff members trained on EE best practices and technologies by EOP	0	At least 325 managers and 675 staff	*To date, more than 596 managers and staff have attended workshops on EE topics and energy auditing at IREEN*	*See Para 69*	5
	Number of successful EE projects implemented by the trained managers and staff members by EOP	0	45[40]	*Over 14 projects have been implemented by the trained managers.*	*See Para 70*	5
Overall Rating – Component 1						**5**

[35] Ibid 25
[36] Centre of Excellence established with full staff completed by year 3
[37] Training institutes with the capacity (i.e. equipment and trained staff) to provide trainings on EE
[38] Testing institutes with the capacity (i.e. test benches, calibration) to test EE measures
[39] At least one training program conducted quarterly in each of the 16 divisions starting from the third year of the project.
[40] A Project is defined as the implementation of defined technology in a specific location. The target is given assuming that all the 5 identified technologies (ref. Box 4) are implemented across the 9 Railway zones

67. Technology Information Resource and Facilitation Desk (TIRFAD) set up at RDSO, Lucknow provides services to various railway divisions in the preparation of documentation for EE measures and technologies to be piloted. The concept of a TIRFAD is useful to all railway divisions, given that personnel time within railway divisions is often focused solely on ensuring railway operations are optimal and uninterrupted. As such, they have very little time to prepare proposals for EE technologies and measures.

68. Locations of training institutes that received assistance from the IEEIRS Project includes IRIEEN, NAIR, Northern Railways, Delhi Division, Jaipur Division, SCR-Securndrabad and CRIS. Locations of the testing institutes receiving IEEIRS Project support are located at:
    - IRIEEN, Nasik (which also serves as the COE) for training and testing facilities for pumps, electric motors, solar wind hybrid systems, HVAC equipment, compressor systems and equipment for energy auditing; and
    - Secunderabad for South Central Railways that is currently under development.

69. Awareness on energy efficient technologies on traction and non-traction side has been disseminated through workshops on Energy Efficiency at the National Academy of Indian Railways (NAIR), Gujarat. As of Nov 2015, 470 mid and senior level staff members had attended these workshops. Furthermore, 596 railway staff from various departments related to electrical engineering within the IRS were sent to IREEN to take computer-based courses on EE topics and energy auditing. This includes 65 certified energy auditors within the IRS as of June 2016.

70. Moreover, the aforementioned training at newly established training facilities and testing venues has resulted in more than 14 pilot EE measures being undertaken by trainees including:
    - Northern Railways division;
    - Delhi Division;
    - Maharashtra Division.

71. In conclusion, the results of Component 1 can be rated as **satisfactory** based on the IEEIRS Project managing to deliver most intended outputs, and generally meeting the intended outcomes of a strengthened IRS institution as well as improved knowledge of EE of its management and staff personnel.

3.3.3 Component 2: Implementation of proven energy efficiency technologies and measures

72. Activities under Component 2 were intended to "implement proven EE technologies and measures in traction and non-traction operations and generate energy savings". Project resources were to be utilized to develop and implement pilot EE technologies and measures (proven in India) in various divisions throughout the IRS.

73. Energy savings targets under this component were not met due to the late start of the Project with Years 1 to 3 (2011 to 2013) being spent in setting up the Project and institutional arrangements with UNDP, and the lack of implementation of *traction-related EE measures*. Energy savings implemented under this component are listed on Table 4. A summary of the actual achievements under Component 2 with evaluation ratings are provided on Table 6.

Table 6: Outcome 2 achievements against targets

Intended Outcome	Performance Indicator	Baseline	Target	Status of Target Achieved	Evaluation Comments	Rating [41]
Outcome 2: Proven EE technologies and measures in traction and non-traction operations are implemented and energy savings realized	Potential energy savings from the implementation of EE technologies and/or measures by Year 3, million kWh/yr	0	1.58 (for traction) 110.40 (for non-traction)	*0 million kWh/yr of energy savings from EE traction measures* *0.593 million kWh/yr of energy savings from EE non-traction measures*	*See Para 74*	3
	Percentage of savings derived from EE measures implemented allocated as incentives to EE implementers by EOP	NA	At least 10%	*46% savings derived from EE measures implemented as incentives to EE implementers*	*See Paras 62, 74-75, and Table 4*	5
	Number of project proposals (technical and financial) prepared by EOP for EE technology / measure application projects	0	45[42]	*25 pilot project proposals completed by mid-2016.*	*See Para 76*	5
Overall Rating – Component 2						**4**

[41] Ibid 25

[42] A Project is defined as the implementation of defined technology in a specific location. The target is given assuming that all the 5 identified technologies (ref. Box 4) are implemented across the 9 Railway zones

74. As mentioned in Para 73, no efforts were made to implement traction EE measures and technologies. In the estimation of the evaluators, it is likely that if one of the authors of this GEF project (who had proposed traction EE measures and technologies) were designated as the National Project Director at the commencement of this Project, the implementation of EE traction measures would have likely occurred. However, this Project file fell under the management of IR personnel who were not familiar with implementing traction EE measures and energy efficiency in general. As such, plans for implementation of traction EE measures were not developed and proposed during the latter stages of the IEEIRS Project.

75. For the same personnel, development of pilot projects for non-traction EE measures and technologies were lower risk, and could be easily implemented by IRS personnel. Since many of the EE measures and technologies were proven already in India (such as LED lighting and EE fans), the use of GEF funds to implement pilot projects along these lines was agreeable to all IRS personnel and managers. Furthermore, non-traction EE measures to improve the IRS energy consumption in stations and locomotive workshops were not being addressed at all in a concerted way within the IRS. Thus, the IEEIRS Project initiatives to address non-traction EE measures and technologies was welcomed by the Railway Board.

76. The success of these pilot projects on non-traction EE measures and technologies has certainly catalysed the interest of IRS in replicating the pilot non-traction EE measures in a number of divisions within Indian Railways. As a result of this outcome, these divisions have prepared successful proposals for 25 pilot EE non-traction projects that were implemented (as under Outcome 1). Examples of some of these proposals included:

- Replacement of tube lights with LED tube lights;
- Replacement of 90 W ceiling fans with 60 W ceiling fans;
- Automation of Pumps with GSM based techniques;
- Use of energy efficient pumps;
- Micro-controller based Automatic Platform Lighting Management System with segregation of 70% / 30% circuits;
- Use of 3 stars and above labelled electrical products and equipment;
- Solar based LED lighting system for level crossing gates;
- Use of solar water heater in place of electric geyser;
- Occupancy sensors in offices;
- IR becoming a part of PAT scheme of BEE under which 16 Zonal Railways and 6 production units were declared as “designated consumers”; and
- Policy issued for use of LED lighting for all IR applications.

77. In conclusion, the results of Component 2 can be rated as **moderately satisfactory** based on the IEEIRS Project utilizing its UNDP funds to pilot EE non-traction technologies and measures (that have already been proven within India, but outside of the IRS) while not undertaking any EE traction technologies or measures.

3.3.4 Component 3: Pilot demonstration of energy efficiency technologies and measures

78. Activities under Component 3 were intended to "increase confidence in piloted EE technologies and practices in the IRS" that have been proven abroad but not in India. IEEIRS Project resources were to be utilized to conduct energy audits at IRS facilities with a load of over 0.5 MW, design and implement pilot EE demonstrations of technologies that have not yet been proven in India, monitor and evaluate pilot technologies for replication, and identification of EE technologies and measures that are feasible and plan for implementation during the latter part and after the IEEIRS Project. A summary of the actual achievements of the Component 3 with evaluation ratings are provided on Table 7.

79. One of the interesting initiatives undertaken by the IEEIRS Project was the design and commissioning of an electrical energy management system (EEMS) by the Center for Railway Information Systems (CRIS) under the Ministry of Railways. CRIS serves as the IT arm of IRS developing and managing over 100 applications mainly involving passenger reservations, ticketing and freight operations. The concept of an EEMS for use by IRS personnel was first discussed in 2012. Work on the EEMS was split into 2 phases:
    - Phase I commencing in 2013 with the development of the "Railsaver" website and application involving energy data entry modules that required rigourous training to railway staff on the process of collecting energy-related data into online forms for collection by CRIS data servers in New Delhi; and
    - Phase II commencing in 2014 for a pilot demonstration of real-time energy data collection on an IT platform and through the installation and use of 500 AMRs (automatic meter reading) meters;

80. Most recently in late 2016, CRIS developed a mobile app for use by railway staff to collect data as well as monitor electricity use of certain non-traction applications in stations, hospitals and workshops of the railway system. The features of the EEMS allow the energy managers within the IRS to monitor energy consumption within the railways electrical network, view energy consumption trends, identify specific areas where energy consumption can be reduced, and prepare energy audits and plans to reduce energy consumption and improve energy management. Without UNDP-GEF funds to undertake "experimental work" such as the development of the EEMS, development of these EE tools would not have occurred for Indian Railways for several years.

81. Funds from this component were also used for over 16 pilot demonstrations other EE technologies and measures for IRS assets that have not yet been "proven" in India (some which are listed in the pilot projects in Table 4) including:
    - Implementation of SCADA for improvement in general power supply systems;
    - Optimal light control systems;
    - Smart sense and smart grid system for buildings;
    - Provision of automatic light and fan control for railway stations;
    - Building management systems for stations, hospitals and railway offices;
    - Automation of pumping arrangement;
    - Installation of variable voltage variable frequency (VVVF) drives for lifts;
    - Intelligent station lighting for two railways stations.

Table 7: Outcome 3 achievements against targets

Intended Outcome	Performance Indicator	Baseline	Target	Status of Target Achieved	Evaluation Comments	Rating[43]
Outcome 3: Increased confidence in the application of piloted EE technologies and practices in the IRS	Number of energy audits conducted in IRS units above 0.5 MW load by year 3	NA	50	*15 No. of audits completed using project funds.* *Energy Auditing guidelines developed under the Project are being used by different Railway Zones under their own initiatives.*	*See Para 79-80*	4
	Number of pilot demonstrations designed and implemented by year 3	NA	At least 8[44]	*8 pilot demonstrations were designed and implemented by EOP.*	*See Paras 81-82*	5
	Total energy savings achieved from pilot projects by EOP, million kWh	0	30.40	*The development and subsequent use of the EEMS by IRS personnel is an excellent achievement that allows IRS personnel to improve their energy management capacities and generate energy savings. However, the Project did not estimate total energy savings from the use of the EEMS, in part due to the difficulties of estimating such savings.*	*See Paras 79-80*	5
	Percentage of successful pilot demonstrations adopted by IRS for replication by EOP, %	NA	At least 25%[45]	*Most of the pilot demonstrations (>75%) were deemed to be successful at for adoption by IRS by EOP*	*See Para 82*	6
	Based on energy audits, number of EE technologies and measures identified as feasible for implementation (planned and budgeted) by year 3	NA	At least 5[46]	*16 EE technologies and measures identified as feasible for implementation with budgets approved or planned by EOP.*	*See Para 81*	6
Overall Rating – Component 3						**5**

[43] Ibid 22
[44] Pilot/demo activities implemented and audited per selected technology
[45] For replication by the end of the project and initiated
[46] Pilots design for implementation as per selected technology and/or measure

82. The success of these EE measures and technologies has also catalyzed IRS interest into the preparation of plans for the replication of the 8 EE measures and technologies listed in Para 81. The high degree of success of replication of these pilot demonstrations can be attributed to the high level of awareness of IR engineers of options for energy savings.

83. In conclusion, the results of Component 3 can be assessed as **satisfactory** in consideration of the strong Project support for the development of EE tools such as the EEMS, and procurement of existing EE tools such as building management systems that will serve to assist in more effective energy management within the IRS.

3.3.5 Component 4: Information and Knowledge Sharing

84. Activities under Component 4 were intended to "increase the availability and accessibility of information and knowledge on EE technologies and measures to IRS divisions and their affiliates". Project resources were to be utilized to develop a web portal specifically for IR personnel on issues related to energy efficiency and conservation, develop and disseminate knowledge sharing products, support awareness campaigns and events specifically on EE railway issues, and facilitating stronger linkages between EE vendors and IRS personnel involved in implementing EE measures. A summary of the actual delivery of outputs from Component 4 with evaluation ratings are provided on Table 8.

85. The primary tool for information and knowledge sharing for the IEEIRS Project has been the "Railsaver" website (https://www.railsaver.gov.in/index.html), a site that serves a number of purposes including the posting of EE news in the Indian Railways, knowledge sharing products (such as technical EE information, energy audits and EE case studies), and Indian Railways plans for low carbonization. The site also serves as a link to the EEMS being developed by CRIS (with IEEIRS support under Component 3).

86. Despite the successes in demonstrating energy savings with the aforementioned EE measures and technologies, the success stories are not shared between railway divisions and zones. Intra-divisional and zonal dialogue on EE initiatives appears to not frequently or if it all occur. One reason cited for this lack of dialogue has been the lack of time of IRS personnel to engage in information sharing activities. This leaves an impression with the evaluation team that there is still a need and demand for events that promote and provide a forum for learning on energy efficiency issues for the IRS.

87. The IEEIRS Project supported an "International Summit on Energy Efficient Technologies for Railways" during November 2015 in New Delhi. The summit provided a unique opportunity for the Ministry of Railways to learn and share experiences of international and national industry experts involved with the latest energy efficiency solutions and technologies that could accelerate EE development within the IRS into one of the most energy efficient rail networks globally. In addition, the summit provided in-depth discussions and insights for MoR officials on a wide range of EE topics for the rail sector, and an opportunity to observe new technologies and innovative solutions showcased at the summit.

88. An example of some of the organizations present at the summit included the International Union of Railways, TTG technologies (Australia), Hitachi and Bombardier, all of whom had provided presentations and roundtable discussions on the future of energy-efficient rolling stock. While UNDP had originally planned on 300 attendees to the summit, more than 400 guests were registered while

another 200, unfortunately, were turned away. The successful and well-attended summit provided a unique opportunity for global railway professionals to understand the energy efficiency needs and the plans of Indian Railways to lower its carbon footprint. There were unsubstantiated reports of several offers of technical assistance to Indian Railways shortly after the summit that are under consideration by IR. There were also recommendations made that the summit should be an annual event for IR.

89. Conclusions from the summit included the need to develop an energy efficient operations road map for the railways (including a path for learning and adoption of new technologies used in other countries), creation of integrated policy and investment roadmaps involving public and private partners with support from a global network of experts, institutions and businesses, the need for standard methodologies for energy efficiency benchmarking in traction and non-traction measures, the need to identify and implement innovative ways of financing energy efficiency solutions for IR, and the need to improve the skill sets of all IR employees to the extent that EE technologies and measures are streamlined for adoption.

Table 8: Outcome 4 achievements against targets

Intended Outcome	Performance Indicator	Baseline	Target	Status of Target Achieved	Evaluation Comments	Rating[47]
Outcome 4: Information and knowledge on EE technologies and measures are widely available and accessible for IRS divisions and their affiliates	Average number of visitors visiting the web portal each year starting year 2	NA	24,000	Total hits on website: https://www.railsaver.gov.in/index.html up to 20,000 as of June 30, 2016	*See Para 85*	5
	Number of sets of knowledge sharing products (KSPs) developed and disseminated by EOP	NA	13 [48]	Target met including 10 CBT modules on energy audit, 15 sample energy audit reports, and a well prepared "Energy Audit Guidelines" that is popular with IRS personnel	*None*	5
	Number of awareness campaigns conducted per division per year starting year 3	0	552 [49]	40 awareness campaigns completed. Achievement is lower than target due to the fact railway divisions did not hold 2 campaigns per year for 3 years. The achievement was lower also since the trainings and events being organized by CoE and PMU were merged together. There was also a highly successful "International Summit on Energy Efficient Technologies in Railways" held in New Delhi during November 2015.	*See Paras 87-89*	5
	Number of IRS divisions that are actively participating in IRS EE programs by EOP	0	68	Target met as all railway divisions have been actively participating in EE programmes	*None*	5
	Number of vendors registering with TIRFAD each year starting year 3 (i.e. from 2013)	NA	About 3 [50]	Target met with 11 vendors registered.	*None*	5
	Cumulative number of vendors attending TIRFAD campaigns by the EOP	0	At least 39 [51]	Around 10 venders participated in the EE events jointly organized by NR and RDSO in November 2015.	*None*	5
Overall Rating – Component 4						**5**

[47] Ibid 22

[48] At least one leaflet/booklet for each technology or a measure that will be demonstrated will be produced. This information is included in a regular (project) newsletter and also uploaded onto the web

[49] At least 2 campaigns per division per year conducted by the end of the project (i.e. 68 divisions + 16 zonal headquarters + 1 railways + IRIEEN + IDSO + 5 production units x 3 years) over 16 zonal headquarters

[50] Per successful pilot technology register with TIRFAD

[51] At least three vendors per technology (13 numbers)

90. In conclusion, the results of Component 4 can be assessed as **satisfactory** in consideration of the setup of the rail saver website complete with a plethora of information on EE issues with the railways, and the completion of numerous EE awareness raising campaigns within the various railway divisions, and the high level of awareness amongst many IR personnel of the importance of energy efficiency to the competitiveness and sustainability of IR operations.

3.3.6 Relevance

91. The IEEIRS Project is **relevant** to the development priorities of India, notably the Integrated Energy Policy (IEP) of 2006 and the National Action Plan on Climate Change (NAPCC). The objective of the IEEIRS Project of reducing GHG emissions from the operations of the Indian Railways is in line with the Government's strategy to increase India's energy security, and to undertake and implement key strategies and actions to mitigate the impacts of climate change.

3.3.7 Effectiveness and Efficiency

92. The effectiveness of the IEEIRS Project has been **satisfactory**, despite the Project not reaching its GHG emission reduction targets, most notably from the lack of implemented traction-related EE measures. However, considering the difficulties experienced by UNDP in working with the Ministry of Railways during the early stages of the Project, and working with a government ministry with no prior experience working with donor agencies, UNDP adapted its working relationship with MoR in a manner to effectively and efficiently provide technical assistance for energy efficiency-related issues. To some extent, however, it is unfortunate that the authors of the IEEIRS ProDoc were unavailable to the Project which likely would have resulted in traction-related EE measures being undertaken.

93. Firstly, UNDP built a strong working relationship with members of the Railway Board who acted as the primary decision-makers in determining activities to be supported by the IEEIRS Project. This required working very closely with senior railway personnel to obtain a strong understanding of their needs, and to prepare plans for technical assistance in implementation. This included measures undertaken by UNDP to accelerate progress of the Project including adapting the NEX modality through "cost-sharing" by channeling the UNDP-GEF Project funds through UNDPs accounting system with sign-off of expenditures through the NPD and using the UNDP system for procuring goods and services, thereby avoiding GoI's procurement system which is more complex and less responsive.

94. Secondly, both UNDP and the Railway Board worked towards agreements that IEEIRS Project funds would be utilized to demonstrate EE measures and technologies (already proven in India), prepare energy audits and business plans for government support and funding, and supporting pilot projects consisting of EE measures and technologies (which have been proven outside of India); all these EE measures and technologies were piloted and demonstrated with IEEIRS Project funds which would not have received funding from GoI allocations. These pilot projects and demonstrations were all implemented in a manner using procurement systems under UNDP to obtain the best value for EE technologies.

95. The efficiency of the IEEIRS Project has been **satisfactory** despite the slow progress between 2010 and 2013 period during a familiarization period for MoR and IR personnel becoming familiar working with multilateral funding agencies. The original Project duration specified in the ProDoc was 3 years.

As such, it is unfortunate that the Project took 3 years to properly mobilize IEEIRS resources, leaving one to ponder if the Project could have actually been implemented within 3 years with better preparations and improved readiness of IR personnel.

3.3.8 Country Ownership and Drivenness

96. During the early stages of the IEEIRS Project, the Ministry of Railways and Indian Railways had initially not understood the purpose of this Project or UNDPs assistance to the railway sector. However, due to the perseverance of UNDP to continually engage MoR and IR on this project, both MoR and IR took stronger ownership of the Project, utilizing its funds for efforts to advance energy efficiency measures and technologies within the IRS. Moreover, there is strong evidence within the IRS of the higher level of awareness of energy efficiency, especially considering the desire of various divisions and zones within the IRS to participate in competitions involving national energy conservation awards. In 2016, 127 entities within Indian Railways were rewarded awarded for their efforts on energy conservation within the IRS.

97. The drivenness of the Government of India to conserve energy is highlighted in their:

- Energy Conservation Act of 2001 which allowed for the establishment of the Bureau of Energy Efficiency (BEE), the National Electricity Policy of 2005 which provided emphasis on energy conservation aspects and mandating BEE to initiate energy efficiency actions;
- the Integrated Energy Policy (IEP) of 2006 which placed an emphasis on improving India's energy security (amongst other measures) by reducing its dependence on imported fossil fuels through improving energy efficiency and shifting freight traffic to Railways, and expanding electrification of railways to reduce diesel demand; and
- the National Action Plan on Climate Change (NAPCC) of 2008 that is organized within the framework of 8 priority programs or “national missions” which includes the National Mission for Energy Efficiency (NMEEE) with the goal of achieving reduction in carbon emissions of 98 million tonnes per year by 2014-15. Within the NMEEE, there is a ”perform, achieve and trade” (PAT) scheme designed as a market-based mechanism to enhance the energy efficiency of designated consumers or DCs to meet goals of reducing energy intensity and allowing those who exceed these goals to receive permits that can be traded to other DCs. The IRS now has 8 DCs which fall under the PAT scheme.

98. The Government of India also has a strong commitment towards energy efficiency and climate change as articulated in their Second National Communications to UNFCCC to reduce its emissions intensity by 20 to 25% from 2005 levels by 2020. The IEEIRS Project serves to advance energy efficiency and reduce energy intensity of its largest industrial sector, the railways.

3.3.9 Mainstreaming

99. The IEEIRS Project has successfully mainstreamed with the UNDAF for India (2013 to 2017)[52]. This includes Project activities that work towards the UNDAF’s Outcome 6: Sustainable Development, specifically India’s aim to reduce GHG emissions, and support its mission on enhanced energy efficiency. To this end, the contribution of the IEEIRS Project includes the enabling and subsequent strengthening of one of India’s largest ministries, the Ministry of Railways, to introduce and

[52] http://in.one.un.org/wp-content/uploads/2016/09/India_UNDAF202013-17_9Jul2012-1.pdf

implement energy efficiency technologies and measures at an accelerated rate in comparison with the business as usual scenario. Moreover, the Project has contributed towards the strengthening of IREEN near Nashik as the Centre of Excellence for energy efficiency in the railway sector, as a means of ensuring the dissemination of EE best practices to the more than 3 million employees of Indian Railways.

3.3.10 Sustainability of Project Outcomes

100. In assessing sustainability of the IEEIRS Project, the evaluators asked "how likely will the Project outcomes be sustained beyond Project termination?" Sustainability of these objectives was evaluated in the dimensions of financial resources, socio-political risks, institutional framework and governance, and environmental factors, using a simple ranking scheme:

- *4 = Likely (L):* negligible risks to sustainability;
- *3 = Moderately Likely (ML):* moderate risks to sustainability;
- *2 = Moderately Unlikely (MU):* significant risks to sustainability; and
- *1 = Unlikely (U):* severe risks to sustainability; and
- *U/A = unable to assess*.

Overall rating is equivalent to the lowest sustainability ranking score of the 4 dimensions.

101. *The overall IEEIRS Project sustainability rating is likely (L).* This is primarily due to:

- Financial resources being in place to continue several EE related activities for all outcomes of this Project;
- Strong support amongst all MoR and IR personnel on implementing energy efficiency projects within the IRS, especially with more widespread knowledge of the benefits of EE to the entire IRS, and the fact that these EE activities strongly support the NMEEE;
- the sustaining of all outcomes through personnel within various divisions within the Indian Railways, the Centre of Excellence at IREEN in Nashik, and the Centre for Railway Information Systems (CRIS).

Details of sustainability ratings for the IEEIRS Project are provided on Table 9.

3.3.11 Impacts

102. The impact of the IEEIRS Project has been significant as it has catalyzed interest in energy efficiency within the IRS on a more widespread scale, and increased the availability of GoI funding and related information for EE initiatives within the IRS. Previously, energy efficiency proposals were made by a small group of dynamic IR officers with poor access to appropriate levels of funding for implementing EE initiatives. With the IEEIRS Project, IR personnel now have improved access to funds for proposing and implementing pilot EE technologies and measures that would not have received funding from GoI budgetary allocations. In addition, with the completion of pilot projects under the IEEIRS Project, GoI budgetary allocations for replication of these pilot projects now receive quicker approvals.

Table 9: Assessment of Sustainability of Outcomes

Actual Outcomes (as of December 2016)	Assessment of Sustainability	Dimensions of Sustainability
Actual Outcome 1: The institutional capacity of IR has been strengthened (actual Outcome 1a) coupled with improved EE management and technical capacity of IR staff (actual Outcome 1b)	• *Financial Resources:* Financial resources are in place to sustain management skills of EE staff at the more than 8 training centres within the IRS during this Project. In addition, this includes 2 testing centres that augment the technical capacity of the IRS for equipment compliance testing for various EE standards; • *Socio-Political Risks:* Continued activities from these outcomes strongly supports the NMEEE, thus ensuring there are no socio-political risks to the sustained operation of training and testing centres that were set up during the IEEIRS Project; • *Institutional Framework and Governance:* The training and testing centres set up during the Project are embedded within the various IRS divisions as well as the Centre of Excellence located at IREEN in Nashik; • *Environmental Factors:* Activities in this outcome strongly support the development of energy efficiency within the IRS and is viewed as a major contributor to the IRS goals of becoming a green institution. ***Overall Rating***	4 4 4 4 **4**
Actual Outcome 2: Non-traction - related EE technologies and measures that have been proven in India have been implemented with energy savings realized. However, traction-related EE technologies and measures were not implemented under this Project.	• *Financial Resources:* GoI budgets have been allocated and committed to various divisions within the IRS to continue implementation of EE technologies and measures for non-traction operations, in light of the energy savings realized during the pilot projects; • *Socio-Political Risks:* Continued implementation of EE technologies and measures for non-traction operations strongly supports the NMEEE thus ensuring no social political risks to continued implementation of EE technologies and measures for both traction and non-traction operations; • *Institutional Framework and Governance:* Actual work on implementing EE technologies and measures for non-traction operations will be sustained as it takes place within the various IRS divisions. There are ongoing initiatives for traction EE initiatives within the IRS with their own resources; • *Environmental Factors:* Activities in this outcome strongly support the development of energy efficiency within the IRS and is viewed as a major contributor to the IRS goals of becoming a green institution. ***Overall Rating***	4 4 4 4 **4**
Actual Outcome 3: IRS has increased confidence in newly developed applications of piloted EE technologies and practices. .	• *Financial Resources:* Financial resources are in place with GoI budget allocations to scale up the use of all 8 piloted EE technologies and practices, as well as the scaled up use system-wide and continued development of the EEMS being developed by CRIS; • *Socio-Political Risks:* All piloted EE technologies and practices and the EEMS are strongly supported by all IR personnel. In addition, continued implementation of piloted EE	4 4

Table 9: Assessment of Sustainability of Outcomes

Actual Outcomes (as of December 2016)	Assessment of Sustainability	Dimensions of Sustainability
	technologies and practices strongly supports the NMEEE thus ensuring no social political risks to this outcome; • *Institutional Framework and Governance:* Actual work on implementing these EE technologies and practices will be sustained as it takes place within the various IRS divisions. Sustained support for the EEMS is being provided by CRIS; • *Environmental Factors:* Activities in this outcome strongly support the development of energy efficiency within the IRS and is viewed as a major contributor to the IRS goals of becoming a green institution. ***Overall Rating***	4 4 **4**
Actual Outcome 4: Information and knowledge on EE technologies and measures are now widely available and accessible for all IRS divisions and their affiliates.	• *Financial Resources:* Financial resources are in place with GoI budget allocations to sustain the operation of the "Railsaver" website with all its relevant data pertaining to energy efficiency issues and needs of the IRS; • *Socio-Political Risks:* The continued operation of the "Railsaver" website strongly supports the NMEEE thus ensuring no social political risks to this outcome; • *Institutional Framework and Governance:* Continued hosting of the "Railsaver" website is with the Ministry of Railways; • *Environmental Factors:* Activities in this outcome strongly support the development of energy efficiency within the IRS and is viewed as a major contributor to the IRS goals of becoming a green institution. ***Overall Rating***	4 4 4 4 **4**
	Overall Rating of Project Sustainability:	**4**

103. The IEEIRS Project has also had an impact on strengthening the technical knowledge of EE issues involving a wider range of IR officers. This can be attributed to accelerated learning within the IRS on EE issues through a dynamic website hosted by the Ministry of Railways with postings of EE developments throughout the IRS and EE equipment testing facilities at IREEN and other locations, technical papers on various EE measures and technologies, and linkages to the EEMS to allow IRS personnel to monitor and manage energy consumption of their non-traction assets.

104. While the Project did not generate significant impacts from its activities on traction energy efficiency, the impact of the IEEIRS Project on non-traction energy efficiency initiatives has raised the profile of energy efficiency as an important issue for the entire railway sector, notably the urgent need for reducing energy costs to its operations, both traction and non-traction costs that comprises a significant portion of the IRS operational budgets. This will likely have the impact of increasing the number of GoI-funded EE initiatives in traction pilots and replications.

4. CONCLUSIONS, RECOMMENDATIONS AND LESSONS

105. The commencement of the IEEIRS Project during its early stages was marked by poor progress caused by a lack of readiness of both the Ministry of Railways and UNDP, typical of many GEF funded projects. A key issue for the MoR was understanding how the availability of GEF funds could assist Indian Railways on implementing energy efficiency initiatives. The perseverance of certain individuals within the Railway Board of the Ministry of Railways and UNDP India allowed these entities to reach common ground by 2014 on efficiently implementing energy efficiency initiatives within the IRS. Common ground included:

- availing IEEIRS Project funds to implement various EE measures and technologies (that would otherwise have not received funding from Government of India):
  - the supply and installation of EE non-traction technologies ("proven" in India) such as LED lighting and efficient fans to demonstrate their energy savings (under Component 2); and
  - the pilot development of web based software and infrastructure for the Electrical Energy Management System (EEMS) that would improve the abilities of IRS personnel to monitor and manage energy consumption of their non-traction assets;
- by cost sharing in the NEX modality, GEF project funds would be channeled through UNDPs financial system with a signoff from the NPD thereby avoiding disbursements through the more complex financial system of the Indian Government.

106. The pilot projects of "proven" technologies under Outcome 2 were successfully completed in 2015 for LED lighting fixtures, efficient ceiling fans, solar pumps systems, as well as SCADA and automated control systems with energy savings realized and documented for dissemination to IRS personnel. The impact of these pilots raised awareness of the benefits of energy efficiency amongst a wide section of electrical engineers within the IRS, and served as a springboard for the Ministry of Railways and IRS towards obtaining government allocations for the scaling up of these piloted "proven" EE technologies and measures. This is evident with confirmed government allocations for the retrofitting of LED lighting and energy efficient fans within the Northern Railways division and the Delhi division of Indian Railways for all their stations and workshops and other non-traction assets.

107. With regards to the lack of traction-related EE measures implemented during the IEEIRS Project, it is unfortunate that senior IRS personnel, in particular, those who authored the IEEIRS ProDoc and who could initiate and undertake traction-related EE technologies and measures within the IRS, were unavailable. This absence of traction -related EE initiatives is somewhat balanced by the successful demonstration of substantial energy savings from non-traction EE pilot projects implemented during the IEEIRS Project.

108. However, despite these successes, more efforts are still required to encourage dialogue and sharing EE success stories between railway divisions and zones. This would require the organization of events for IRS personnel to provide a forum exchanging information on energy efficiency issues for the IRS.

4.1 Corrective actions for the design, implementation, monitoring and evaluation of the project

109. *Action 1 (to UNDP): For projects that involve building the capacity of an institution, more care is required in designing the implementation arrangements to minimize delays in the startup of a project.* For a number of recently completed GEF projects, poorly planned projects often experience problems in implementation due to wrong assumptions and a lack of baseline information. In the case of the IEEIRS Project, more investigations should have been undertaken during the design phase to better understand the nature of working with the Ministry of Railways as well as Indian Railways. Additional care in designing the implementation arrangements of this Project would have revealed issues on NEX implementation arrangements in the integration of UNDP fund flows with the Government of India financial system. Furthermore, the project preparation teams could have been more thorough in their capacity assessment of MoR and IR in the context of existing capacities, institutional priorities, processes and systems, and institutional mindsets and value systems. An understanding of these capacities at the outset of the Project would have possibly led to employing different strategies at the commencement of the Project, including employing the project personnel who have commensurate experience and seniority with counterpart IRS personnel..

110. *Action 2 (to UNDP): Implementation of projects where the primary beneficiary is a public organization (such as Ministry of Railways or Indian Railways) should adhere to a basic set of principles for capacity development.* For UNDP projects, there is a 2010 report on "Ownership, Leadership and Transformation"[53] that provides a useful set of "default principles" in capacity development. The evaluators are of the opinion that these principles do provide a useful reminder of how best to commence and implement capacity development projects such as the IEEIRS Project in 2011. While it may be difficult to adhere to all the 10 principles listed in the report, knowledge of these principles can serve as a useful measuring stick in the context of how efficiently a capacity development project can be started. UNDP project officers and associated project management staff should be fully aware of these capacity development guidelines that would apply to institutional strengthening can projects such as the IEEIRS Project, especially in the context of how UNDP interacts with their government counterparts. Towards the end of the IEEIRS Project, the successes of the last 2 years of implementation could possibly be linked to the adherence to many of the principles listed in this report. A listing of these default principles is provided in Appendix H.

4.2 Actions to follow up or reinforce initial benefits from the project

111. *Action 3 (to Indian Railways): Capacity building should extended to IRS staff beyond electrical engineers to other engineers (mechanical and civil) as well as MoR finance and admin personnel*. The evaluation team observed that there appears to be very little sharing of information on the positive experiences of EE from pilot projects between the various divisions and even other engineering professionals outside the electrical departments. In addition, some of the IR electrical engineers had mentioned delays in getting financing for EE initiatives approved with financing departments within the IRS. The evaluation team believes that Indian Railways after completion of the IEEIRS Project, should foster an environment of information sharing between the different divisions in IR, and to

[53] www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/drivers-of-change/leadership/ownership-leadership-and-transformation-full-text/ownership_leadership_and_transformation-FULL-TEXT.pdf?download

personnel beyond electrical engineers. This would include sharing knowledge of EE benefits to civil and mechanical engineers, as well as finance and administration personnel of the Ministry of Railways. This could only help Indian Railways in raising the awareness and knowledge of EE to all of its personnel that would in turn allow these personnel to support and sign off on energy efficiency initiatives within the IRS. Providing basic knowledge of EE benefits to finance and administrative personnel would likely have the impact of minimizing processing times for financing requests for EE initiatives, which are often stalled if the finance or administrative personnel do not understand the reasons behind a request for funds of an EE initiative. The Project should hold a terminal event for the IEEIRS Project that should include the dissemination of results of all the pilot project as well as financial and operational benefits to the IRS to personnel across the different divisions and departments of IR, that should reach out to other engineering disciplines as well as financial and administrative personnel.

112. Otherwise, no further actions are recommended to reinforce the original intended outcomes and benefits of the IEEIRS Project which were to "remove key barriers that prevent the wide adoption of energy efficiency technologies and measures in the IRS", and reduce GHG emissions in the IRS. This was based on discussions with key Railway Board personnel concerning IR efforts to scale up EE measures and practices throughout the entire system. From the evaluator's perspective, the replication of the deployment of EE technologies and measures throughout the IRS is robust, albeit only for non-traction EE initiatives. This includes the systems that are in place to monitor energy efficiency, and the internal competition amongst all divisions to become the most energy efficient division within the IRS, a source of pride for its employees. In addition, key Railway Board personnel also disclosed that they were no other (non-traction) EE technologies worth considering that required pilots to demonstrate energy savings. They implied that the demonstrations for LED lights, ceiling fans, SCADA systems, and solar-wind hybrid generation systems covers most of the opportunities available within IRS for energy savings and energy efficiency.

4.3 Proposals for future directions underlining main objectives

113. *Action 4 (to UNDP): Assist the Ministry of Railways to develop a donor-assistance project involving deployment of other unproven technologies that can be applied to lower the carbon footprint of Indian Railways.* Assistance from UNDP as well as GEF can be utilized for the development of these unproven ventures, many of which were listed in the ProDoc but not implemented during the IEEIRS Project. This may include:

- Energy efficient transformers;
- Automatic power factor correctors that would replace the current capacitors which could be applied in both traction and non-traction applications;
- Development of net zero building that house running rooms and barricks for train crew accommodations. This would include retrofitting such a building with zero carbon cooking facilities, water heating, air conditioners, etc.

4.4 Best and worst practices in addressing issues relating to relevance, performance and success

114. *Best practice: Sustained and effective engagement by project management personnel is essential in building capacities of public institutions*. On the IEEIRS Project, despite the slow commencement of the Project, project management was effectively being done by UNDP. UNDP demonstrated its ability to understand the institution whose capacity was being built for energy efficiency. It reacted accordingly and efficiently to its demands by providing appropriate funding for various consultancies, workshops and information dissemination activities, and provided financing for EE technologies that were unproven to Indian Railways. Moreover, the conduct of UNDP interactions with UNDP with MoR and Indian Railways after 2014 can be viewed as a best practice including:

- its ability to ensure steady engagement despite the difficult circumstances experience by UNDP with MoR and Indian Railways between 2011 and 2013. This included frequent, proactive and focused communication, as well as contributions from UNDP on solutions to integrate project inputs with the priorities of Indian Railways, and building on the existing engineering strength of Indian Railways personnel;
- UNDP remaining accountable to MoR and Indian Railways on the use of project funds, and fostering an environment of transparency between the 2 parties;
- supporting suggestions by the beneficiaries for sustainable capacity outcomes such as the inventory of energy consuming equipment and their energy consumption, and reporting system by divisions on energy consumption. While these were not on the original ProDoc, their development would have long ranging impacts in terms of supporting quantifiable energy efficiency efforts by Indian Railways by establishing a system to monitor baseline energy consumption.

115. *Poor practice: The IEEIRS Project was a climate change mitigation project that did not employ a monitoring and evaluation officer to carry out Project M&E functions, most importantly, credible estimates of energy savings and GHG reductions generated from Project activities.* Energy savings and GHG emission reduction estimates are important metrics in the evaluation of almost all CCM projects in the GEF portfolio. As such, the absence of such a person on the IEEIRS Project with this technical knowledge would only lead to unreliable estimates of GHG emission reductions generated by Project activities. The presence of such an officer with this skill would be of benefit not only to the reporting of this project, but also to the Indian Government and their reporting of GHG emission reductions to the UNFCCC.

APPENDIX A – MISSION TERMS OF REFERENCE FOR IEEIRS PROJECT FINAL EVALUATION

1. INTRODUCTION

In accordance with UNDP and GEF M&E policies and procedures, all full and medium-sized UNDP support GEF financed projects are required to undergo a terminal evaluation upon completion of implementation. These terms of reference (TOR) sets out the expectations for a Terminal Evaluation (TE) of the Improving Energy Efficiency in the Indian Railways System Project.

The essentials of the project to be evaluated are as follows:

2. PROJECT SUMMARY TABLE

Project Title:	Improving Energy Efficiency in the Indian Railways System			
GEF Project ID:	3554 (GEF PMIS#)		*at endorsement*	*at completion*
UNDP Project ID:	4044 (UNDP PIMS#) 00076108 (Atlas ID#)	GEF financing:	$5,200,000	
Country:	India	IA/EA own:		
Region:	Asia and Pacific	Government:	$20,000,000	
Focal Area:	Climate Change	Other (Financing Institutions & Promoters):	$1,000,000	
FA Objectives, (OP/SP):		Total co-financing:		
Executing Agency:	UNDP	Total Project Cost:	$26,200,000	
Other Partners involved:	N/A	ProDoc Signature (date project began):		Sep 02, 2011
		(Operational) Closing Date:	Proposed: Oct 30, 2014	Actual: Dec 31, 2016

3. OBJECTIVE AND SCOPE

In order to achieve the project objective, the project key Components and Outcomes are as follows.

Project objective, outcomes and outputs/activities
Indian Railways (IR) has developed a long-term Energy Efficiency and Conservation Program (EECP) (2010-2032). The Program aims at progressively introducing a number of energy efficiency technologies and measures in the railways system. The objective of this Program is to save 10% of the electricity consumption in absolute terms by 2032, in line with the targets of national initiatives on energy conservation and climate change.

This project aims at improving energy efficiency in the Indian Railways system (and thereby reducing GHG emissions) by removing some of the key barriers that prevent the wide adoption of energy efficiency

technologies and measures in the IR system. Specifically, this project aims at achieving the stated objective by:

(1) Institutional capacity development and technical training on EE,
(2) Implementation of proven EE technologies and measures to build capacity and confidence on EE;
(3) Pilot demonstration of EE technologies and measures to prove their applicability in the Indian environment; and
(4) Information and knowledge sharing.

Institutional capacity development and technical training on EE:
This component has below mentioned outputs –

- Documented energy efficiency (EE) best practices (measures and technologies) and define EE benchmarks for railway systems
- Established and supported Centre of Excellence (COE)
- Trained and qualified staff members of the relevant IR departments capable of implementing EE technologies, measures, and best practices

Implementation of proven EE technologies and measures to build capacity and confidence on EE:

This component has below mentioned outputs –

- Documented detailed information on available EE technologies and measures
- Developed and implemented energy audit procedures
- Completed implementation of ready and proven technologies and measures
- Developed and implemented incentive schemes

Pilot demonstration of EE technologies and measures to prove their applicability in the Indian environment

This component has below mentioned outputs –

- Completed demonstration of EE technologies and measures

Information and knowledge sharing

- Collected lessons learned and developed knowledge sharing products
- Developed post-project action plan for COE

The TE will be conducted according to the guidance, rules and procedures established by UNDP and GEF as reflected in the UNDP Evaluation Guidance for GEF Financed Projects.

The objectives of the evaluation are to assess the achievement of project results, and to draw lessons that can both improve the sustainability of benefits from this project, and aid in the overall enhancement of UNDP programming.

4. EVALUATION APPROACH AND METHOD

An overall approach and method1 for conducting project terminal evaluations of UNDP supported GEF financed projects have developed over time. The evaluation should include a mixed methodology of document review, interviews, and observations from project site visits, at minimum, and the evaluators should make an effort to triangulate information. The evaluator(s) is(are) expected to frame the

evaluation effort using the criteria of relevance, effectiveness, efficiency, sustainability, and impact, as defined and explained in the UNDP Guidance for Conducting Terminal Evaluations of UNDP-supported, GEF-financed Projects. The international consultant will be the team leader and coordinate the evaluation process to ensure quality of the report and its timely submission. For additional information on methods, see the Handbook on Planning, Monitoring and Evaluating for Development Results, Chapter 7, pg. 163

The international consultant will provide supportive roles both in terms of professional back up, translation etc. The evaluation team is expected to become well versed as to the project objectives, historical developments, institutional and management mechanisms, activities and status of accomplishments. Information will be gathered through document review, group and individual interviews and site visits. A set of questions covering each of these criteria have been drafted and are included with this TOR (Annex D). The evaluator(s) is(are) expected to amend, complete and submit this matrix as part of an evaluation inception report, and shall include it as an annex to the final report.

The evaluation must provide evidence-based information that is credible, reliable and useful. The evaluator is expected to follow a participatory and consultative approach ensuring close engagement with government counterparts, in particular the GEF operational focal point, UNDP Country Office, Project Management Unit, and other key stakeholders. The evaluator is expected to conduct a field mission as indicated in section 4 of this Procurement Notice i.e. Financial Proposal (page 2). Interviews will be held with the following individuals and organizations at a minimum, but not limited to:

- Relevant personnel at UNDP Country Office in New Delhi, India and Program Officer in-charge of the Project
- National Project Director (NPD)
- National Project Coordinator (NPC)
- Project Management Unit (PMU)
- Relevant project stakeholders

The evaluator will review all relevant sources of information, such as the project document, inception workshop report, annual work and financial plans, project reports – including Annual APR/PIR (until 2015), project budget revisions, quarterly reports, Minutes of Project Technical Committee/Project Steering Committee meetings, Back- to-Office Reports of UNDP staff (if any), Study reports/Conference proceedings/government guidelines, etc., midterm review, progress reports, GEF focal area tracking tools, project files, national strategic and legal documents, and any other materials that the evaluator considers useful for this evidence-based assessment such as terms of reference for past consultants' assignments and summary of the results; past audit reports (if any). A list of documents that the project team will provide to the evaluator for review is included in Annex C of this Terms of Reference.

5. EVALUATION CRITERIA & RATINGS

An assessment of project performance will be carried out, based against expectations set out in the Project Logical Framework/Results Framework (see Annex B), which provides performance and impact indicators for project implementation along with their corresponding means of verification. The evaluation will at a minimum cover the criteria of: relevance, effectiveness, efficiency, sustainability and impact. Ratings must be provided on the following performance criteria. The completed table must be included in the evaluation executive summary. The obligatory rating scales are included in Footnote 27.

Evaluation Ratings:			
1. Monitoring and Evaluation	***rating***	**2. IA& EA Execution**	***rating***
M&E design at entry		Quality of UNDP Implementation - Implementing Agency (IA)	
M&E Plan Implementation		Quality of Execution - Executing Agency (EA)	
Overall quality of M&E		Overall quality of Implementation / Execution	
3. Assessment of Outcomes	**rating**	**4. Sustainability**	**rating**
Relevance		Financial resources	
Effectiveness		Socio-political	
Efficiency		Institutional framework and governance	
Overall Project Outcome Rating		Environmental	
		Overall likelihood of sustainability	

6. PROJECT FINANCE / COFINANCE

The Evaluation will assess the key financial aspects of the project, including the extent of co-financing planned and realized. Project cost and funding data will be required, including annual expenditures. Variances between planned and actual expenditures will need to be assessed and explained. Results from recent financial audits, as available, should be taken into consideration. The evaluator(s) will receive assistance from the Country Office (CO) and Project Team to obtain financial data in order to complete the co-financing table below, which will be included in the terminal evaluation report.

7. MAINSTREAMING

UNDP supported GEF financed projects are key components in UNDP country programming, as well as regional and global programmes. The evaluation will assess the extent to which the project successfully mainstreamed other UNDP priorities, including poverty alleviation, improved governance, the prevention and recovery from natural disasters, and gender. The evaluation will examine this project's contribution to the United Nations Development Assistance Framework (UNDAF).

8. IMPACT

The evaluators will assess the extent to which the project is achieving impacts or progressing towards the achievement of impacts. Key findings that should be brought out in the evaluations include whether the project has demonstrated: a) verifiable improvements in ecological status, b) verifiable reductions in stress on ecological systems, and/or c) demonstrated progress towards these impact achievements.2

9. CONCLUSIONS, RECOMMENDATIONS & LESSONS

The evaluation report must include a chapter providing a set of conclusions, recommendations and lessons. Conclusions should build on findings and be based in evidence. Recommendations should be prioritized, specific, relevant, and targeted, with suggested implementers of the recommendations. Lessons should have wider applicability to other initiatives across the region, the area of intervention, and for the future.

10. IMPLEMENTATION ARRANGEMENTS

A useful tool for gauging progress to impact is the Review of Outcomes to Impacts (ROtI) method developed by the GEF Evaluation Office: ROTI Handbook 2009. The principal responsibility for managing this evaluation resides with the UNDP CO in New Delhi, India. The UNDP CO will contract the evaluators and ensure travel arrangements within the country for the evaluation team. The Project Team will be responsible for liaising with the Evaluators team to set up stakeholder interviews, arrange field visits, coordinate with the Government etc.

Throughout the period of evaluation, the evaluation team will liaise closely with the Programme Officer/ Adviser/Project Manager, the concerned agencies of the Government, any members of the international team of experts under the project and the counterpart staff assigned to the project. The team can raise or discuss any issue or topic it deems necessary to fulfil its task, the team, however, is not authorized to make any commitments to any part on behalf of UNDP/GEF or the Government.

Logistics: The team will conduct a mission visit to New Delhi and selected project sites, to meet with relevant project stakeholders. This visit will also include meetings with the officials of UNDP, the Implementing Partner, stakeholders from other institutions and ministries related to the project.

After the initial briefing by UNDP CO, the review team will meet with the National Project Director (NPD), National Project Coordinator (NPC) and the GEF Operational Focal Point as required.

11. EVALUATION TIMEFRAME

The total duration of the evaluation will be 25 working days according to the following plan:

Activity	Working Days	Completion Date
Preparation	5 days	*15th June, 2016*
Evaluation Mission	10 days	*4th July, 2016*
Draft Evaluation Report	7 days	*20th July, 2016*
Final Report	3 days	*3rd August, 2016*

12. EVALUATION DELIVERABLES

The evaluation team is expected to deliver the following:

Deliverable	Content	Timing	Responsi
Inception Report	Evaluator provides clarifications on timing and method	No later than 2 weeks before the evaluation mission.	Evaluator submits to UNDP CO
Presentation	Initial Findings	End of evaluation mission	To project management,
Draft Final Report	Full report including TT sheet calculations, (per annexed template) with annexes	Within 7 days of the evaluation mission	Sent to CO, reviewed by RTA, PCU, GEF OFPs
Final Report	Revised report	Within 3 days of receiving UNDP comments on draft	Sent to CO for uploading to

13. TEAM COMPOSITION

The evaluation team will be composed of 1 international and 1 national evaluator3. The individual experts in the team need to have good technical knowledge of energy efficiency and its impact on climate change in general, specifically Railways sector and its national context, and program/project implementation in India, possess good evaluation experience, and writing skills to carry out the assignment. The consultants shall have prior experience in evaluating similar projects. Experience with GEF financed projects is an advantage. International evaluator will be designated as the team leader and will be responsible for quality and timely submission of the report. The allocation of tasks in the execution of this TOR shall be decided mutually between the International and National consultants. The evaluators selected should not have participated in the project preparation and/or implementation and should not have conflict of interest with project related activities.
The international consultant must present the following qualifications and professional background:

- Minimum of ten years accumulated and recognized professional experience energy efficiency and climate change projects, and knowledge of UNDP and GEF;
- Minimum of six years of project evaluation experience in the result-based management framework, adaptive management in climate change projects and community development
- Minimum Post-Graduate degree in Engineering, Management or Business administration.
- Knowledge of energy efficiency policies/conditions in India and abroad through implementation or through consultancies in evaluation of donor funded projects
- Demonstrated ability to assess complex situations, succinctly, distils critical issues, and draw forward- looking conclusions and recommendations;
- Ability and experience to lead multi-disciplinary and national teams, and deliver quality reports within the given time;
- Experience with multilateral and bilateral supported energy efficiency and/or climate change projects;
- Very good report writing skills in English.

The evaluation team shall conduct debriefing for the UNDP Country Office, NPD, NPC, Project Management Unit, in India towards the end of the evaluation mission. The international consultant shall lead presentation of the draft review findings, creating the recommendations, and shall lead the drafting and finalization of the terminal evaluation report.

Note: Candidates meeting minimum qualification and experience as stated above will get 70% marks , additional marks will be awarded for additional expertise.

14. EVALUATOR ETHICS

Evaluation consultants will be held to the highest ethical standards and are required to sign a Code of Conduct (Annex I) upon acceptance of the assignment. UNDP evaluations are conducted in accordance with the principles outlined in the UNEG 'Ethical Guidelines for Evaluations'.

APPENDIX B – MISSION ITINERARY (FOR JANUARY 2017)

#	Activity	Stakeholder involved	Place
***January 15, 2017** (Sunday)*			
	Arrival of Roland Wong in New Delhi		
January 16, 2017 (Monday)			
1	Evaluation debriefing meeting with Mr. Saba Kalam, Programme Officer	UNDP	New Delhi
January 17, 2017 (Tuesday)			
2	Meeting and site visit with Mrs. Tarini Baswal, GM of Electrical Project, Mr. Sanjaya Das, Managing Director	Central Railways Information System (CRIS) of Indian Railways	New Delhi
January 18, 2017 (Wednesday)			
3	Meeting with Mr. Sudhil Garg, Executive Director (Electrical Energy Management) and Member, Railway Board	Ministry of Railway	New Delhi
4	Meeting with Mr. Vivek Agarwal, former IEEIRS Project Manager	UNDP	New Delhi
	Travel from New Delhi to Nashik, Maharashtra		
January 19, 2017 (Thursday)			
5	Meeting and site visit with Mr. A.K. Mathur, Senior Professor and IRIEE staff	Indian Railways Institute of Electrical Engineering (IRIEE)	Nashik, Maharashtra
January 20, 2017 (Friday)			
	Travel from Nashik, Maharashtra to Mumbai		
6	Meeting with Electrical Engineering Division of the Chattraputi Shivaji Terminus	Indian Railways	Mumbai
	Travel from Mumbai to New Delhi		
January 21-22, 2017 (Saturday and Sunday)			
	Work on report		
January 23, 2017 (Monday)			
	Travel from New Delhi to Lucknow		
7	Visit with RDSO	Indian Railways	Lucknow
	Travel from Lucknow to New Delhi		

#	Activity	Stakeholder involved	Place
January 24, 2017 (Tuesday)			
8	Meeting with Mr. Saba Kalam	UNDP	New Delhi
9	Meeting with Mr. R.K. Chaudry, Chief Electrical General Engineer	Northern Railways under the MoR	New Delhi
10	Meeting with Mr. Vikram Yadav, IRSEE and Senior Divisional Electrical Engineer of DRM	Northern Railway	New Delhi
January 25, 2017 (Wednesday)			
11	Evaluation debriefing meeting at UNDP offices	UNDP	New Delhi
February 3, 2017 (Friday)			
	Departure of Roland Wong from New Delhi		

Total number of meetings conducted: 10

APPENDIX C – LIST OF PERSONS INTERVIEWED

This is a listing of persons contacted in New Delhi, Nashik and Lucknow (unless otherwise noted) during the Terminal Evaluation Period only. The Evaluation Team regrets any omissions to this list.

1. Ms. Marina Walter, Deputy Country Director, UNDP India, New Delhi;
2. Ms. Preeti Soni, Energy and Environment Cluster Lead, UNDP India, New Delhi;
3. Mr. Saba Kalam, Programme Officer, UNDP India, New Delhi;
4. Mr. Sudhir Garg, Executive Director, Ministry of Railways, New Delhi;
5. Dr. Sh. Anil Mathur, Senior Professor, IRIEEN, Nashik, Maharashtra;
6. Mr. R.K. Chaudhary, Chief Electrical Engineer, Northern Railway, Delhi;
7. Mr. Vikram Yadav, Senior Divisional Electrical Engineer, Northern Railway, Delhi;
8. Mr. R.K. Chauve, Senior Divisional Electrical Engineer, Ministry of Railways, Chhatrapati Shivaji Terminus, Mumbai;
9. Mr. D N Sahu, Divisional Electrical Engineer, Chhatarapati Shivaji Terminus, Mumbai
10. Mr. Suresh V, Asst. Divisional Electrical Engineer, Chhatarapati Shivaji Terminus, Mumbai
11. Mr. Sanjaya Das, Managing Director, CRIS, New Delhi;
12. Mrs. Vandana Nanda, Director Finance, CRIS, New Delhi;
13. Ms. Tarini Baswal, General Manager, Electrical Project, CRIS, New Delhi;
14. Mr. Abhijit Nanada, Registrar, CRIC, New Delhi
15. Mr. Arvind Kumar, Project Engineer, CRIS, New Delhi
16. Mr. Aditya Pandey, Project Engineer, CRIS, New Delhi
17. Mr. Namit Kumar, Assistant Manager, RITES Limited, Gurgaon;
18. Mr. R.K. Mishra, Executive Director, Energy Management, RDSO, Lucknow;
19. Mr. Sh. A.K. Maurya, Director, Energy Management, RDSO, Lucknow.

APPENDIX D – LIST OF DOCUMENTS REVIEWED

1. UNDP Project Document for the "Improving Energy Efficiency in the Indian Railways System" (IEEIRS Project);

2. UNDP-GEF Mid-Term Review Report for the IEEIRS Project by Eugenia Katsigris and Sandeep Tandon, January 2015;

3. UNDP-GEF and Ministry of Railways report on "Project Inception Report for the IEEIRS Project", November 2011;

4. UNDP-GEF final report on "Improving Energy Efficiency in the Indian Railway system under Indian Railway - UNDP project" by KPMG, February 2015;

5. IEEIRS Annual Work Plans from 2012 to 2016;

6. IEEIRS Quarterly Progress Reports from 2011 to 2016;

7. IEEIRS Project Implementation Reports from 2013 to 2016;

8. IEEIRS Project Steering Committee meeting minutes from 2009 to 2016;

9. IEEIRS Project Combined Delivery Reports from 2012 to 2016;

10. IEEIRS Project Back to Office Reports (BTOR) for 2014 only;

11. Ministry of Railways report "Whistling Ahead - Story of Growth and Modernization", by Electrical Department, 2016, available on: http://www.indianrailways.gov.in/Indian%20Railways%20Whistling%20Ahead-%20%20Story%20of%20Growth%20and%20Modernisation-Booklet.pdf;

12. UNDP India report on "Energy Smart: the Indian Railways Powers Ahead", November 2015, available on: https://undp-india.exposure.co/energy-smart-the-indian-railways-powers-ahead;

13. UNDP India videos on IEEIRS Project, available on: http://www.in.undp.org/content/india/en/home/ourwork/environmentandenergy/videos/on-track--energy-efficiency-in-the-indian-railways.html; and http://www.in.undp.org/content/india/en/home/ourwork/environmentandenergy/videos/data-is-power--innovations-in-the-indian-railways-support-effect.html

14. Proceedings - International Summit on Energy Efficient Technologies in Railways, jointly prepared by Ministry of Railways, Institute of Railway Electrical Engineers, and UNDP, November 2015;

15. Ministry of Railways website for IEEIRS project: www.railsaver.gov.in.

APPENDIX E – COMPLETED TRACKING TOOL

Tracking Tool for Climate Change Mitigation Projects (For Terminal Evaluation)

Special Notes: reporting on lifetime emissions avoided

Lifetime direct GHG emissions avoided: Lifetime direct GHG emissions avoided are the emissions reductions attributable to the investments made **during the project's supervised implementation period**, totaled over the respective lifetime of the investments.

Lifetime direct post-project emissions avoided: Lifetime direct post-project emissions avoided are the emissions reductions attributable to the investments made outside the project's supervised implementation period, but supported by financial facilities put in place by the GEF project, totaled over the respective lifetime of the investments. These financial facilities will still be operational after the project ends, such as partial credit guarantee facilities, risk mitigation facilities, or revolving funds.

Lifetime indirect GHG emissions avoided (top-down and bottom-up): indirect emissions reductions are those attributable to the long-term outcomes of the GEF activities that remove barriers, such as capacity building, innovation, catalytic action for replication.

Please refer to the Manual for Calculating GHG Benefits of GEF Projects.

Manual for Energy Efficiency and Renewable Energy Projects

Manual for Transportation Projects

For LULUCF projects, the definitions of "lifetime direct and indirect" apply. Lifetime length is defined to be 20 years, unless a different number of years is deemed appropriate. For emission or removal factors (tonnes of CO2eq per hectare per year), use IPCC defaults or country specific factors.

General Data	Results at Terminal Evaluation	Notes
Project Title	Improving Energy Efficiency in the Indian Railway System	
GEF ID	3554	
Agency Project ID	4044	
Country	India	
Region	SAR	
GEF Agency	UNDP	
Date of Council/CEO Approval	April 20, 2011	**Month DD, YYYY (e.g., May 12, 2010)**
GEF Grant (US$)	5,200,000	
Date of submission of the tracking tool	April 30, 2017	**Month DD, YYYY (e.g., May 12, 2010)**
Is the project consistent with the priorities identified in National Communications, Technology Needs Assessment, or other Enabling Activities under the UNFCCC?	1	**Yes = 1, No = 0**
Is the project linked to carbon finance?	0	**Yes = 1, No = 0**
Cumulative cofinancing realized (US$)	19980000	
Cumulative additional resources mobilized (US$)		**additional resources means beyond the cofinancing committed at CEO endorsement**

Objective 2: Energy Efficiency		
Please specify if the project targets any of the following areas		
Lighting	1	Yes = 1, No = 0
Appliances (white goods)	0	Yes = 1, No = 0
Equipment	1	Yes = 1, No = 0
Cook stoves	0	Yes = 1, No = 0
Existing building	1	Yes = 1, No = 0
New building	0	Yes = 1, No = 0
Industrial processes	0	Yes = 1, No = 0
Synergy with phase-out of ozone depleting substances	0	Yes = 1, No = 0
Other (please specify)	Railway EE	
Policy and regulatory framework	2	0: not an objective/component 1: no policy/regulation/strategy in place 2: policy/regulation/strategy discussed and proposed 3: policy/regulation/strategy proposed but not adopted 4: policy/regulation/strategy adopted but not enforced 5: policy/regulation/strategy enforced
Establishment of financial facilities (e.g., credit lines, risk guarantees, revolving funds)	0	0: not an objective/component 1: no facility in place 2: facilities discussed and proposed 3: facilities proposed but not operationalized/funded 4: facilities operationalized/funded but have no demand 5: facilities operationalized/funded and have sufficient demand
Capacity building	3	0: not an objective/component 1: no capacity built 2: information disseminated/awareness raised 3: training delivered 4: institutional/human capacity strengthened 5: institutional/human capacity utilized and sustained
Lifetime energy saved	21,369,600	MJ (Million Joule, IEA unit converter: http://www.iea.org/stats/unit.asp) Fuel savings should be converted to energy savings by using the net calorific value of the specific fuel. End-use electricity savings should be converted to energy savings by using the conversion factor for the specific supply and distribution system. These energy savings are then totaled over the respective lifetime of the investments.
Lifetime direct GHG emissions avoided	4,850	tonnes CO2eq (see Special Notes above)
Lifetime direct post-project GHG emissions avoided	-	tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (bottom-up)	11,940	tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)	9,600,000	tonnes CO2eq (see Special Notes above)

APPENDIX F – PROJECT PLANNING MATRIX FOR IEEIRS PROJECT (FROM APRIL 2010)

Objective / Outcome: Description of Objective / Outcome	Description of Indicator	Baseline Level	Target Level at end of project
Project Goal: Reduction of GHG emissions in the Indian Railways System (IRS)	Cumulative emission reductions[54] achieved in the IRS by EOP[55] (million t CO_2)	0	0.117
Project Objective Removal of key barriers that prevent the wide adoption of energy efficiency technologies and measures in the IRS	Total direct energy savings[56] by EOP (billion kWh)	0	0.142
Component 1: Institutional capacity development and technical training			
Outcome 1.1: Strengthened IR institutional capacity	Status report of targeted EE technologies / measures, its availability in India/abroad and gap analysis for its implementation	0	1
	Established and functioning of EE Centre of Excellence (COE) in IRS by EOP	0	1
	TIRFAD established and functioning by EOP	0	1
	COE website established and operational by EO	0	1
	Number of training and testing institutes with capacity to provide trainings and test EE measures/equipment respectively by year 3	0	8
	Number of training courses conducted by the training institutes each year starting from year 3	0	64
Outcome 1.2: Improved EE management & technical capacity of IR staff	Number of managers and staff members trained on EE best practices and technologies by EOP	0	At least 325 managers and 675 staff
	Number of successful EE projects implemented by the trained managers and staff members by EOP	0	45
Component 2: Implementation of proven energy efficiency technologies and measures			
Outcome 2: Proven EE technologies and measures in traction and non- traction operations are implemented and energy savings realized	Potential energy savings from the implementation of EE technologies and/or measures by EoP, million kWh/yr	0	1.58 (for traction) 110.40 (for non-traction)
	Percentage of savings derived from EE measures implemented allocated as incentives to EE implementers by EOP	NA	At least 10%
	Number of project proposals (technical and financial) prepared by EOP for EE technology / measure application projects	0	45

[54] Total direct emission reductions (from year 3 of the project i.e. final year)
[55] The use of words "End of Project (EOP)" and "Year 3" are interchangeably used, which means the same
[56] Total direct energy savings (from year 3 of the project i.e. final year)

Objective / Outcome: Description of Objective / Outcome	Description of Indicator	Baseline Level	Target Level at end of project
Component 3: Pilot demonstration of energy efficiency technologies and measures			
Outcome 3: Increased confidence in the application of piloted EE technologies and practices in the IRS	Number of energy audits conducted in IRS units above 0.5 MW load by year 3	NA	50
	Number of pilot demonstrations designed and implemented by year 3	NA	At least 8
	Total energy savings achieved from pilot project by EOP, million kWh	0	30.40
	Percentage of successful pilot demonstrations adopted by IRS for replication by EOP, %	NA	At least 25%
	Based on energy audits, number of EE technologies and measures identified as feasible for implementation (planned and budgeted) by year 3	NA	At least 5
Component 4: Information and knowledge sharing			
Outcome 4: Information and knowledge on EE technologies and measures are widely available and accessible for IRS divisions and their affiliates	Average number of visitors visiting the web portal each year starting year 2	NA	24,000
	Number of sets of knowledge sharing products (KSPs) developed and disseminated by EOP	NA	13
	Number of IRS divisions that are actively participating in IRS EE programs by EOP	0	68
	Number of vendors registering with TIRFAD each year starting year 3	NA	About 3
	Cumulative number of vendors attending TIRFA campaigns by the EOP	0	39

APPENDIX G: EVALUATION CRITERIA QUESTIONS

Evaluative Criteria	Questions	Indicators	Sources[57]	Methodology[58]
Relevance: How does the project relate to the main objectives of the GEF focal area, and to the environment and development priorities at the local, regional and national levels?				
• Is the project relevant to National priorities and commitment under international conventions?	• Is the project country-driven? BEE is a statutory body under Ministry of Power, Government of India. It was set up in set up in 2002, it is responsible for implementation of the Energy Conservation Act 2001 with the primary objective of promoting energy saving measures and in turn reducing energy intensity. 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. With BEE as the coordinator of umbrella programme on "Programmatic Framework Project for EE" under which IEEIRS is one of the projects, and BEE is one of the PSC members.	BEE and IRS contributions at PSC meetings	PSC meeting minutes	Document analysis and interviews with PSC members
	• Does the project adequately take into account the national realities, both in terms of institutional and policy framework in its design and its implementation? Consistent with the National Action Plan on Climate Change (2008), and particularly with the National Mission for Energy Efficiency, which calls for strengthening legal mandate of 2001 ECA. Project is linked with the EECP implementation, and with relevant stakeholders who would be involved with implementing and adopting EE technologies and measures.	BEE and IRS contributions at PSC meetings	PSC meeting minutes	Document analysis and interviews with PSC members

[57] Various sources, but not limited to project document, project reports, national policies & strategies, key project partners & stakeholders, needs assessment studies, data collected throughout monitoring and evaluation, data reported in project annual & quarterly reports etc

[58] Various methodologies, but not limited to Data analysis, Documents analysis, Interviews with project team, Interviews with relevant stakeholders etc.

Evaluative Criteria	Questions	Indicators	Sources[57]	Methodology[58]
	• How effective is the project in terms of supporting and facilitating energy efficiency policies and programmes in the Indian Railways? The PSC includes key institutions to support and implement EE policies and programmes including BEE and the Ministry of Power who would support Indian Railways in adopting and implementing EE policies and programmes.	BEE and IRS contributions at PSC meetings	PSC meeting minutes, PIRs and QPRs	Document analysis and interviews with PSC members
	• What was the level of stakeholder participation in project design and ownership in project implementation? To be determined during course of evaluation. There is evidence of strong participation of the Indian Railways on project design.	BEE and IRS contributions at PSC meetings	PSC meeting minutes, PIRs and QPRs	Document analysis and interviews with PSC members
• Is the project internally coherent in its design?	• Are there logical linkages between expected results of the project (log frame) and the project design (in terms of project components, choice of partners, structure, delivery mechanism, scope, budget, use of resources etc.)? Yes, the design provides a detailed approach to the EE opportunities, the barriers within the institutions and that constrain widespread EE implementation, the roles and responsibilities of relevant government and private stakeholders, and a logical framework to implement a barrier removal strategy.	All indicators in the log frame	PIRs and QPRs	Document analysis and interviews with PSC members
	• Even after one extension, does the project achieve its expected outcomes? Yes though the extent of achievement will be determined during the evaluation.	All indicators and targets in the log frame	PIRs and QPRs	Document analysis and interviews with PSC members
	• Did the project made satisfactory accomplishment in achieving project outputs vis-à-vis the targets and related delivery of inputs and activities? Most outputs appear to have been achieved in a satisfactory manner.	All indicators and targets in the log frame	PIRs and QPRs	Document analysis and interviews with PSC members

Evaluative Criteria	Questions	Indicators	Sources[57]	Methodology[58]
• Does the project provide relevant lessons and experiences for other similar projects in the future?	• Has the experience of the project provided relevant lessons for other future projects targeted at similar objectives? None identified at this time although this project is one of the 5 projects under the "Programmatic Framework Project for Energy Efficiency in India" (GEF project 3538) that will coordinate with other EE projects to exchange experiences.	All indicators and targets in the log frame	PIRs and QPRs	Document analysis and interviews with PSC members
Effectiveness: The extent to which an objective has been achieved or how likely it is to be achieved?				
• Does the project been effective in achieving the expected outcomes and objectives?	• Whether the performance measurement indicators and targets used in the project monitoring system are accomplished and able to achieve desired project outcomes within 31st December 2016? Most targets appear to have been achieved. However, energy savings and GHG reduction targets are not likely to be achieved (as per UNDP comment)	All indicators and targets in the log frame	PIRs and QPRs and consultant reports on GHG reductions and energy savings	Document analysis and interviews with PSC members
• How is risk and risk mitigation being managed?	• How well are risks, assumptions and impact drivers being managed? To be determined through review of the Project Risk Logs.	Risks identified in risk log	Risk log, PIRs and QPRs	Document analysis and interviews with PMU
	• What was the quality of risk mitigation strategies developed? Were these sufficient? Based on the review of the PIRs, the proactiveness of IR personnel has mitigated risks considerably. This will need to be reviewed with the	Risks identified in risk log	Risk log, PIRs and QPRs	Document analysis and interviews with PMU
	• Are there clear strategies for risk mitigation related with long-term sustainability of the project? No, probably due to the proactiveness of IR personnel in advancing the project.	Risks identified in risk log	Risk log, PIRs and QPRs	Document analysis and interviews with PMU
• Consideration of recommendations and reporting of information	• Did the project consider Midterm Review recommendations conducted on time and reflected in the subsequent project activities? Need to review the MTR although the 2015 PIR does mention the MTR on pg 12 • Reporting of the petroleum fuels and the power reduction in each of the model units from implementing eco- tech options and the corresponding carbon emission reductions. No reports seen thus far. This will need to be done during the Evaluation.	Recommendations in MTR	MTR report	Document analysis and interviews with PMU

Evaluative Criteria	Questions	Indicators	Sources[57]	Methodology[58]
• What lessons can be drawn regarding effectiveness for other similar projects in the future?	• What lessons have been learned from the project regarding achievement of outcomes? To be determined during the Evaluation.	All outcome indicators in log frame	PIRs and QPRs	Document analysis and interviews with PMU
	• What changes could have been made (if any) to the project design in order to improve the achievement of the project's expected results? None identified to date.	All outcome indicators in log frame	PIRs and QPRs	Document analysis and interviews with PMU
Efficiency: Was the project implemented efficiently, in-line with international and national norms and standards and delivered results with the least costly resources possible?				
• Was project support provided in an efficient way?	• How does the project management systems, including progress reporting, administrative and financial systems and monitoring and evaluation system were operating as effective management tools, aid in effective implementation and provide sufficient basis for evaluating performance and decision making? Initial review of QPR's and PIR's reveals an adequate level of project reporting to allow M&E and management of project activities.	All outcome indicators in log frame	PIRs and QPRs	Document analysis and interviews with PMU
	• How effective was the adaptive management practiced under the project and lessons learnt? Some adaptive management appears to have been initiated by IR based on their EE analysis.	All outcome indicators in log frame	PIRs and QPRs	Document analysis and interviews with PMU
	• Did the project logical framework and work plans and any changes made to them used as management tools during implementation? To be analysed during evaluation.	All outcome indicators in log frame	PIRs and QPRs	Document analysis and interviews with PMU
	• Utilization of resources (including human and financial) towards producing the outputs and adjustments made to the project strategies and scope. Appears satisfactory upon initial review.	Annual project expenditures broken down into outcomes	ATLAS logs	Review of ATLAS logs and interviews with PMU
	• Details of co-funding provided and its impact on the activities (Refer to Table in section 6. Project Finance /Co-Finance). Co-financing reported to be low in 2015 PIR. This needs to be reconfirmed during evaluation to see if level of co-financing has been improved.	Co-financing	Co-financing reports from PMU	Review of co-financing reports and interviews with PMU

Evaluative Criteria	Questions	Indicators	Sources[57]	Methodology[58]
	• How does the APR/PIR process helped in monitoring and evaluating the project implementation and achievement of results? To be analyzed during evaluation.	All outcome indicators in log frame	PIRs and QPRs	Document analysis and interviews with PMU
• How efficient are partnership arrangements for the project?	• Appropriateness of the institutional arrangement and whether there was adequate commitment to the project? Appears to be adequate but will be reviewed during evaluation.	All outcome indicators in log frame	PIRs and QPRs	Document analysis and interviews with PMU and PSC members
	• Was there an effective collaboration between institutions responsible for implementing the project? Collaboration appears to be effective but will be reviewed during evaluation.	All outcome indicators in log frame	PIRs and QPRs	Document analysis and interviews with PMU and PSC members
	• Is technical assistance and support received from project partners and stakeholders appropriate, adequate and timely specifically for project PMU? To be reviewed during evaluation.	All outcome indicators in log frame	PIRs and QPRs	Document analysis and interviews with PMU and PSC members
Sustainability: To what extent are there financial, institutional, social-economic, and/or environmental risks to sustaining long-term project results?				
• Will the project be sustainable on its conclusion and stimulate replications and its potential?	• How effective is the project in terms of strengthening the capacity of railways professionals? To be determined during evaluation.	All outcome indicators in log frame	PIRs and QPRs	Document analysis and interviews with PSC members training beneficiaries
	• Was an exit strategy prepared and implemented by the project? What is the "Expected situation at the end of the Project"? To be determined during evaluation.	All outcome indicators in log frame	PIRs and QPRs	Document analysis and interviews with PMU and PSC members
	• Appropriateness of the institutional arrangement and whether there was adequate commitment to the project? Collaboration appears to be effective but will be reviewed during evaluation.	All outcome indicators in log frame	PIRs and QPRs	Document analysis and interviews with PMU and PSC members
Impact: Are there indications that the project has contributed to, or enabled progress towards maximizing environmental benefits?				

Evaluative Criteria	Questions	Indicators	Sources[57]	Methodology[58]
• What was the project impact under different components?	To what extent has the project contributed to the following?: (a) Institutional Arrangements Strengthened (b) Effective Information Dissemination Program Developed (c) Stakeholders capacity enhanced To be reviewed during evaluation	-Evidence of institutional collaboration -Indicators from Component 4 -indicators from Component 2	Key indicators in log-frame listed in project document	Document analysis and interviews with PMU and PSC members
• What are the indirect benefits that can be attributed to the project?	• Were there spinoffs created by the project, if any, as a result of the various workshops held nationwide, toolkits, case studies developed? To be reviewed during evaluation.	Quality of knowledge products from component 4	Key indicators in log-frame listed in project document	Document analysis and interviews with PMU and PSC members
• Impacts due to information dissemination under the project	• To what extent did the dissemination activities facilitate the progress towards project impacts? To be reviewed during evaluation.	Quality of dissemination activities from component 4	Key indicators in log-frame listed in project document	Document analysis and interviews with PMU and PSC members

APPENDIX H - UNDP'S 10 DEFAULT PRINCIPLES FOR CAPACITY DEVELOPMENT

These are reproduced from the 2010 UNDP report on "Ownership, Leadership and Transformation" by Carlos Lopes and Thomas Theisohn[59].

1. Don't rush. Capacity development is a long-term process. It eludes delivery pressures, quick fixes and the search for short-term results.	**6. Establish positive incentives**. Motives and incentives need to be aligned with the objective of capacity development, including through governance systems that respect fundamental rights. Public sector employment is one particular area where distortions throw up major obstacles.
2. Respect the local value system and try to foster self-esteem. The imposition of alien values can undermine confidence. Capacity development builds upon respect and self-esteem.	**7. Integrate external inputs into national priorities, processes and systems**. External inputs need to correspond to real demand and be flexible enough to respond to national needs and agendas. Where national systems are not strong enough, they should be reformed and strengthened, not bypassed.
3. Scan locally and globally; reinvent locally. There are no blueprints. Capacity development draws upon voluntary learning, with genuine commitment and interest. Knowledge cannot be transferred; it needs to be acquired.	**8. Build on existing capacities rather than creating new ones**. This implies the primary use of national expertise, resuscitation of national institutions, as well as protection of social and cultural capital.
4. Challenge mindsets and power differentials. Capacity development is not power neutral, and challenging mindsets and vested interests is difficult. Frank dialogue and a collective culture of transparency are essential steps.	**9. Stay engaged under difficult circumstances**. The weaker the capacity is, the greater the need. Low capacities are not an argument for withdrawal or for driving external agendas. People should not be held hostage to irresponsible governance.
5. Think and act in terms of sustainable capacity outcomes. Capacity is at the core of development; any course of action needs to promote this end. Responsible leaders will inspire their institutions and societies to work accordingly.	**10. Remain accountable to ultimate beneficiaries**. Any responsible government is answerable to its people, and should foster transparency as the foremost instrument of public accountability. Where governance is unsatisfactory it is even more important to anchor development firmly in stakeholder participation and to maintain pressure points for an inclusive accountability system.

[59] Available on: www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/drivers-of-change/leadership/ownership-leadership-and-transformation-full-text/ownership_leadership_and_transformation-FULL-TEXT.pdf?download

APPENDIX I - EVALUATION CONSULTANT AGREEMENT FORM

Evaluator 1:

1. Must present information that is complete and fair in its assessment of strengths and weaknesses so that decisions or actions taken are well founded.
2. Must disclose the full set of evaluation findings along with information on their limitations and have this accessible to all affected by the evaluation with expressed legal rights to receive results.
3. Should protect the anonymity and confidentiality of individual informants. They should provide maximum notice, minimize demands on time, and respect people's right not to engage. Evaluators must respect people's right to provide information in confidence, and must ensure that sensitive information cannot be traced to its source. Evaluators are not expected to evaluate individuals, and must balance an evaluation of management functions with this general principle.
4. Sometimes uncover evidence of wrongdoing while conducting evaluations. Such cases must be reported discreetly to the appropriate investigative body. Evaluators should consult with other relevant oversight entities when there is any doubt about if and how issues should be reported.
5. Should be sensitive to beliefs, manners and customs and act with integrity and honesty in their relations with all stakeholders. In line with the UN Universal Declaration of Human Rights, evaluators must be sensitive to and address issues of discrimination and gender equality. They should avoid offending the dignity and self-respect of those persons with whom they come in contact in the course of the evaluation. Knowing that evaluation might negatively affect the interests of some stakeholders, evaluators should conduct the evaluation and communicate its purpose and results in a way that clearly respects the stakeholders' dignity and self-worth.
6. Are responsible for their performance and their product(s). They are responsible for the clear, accurate and fair written and/or oral presentation of study imitations, findings and recommendations.
7. Should reflect sound accounting procedures and be prudent in using the resources of the evaluation.

Evaluation Consultant Agreement Form[60]

Agreement to abide by the Code of Conduct for Evaluation in the UN System

Name of Consultant: Roland Wong

Name of Consultancy Organization (where relevant)**:** _____

I confirm that I have received and understood and will abide by the United Nations Code of Conduct for Evaluation.

Signed at *Surrey, BC, Canada* on *May 16, 2017*

[60] www.unevaluation.org/unegcodeofconduct

Evaluator 2:

1. Must present information that is complete and fair in its assessment of strengths and weaknesses so that decisions or actions taken are well founded.
2. Must disclose the full set of evaluation findings along with information on their limitations and have this accessible to all affected by the evaluation with expressed legal rights to receive results.
3. Should protect the anonymity and confidentiality of individual informants. They should provide maximum notice, minimize demands on time, and respect people's right not to engage. Evaluators must respect people's right to provide information in confidence, and must ensure that sensitive information cannot be traced to its source. Evaluators are not expected to evaluate individuals, and must balance an evaluation of management functions with this general principle.
4. Sometimes uncover evidence of wrongdoing while conducting evaluations. Such cases must be reported discreetly to the appropriate investigative body. Evaluators should consult with other relevant oversight entities when there is any doubt about if and how issues should be reported.
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6. Are responsible for their performance and their product(s). They are responsible for the clear, accurate and fair written and/or oral presentation of study imitations, findings and recommendations.
7. Should reflect sound accounting procedures and be prudent in using the resources of the evaluation.

Evaluation Consultant Agreement Form[61]

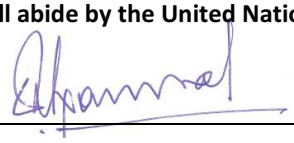
Agreement to abide by the Code of Conduct for Evaluation in the UN System

Name of Consultant: __Dinesh Aggarwal____

Name of Consultancy Organization (where relevant)**:** _____

I confirm that I have received and understood and will abide by the United Nations Code of Conduct for Evaluation.

Signed at *New Delhi, India* on *May 16, 2017*



[61] www.unevaluation.org/unegcodeofconduct