INDEPENDENT EVALUATION UNIT
OFFICE OF EVALUATION AND INTERNAL OVERSIGHT

INDEPENDENT TERMINAL EVALUATION

INDIA

ENVIRONMENTALLY SOUND MANAGEMENT OF MEDICAL WASTES IN INDIA

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The Evaluation Team hopes that the findings, conclusions and recommendations will contribute to the successful completion of the Project and to the continuous improvement of similar projects in other countries.

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Abbreviations and acronyms

Acronym	Meaning
APC	Air Pollution Control
BAT	Best Available Techniques
BATNEEC	Best Available Techniques Not Entailing Excessive Costs
BEP	Best Environmental Practices
BMW	Bio-Medical Waste
BMWM	Bio-Medical Waste Management
CHC	Community Health Centre
CPCB	Central Pollution Control Board
CTF	Common Treatment Facility (or Common Bio-Medical Waste Treatment Facility - CBMWTF)
ENT	Ear, nose, throat (surgeon specialist)
ESM	Environmentally Sound Management
GEF	Global Environment Facility
GU	Gujarat
HCF	Healthcare Facility
HCW	Health Care Waste
ICU	Intensive Care Unit
KA	Karnataka
M&E	Monitoring and Evaluation
MA	Maharashtra
MoH&FW	Ministry of Health & Family Welfare
MoEF&CC	Ministry of Environment, Forests and Climate Change
NABH	National Accreditation Board for Hospitals (India)
NIP	National Implementation Plan (for POPs)
OD	Odisha
OPD	Out patients per day
PCDD	Polychlorinated dibenzodioxins
PCDF	Polychlorinated dibenzofurans
PHC	Primary Health Centre
POPs	Persistent Organic Pollutants
PU	Punjab
PVC	Polyvinyl Chloride
RBM	Results Based Management

Acronym	Meaning
SOPs	Standard Operating Procedures
SPCB	State Pollution Control Board
TEQ	Toxic Equivalents
TOT	Training of Trainers
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UP-POPs	Unintentionally Produced Persistent Organic Pollutants
VIMS	Vydehi Institute of Medical Sciences & Research Centre
WHO	World Health Organisation

Glossary of evaluation-related terms

Term	Definition
Baseline	The situation, prior to an intervention, against which progress can be assessed.
Effect	Intended or unintended change due directly or indirectly to an intervention.
Effectiveness	The extent to which the development intervention's objectives were achieved, or are expected to be achieved.
Efficiency	A measure of how economically resources/inputs (funds, expertise, time, etc.) are converted to results.
Impact	Positive and negative, intended and non-intended, directly and indirectly, long term effects produced by a development intervention.
Indicator	Quantitative or qualitative factors that provide a means to measure the changes caused by an intervention.
Lessons learned	Generalizations based on evaluation experiences that abstract from the specific circumstances to broader situations.
Logframe (logical framework approach)	Management tool used to facilitate the planning, implementation and evaluation of an intervention. It involves identifying strategic elements (activities, outputs, outcome, and impact) and their causal relationships, indicators, and assumptions that may affect success or failure. Based on RBM (results based management) principles.
Outcome	The likely or achieved (short-term and/or medium-term) effects of an intervention's outputs.
Outputs	The products, capital goods and services which result from an intervention; may also include changes resulting from the intervention which are relevant to the achievement of outcomes.
Relevance	The extent to which the objectives of an intervention are consistent with beneficiaries' requirements, country needs, global priorities and partners' and donor's policies.
Risks	Factors, normally outside the scope of an intervention, which may affect the achievement of an intervention's objectives.
Sustainability	The continuation of benefits from an intervention, after the development assistance has been completed.
Target groups	The specific individuals or organizations for whose benefit an intervention is undertaken.

As the project was prolonged for two years after the 2019 Terminal Evaluation (due to the COVID pandemic,), it was necessary to conduct a follow-up evaluation to assess the project's overall performance and results. Consequently, this Terminal Evaluation report was updated. Therefore the new Executive Summary, as well as a new chapter 7 have been added to the 2019 evaluation report.

Executive Summary of the original terminal evaluation conducted in 2019

(The summary of the updated evaluation in 2021 is at the end of the section)

Background

The "Environmentally Sound Management of Medical Wastes" project in India was implemented following India's signing of the Stockholm Convention on Persistent Organic Pollutants (POPs) signifying a commitment to reduce emissions. The project was funded by the Global Environment Facility (GEF), implemented by UNIDO, and executed jointly by the Government of India's Ministry of Environment, Forests and Climate Change (MoEF&CC), as nodal agency and five (5) States Department of Environment and Health across India through State Pollution Control Boards in Gujarat, Maharashtra, Odisha and Punjab and Health Department in Karnataka.

The project had an overarching objective to: "reduce and ultimately eliminate the releases of unintentionally produced POPs and other globally harmful pollutants into the environment, and assist India in implementing its relevant obligations under the Stockholm convention." Additionally, the project work towards the following outcomes:

- Enable and harmonise environmental and healthcare policy and regulatory instruments
- Strengthen institutional capacity for the environmentally sound management of medical waste.
- Improve facility-level handling and processes by facilitating and promoting public-private partnerships to improve and support capacities in medical waste management.
- Enhance transport and disposal of medical waste by facilitating and promoting public-private partnerships to improve local technologies and capacities.
- Demonstrate participatory funded and integrated systems for medical waste management and disposal.

Simultaneously, the project also aimed for effective project management and monitoring and evaluation.

Evaluation purpose and methodology

The purpose of this evaluation is two-fold: for accountability and learning purposes. It assesses the results of the Project and presents a series of findings; lessons and recommendations for use in future projects. The evaluation rates the project in terms of the OECD-DAC criteria of relevance, effectiveness, efficiency and sustainability as well as the UNIDO criteria of progress towards impact on the UNIDO six point rating scale. The evaluation utilised methods of document review, stakeholder consultation at national level and across all five States in India. In the 2019 evaluation, the team reviewed training materials, assessed procurement, and visited 37 healthcare facilities and six common treatment facilities to assess bio-medical water management (BMWM) processes. Analysis included technical assessment and review of the project logical framework and a retroactive theory of change. Findings are as of the date of the evaluation are summarised in the following paragraphs. The 2019 evaluation recommended to extent the project for one more year till December 2020, so that the project could complete pending activities, consolidate some of the project results and use up the available funds. At the end of the extension, it was foreseen that an updated evaluation would be conducted to make overall assessment of the project performance and results. However due to COVID pandemic, the project was actually extended

for two more years till end of 2021. The findings of the updated evaluation in 2021 are presented at the end of this Executive Summary and in chapter 7 of this report.

Key Findings

Relevance

This project is rated moderately satisfactory in terms of relevance. There was high level of alignment with the priorities of the national government but relevance was affected by insufficient recognition of the context and capacity within India, and the changing context during implementation. In terms of relevance to national priorities, the Government of India demonstrated a commitment to reducing pollution by signing the Stockholm Convention and taking action to update relevant policies, rules and protocols. Similarly, the project reflected UNIDO's commitment to the Stockholm convention. The 'model facilities' approach adopted by the project did not sufficiently acknowledge the systems and frameworks that were already in place in a number of hospitals and while it enhanced the focus on training, did not provide a sufficiently coherent approach to systematize district processes within the project period. The project could have identified best practice from these pre-existing processes and replicated or promoted these. In addition, the project approach focused heavily on the segregation of waste and insufficient guidance was provided in the design framework on how to progress support for the common treatment facilities – the main source of POPs. Implementation delays further impeded relevance because training initiatives in Bio-medical waste management (BMWM) were undertaken by other stakeholders. The project training was still valuable and appropriate but had less relevance than originally expected.

Effectiveness

This evaluation finds that overall the project was moderately ineffective in achieving its stated objectives.

The first objective of the project was to **enable and harmonise environmental and healthcare policy** and regulations. The project has contributed significantly to this objective through support to processes of updating and BMWM amending rules and policies including the development of new rules governing medical waste in 2016 to replace the previous guidelines from 1998 and further amendments to these rules in 2018 and 2019. In addition, the project has encouraged the implementation and uptake of these new rules by supporting enforcement measures. However, this component of the project was also meant to include a domestic market analysis that was designed to inform the implementation of other component activities but this was only implemented in 2019, towards the end of the project.

The project aimed to **improve institutional capacities** through the provision of training and use of equipment. The training that was provided to 167 healthcare facilities and was generally of a high standard and useful to healthcare staff. However, these training efforts did represent somewhat of a duplication of effort with other actors in the medical waste sector. In addition, it was found that refresher courses and ongoing training present an important opportunity for improvement within the medical waste sector as a high turnover of staff leads to loss of learning and skills in healthcare institutions.

The objective relating to **improving facility level handling and processes through public-private partnerships** involved the provision of equipment. The direct supply of equipment and the segregation management of medical waste has accomplished in an efficient manner. However, the central procurement approach adopted ran contrary to the expected approach in the design of building local procurement and building local supply capacity. In general, the distribution of equipment was effective and appreciated but there were some issues with the standard and suitability of the equipment. While a

number of interventions relating to this objective were implemented there are a number that still remain to be actioned. These include the inclusion of medical waste training in the curriculum of medical colleges that would then continue local provision of BMWM training.

The project was designed to focus on **improving local technological and manufacturing capacities relating to the transport and disposal of medical waste**. The project commenced with a comprehensive and detailed capacity assessment of all treatment facilities in each target state. However, this information was never collated or used effectively. While the project did contribute to some capacity building as envisioned this was largely through its work in regards to policy outcomes as opposed to interventions directly addressing this objective. As a result the efficiency level of treatment facilities in the five model districts is still considered to be low and expected increase in standards are not always met impacting on the project's achievement of its overall objective relating to the reduction of POP emissions.

The project aimed to demonstrate **participatory funded and integrated systems for medical waste management and disposal**. Achievement of this objective was hampered by the delay in a domestic market study as envisioned under component one. Progress notes continuously record that activities outlined in relation to this objective are pending, despite the extension of project period. Overall, healthcare facilities in all states showed a limited understanding of funding systems for bio-medical waste management and no specific allocation of State budgets, although it was agreed that funding was made available as required. The marginal economic viability of medical waste treatment facilities is impacting on investment in upgrading of facilities, preventing improved compliance with standards.

The project established a **project management structure** and was expected to implement a monitoring and evaluation mechanism. The project management structure was established at the national and State level but the lack of State Technical Advisors affected progress in three States. Despite a good quality capacities and gap analysis at the commencement of the project, the project was hampered by the lack of monitoring framework or database that would have assisted in the identification and solution of issues during implementation.

Efficiency

The project suffered from a number of significant delays. The original closing date was November 2016 while the revised closing date was 31st October 2019. Delays relating to the accomplishment of outputs such as the domestic market analysis as well as a duplication of the training efforts of other development actors contributed to a poor efficiency rating. In addition, there were procurement delays resulting from increased import taxes on equipment and the decision to use centralized procurement as opposed to local options further impacting on efficiency. The project expended approximately 85% of the allocated budget but most of the expenditure was during the period of extension. The remaining budget could have been expended during the project period on items that were important to accomplishment of project objectives and consequently the project rated as highly unsatisfactory in terms of efficiency.

Impact

The project is considered to be moderately unsatisfactory in terms of progress towards impact. The project was envisioned to contribute to improvements in economic competitiveness through the facilitation and promotion of public-private partnerships but the extent to which this actually occurred was minimal. The main objective of the project was to impact on the environment through better pollution control, yet the results in reduction in emissions was estimated to be only 14 per cent of the target in direct benefits, increasing to 42% when the indirect impacts of policy changes, and of the positive effects of improved segregation are taken into consideration. The aspect where the project most contributed to impact is in terms of safeguarding the public through improved infection control in

healthcare facilities. In addition, the project has contributed to increased capacities for individuals involved in the training activities.

With regards to broader adoption, the project outlined at design phase an intention to replicate and upscale the results achieved in the five project states. The projects contribution to updating and enforcing rules relating to bio-medical waste management can also be seen as a positive contribution to broader adoption. The increased capacity of training participants has also resulted in a mainstreaming of best practice within healthcare facilities.

Sustainability

The project is rated as moderately unsatisfactory for sustainability of results. The project's contributions to policy and institutional reform are likely to be sustained and have a lasting impact. However, the financial uncertainty in all of the states regarding future management of bio-medical waste suggests that recurring costs may not always be covered in facility budgets. At present, most facilities are covering the recurrent costs of BMWM, but there is no designated budget allocation and the evaluation team found that public medium-sized facilities in particular faced challenges in covering BMWM costs. In addition, there is no clear strategy on how to ensure the ongoing benefits of training activities or to continuously improve institutional capacities. The project design envisaged that a sustainable supply of suitable equipment would be available locally through project support in local capacity development. That did not occur and there are maintenance issues with the bins supplied. Most small and medium-sized facilities indicated that they would be unable to afford to replace bins and trolleys at present.

Management and Cross Cutting Issues

The final component of the project aimed to directly address monitoring and evaluation and results based management but as mentioned above despite some promising signs at the beginning of the project these issues were not addressed or incorporated to the level they could have been. As such both of these are rated as highly unsatisfactory. In terms of cross-cutting issues, gender mainstreaming was not a focus of the project but some benefits for women did accrue given the high proportion of health facility staff that received training are female. In addition, the benefits of improved BMWM particularly favour women, elderly and children. However, no structural changes occurred as a result of the project and some equipment was not gender-appropriate; consequently gender mainstreaming is rated as unsatisfactory.

Performance of Partners

The performance of UNIDO is rated as unsatisfactory given that UNIDO did contribute to policy outcomes but the financial and technical management relating to procurement and recruitment was not effective and project management was not significantly delegated to the state level to ensure sustainability. Procurement and recruitment all were made within the policy framework of UNIDO and MOEF&CC and all five States were involved in the procurement and recruitment. Nonetheless, the substantial delays and centralized processes constrained project achievements. National counterparts' performance in the project is rated as moderately satisfactory due to the strong level of support received by the project and the provision of a large amount of in-kind resources. Despite high staff turnover rates and subsequent delays in approval; on the whole; project stakeholders found State staff to be knowledgeable and helpful.

Conclusions

The contribution of the project towards policy and regulation reform is noted to have been well regarded and critical. Similarly, capacity development activities and practical measures implemented achieved positive results. However, the components of the project relating to public-private partnerships were not implemented to the level envisioned and so possible improvements in local manufacturing and technological capacities and handling and disposal processes were not accomplished as expected.

Recommendations

The evaluation team recommends to extend the project for 12 months, till December 2020. The specific recommendations focus on activities that should occur within a one year extension of the project (Table 1). These actions will encourage the safeguarding of project benefits into the future and encourage the replication and scaling up of project activities.

Table 1. Key Recommendations from Evaluation Findings

Recommendation	Suggested Actions
Review the technical options and rules for the use of microwaves in hospitals	- Most hospitals that have received microwave units have insufficient capacity to disinfection all generated plastic waste. Review the risks incurred when this waste stream is only partially disinfected. - Document the Karnataka model of hospitals providing microwaves plastics directly to authorized recycling agents, to verify if this model is suitable for replication in other States. - Consider the option of sterilising the plastic materials at the CTFs rather than at the hospitals. Carry out a cost-benefit analysis of using microwave technology compared with autoclaving. - Summarise lessons learned regarding options for cost-effective microwave use and how plastic materials are best handled.
Focus on CTF upgrade to enhance BMW handling and more efficient processing of BMW	- CTFs clearly operate on a minimal budget, forcing these to take any available cost-cutting actions. Measures should be considered to strengthen CTFs, for example through increased treatment fees, targeted government scheme and/ or general strengthening/ capacity building for the sector. - Consider contracting specialist advice on biomedical waste treatment to consider CTF upgrading required to improve non-burn options.
Consider the feedback loop for policy review to address some remaining issues in implementation of the 2016 BMWM Rules	- Harmonise all waste related regulations presently enforced e.g. colour coding confusion between the BMWM Rules 2016 & SWM Rules 2016. - Greater clarity of guidelines for disposal of infectious plastic waste - Progress the technical assessment of non-burn technology for treating infectious waste, as it is costly to meet stringent emission limits for incinerators that handle relatively small quantities of infectious waste per hour. The 2016 BMWM Rules require that most yellow bags be incinerated. The option for use of non-burn technologies such as autoclaves or microwaving could be further considered.

Executive Summary of the updated evaluation in 2021/2022

Methodology

Due to the prevalence of COVID 19 in India, the evaluation was conducted remotely. It was accomplished through a desk review of all available documents and remote interviews with project stakeholders. The evaluation team collaborated to update the assessment of the project performance and results.

Key Findings

The three objectives of the 12-month extension of the project were to enable: 1) the continuation of policy and regulatory support, 2) the replication and up-scaling of project benefits, and 3) the preparation and implementation of a formal exit strategy; also including technical advice on the next steps for addressing UP-POPs reductions. The project's performance was evaluated against its achievements in these three areas.

The project continued to provide policy and regulatory support, though as can be seen in section 7.2.1, many of the key concerns raised by the 2019 evaluation were disregarded[1] and hence never resolved.

The second task to be undertaken during the extension period was to make full use of the project knowledge and to apply the understanding gained through the Market Survey, to benefit as much of the Indian healthcare sector as possible. Over the past two years, the project has expanded its already wide-ranging training programme, including a new online training syllabus. The project participated in India's response to the COVID-19 pandemic, providing training courses especially developed for the pandemic, new guidelines and updating of the existing BMWM regulations. Interviews with healthcare facilities revealed that the support was very beneficial and greatly appreciated. The BMWM training provided over the past 5 years also helped keep COVID-19 infection rates low amongst hospital staff in the project areas, indicating that good infection control and waste management practices had been successfully communicated by the project to its model districts.

Lastly, the 2019 evaluation emphasised the importance of devising and implementing an exit strategy during the project extension. No national or state roadmaps for the continued implementation of the BMW rules were developed by the project, but that could at least be partly attributed to the lack of enthusiasm for a project continuation within the Indian authorities. The project worked hard and successfully to disseminate the lesson's learnt on how to best manage BMW.

Conclusions

The project performance did not change over the past two years. The project paid little, if any, attention to the recommendations of the 2019 Terminal Evaluation. It persisted to be proficient in capacity building within BMWM, the project's components 1 and 2, whilst mostly ignoring the project's components 4 and 5. These latter components were to strengthen the waste transport and disposal system through measures that would make the operation of CTFs financially more sustainable, improve their environmental performance and establish model district to test and demonstrate the best available technologies. Likewise, the public-private partnerships (PPPs) features of the project were not addressed as intended, resulting in minimal progress in terms of strengthening local BMW equipment supply and improved BMW treatment systems. This in turn meant that the global objective of the project, a significant reduction in UP-POP emissions, was not realised.

As the project performance did not change over the past two years, the overall assessment and ratings remain unchanged. Both the 2016 Mid-Term Evaluation and the 2019 Terminal Evaluation recommend that the project management be strengthened and that monitoring and evaluation systems be implemented. With the benefit of hindsight, it is easy to suggest that once the difficulties and delays faced by the project were apparent, there should have been a determined intervention by the National Project Steering Committee to strengthen the project management.

The recommendations from the 2019 Terminal Evaluation, except the recommendation to extend the project for 12 months, still apply as they were hardly addressed during the 2 year-extension.

[1] The project management team informed the evaluation team that following the 2019 terminal evaluation, the project management team prepared an action plan to address the evaluation recommendations. However the plan was not approved by the government counterparts.

1. INTRODUCTION

The project *Environmentally Sound Management of Medical Wastes in India* was designed to promote country-wide adoption of best available techniques/best environmental practices (BAT/BEP) in healthcare institutions to protect human health and reduce adverse environmental impacts of bio-medical waste (BMW)[2]. The project was funded by the Global Environmental Facility (GEF) under the fourth funding cycle commencing on February 11, 2011 and with a current closing date of October 31, 2019. This in-country evaluation was conducted during September 2019 and the findings are contextualized at the time of the evaluation visit. The Ministry of Environment, Forests and Climate Change (MoEF&CC) is the national focal point for the management of Persistent Organic Pollutants (POPs) in the country and lead agency for the project. The project was implemented across five States in India (Gujarat, Karnataka, Maharashtra, Odisha, and Punjab) with lead agencies in each State directing the project implementation.

1.1. Evaluation objectives and scope

This evaluation independently assesses the entire duration of the 'Environmentally Sound Management of Medical Waste' project. The objectives of this evaluation are two-fold:

1) **Accountability -** to assess the performance in terms of relevance, effectiveness, efficiency, sustainability and progress to impact.
2) **Learning -** to develop a series of findings, lessons and recommendations for enhancing the design of new and implementation of ongoing project by UNIDO.[3]

The evaluation was conducted between August and October 2019. The evaluation team met with officials in UNIDO and India and spent three weeks in India travelling to each of the five States.

1.2. Overview of the project context

On 13 January 2006 India ratified the Stockholm Convention on POPs, committing the country to eliminate or restrict the production and use of persistent organic pollutants. One group of POPs are dioxins and furans, these are mostly by-products of various industrial processes or an unintended product of combustion, for example the burning of garbage. This group of compounds includes polychlorinated dibenzo-p-dioxins (PCDDs), better known as dioxins. There are 75 PCDD congeners, differing in the number and location of chlorine atoms. The most toxic of these being 2,3,7,8-Tetrachlorodibenzodioxin (TCDD). The toxicity of all compounds is calculated in "toxicity equivalents of TCDD" (TEQ), where each congener has been given a toxicity equivalence factor which indicates its relative toxicity as compared with TCDD. The other grouping of compounds is polychlorinated dibenzofurans (PCDFs), or furans, again with many congeners. The ratification of the Stockholm Convention obliged the country to comply with the requirements of Article 5 of the Convention, which requires the elimination of unintentionally produced POPs (UP-POPs). The GoI generated a National Implementation Plan (NIP) for India to address Stockholm Convention requirements. This NIP identified the "Environmentally Sound Management of Medical Waste" as a priority for NIP implementation.

[2] GEF and UNIDO, 2011. Project of the Government of India Project Document (PRODOC) 23 July 2011.
[3] UNIDO, May 2019. *Terms of Reference: independent Terminal Evaluation of project: Environmentally Sound Management of Medical Wastes in India.*

Bio-medical waste is bio-hazardous with the potential to spread infection when improperly handled and/or managed. When burnt, BMW generates UP-POPs. The incineration of polyvinyl chloride (PVC) plastic and other chlorine compounds commonly found in medical waste causes the formation dioxins and furans.

Healthcare institutions (hospitals, primary health centres, clinics, medical practices, diagnostic services, laboratory services, nursing care, assisted living, etc.) generate large amounts of waste that fall into different categories. Roughly three quarters of the waste produced by healthcare institutions is non-risk or general waste that is comparable to domestic waste. This waste comes from offices, kitchens, visitor areas and so forth; usually it is collected by the local solid waste management service. The balance is bio-medical waste that poses an increased risk of infection, as well as injuries from sharps, such as needles and scalpel blades.

In 1998, the Biomedical Waste (Management & Handling) Rules were developed to address the harmful effects of unsafe management of medical waste. Following the introduction of the 1998 Rules, many small and large healthcare facilities in India installed individual incinerators to dispose of medical waste. However, they operated with sub optimal efficiency and emitted high levels of air pollution. After the Stockholm Convention agreements, an update of these Rules was seen as a priority to help meet the new targets.

The efficiently and safe management of BMW requires the segregation of hazardous BMW at source, followed by proper waste collection, transport and disposal procedures. In India, all collected BMW must be sent for treatment in approved Common Treatment Facilities (CTFs).

In addition to the requirements of the Stockholm Convention, increased public awareness of the global hazards posed by medical waste, and the interest in the mounting potential of the health sector in India as a growth industry, has placed new demands and urgency on ensuring high standards for the management of bio-medical waste.

1.3. Overview of the project

Project Rationale the project aimed to promote the adoption of BAT and BEP in the BMW management infrastructure and industry to minimize and/or eliminate the formation and releases of PCDD/PCDF through public-private partnerships (PPPs).

Project Objectives The objective of the project is to reduce and ultimately eliminate the releases of UP-POPs and other globally harmful pollutants into the environment, and assist India in implementing its relevant obligations under the Stockholm Convention.

Expected outcomes -The project worked towards five outcomes[4]:

1. Enable and harmonize environmental and healthcare policy and regulatory instruments through appropriate networking for creation and promotion of ESM of medical waste, disposal sector and market. Activities to be undertaken included the establishment of inter-ministerial network; introduction of regulatory, economic and market incentives and placement of policy and regulatory enforcement mechanisms;

[4] Project of the Government of India Project Document (PRODOC) 23 July 2011

2. Strengthen institutional capacity for ESM of medical waste, in particular in large, medium and small healthcare facilities in five (5) selected states namely Gujarat, Karnataka, Maharashtra, Odisha and Punjab. Institutional capacity building was to include strengthening of technical capabilities for the ESM of medical wastes and awareness raising;

3. Improve facility-level handling and processes. Facilitate and promote PPPs to improve support and supply capacities in medical waste management within the healthcare facility perimeter. This outcome focused on technologies/methods/systems and processes that can be adopted at healthcare facility level to achieve reduction in waste volume. Activities were to include: specific training curriculum on medical wastes management; effective and efficient segregation of medical wastes at source; protocols for medical waste movement in healthcare facilities from source to collection points, and the introduction of significant volume reduction of medical wastes at source;

4. Enhance transport and disposal. Facilitate and promote PPP to improve local technological and manufacturing capacities in medical waste transport (internal and external transportation) and disposal sectors with specific reference to avoidance of generation of PCDD/PCDF and other unintentionally produced POPs releases by applying BAT/BEP measures; and

5. Demonstrate participatory funded and integrated systems for medical waste management and disposal in the 5 selected states.

In addition, a proportion of funds were allocated for project management, monitoring and evaluation (M&E). The project was considered to be a pilot that would later be replicated and scaled up within each project State and in other States across India.

Project Budget Allocation

The total estimated budget for this project was USD 40.444 million. This comprised USD 10 million from GEF. A summary of expenditure from the GEF funds at the time of the evaluation (as of September 30, 2019) is provided in Table 2.

Table 2. Budget allocation and expenditure for the GEF funds

Component	Planned budget (US$)	Actual expenditure (US$)	Amount not spent (US$)	Amount over budget (US$)
Component 1	$173,000	$ 250,699		$ 77,699
Component 2	$2,760,000	$2,482,333	$277,667	
Component 3	$1,137,000	$ 999,644	$ 137,357	
Component 4	$2,450,000	$ 1,657,503	$ 792,497	
Component 5	$2,980,000	$2,554,943	$ 425,057	
Component 6				
Project Mgt	$200,000	$409,767		$ 209,767
M&E	$300,000	$ 130,092	$169,908	
Total	**$10,000,000**	**$ 8,484,981**	**$1,802,486**	**$287,466**
Total amount remaining			**US$1,515,019**	

Source: UNIDO project database, extracted October 10, 2019

An estimated amount of USD 30.444 million in cash and in-kind financing was received from UNIDO, the GoI National Ministries (Health and Family Welfare (MoH&FW) and MoEF&CC); participating State governments; Ramaiah Medical College that conducted the training activities and private sector investment, largely the CTFs contributed by upgrading their own incinerators and improving tracking processes. The co-financing was not closely tracked through the project; however, the evaluation team did observe considerable contribution to the implementation of the new BMW Management (BMWM) Rules at State level, at Ramaiah College and in the CTFs. This is assessed in section 2.1.

1.4. Evaluation methodology

This evaluation responds to a terms of reference prepared by UNIDO (see Annex 1). The evaluation was conducted in accordance with the UNIDO Evaluation Policy and the UNIDO Guidelines for the Technical Cooperation Project and Project Cycle. In addition, the GEF Guidelines for GEF Agencies in Conducting Terminal Evaluations, the GEF Monitoring and Evaluation (M & E) Policy and the GEF Minimum Fiduciary Standards for GEF Implementing and Executing Agencies were taken into account.

Key evaluation questions The evaluation purpose and objectives, theory of change, and UNIDO's evaluative requirements all provide the basis for the **evaluation framework**, (see Annex 2) which in turn underpins and guides the whole approach. The framework is structured against the standard OECD-DAC criteria agreed for the evaluation (**relevance**, **efficiency**, **effectiveness**, **sustainability**) but in line with the UNIDO Evaluation Manual a focus was placed on the project's contribution to development results. The evaluation uses the UNIDO rating scale to rate each criteria. The evaluation framework identifies **key evaluation questions**, supported by guiding **sub-questions**.

The key questions explored by the evaluation were:

1. What are the key drivers and barriers to achieve the long term objectives? To what extent has the project helped put in place the conditions likely to address the drivers, overcome barriers and contribute to the long term objectives?
2. How well has the project performed? Has the project done the right things? Has the project done things right, with good value for money?
3. What have been the project's key results (outputs, outcome and impact)? To what extent have the expected results been achieved or are likely to be achieved? To what extent the achieved results will sustain after the completion of the project?
4. What lessons can be drawn from the successful and unsuccessful practices in designing, implementing and managing the project?

The evaluation drew on a series of tools. These included:

- **Desk review** of project and associated documents including (see Annex 4) for a full list of documents reviewed);
    - The original project document,
    - Monitoring reports (such as progress and financial reports, mid-term review report, output reports, back-to-office mission report(s), end-of-contract report(s) and relevant correspondence).
    - Notes from the meetings of committees involved in the project.

- **Stakeholder consultations** through structured and semi-structured key informant interviews in each state and with national stakeholders. Key stakeholders interviewed include:
    - UNIDO Management and staff involved in the project; and

- Representatives of donors, counterparts and stakeholders
- See Annex 5 for a full list of stakeholders consulted.

- **Review of training materials and feedback** on capacity development activities

- **Assessment of procurement** of goods and services supported by the project;

- **Field visits** to project sites in the Republic of India.
  - Visits to 5 states; 37 hospitals; 14 large, 10 medium, 13 small (see Annex 6 for details);
    - 22 Government hospitals
    - 11 Private hospitals
    - 2 Charitable hospitals; also
    - 2 Non-project facilities
  - Visits to five CTFs, one in each state; plus one CTF that was not included in project activities – a total of six CTFs were visited.

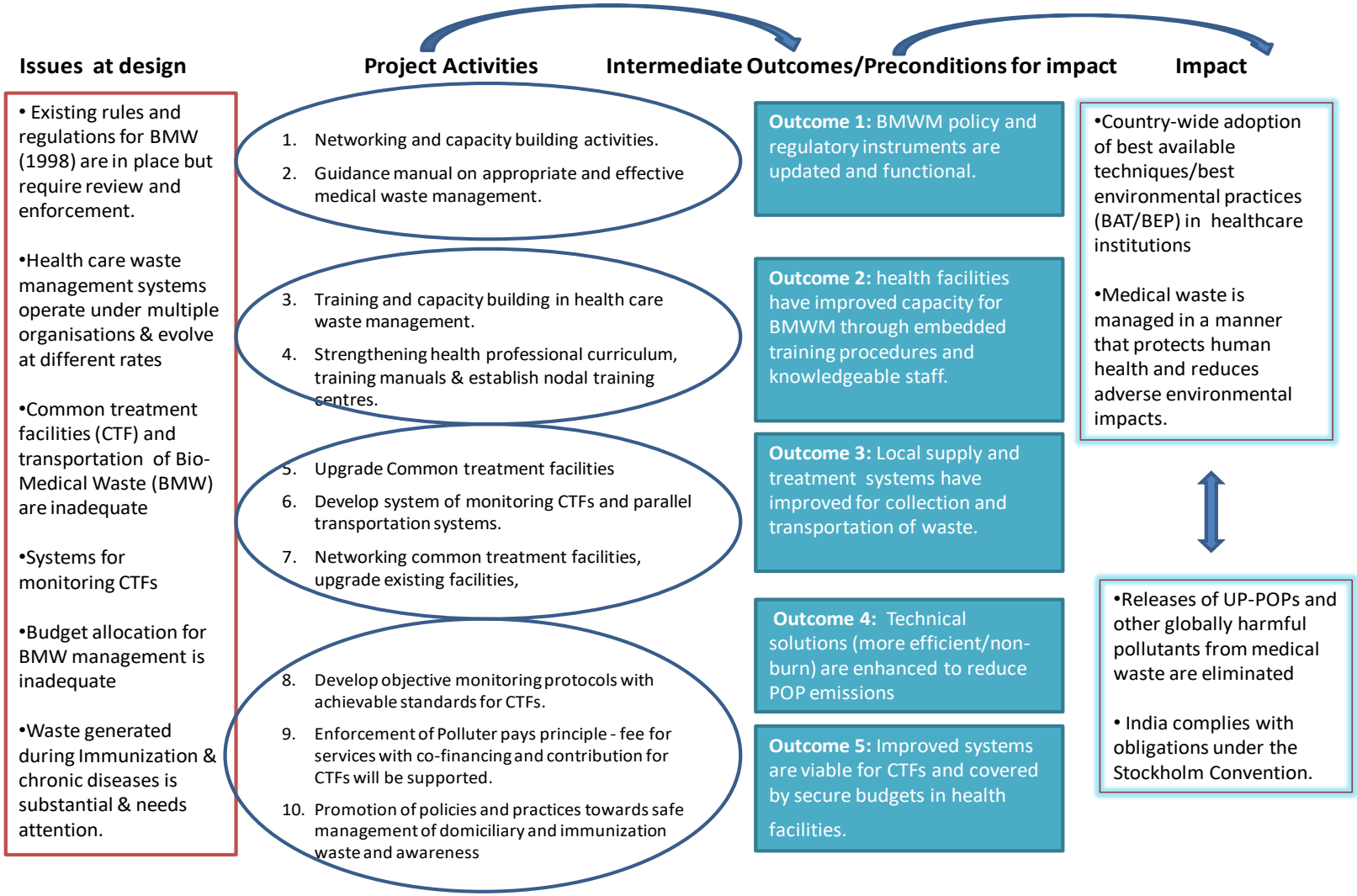
- **Technical assessment** of model hospitals and other facilities with visits also to CTFs and review of the effectiveness of transportation systems;

- **Analysis of project logical framework** (see Annex 7), validation of available progress documentation, retrospective theory of change (Figure 1), contribution analysis and assessment for UNIDO ratings.
  - The Theory of change identifies the key issues that the project addresses and notes the causal and pathways from the project activities/outputs to outcomes towards longer-term impact. The issues were identified through the preparatory grant and the activities were designed based on the learning from previous UNIDO and GEF-supported initiatives in India and other countries.
  - In order to achieve impact, the project was expected to achieve five major outcomes that would demonstrate that preconditions for contribution to the expected outcomes are being achieved. The Theory of Change identified six key outcome areas based on the six key components identified in the project design document[5]; namely:

    1. Updated Policy Environment
    2. Improved Institutional Capacity
    3. Direct supply capacity
    4. More efficient CTF function
    5. Viable CTF and BMW collection systems
    6. Sustainable mechanisms (M&E, replication, upscale)

[5] GEF and UNIDO, 2011. Project of the Government of India Project Document (PRODOC) 23 July 2011

Figure 1. Theory of Change



ASSUMPTIONS

- Expected level of state level financial contributions is received.
- Public private partnerships can be forged and become operational.
- Stakeholders engage with project activities.
- Private sector operations are viable to maintain CTF and transportation systems.
- Technical processes for BAT/BEP are appropriate to context.

1.5. Limitations

There were several key limitations that affected the conduct of the evaluation. These are summarized in Table 3 with identified mitigation measures to maintain evaluation quality. The most critical of these was the lack of detailed project monitoring. This meant that there was very little secondary data available to the evaluation team affecting the ability to triangulate data.

Table 3. Limitations of the Evaluation

Challenge/Limitation	Mitigation
The original project results framework constructed at the time of design was narrative in nature, rather than offering clear targets for implementation.	The evaluation team worked with the project team to understand how the narrative approaches were interpreted.
Absence of detailed project monitoring database. There was a good baseline conducted but few hospitals used the data as intended – to focus interventions. The project did not establish a database of supported facilities; not even a list of hospitals covered. Virtually no data sets were provided to the team – rather process documents such as meeting minutes and procurement records, rather than synthesized performance data per component.	The evaluation team had to reconstruct datasets with the assistance of the project team. However this was difficult due to time elapsed and with lower than normal confidence in data generated. It was time consuming and incomplete. The team had to rely more heavily on process records and qualitative data than being able to cross-check quantitative monitoring data. The team relied heavily on interviews and observations; information across a range of respondents and devised analytical methods to cross-check qualitative data.
The large scope of the project and limited coverage of the evaluation could result in variation of performance across the project area not being adequately represented.	The mission schedule was designed to cover a range of interventions at the State and other levels such as model hospitals as well as more remote and less sophisticated facilities to gain a range of assessments in different contexts.
High turn-over of GoI staff, particularly at national level meant that there was low institutional knowledge of the project.	Information was sought from both current and previous staff members, cross checking with project staff and stakeholders.

2. PROJECT'S CONTRIBUTION TO DEVELOPMENT RESULTS - EFFECTIVENESS AND IMPACT

This section provides a summary of project performance by component outcome. It identifies key achievements and notes any gaps in performance in relation to expected results. The summary is drawn from consideration of the design framework as well as the Theory of Change. The design framework identified a large number of activities but lacked specific, quantifiable targets. While many of the activities were completed, there were also critical activities that were not progressed that created barriers to achievement of expected outcomes.

2.1. Project's achieved results and overall effectiveness

This section provides a brief description of project results by component and then a concluding section on analysis of overall effectiveness. The detailed assessment of outputs by component demonstrates that while many actions were progressed satisfactorily, in other components, the gaps in achievements affected the progress towards outcomes (Table 5). For clarity, a short title of the component is provided as used in the Theory of Change. For detailed descriptions see section 1.3.

Component 1: Updated Policy environment
This component aimed to "support enabling and harmonized environmental and health-care policy and regulatory instruments through appropriate networking for creation and promotion of ESM of the medical waste, disposal sector and market."

Positive policy level outcomes result in national improvements in bio-medical waste management. Key activities included supporting GoI networks and processes to harmonize environmental and health policies related to BMWM. This involved a series of inter-ministerial meetings and dialogue, including State representation in discussions. There is no detailed records of the meeting conducted, number or profile of the participants; yet all those met during the evaluation who had been engaged in the process recalled that a series of meetings and workshops were supported through the project and that these had been instrumental in providing a forum for robust discussion on the policy and practical matters related to BMWM. It was also agreed that these processes contributed substantially to the eventual high quality of the improved Bio-Medical Waste Management Rules, 2016, (BMWM Rules). The new Rules include emission standards for dioxins and furans (Rule 9 Schedule III, 2016). The Project also contributed to the development of two subsequent amendments in March 2018 and February 2019.

The new rules have addressed issues that were inadequately covered in the 1998 regulations, such as the waste generator's onsite waste management, bar coding for waste tracking, reporting and training to ensure good segregation. It has also simplified the waste segregation and disposal system. While previously there were 10 categories of waste; with at times interchangeable colour categories, presently there are four, with an emphasis on segregation at source.

Table 4 Summary of Project Outcomes by component

Summary of project intermediate outcomes by component		
Component	Achievements	Gaps in achievement
Updated Policy Environment	• Project support for policy dialogue processes was highly appreciated. • This involved a range of workshops and technical support to develop policy and protocols. • Updated Rules released in 2016; further updates in 2018 and 2019. • Substantial benefits from change in practice due to policy amendments.	• Minor gaps in policy coherence. • Focus on waste disposal via incineration rather than on encouraging non-burn technologies.
Improved Institutional Capacity	• Curriculum & Training provided across 5 States. • Good evidence in hospitals that Training of Trainers (TOT) has been effective, training records are kept, materials in use and on-going training is being provided. • Consistent, positive feedback on quality of training.	• A few hospitals have lower levels of performance, usually due to insufficient resources or high staff turn-over.
Direct supply capacity	• Equipment (coloured bins and trolleys, spill kits) provided to all hospitals and in use. • Microwaves installed and mainly in use	• Malfunction in some batches of bins. • Trolleys too large for most facilities & difficult to clean. • Microwave use is expensive & these have insufficient operating capacity.
More efficient CTF function	• CTFs note increase in BMW segregation that assists with waste management. • Any upgrades are self-funded – mainly enlarging secondary combustion chambers, implementing vehicle tracking and bar-coding systems to reduce potential theft of infected but valuable plastic waste materials.	• Little assistance of project to support improvements in CTF operations. • CTFs still operating at low levels of efficiency and with limited compliance to environmental and safety standards.
Viable CTF and BMW collection systems	• Improvement in allocation of funds for BMWM to pay for waste collection as a result of updated Rules.	• No specific budget line item for BMWM at hospital level, so these systems are financially vulnerable. • CTFs operations are commercially marginal with little opportunity for investment in improvements.
Sustainable mechanisms (M&E, replication, upscale)	• Project knowledge in support of policy initiatives acknowledged. • Model districts established to demonstrate system more fully.	• Only 2 consistent State Technical Advisors, so technical knowledge & State activity lower than expected. • No M&E system, so insufficient tracking and adaptive management of performance. • No clear path for replication and sustainability.

Good progress has been achieved in policy implementation through compliance and enforcement mechanisms. As part of the process of revising the 1998 Rules for BMWM, the Project also supported the review of policy and regulatory enforcement mechanisms. This was partially carried out through the policy dialogue process but was also contributed to through a baseline study of targeted health care facilities in the five pilot States. The findings from this Gap Analysis contributed to the consideration of the need for practical guidelines and Standard Operating Procedures (SOPs). This work informed the preparation of the training materials prepared through the Project under Component 2.

The CPCB has developed guidelines for CTFs based on the 2016 Rules and these have been disseminated to State Pollution Control Boards (SPCB) and CTFs, which is now guiding improved operations. The evaluation found that the SPCBs have been active in promoting the new Rules both in CTFs and Healthcare facilities (HCFs). The 2019 project progress report[6] noted that the CPCB has also been preparing guidelines for BMW incineration as well as plasma pyrolysis and hydroclaving.

The amended BMWM Rules have been highly instrumental in amendment of in-hospital systems for waste management in the five States. The five project States account for between estimated 25-40%[7] of the BMW generated. Yet the BMWM Rules are implemented on a nation-wide basis so also influence BMW management operations in non-project States, and consequently, the other 60-75% of BMW generated. Key informants during the evaluation who have visited HCFs and CTFs in other States have seen that the release of the updated BMW Rules has improved performance of segregation and attempts to upgrade CTFs nationwide. This aspect has been acknowledged in the estimation of project benefits in section 0. An expected activity that still requires attention is the expected amendment of the formal medical training colleges and the national curriculum to ensure integration of learning regarding the ESM of medical waste (see also component 3).

However, there was one key activity under this component that did not proceed as planned. This was the domestic market analysis of BMWM and disposal. This activity was designed as a foundation for the activities under Components 4 and 5 relating to strengthening PPPs in BMWM. The market analysis was expected to provide critical market information that would help to identify the status of the domestic market in relation to provision of BMWM supplies and on incentives required to ensure a fully functional system for commercial viability of BMWM. It was also expected to support the strengthening of local supply of bins, trolleys and treatment equipment in India. The market analysis was further supposed to consider the regulators, economic and market status for disposal of BMW, with a particular focus on how CTFs could function most cost-effectively to ensure market viability of operations.

Delays in the conduct of the domestic market analysis caused a major bottleneck that adversely affected the outcomes in other project components. The contract for the domestic market analysis was only progressed during 2019 and the process was still in progress during the time of the evaluation. However, a presentation of initial findings was made to the evaluation team and this implied that the study process had yielded important information on the status of the domestic market in each of the five States in terms of the supply of bins, plastic bags, trolleys etc. The findings suggest that there is ample supply of equipment of suitable quality for HCF requirements and that given required specifications; the project supported equipment could have been produced locally in each of the five States.

[6] Project Progress Report (8th September 2019)

[7] Available data was inconsistent on the extent of project coverage. The estimated number of CTFs is 198, with 225 HCF with on-site incinerators and the rest being disposed of by deep burial. The 5 States are estimated to have a total of 57 CTFs i.e. 29% of national total. Yet project documents consistently quote 40% of national coverage.

The assessment of the CTF commercial operations also highlighted the current inefficiencies in the BMWM domestic market; particularly the effects of high costs and low revenue that affects the viability of CTF operations and precludes major capital investment to upgrade their equipment.

While the achievements in updating and improving the policy environment for BMWM and UP-POPs in relation to Stockholm Convention requirements are evident, the achievements required lengthy processes and resulted in major project delays. At the time of the Midterm review in 2016[8], the project had achieved little physical or financial progress as a result of awaiting completion of the 2016 Rules.

Remaining inconsistencies in BMWM Rules. Overall, the feedback on the implementation of the updated BMWM Rules 2016 was that they are generally clear and substantially improved. However, some minor areas remain for clarification. Such an area of continuing confusion is colours of waste bins as illustrated below. While, most hospitals have ensured that red and yellow bins are only for BMW, in one facility visited, there were different colour bins; including red, for general waste. This may cause confusion, and perhaps even mixing of general waste bins with the infectious waste bins. However, the major concern identified was that between the colour coding between 2016 BMWM rules and the 2016 Solid Waste Management (SWM) Rules. Although, the 2016 SWM rules do not mention blue as the colour of bins for recyclables, the 2015 draft regulations did, and presently, most public spaces also use this as the colour for recyclables. This creates confusion between the colour code for blue sharps and the recyclables. Equally, the 2016 SWM regulations now mentions recyclables to be in a white container/bag, which is a colour designated for sharps – needles. This is a concerning potential area of confusion for implementation of waste management in hospitals.

It was found that CTFs do not distinguish between the disinfected and non-disinfected red bags. Although disinfected bags are supposed to have a marker, these are small and not very visible. Furthermore, the red bags (infected and disinfected) tend to get combined again during transport. Another issue with plastic waste is the high value of the waste for recycling. Discussions with HCFs and CTFs during the evaluation suggested that it is likely that part of the plastic waste was being segregated before (or after) disinfection, and sold illegally.

Another possible area of concern is the management of BMW at laboratories at HCF and for blood banks. Of the two laboratories visited, one identified a concern on disposal of broken slides and other equipment that had been used for testing equipment that had possibly come in touch with infectious material. At the laboratory there was ambiguity on how to manage and segregate different biomedical waste categories.

Component 2 - Improved Institutional Capacity

The project aimed to strengthen institutional capacity for BMWM across the five States. Each State selected 28 HCFs initially: 4 large HCFs with over 500 beds; 8 medium HCF with 100-500 beds and 16 small HCF with less than 100 beds were selected. Some HCFs were changed during implementation and each State also identified extra HCFs as part of establishing their "Model District concept," where more intensive support was provided to a single district. This included identification of a specific CTF. Microwaves were provided for large facilities. By project completion, based on State records, a total of 167 HCFs were covered: 25 large, 45 medium, 90 small and 7 of an undetermined size (Annex 8). Institutional strengthening was expected to occur as a result of training and awareness-raising of BAT/BEP.

Training provided was high quality and well-accepted. The project provided high quality training coverage across all project states through the Ramaiah College. Adult learning techniques and practical

[8] UNIDO Independent Mid-Term Evaluation, Environmentally Sound Management of Medical Wastes in India. 2016

sessions contributed to increasing knowledge and capacity levels. Of particular note were the ToT courses that were instrumental in transferring knowledge from the participants to other staff within each project HCFs. A total of 126 ToTs were conducted across the five States (68% male; 38% female) during February 2017. The combination of high quality training and wide dissemination of training activities and materials has led to a significant increase in the training capacity of hospitals.

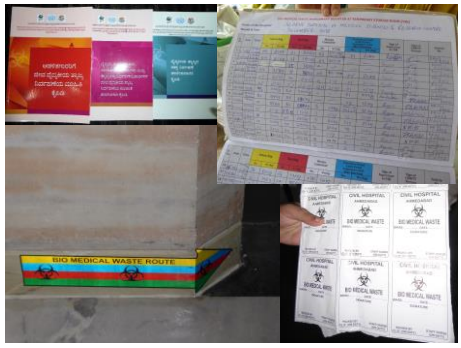
A total of 3899 health care professionals participated in training across all five project states (Table 5)[9]. These training figures include participants from ToT courses, SOP courses and Model District training courses.

Table 5. Number of healthcare participants in training delivered by M.S. Ramaiah Medical College

State	Male	Female	Total
Gujarat	311	370	681
Karnataka	243	368	611
Maharashtra	266	317	583
Odisha	338	417	755
Punjab	334	935	1269
Total	**1492 (38.2%)**	**2407 (61.8%)**	**3,899**

Materials were initially in English but have now been translated for circulation.

While the training material is considered to be of good quality, all material provided initially were in English. Translation into the five State languages has been completed but materials have not yet been circulated, apart from those in Karnataka that have just been released. Some translations have been done locally, but only for a few posters or instructions for the bins. Some of the local language information is from other programmes or SPCB programmes. Given that most of the training involves infection control nurses and nursing staff who are not always conversant with English, the training material becomes less accessible.



Delay in preparation of training approach resulted in some duplication of efforts. At the time of implementation, there were already a number of other ongoing training and communication activities underway for BMW and the 2016 Rules. These included the LaQshya programme that aimed to improve the quality of care in the labour room and maternity wards, and the Kayakalp programme that intended to encourage and incentivize Public Health Facilities to demonstrate high levels of cleanliness, hygiene and infection control. Both of these programmes were run by the MoH&FW. In addition, the SPCB organized awareness activities to ensure compliance to the 2016 Rules such as the demonstration board pictured. The MoH&FW of Gujarat[10] had also published a detailed manual for Infection Prevention and Control for Public Health Facilities that includes biomedical waste management. Two hospitals in the Ahmedabad-Gandhinagar area had already developed their own material for ensuring compliance to the BMWM 2016

[9] M.S. Ramaiah Medical College, 2019. M.S. Ramaiah College Presentation on Training for the UNIDO Terminal Evaluation Team. September 4th, 2019.

10 Department of Health and Family Welfare, Government of Gujarat, 2017. Infection Prevention and Control. An Implementation Handbook for Public Health Facilities in Gujarat. Government of Gujarat, Gandhinagar.

regulations. Therefore, the UNIDO programme is only one of the many training programmes being given in the project states, and apart from hospitals visited in Odisha, not the first or only programme providing training and support for improving BMW management.

Clear evidence that training is being applied and replicated in project-supported HCFs. During the evaluation, it was found that the application of training and the training materials provided under the project has been considered to be of good quality at all HCFs visited. The material covers the 2016 BMWM Rules and its implementation well and is seen as easy to understand and useful. All HCFs have also received training directly from the MS Ramaiah Medical College. Follow-up training and refresher courses are being conducted by the trainers supported by the project.

The role of the Infection Control Nurses, Ward In-charges and BMW committee members are critical for ensuring day to day supervision of BMW segregation and safe handling practices. The importance of this stakeholder group has resulted in their inclusion in training activities. Many hospitals have carried out awareness raising activities for both staff and the public on the link between effective waste management and disease (see example above). Most hospitals maintained records of needle stick injuries and hospital-acquired infections and understood the implications of BMWM for reducing these. The materials are present and are evidently being used. Most hospitals had also displayed posters and other material received to help staff remember colour coding for the management of BMW. Furthermore, discussions with the microwave unit operators suggest that they have received training and are well equipped to manage the microwaves and ensure disinfection of contaminated plastic waste.

Yet, gaps and risks remain; particularly in handling of plastics. However, the training was provided in 2017 and 2018, late in the project. Given, that behaviour change takes time, and there is a need for repeated messaging and emphasis on the management of biomedical waste right through the chain, from the source to its end disposal the visible and tangible results are limited. Source segregation and post collection waste mixing are still an issue, and this change in behaviour will need continuous emphasis. Of particular importance were the training of nurses in intensive care area who need to ensure segregation from bedside to bin, as was the training of 'Class 4' staff that are responsible for collection and segregation at the storage area. As aforementioned, currently the training materials are in English and local language materials are not yet available impacting on the widespread accessibility of training. Numerous examples of staff both in HCF and in CTFs segregating waste by hand to find valuable plastics were witnessed – e.g. separating needles from syringes by hand as pictured opposite. This is highly risky practice.

Continuous training is still required. Furthermore, there were several hospitals where progress had been affected by change in staff and follow-up training is required, for example SCB Medical College and Hospital Cuttack, Neelanchal Hospital Puri, DHQ Hospital Baripada and Ranjendra Hospital Ludhiana. A challenge being faced in the hospitals is the large turn-over of staff at the hospital attendant and the lower staff level that are usually involved with the handling of BMW. Ensuring the new staff undertake proper source segregation and disposal of BMW, requires continuous training and supervision from the nurses and other staff members. Another concern is the confused messages provided by the various training programmes and regulations. While the LaQshya guidelines state that plastic gloves may be disposed directly after use, all other guidance suggests cutting them to ensure no reuse occurs.

Examples of good practice. There are different practices followed in some hospitals which represent good examples that may be worth reviewing to improve practices in other hospitals. Examples of such good practice include a source segregation, cutting intravenous fluid bottles and tubes prior to disposal to reduce pilferage; proper recording of waste at ward level.

Component 3 - Direct supply capacity

The project aimed to facilitate and promote PPPs to improve support and supply capacities for BMWM. This includes influencing the training curriculum for medical colleges (targeting 150,000 medical students of 297 medical colleges). This has not yet occurred but discussion with several medical students during the evaluation suggests that there is a focus on BMWM but that the teaching still covers the 1998 Rules.

A strong focus on segregation equipment. This component also focused on actual enhanced effectiveness and efficiency of segregation of medical wastes at source through the provision of equipment, and strengthening the relationship between the HCFs and the CTFs. This was expected to significantly reduce the volume of hazardous medical waste at source by proper segregation ensuring only hazardous waste needs to be treated. Segregation was expected to be achieved by providing colour-coded bins and improved movement through hospitals and segregation at temporary storage areas. It also targeted on-site disinfection of infected plastic waste in line with the 2016 BMWM Rule's requirements and overall improvement of the system of BMWM movement between patient to waste treatment. Overall the provision of equipment has facilitated segregation and according to both HCFs and CTFs, there has been a reduction in general waste mixed with BMW. Nonetheless, the volume of hazardous BMW in the facilities visited appears to have increased during the period of the project, due to the increase in the use of disposable medical materials and the volume of patients treated.

Customized and standardized designs were prepared.
The project invested time in preparing a standard design for bins that were robust and that used hydraulics for foot operated opening and automatic closing of lids to ensure that staff were not required to touch the bins, thereby decreasing hazardous waste handling and reducing the risk of infection transmission (as pictured). Similarly, trolleys for movement of waste within hospitals were designed with closed lids to reduce likelihood of infection as waste is moved through public areas of HCFs. Options were considered for on-site disinfection of plastic waste and microwave technology was decided upon. There were discussions of different options for technologies but the choice of microwave technology appeared to be largely because it was a more modern technology that the existing, prevalent process of autoclaving.

However, a decision for central procurement was contrary to design aims to build local supply capacity. The project concept was to work with local suppliers in each State to build capacity in local suppliers to provide high quality BMWM equipment close to HCFs at affordable costs. However, a decision was made by project management to procure equipment centrally. This was decided, largely by UNIDO, for reasons of cost-efficiency and more professional quality control. While this did allow the procurement process to be centrally managed and did result in a fulfilment of expected targets for procurement and distribution and contributed to receipt of equipment by participating HCFs, it did not lead to the expected outcome related to building local capacity.

Largely effective distribution of equipment but some sub-standard items provided. During 2017, 2018 and 2019, the project managed the design, procurement and distribution of coloured bins (in sets of 4) and trolleys across all five states. The central procurement was through open competitive bidding

and resulted in a contract to a USA company which sub-contracted to an Indian producer. Microwave units were purchased from Austria. The supply of bins and trolleys was largely successful but several batches suffered from quality issues. The project used a contracted quality control agent that did identify most of the deficiencies but in some States, the problems were identified by SPCB staff; in several cases the substandard items reached the hospitals. The quality of microwave units was high and all were properly installed.

Equipment was installed, largely functional and appreciated.

The task of procuring and distributing equipment across the five states and 167 HCFs was a substantial task and despite major delays the project was completed effectively on schedule. Most hospitals have accepted the distribution of equipment with appreciation. The installation of equipment leveraged in-kind support from the HCFs in terms of time and effort to receive and install the equipment and staff time to orient the users of the equipment towards proper use. The installation of the microwave units, in particular, required financial contributions to construct or convert facilities that were suitable for operation including areas that were in or close to the temporary storage area for microwave operation. It also required designation and training of, generally, two additional staff members for microwave function and subsequent work on operations. The training received was of a high quality and aligned with the design process contributing to the evaluation team finding that the operations are technically effective.

However, issues with equipment were experienced.

In several HCFs, around 20-30% of bins are non-operational or of inappropriate size. One of the main issues with the bins was that the lids broke, rendering the expensive hydraulic system redundant. In addition, the wheels were liable to breakages and were found to collect dirt and be difficult to clean. The evaluation team often observed the bins being rested on bricks (see photo). Actually few hospitals moved the bin units and so reported that it would have been easier to have the bins without wheels.

The trolleys also had design flaws. For most facilities (small and medium), the size of the trolleys was too large, requiring two staff or more to move the trolleys around the premises. Some facilities had reverted to their local trolley system that could be handled by a single person and this resulted in the supplied trolleys remaining unused. In others, the trolleys were used but there were issues with removing the waste and cleaning the unit due to the single top opening. This was effective for putting waste into the unit but the units were too large for easy removal of waste. This led to a build-up of waste inside the unit and required unsafe removal practices – staff standing on steps or tables to lean over far enough to remove waste at the bottom. The addition of a side door for easy removal and cleaning would have been more appropriate.

Microwave units were too small for effective operation and were expensive to operate.

In most hospitals that received microwave units, the quantity of plastic waste generated is greater than the unit's treatment capacity. The capacity of the microwave units is approximately 60 kilograms per 24 hour period, whereas the waste generated by the larger hospitals is more in the region of 200 to 500 kilograms per day. This means that only a proportion of the plastic waste could be processed, leading to a situation where a HCF would have two types of red bags: disinfected bags (with small sticker) and non-disinfected bags. In practice these bags were not kept or handled separately by the HCFs or the CTFs, meaning that cross-contamination was again likely to occur. The evaluation team found that most CTFs were unaware that the hospitals were partially disinfecting red bags and continued with their own disinfection processes – usually by autoclave. Furthermore, the HCFs found that the microwave operations were expensive given the labour and power costs required. Several HCFs had ceased operating their microwave unit or only used it rarely due to these inefficiencies. Other HCFs were seeking approval for the disinfected plastic to be sold directly to registered recycling agents, so that the income would cover the costs of sterilization. This has been approved in Karnataka but not in other States. In consequence, there is currently little added value from the microwave process, apart from employment generation for operators and partial compliance with the 2016 Rules.

Other identified issues with the waste management BAT/BEP

Some additional matters were identified. The selected technologies did not fully align with the expectations at design. For example, the Project Document calls for volume reduction through developing a "mechanism for compaction of the waste from hospitals." This was not pursued. Further, it was found that waste disposal in some hospitals was not appropriate due to unsuitable burial pits with regard to water table and local water courses; as well as unauthorized treatment methods (open burning and perhaps illegal dumping).

CTFs reported that while segregation processes have substantially improved, they are still not adequate across all hospitals, so the facilities still need to manually sort much of the received waste. The waste tracking/ barcode system has been installed by most CTFs visited but the process is poorly understood by the HCF and not implemented to optimum effect by the CTFs. Many HCFs are reluctant to implement the legally required systems due to the extra costs involved. Others do pay for and use the barcodes, but do not have a HCF-based registry of the codes either manually or by scanner, so the potential of cross-checking of valuable waste quantities to identify discrepancies is lost. There are also still some issues with the disinfection of BMW. While these were isolated cases of leaking autoclaves and combined disinfection of all types of waste at once they are still present.

In addition, it was expected that providing opportunities for communication between HCFs and CTFs would result in improvements in the efficiency of transfer of BMW between the two parties but this progress was not evident. In most cases the relationship was largely contractual and there were few discussions of substance in terms of for instance, how to protect against cross contamination in storage and transportation. In a few cases, larger hospitals invited the CTF to attend Infection Control Committee meetings on an ad-hoc basis but there was little discussion on how the overall processes could be improved.

Component 4 - More efficient CTF function

This component was designed to facilitate and promote PPPs to improve local technological and manufacturing capacities in medical waste transport and disposal sectors, to avoid the generation of PCDD/PCDF and other UP-POPs releases by applying BAT/BEP measures. This was expected to occur by strengthening the performance of the five selected CTFs to enhance their capacity in terms of technology and BMW transport and treatment. This was to occur partially through the policy changes and consequent compliance associated with component one, improved disposal technologies, reduction of

incineration of plastics through segregation and better compliance with environmental standards as outlined in component two. However, given the lack of focus of the project on this component and no further in country technical assistance to the CTF, the alternative technology testing envisaged did not occur.

During project design, there was a detailed assessment of the capacity of all CTFs in each State. This was comprehensive and could have been useful, but as with the gap analysis in the HCFs, the information was not compiled into a baseline database that could have been used more effectively to track progress and improve performance. However, based on visits to the five project CTFs, there has been little improvement in the operating practices of the CTFs since the baseline study was completed ten years ago. This is largely due to lack of attention by the project on the CTF operations or on strengthening the PPP approach.

The evaluation found that the main contribution of the project has again been its role at the policy level in terms of the strategic importance of the updating of the BMWM Rules. However, this contradicts the implementation focus which has been on the increase in combustion period from 1 second to 2 seconds chamber residence and the attainment of higher temperatures. Consequently, four of the five CTFs have already or are about to add a secondary combustion chamber at their own cost. Most of the CTFs use vehicle tracking and bar-coding but this had been introduced by most prior to the project and is a matter of compliance to the 2016 Rules and also of commercial rather than technical value. As noted above, the bar-coding system has not achieved its potential due to the unwillingness of the HCFs in most States to introduce the system. The incineration technology used by the CTFs is generally inefficient and standards are still at a relatively low level. Compliance with standards for air emissions, effluent management and disposal of residues are tracked by the State Pollution Control Boards but have not been enhanced under the project and are still questionable in terms of compliance with the 2016 Rules.

Component 5- Viable CTF and BMW collection systems

This component aimed to achieve demonstration of participatory funded and integrated systems for medical waste management and disposal in the selected states and with particular attention to the model districts. The actions for this component were expected to be framed by the domestic market study carried out as part of component 1. This study was delayed until the last months of the project and consequently little action relating to this component has occurred. Even progress reports noted these activities are pending completion of other activities.

The component envisaged a better understanding of the funding system for BMWM and enhancement of the participatory funding system. The evaluation found that HCFs are paying the CTFs, generally on a per bed basis, regardless of occupancy representing, sometimes large, inefficiencies. Payments are drawn from budgets but in each State, there was no designated line item for BMWM; generally it was drawn from general operations categories. This means that the amount for BMWM is not guaranteed in case of budget cuts or changes in priorities. An added pressure on HCF financial systems, particularly small and medium facilities, is the implementation of a health insurance scheme, which while of substantial benefits

to patients, results in a financial gap between the costs incurred for treatment by the facility (particularly medium size facilities) and the amount the facility is paid for the same treatment by the government. HCFs reported concern that given dwindling incoming funds, there is a risk that there will be insufficient budget available to properly manage BMW.

It was also found that there is not always a clear understanding of the funding system for BMWM. While each HCF bears its own BMWM costs and this is currently well managed in most facilities, the HCFs visited, particularly medium-sized facilities expressed lack of certainty of sufficient future funding. In particular, costs for bar-coding, plastic bags and microwaving were seen as high. Given these financial pressures faced by HCFs the treatment of valuable plastics was an issue in many hospitals, with several hospitals clearly retaining potentially infectious plastics for sale to local recycling agents in an attempt to increase financial viability. In addition, the evaluation identifies concerns that in such a financially constrained context BMWM will be one of the first expenses to be cut from budgets.

It was expected that a manual for HCF administrators would be produced as part of this component. Such a manual was produced but the content focuses on the technical and human resource aspects of BMWM and does not include any information on the funding aspect.

Another aspect of funding is the viability of the CTFs. The evaluation assessed that the CTFs visited are marginally viable and hence have little capital available for upgrading equipment. The assumption in the project design was that with more efficient operations, the CTFs would be self-sustaining. The evaluation found that given the low margins, it is likely that some CTFs are circumventing the Rules to save costs. An additional factor is the current approach of the CPCB to provide financial support to potential new CTFs. This is likely to increase competition and runs the risk of impacting further on the viability of existing CTFs. In some States support to new CTFs is being carefully managed to ensure that current CTFs can continue to operate at a viable level. A potential way to address these concerns is to consider expanding the national scheme of CTF support to include funding for upgrading existing CTFs.

The final action in this component was to prepare lessons learned for country-wide dissemination through a communication and demonstration programme. This aspect has not yet been progressed and is covered as part of the project management component given the coordination role by the project.

Component 6- Sustainable mechanisms (M&E, replication, upscale)

The key outputs identified for the final component were to establish a project management structure and design and implement an M&E mechanism. Given that effective project management is a prerequisite for the effective and efficient completion of other project activities contained within this component the other outputs were not well designed and therefore the achievement of the outcomes of this component was limited. The implementation of an M&E mechanism should be designed to capture learning and ensure that lessons are disseminated in line with project objectives. In the case of this project, it was designed as a pilot with an expectation that lessons learned would be documented and shared with other States to enhance nationwide compliance with the Stockholm Convention requirements for BMWM.

The project management structure was established through National and State Level Steering Committees and has been largely functional. The lead implementing agency in each State has been active: SPCB for Punjab, Maharashtra, Gujarat and Odisha, and the MoH&FW in Karnataka. Although the lead agencies at State level support and have been engaged with the project, government staff have many other roles and cannot devote dedicated time to the project. It was envisaged that a State Technical Advisor (STA) in each State would coordinate and support the implementation of all components within the State. Unfortunately, only two STAs were in place for long periods. In other States suitable staff were not identified or were only available for a short period of time. This meant that implementation largely relied on part-time attention from already stretched staff, and in general, did not receive the attention it required to be effective. Furthermore, the focus of implementation was largely on policy matters and waste segregation in HCFs; leaving other component activities without sufficient focus.

The initial gap analysis of HCFs and technical assessment of CTFs as part of the design provided a wealth of valuable baseline data. Unfortunately, this was not converted into a monitoring system that could assist the project in adequately monitoring its progress. Progress reports were generated but this was largely based on verbal ad-hoc reports from States[11] rather than a systematic and analytical approach to results-based management; although this has improved substantially since 2015. Consequently, project management was not sufficiently informed on progress and issues surfaced during the evaluation that could have been addressed earlier in the project.

The design of the project as a pilot was an important strategic aspect of the design and relates to the expectation that each component would generate lessons that could be replicated in other parts of each project-supported State and in other States. Each State does plan to conduct a learning workshop but overall little planning has been embedded in the M&E and project management processes to build towards effective replication and scaling up from the pilot.

Summary of Results and Effectiveness

Based on the evidence gathered during the evaluation and given the paucity of data for qualitative analysis, the evaluation team prepared an analysis to illustrate project results by component. A spider diagram was prepared with a qualitative score between 0—no results achieved and 10 – all expected results achieved (Figure 2).

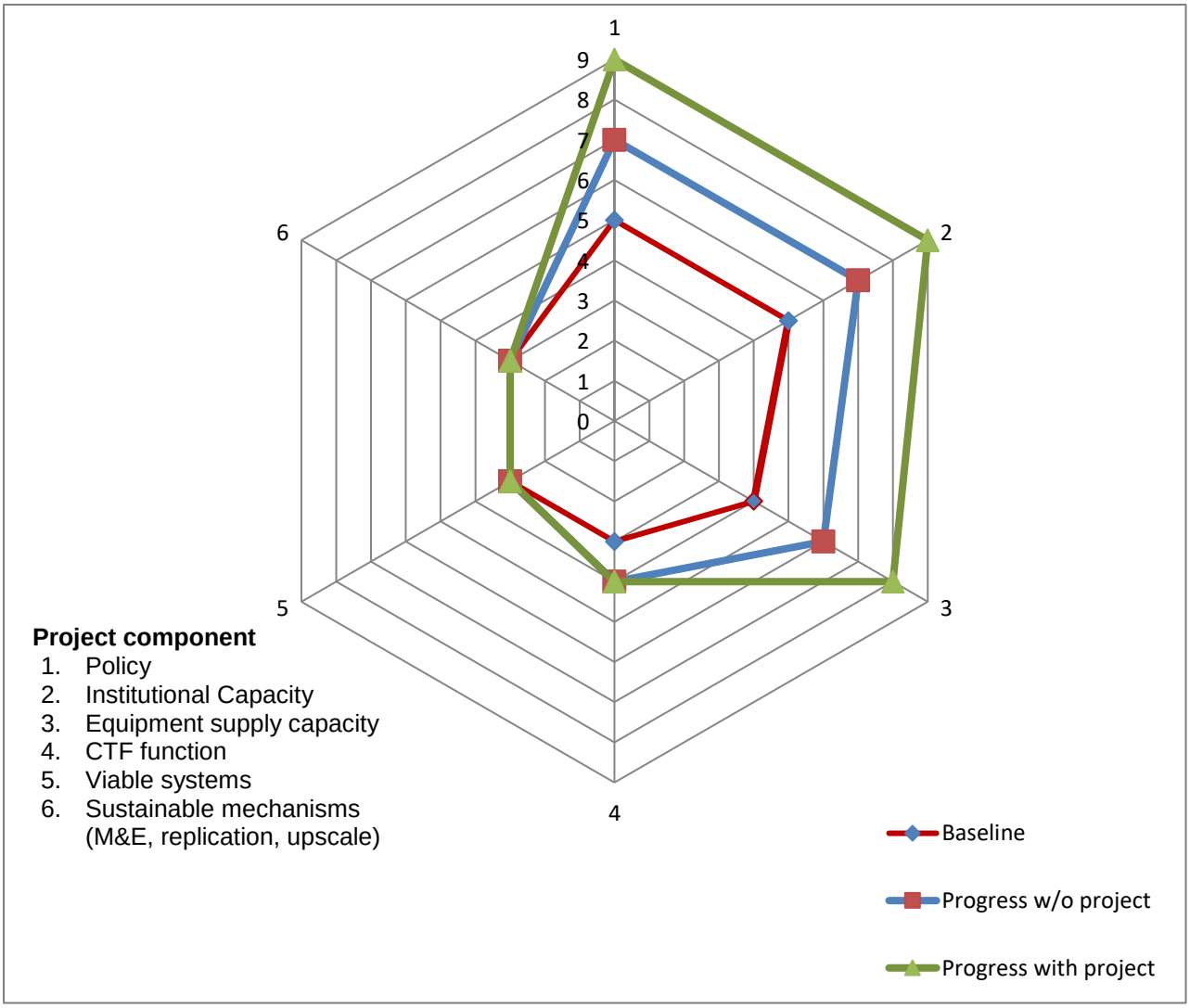
Baseline – the baseline data showed that the project was not operating in isolation from other activities. The gap analysis showed that results were being achieved even before project commencement based on on-going work by GoI, HCFs and CTFs.

Expected progress without the project – For the likely "without project" scenario, information was gathered on pre-project data were available and in several non-project facilities. The GoI had planned to proceed with updating the 1998 BMWM Rules even if the project had not proceeded, a range of activities and schemes to promote the updated 2016 Rules were already in place and active in project sites, some HCFs already prepared their own materials for training based on the 2016 Rules and had gone ahead to upgrade the quality of bins and trolleys based on locally available supplies. Conversely, little support was available to the CTFs and minimal change was observed from the baseline condition.

Results with the project – the diagram illustrates the extent of progress attributable to the project. The results were largely achieved in components 1, 2 and 3 where effective progress was achieved. Progress in components 4, 5 and 6 were lagging and received little project attention; consequently these components are considered ineffective. Overall, the project effectiveness is assessed as moderately unsatisfactory.

[11] i.e. Progress Report for GEF-UNIDO funded MOEFCC project entitled 'Environmental Sound Management of Medical Waste in India' – Maharashtra, 16-9-2016.

Figure 2. Projects contribution to progress in the BMW sector



2.2. Progress towards impact

This section assesses the extent to which the project made progress towards UNIDO's three impact domains regarding behavioural change in order to assess how the benefits of the project have accrued to the target beneficiaries:

- Economically competitive - Advancing economic competitiveness
- Environmentally sound – Safeguarding environment
- Socially inclusive – Creating shared prosperity

This section address the extent of behaviour change in each of the three domains as well as the contribution of the project towards broader adoption through mainstreaming, replication and scaling up given the initial concept at design was for the project to feed into a larger programme. Overall, the project is assessed as having made moderately unsatisfactory progress towards impact.

2.2.1. Behavioural change

Advancing economic competitiveness

The project had no perceived impact on economic competitiveness, despite the expectation in the design that PPPs would be a main mechanism for implementation. The centralized procurement acted contrary to the expected capacity building in the local market for BMW supplies. It was observed during HCF visits that in larger facilities, the project-supported bins were insufficient but they had been able to source adequate bins locally (see photo). Feedback from stakeholders generally was that with specifications and initial technical support for local businesses, it should have been possible to procure suitable equipment locally. This would also have enabled capacity for local repair or replacement of equipment. Currently, hospitals are finding challenges in accessing parts for repair of equipment received through the project.

Another economic factor that is of concern to HCFs and CTFs is the treatment of infected plastic waste. There is a constant battle between the economic and environmental benefits of collecting plastic materials and waste and the temptation to acquire these financial gains by recovering infectious plastic waste. The pilferage of plastic for sale for recycling therefore continues to be a drain on resources and as well as a health hazard. Furthermore, the high cost of microwaving is leading to some HCFs leaving the machines idle.

One positive impact of the project was its support for hospitals that have a plan (or are already) receiving overseas patients for "medical tourism" visits. This is a major growth industry worldwide and India is prominent in the industry as a professional and affordable destination. While the project did not mention this economic potential at any stage, it was mentioned on several occasions by larger hospitals in terms of having better trained staff and improved waste management processes.

It is expected that the domestic market study under component 1 may be able to contribute to progress once data has been analysed and the recommendations received. However, additional time would be required to assess and implement necessary action arising from the study before impact is achieved.

Safeguarding the environment

This was the main aim of the project so is given precedence in the assessment of impact.

The project's stated objective is to "... reduce and ultimately eliminate the releases of unintentionally produced POPs (UP-POPs) ..."

As part of the project preparation a "situation analysis [was] carried out among 57 Common Biomedical Waste Treatment Facilities (CBWTFs), which is 40% of total CBWTFs in the country, the amount of PCDD/F emission was estimated to be 105.44 g I-TEQ/y using the UNEP Toolkit. If the same is extrapolated to the country, it will be 263.6 g I-TEQ/y PCDD/F releases."[12] According to the Project Document, it was estimated that by "proper segregation and either by applying non-incineration techniques or upgrading existing incinerators in the 57 CBWTFs, that 50.7 g I-TEQ/y PCDD/F reduction can be achieved." The basis for this estimate is provided in detail but seemed a low approximation, as it assumes that the improvements will only roughly halve the emissions (reducing emissions by 51 grams from the assessed 105 grams per year).

The project expected to upgrade existing incinerators to improve the flue gas cleaning system and hence their emissions to the atmosphere. The UNEP Toolkit gives emission estimates for incinerators with various configurations of air pollution control system, although it does not offer an emission estimate for systems equipped with wet scrubbers. Yet, it was found that wet scrubbers are very common on small incinerators and was the system used on all the incinerators visited by the evaluation team. [13] A gas cleaning system using bag filters can be expected to have an equal or higher removal efficiency for dioxins and furans, so using this data means that the emission reduction estimates may be slightly overestimated for the incinerators the project worked with. Nonetheless, the estimates shown in Table 6 of before and after project impact on emissions are considered reasonable.

Table 6. Before and after estimates of dioxin and furan emissions for the project incinerators using the UNEP Toolkit and in the project document

Situation	Type of system	TCDD/F Emission factor (µg I-TEQ/t)
Before project	Non- properly controlled batch type with no or minimal Air Pollution Control (APC) (wet scrubbers)	10,000
After project	Non- properly controlled batch type with no or minimal APC (2 seconds in SCC & wet scrubbers)	7,000

The project has worked with five incinerators and the reduction in emissions for dioxins and furans for these facilities are calculated in Table 7 below. The current waste throughputs are used, as well as the estimated reduction in emissions based on the UNEP Toolkit, where the "before" situation is an incinerator without air pollution control and the "after" situation assumes that an operational air pollution control system is in place. Hence, the presence of a gas cleaning system reduces the emissions of dioxins and furans by 8,500 ug I-TEQ per tonne of waste incinerated. Based on the data collected from each CTF, a total of 6.9 g I-TEQ/y is estimated.

12 Project of the Government of India Project Document (PRODOC) 23 July 2011. Page 2/187

13 There could be a technical explanation for the lack of data for wet scrubbers: Unless the gases are reheated after the wet scrubber(s), the flue gases will be saturated with water vapour making any analysis of the flue gas composition difficult.

Table 7. Estimates of dioxin and furan emissions for the project incinerators

Facility	Incinerator capacity (kg/hr)	Daily hours of operation (hours)	Annual amount of waste incinerated (t/y)	TCDD/F Emission factor reduction (µg I-TEQ/t)	TCDD/F emission reduction (g I-TEQ/y)
e-coli Waste Management (GU)	100	17	530.4	3,000	1.6
Shree Consultants (KA)	100	6	187.2	0	0
Water Grace Product's (MA)	250	6	468.0	3,000	1.4
Sani Clean (OD)	100	10	312.0	3,000	0.9
Medicare (PU)	200	16	998.4	3,000	3.0
Total:			**2,496.0**		**6.9 (14% of target)**

Note 1: Assuming operation six days per week, 52 weeks per year.

The project also indirectly reached out to the other CTFs within and beyond the five states through the new 2016 BMWM Rules that it helped draft, and due to the awareness raising it provided. Therefore, the project can be given some credit for the fact that all CTFs are in the process of upgrading their incineration systems to be in compliance with the new Rules and to have a longer SCC residence time.

The combined estimated contribution of the project to emissions reductions for dioxins and furans is:

- The 263.6 grams/ year emissions reduced by 30% (from 10,000 to 7,000 ug I-TEQ/t) corresponding to a decrease of 79.1 g/yr. Ten percent of this is 7.9 g/yr.
- If the project is credited with 10% of these ongoing emission reductions, that would be a 7.9 grams/ year reduction in emissions of dioxins and furans.
- If 10% of the waste stream now avoids incineration due to better separation - for all of India that would be a decrease of 26 grams (10% of the Project Document's total estimate for India of 263.6 g I-TEQ/y PCDD/F released per year). The project could receive 25% credit i.e. 6.5 g I-TEQ/y PCDD/F given the intensity of improvement in the 5 States.

Estimated contribution of project towards safeguarding the environment
The overall estimated reduction in dioxins and furan in emissions achieved:
Direct benefit = 6.9 g I-TEQ/y PCDD/F reduction (14% of target)
Indirect influence of policy change and segregation - 7.9 + 6.5 g I-TEQ/y PCDD/F reduction, respectively
Total estimated reduction of 21.3 g I-TEQ/y PCDD/F reduction (i.e. 42% of target)

Socially inclusive – Creating shared prosperity

This project tackles healthcare waste management and consequently has a large positive impact on public health: With relatively modest investment, bio-medical waste is more properly handled with hospitals and clinics, safely stored and treated. This improvement decreases infections within hospitals; increasing the safety of patients, health workers, waste collectors and scavengers.

Reduction in Hospital Acquired Infections. Nosocomial infections or "hospital acquired infections, (HAI)" are infections occurring within 48 hours of hospital admission, 3 days of discharge or 30 days of an operation. In Great Britain they affect 1 in 10 patients admitted to hospital and annually this causes

5,000 deaths. [14] The United States Centre for Disease Control and Prevention estimates that there are roughly 1.7 million hospital-associated infections, from all types of microorganisms, including bacteria and fungi combined, within the United States every year and that the infections cause or contribute to 99,000 deaths each year. [15]

Any decrease in HAI through proper management of the infectious waste is a tangible benefit. The evaluation reviewed the infection control minutes in most HCFs. The majority track and report on HAI. The hospital note that actual numbers of HAIs are increasing overall but this is largely due to the rise in antibiotic-resistant bacteria. The hospitals believe that the improvement in medical waste management does contribute positively to prevention of infection. Of particular interest were neonatal wards and those with chronic diseases.

Through the project's efforts to establish new BMWM Rules, raise awareness and to establish model facilities, it can be deducted that the project has made a significant contribution to reducing the prevalence of hospital-acquired infections in the project-supported HCFs; noting that not all the improvement is attributable to the project as explained in the results section.

Capacity/knowledge building for individuals. Other social factors that were affected by the project were the individual capacities built through the direct training and the referred training through training of trainers. Of particular importance was the training for the waste handlers. Raising the skills and knowledge level of the waste handlers increased their apparent value within the hospital and drew attention to the importance of the work they carry out. Several nursing staff also noted that the training received is used by them at home and in the community to improve waste handling more generally.

2.2.2. Broader adoption

As noted in the results section for Component 6, the project has not yet placed attention on the design intention and the potential for broader adoption. Within the project- supported facilities, mainstreaming of BAT/BEP based on the training received is evident in almost all facilities. Some replication has occurred in the Model Districts where the number of HCFs was expanded, however, this was not implemented as replication, rather as expansion within one district with the objective of creating a stronger pilot for an integrated BMWM system.

2.2.2.1. Scaling up – Arguably, the main impact in scaling up has been the achievements in approval of the 2016 BMWM Rules and subsequent amendments. However this has been by default as the release of a national policy covers the whole country. Yet, there are indications that the workshops held in preparation of the Rules assisted in engaging SPCB representatives from other States and resulted in a higher level of awareness of the reasons for the Rules and the protocols for implementation. Nonetheless, as a pilot project, a pathway towards scaling up was integral to the project design. In order to achieve a strong foundation for scaling up, strategies should have been evident across the project implementation. There is substantial potential for this to occur, for instance with wider dissemination of the training materials, more intensive work on embedding BMWM in the BMSc curriculum, and in documenting and sharing lessons learned from the project. There is still potential for this to be addressed to some extent if a short project extension occurs; however, the project is not currently ready for such activities and would require assistance to prepare a realistic plan for scaling up.

14 See http://ceaccp.oxfordjournals.org/content/5/1/14.full

15 See https://en.wikipedia.org/wiki/Hospital-acquired_infection

3. PROJECT QUALITY AND PERFORMANCE

3.1. Design

The project design is similar to other GEF financed projects aiming to reduce the release of UP-UPOPs, see Annex 9 for a summary of such similar projects. Yet, the design was not fully contextualised to the Indian situation. At the time of project design, the regulatory framework for bio-medical waste management was already in place with the 1998 Rules. Furthermore, major healthcare facilities already had source separation of bio-medical waste in place, making this project far less relevant than for poorer countries, such as Kyrgyzstan (where there were no regulations or BMWM systems in place when the first project started in 2005).

Most similar projects have been in countries where the waste is treated at a healthcare facility, i.e. the large hospitals operate either an incinerator or autoclaves to treat their own waste; frequently they also treat waste from adjacent healthcare facilities. In India, CTFs were already in existence and mandated by the regulations. Little thought and planning was put into devising a project strategy that adequately took this fact into account. More consideration should have been given to determining best available techniques not entailing excessive costs (BATNEEC) for waste treatment at the CTFs; strengthening their capabilities through training, establishing an industry association, and so forth.

The Project Document foresaw waste being managed in PPPs, ignoring that these CTF were already established and under private ownership. Given that proper handling of BMW with hospitals was already established at the better HCFs when the project was designed, a greater focus on the CTFs would have been more fitting. This would have required more technical guidance at national level and to the States to assist with local procurement of equipment for hospitals, establishing the BAT for the CTFs and so forth. The presence of such advisors could have helped ensure: that the BAT was determined for the treatment of BMW. Hence a far greater contribution to achieving the project's objective to "reduce and ultimately eliminate the releases of UP-POPs" would have been possible.

Other issues included a design framework that was not clear, especially in relation to PPP activities. The Framework was largely output based but without clear indicators and targets. This contributed to incomplete detailed annual plans and insufficient tracking of results. In conclusion, the project is rated as having a moderately satisfactory design.

3.2. Relevance

The project addressed a priority interest of the GoI and aligned with UNIDO's commitment to Stockholm Convention implementation. The design linked the health and waste industries with a focus on PPPs. Yet, India already had the 1998 BMWM Rules and major hospitals were already source separating their waste in the early 2000s. Furthermore, there was previous UNDP work in waste segregation, adding focus on increasing environmental benefits through POPs management and private sector (hospital and waste industry) participation. This was only in one State but did generate useful learning that was not clearly acknowledged in project processes. The National Accreditation Board for Hospitals & Healthcare Providers (NABH) is a constituent board of the Quality Council of India that operates an accreditation programme for HCFs which includes a focus on infection control. At present, more than 350 Indian hospitals have achieved accreditation by NABH. The Kayakalp Award Scheme was launched in 2015 and is intended to encourage and incentivise high levels of cleanliness, hygiene and infection control practices within the HCFs. The project is well aligned with these strategies to raise the standard of healthcare services in India; yet minimal contact was made with these programs to consider the potential of partnering.

The relevance of establishing "model facilities" with modern BMWM procedures is questionable as these were already in existence in some major hospitals and could already have been used as model facilities and replication of BAT/BET could have commenced earlier in the project. While improvements in segregation were a valid objective, for achievement of the overall project objective, a stronger focus on CTF operations could have been more relevant. Delays in implementation weakened relevance, as other parallel GoI initiatives also addressed BMW management processes, so prior training was available and already in place in some areas (although refresher and practical training was welcomed).

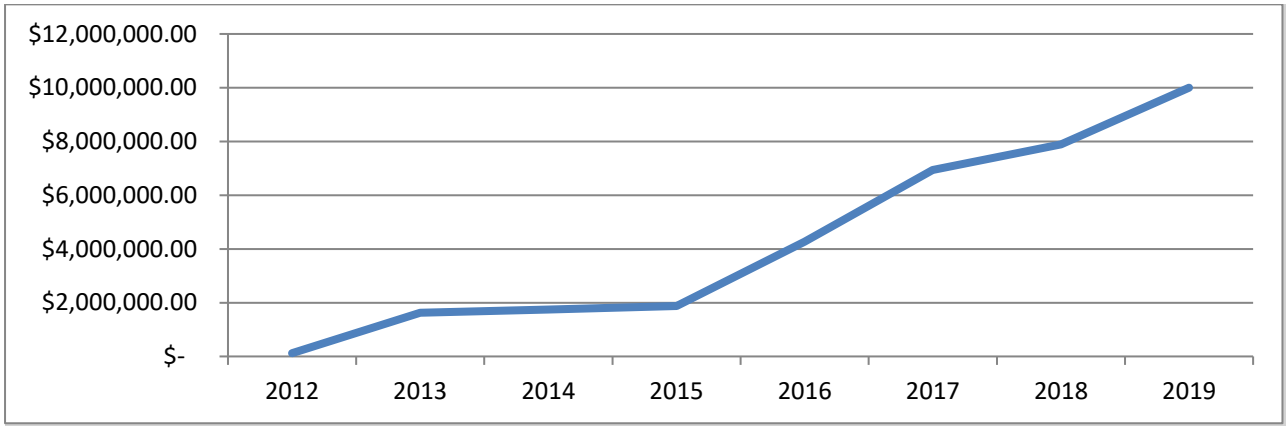
The project is evaluated as being moderately relevant.

3.3. Efficiency

The original project duration was five years, beginning in November 2011 and ending in November 2016. The expected implementation end date after delays was the end of October 2019 representing a three year delay.[16] Disbursement was initially slow due to the delays in policy processes. Financial progress then accelerated but at closure approximately US $1.5 million remained unspent (Figure 3).

A total of INR 87,725,000 has been released by the States of Gujarat (INR 200,000,00); Karnataka (INR 7,725,000); Maharashtra (INR 200,000,00) and Odisha (INR 400,00,000).
Additionally, State resources have been mobilised in kind to an estimated value of R81, 627,028. These expenses have ranged from supporting transport to meetings and training costs.[17] The TE team assesses that it is likely that the level of in-kind support was higher than computed but this has not been tracked and cannot be verified.

Figure 3. Disbursement by year



Source: Source: UNIDO project database, extracted October 10, 2019

A major contribution to project delays was the imposition by GoI of a Goods and Services Tax in July 2017. This tax increased the costs associated with importing microwave units by between 8 and 28 per cent[18]. These increases in costs contributed to procurement delays amounting to over 12 months. These issues have largely been resolved through collaboration between UNIDO, MoEF&CC and the Ministry of External Affairs as well as GoI but did significantly impact of the efficiency of the project[19].

Major impediments in procurement were experienced. The centralised procurement ran contrary to the project design that included objectives regarding building local supply capacity. At the same time, UNIDO

[16] UNIDO, 2019. *Terms of Reference: Independent Terminal Evaluation of the Project Environmentally Sound Management of Medical Wastes in India.*
[17] UNIDO Environmentally Sound Management of Bio-Medical Waste Project Data: In-Kind Contributions
[18] UNIDO, 2018. *Independent Country Programme Evaluation: Republic of India,*
[19] UNIDO GEF, 2018. UNIDO GEF Annual Monitoring Report FY 2018.

perceived that central procurement would be more cost-efficient. This is a valid point in terms of the international competitive bidding process that saw the lowest bid by the successful contractor being substantially below Indian-based tenderers. Nonetheless, there were continued issues with quality of supply and difficulties for the Indian sub-contractor, so the overall efficiency of the process is questionable, particularly in the light of the project intention to build local supply capacity.

The centralised procurement also led to undue difficulties with equipment maintenance and also a focus on standardised sizing, despite the bins and trolleys being too big for many of the smaller HCFs. Similarly, the issues with microwave units and CTF viability and the lack of attention to Component 5 that was designed to enhance the funding mechanisms for BMWM leads to major concerns regarding project efficiency.

There were already a number of government training and accreditation programmes that also addressed BMW. Therefore, training activities and the development of SOPs and guidelines may have been able to be used more efficiently if these programmes were taken into account to mainstream rather than develop stand-alone materials.

As a result, the project is rated as highly unsatisfactory in terms of efficiency.

3.4. Sustainability

The changes in BMW practice are now embedded in policy and institutional requirements as well as in hospital facility practice in the five targeted States and this is likely to be sustained. Yet, there is no clear allocation of budget at State or hospital level for BMW management so uncertainty of whether recurring costs will continue to be covered significantly impacts on assessments of sustainability. There is not yet a clear mechanism for sustaining BMW training and pilferage of plastic waste continues to be pervasive. The barcoding system is not yet widely understood or implemented and there is no clear process for how the good examples will be replicated. The designation of model districts has led to an intensification of investment in certain areas but there is not a defined pathway for how the model districts will act as a spearhead for wider benefit. There are challenges with the viability of the CTFs, as the costs of BMW treatment are marginal and do not allow for capital investment for upgraded equipment on a commercially and environmentally sustainable basis. Overall, the impact on environmental benefits has been moderate and in places BMW is still not disposed of properly, leaving environmental sustainability still at risk. As such, the project is determined to be moderately unsustainable.

3.5. Gender mainstreaming

Given this projects contribution to medical waste management practices that impact on the population as a whole through improvements in healthcare and reductions in infection risks some of these benefits did accrue for women. This is especially relevant given the high proportion of caregivers who are women and the positive impacts improved medical waste processes have on caregivers as a group. In addition, gender benefits were achieved through the high proportion of women trained given the high levels of female staff in hospitals.

However, the project did not contain any specific focus on gender and could have been more gender sensitive in its design, especially in terms of the equipment provided. The waste collection trolley for example, is bulky and difficult to handle. Furthermore, it is large in size and therefore makes it difficult to operate and clean. Where women are involved in the waste collection and disposal, as was noted in Indus Hospital in Mohali, it needed more than one woman to maneuverer the trolley.

Given this lack of specific focus the project is assessed as unsatisfactory in terms of gender mainstreaming.

4. PERFORMANCE OF PARTNERS

UNIDO Partnering with the MoEF&CC for BMWM through this project, UNIDO supported the development of the new guidelines. This was done through a number of activities, such as discussions as a part of the Project Management Committee, and human resource for the MoEF&CC.[20]

UNIDO support ensured that project mechanisms were in place and operational; although the lack of STAs in three States did adversely affect progress. All financial and procurement records are in place so that fiduciary management was sound. Nonetheless, the decision, seemingly led by UNIDO to have centralised procurement that ran contrary to design on building local supply capacity was an error that affected project results.

The Project management was not sufficiently delegated to State level, for instance for local recruitment of STAs and equipment. Greater national staffing of technical support for the States to independently implement could have made stronger implementation arrangements. There was insufficient technical/practical analysis of product procurement and installation so that quality concerns were not easily identified or addressed as well as insufficient attention and support to CTF capability building activities as a main source of reducing dioxins and furans. The lack of an M&E system led to uneven and ad-hoc reporting and inadequate supervision. UNIDO's performance in this project is rated as unsatisfactory.

National counterparts The State level counterparts were strongly supportive of the project within the realities of time and resources available. The evaluation found that the State level staff were knowledgeable and helpful; although similarly, the lack of an M&E system and of critical technical support from the national level hindered effectiveness. The States provided in-kind resources but most States were unable to leverage the expected cash resources to support State activities. At the national level, the project was delayed by the frequent turn-over of MoEF&CC and SPCB staff. This meant that with each change of leadership, the project was required to re-orientate new staff and that approvals were hard to progress in a timely manner – particularly when the project faced issues with tax charges. The performance of national counterparts in this project is rated as moderately satisfactory.

Donor The main donor was GEF who played little direct role in project implementation and consequently is not rated in terms of performance in this evaluation. The GEF focal point has changed during the project and the project has endeavoured to keep the requisite incumbent informed.

20 Minutes of the 2nd meeting of the Project Management Committee for the GEF-UNIDO-MoEF project titled "Environmentally Sound Management of Medical Wastes in India" held on 20th August 2014 in the Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi.

5. FACTORS FACILITATING OR LIMITING THE ACHIEVEMENT OF RESULTS

5.1. Monitoring & Evaluation

The potential for improved M&E cuts across different aspects of the project. As aforementioned, the HCF gap analysis and CTF assessment could have been compiled into an active monitoring database to ensure more systematic flow of data. Consequently, the project does not have an effective monitoring of BMW practice from source to final disposal. Discussions and visits to various HCFs suggest that there are some facilities where waste segregation is weak and waste gets mixed, yet this was not identified at State or national level nor was corrective action put in place.

Monitoring progress and responding to needs at all levels of the project (overall, state, hospital) is vitally important to achieve effective implementation. Therefore, while the training activities have been useful and appreciated in all hospitals there was limited acknowledgement of the differences that exist between states and facilities regarding capacities and other ongoing programmes. For example, some hospitals, such as those in Odisha, may have benefitted from more focused attention on capacity building as opposed to other project hospitals. It is likely that incorporating such flexibility into the implementation of the project would have been likely to have made the outcomes much more effective in achieving good BMW management.

The limited incorporation of M&E across the project life cycle has resulted in a rating of highly unsatisfactory.

5.2. Results-Based Management

As previously noted, the results framework at the design stage lacked clarity and hence was not used to most effect by the project team. The logframe did not easily translate into annual action plans in a way that allowed the project to identify clearly where there were performance gaps. Overall, the project took an output rather than outcome-based approach towards management – focusing on achievement of training and equipment provision rather than tracking the use and effectiveness of these inputs. The lack of effective results-based management undermined the effectiveness of the project.

The poor quality of the results framework and a lack of results-based management have resulted in a highly unsatisfactory rating.

6. CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

6.1. Overall assessment and rating table

Table 8. Summary of ratings by evaluation criteria (2019 and 2021)

#	Evaluation Criteria	Rating
A	**Progress to Impact**	**3**
B	**Project Design**	
1	Overall Design	4
2	Logframe	3
C	**Project Performance**	
1	Relevance	4
2	Effectiveness	3
3	Efficiency	2
4	Sustainability of benefits	3
D	**Cross-cutting Performance Criteria**	
1	Gender mainstreaming	2
2	M&E	1
3	Results-based management	1
E	**Performance of Partners**	
1	UNIDO	2
2	National counterparts	4
F	**Overall Assessment**	**3**

6.2. Conclusions

In conclusion, this project has been of value to improving BMWM in India but it has been beset by a range of challenges that have affected performance. In particular, the delays and gaps in project implementation have contributed to delays that have undermined the achievement of expected outcomes. Table 8 provides a summary of ratings by evaluation criteria and leads to the overall conclusion that the project was moderately unsatisfactory in implementation.

The six components of the project had substantially different performance. The contribution that supported the GoI in updating the BMW rules was well regarded and instrumental in achieving improved practice guidelines. Activities related to capacity development and practical segregation were implemented with positive results. Yet the PPP aspects of the project were not effectively pursued as designed. This means that the improvements in local BMW equipment supply and in processing of waste were not achieved as expected.

The achievements in BMWM improvements as a result of the policy changes have created nation-wide impact. The main credit is due to the SPCB for leading the policy changes but the project contribution is evident. The impact on BMW practice in the 5 targeted States is largely positive, but similar impact was

also seen/ reported in non-project hospitals as a result of MoH&FW initiatives. The project-supported manuals have only just been released/ translated and are still to be disseminated beyond the 5 target States; so their impact may still widen and grow in terms of BMW management practices. Yet, the overall aim of the project to achieve reduction in POP emissions is not yet realised to the expected extent. It was noted that unsafe handling of BMW continues to occur in CTFs.

6.3. Recommendations

The evaluation team recommends UNIDO to extend the project completion date to 12 months. The specific recommendations to the UNIDO project management team to focus on actions that should be conducted to maximum the project achievement with the remaining budget. This extension will enable: 1) the continuation of policy and regulatory support, 2) the replication and up-scaling of project benefits, and 3) the preparation and implementation of a formal exit strategy; also including technical advice on the next steps for addressing UP-POPs reductions. Combined these actions have the potential to strengthen the sustainability of project benefits and capitalise on achievements by replicating activities, particularly training, within and beyond the five States.

Firstly, the continuation of policy and regulatory support for a further 12 months will allow for clarification and streamlining of some confusing policies, procedures and regulations identified in this report. Achievement of these objectives would depend upon the implementation of the following activities:

- Provision of clarification on currently confusing procedures including waste colour coding through the harmonisation of medical waste rules as outlined in the 2016 BMWM rules and the 2016 SWM rules;
- Working to improve the clarity of guidelines for the disposal of infectious plastic waste; this could include expanding the work of the current Market Study team to consider the policy implications of their work including reviewing the disadvantages and advantages of different options for red bag processing and preparing a policy brief of the resulting findings,
- Increasing knowledge levels regarding BMW by mainstreaming training on safe handling and disposal into the BMSc curriculum; particularly into the first year of the course rather than the third;
- Collaborating with the CPCB to amend current schemes to include upgrading existing CTFs as well as the establishment of new CTFs to assist CTFs to upgrade equipment and processes in line with the BMWM rules; this could include support for technical review of the CTFs and the preparation of guidelines for upgrading CTFs to reduce POP emissions; and,
- Working with States to advocate for specific budget allocations for BMW management in hospital budgets to ensure the continuation of project benefits.

Furthermore, this evaluation recommends actions to replicate and upscale the benefits of this project. These actions include use research through the Market Study to generate additional tools and guidance materials for hospitals and CTFs. These findings can be translated into tools to update existing training materials and expand the coverage of the training to upscale benefits from the successful training implementation. It would also address the gap in support for local procurement that was identified during the evaluation.

The findings of the Market Study can be used to generate tools and guidance for hospitals and CTFS on additional topics such as:

- local suppliers and sources of BMW equipment;
- costing of non-chlorinated bags and options for biodegradable bags;
- model costing for BMW budgets for different sized hospitals;

- options for red bag processing including the advantages and disadvantages of different approaches; and,
- the do's and don'ts for locally purchasing supplies including example templates such as for tenders, budgets, quality supervision and standard requirements and addressing risks.

There is also potential to improve, replicate and scale up the training activities. This would capitalize on the investment in developing the training materials and approaches, particularly the TOT approaches that have contributed substantially to the sustainability of benefits. This could involve updating training materials to provide additional guidance to fill current gaps on objectives and functions of the barcode system, options for red bag processing and the specific requirements for suitable laboratories and blood banks etc. Lastly, the replication and up scaling of project benefits could gain from additional training and greater dissemination of current training materials beyond the existing scope of the project. This could include:

- conducting refresher training for hospitals that have been identified as underperforming in terms of segregation as well as to pilot states,
- identifying potential training partners to adopt and continue training in all states,
- conducting TOT in non-project states and
- publishing hard copy and online training materials with translation into local languages as far as funding permits for distribution to non-project hospitals.

Therefore, it is important that the project extension include devising and implementing an exit strategy. The first steps to developing such a strategy would be to synthesize project lessons to the state and national level and identify how model districts and pilot states can be used to identify best practice that can expand benefits to a national level. Next, mechanisms should be arranged to ensure current training materials are continually updated and disseminated as required. Thirdly, specialized technical support could be provided to review the status of the CTFs, based on the initial screening conducted in the project, the efforts already made by the CTFs in upgrading incinerators and other processes, and reviewing most technically appropriate and commercially viable options for reducing POP emissions from CTFs. Lastly, roadmaps should be prepared; both individually for each state as well as nationally, that assign roles and responsibilities and identify required resources to continually progress the implementation of BMW rules.

There are a few important notes in conjunction these recommendations.

- Additional proven expertise in effective project management over short time frames will be essential to the success of the extension in a timely manner within the new timeframe;
    - The evaluation team does not support the action of procuring more microwaves until significant issues with plastic waste management identified are resolved; The project should reconsider the approach to promote microwave technology for BMWM at hospitals. Firstly, the hospitals generally have insufficient staff and resources to manage microwave operations. Secondly, if the sterilisation took place at CTFs, all healthcare facilities could have their plastic material treated and recycled.
    - If any further procurement in relation to plastic waste disinfection is considered then it is important to assess alternative procurement avenues for non-burn technologies such as locally produced autoclaves to ensure maximum cost-effectiveness given the volume of BMW that is produced and maximum impact on reduction of POPs.
    - If further assessment of CTFs is considered to consider next steps required for UP-POPs control, appoint up to date expertise specific to BMWM to bring in more recent technology that is cost-effective.

Additionally, it should be noted that the evaluation team does not at this stage recommend a long term extension of the program due to difficulties in implementing components 4, 5 and 6 of the project. Such an extension would require a shift in focus of the project as a whole towards CTFs, a complete amendment of project design and requiring significant management attention from both UNIDO and GoI.

6.4. Lessons learned

The major lessons learned are:

1. The importance of policy change and rigorous awareness raising and internal systems for implementation of new Policies and Protocols;

2. Policy change is a lengthy process requiring assistance with coordination but is valuable. Overall, the timeframe for the project was underestimated due to the time investment required in policy work as a foundation for wider implementation.

3. Specific attention paid to BMW by stakeholders across the industry simultaneously has created a shift across the whole medical industry i.e. the Project added value to other parallel initiatives – and there was potential to achieve more synergy if greater alignment with other initiatives had occurred.

4. Building local capacity requires taking risks with decentralised responsibilities. While it may not be efficient in the short term, it can be a worthwhile investment in the longer term.

5. The gap in RBM was a fundamental building block for the project that undermined performance in all components. It is worthwhile to take time to establish M&E procedures and decision-making processes early in the project.

7. UPDATED TERMINAL EVALUATION IN 2021

7.1. Context

Following the recommendations of the 2019 Terminal Evaluation, the project was extended by one year to an October 31, 2020 completion date. The COVID pandemic delayed the project's work and a further extension was granted up to October 31, 2021.

This update of the Terminal Evaluation reviews the activities of the project over the past two years against the recommendations of 2019 Terminal Evaluation. This was accomplished through a desk review of all available documents, covering progress and technical reports, minutes of meetings and workshops. The finding of the desk review was the supplemented through remote interviews with project stakeholders. In these discussions, additional information and the interviewee's experiences were sought. Hereafter, the team collaborated to update the assessment of the project performance and results. Finally, additional communication and interviews were used to clarify ambiguities.

The team's findings were used to review the rating table for the whole project, to update the executive summary, and the conclusion and recommendations. Given the fluidity of the COVID 19 situation in India, this evaluation was conducted remotely.

7.2. Findings

The three objectives of the 12-month extension of the project, as seen in the earlier recommendations (section 6.3), were to enable: 1) the continuation of policy and regulatory support, 2) the replication and up-scaling of project benefits, and 3) the preparation and implementation of a formal exit strategy; also including technical advice on the next steps for addressing UP-POPs reductions. The project's achievements in these three areas are discussed in sections to 7.2.1 to 7.2.3 below, where the 2019 recommendations are described and then followed by the Evaluation Team's findings *given in italics.*

7.2.1. Clarification and streamlining of policies

The continuation of policy and regulatory support was deemed as an essential endeavour during the project extension for two reasons. Firstly, to fine-tune the project's earlier decisions and actions regarding the management of plastic materials from HCFs. Secondly, the extension was required for the project to resolve some concerns that it yet to address surrounding the operation of CTFs, thereby making .their operation more sustainable and, hopefully, also contributing to reducing their emissions of UP-POPs. These are two independent issues, the plastic waste materials will be discussed first, followed by the matters pertaining to the sustainability of CTFs and the further reduction of UP-POP emissions.

A large fraction of healthcare waste is plastics, these can contain chlorine compounds. When incinerated in an uncontrolled manner, any chlorinated compounds can cause the formation dioxins and furans, the UP-POPs that the project seeks to eliminate. In its efforts to assist India in meeting its relevant obligations under the Stockholm Convention, the project supported the adoption of measures that would minimise the formation of UP-POPs. As the 2019 Terminational Evaluation found, and as explained in this report, some of the actions had unintended consequences as described below.

The project contributed significantly to the modification of the 1998 BMWM Rules, with new regulations governing medical waste being issued in 2016, and further amendments to these rules released in 2018 and 2019. The 2019 Terminal Evaluation requested that the following issues be studied and possibly resolved:

I. A lack of coordination means that the 2016 BMWM Rules and the 2016 SWM Rules have different colour codes to indicate various waste categories. The project was requested to resolve these differences, so that the same colour code is no longer used for both recyclable materials and sharps.

II. The 2016 regulation promoted by the project commands that only decontaminated and shredded plastics can be sold to recyclers. This necessitates that all recovered plastic must be treated before it leaves the healthcare facility. As most facilities do not have equipment to shred and sterilise waste, this legal requirement makes it impossible for most HCFs to recycle their plastic. The project was asked to examine other options that would allow for all HCFs to sell/ recycle their plastic materials.

The project did not directly endeavour to amend the rules over the past two years, but considerable efforts were made to ensure that regulatory requirements could be met. In each of the project states, the four large hospitals that had previously received microwave units were provided with shredders.

In the 2019 project evaluation, it was noted that there were no authorised plastic recyclers for plastic materials from bio-medical sources. The outcome was the illegal selling of waste to unauthorised recyclers or the export of this waste to other states. Recognising this issue, the project supported the government of Odisha in a pilot project where an authorised medical plastic waste recycling unit was to be established. The efforts to set up this facility have been initiated, some government requirements still need to be fulfilled before permits can be obtained, and the facility established. Funds have already been allocated for the facility and are available with the government.

Today, there are still some obstacles to the direct sale of decontaminated and shredded plastics from the HCFs that have the necessary equipment. In Gujarat, the existing regulation does not permit for the HCFs

to sell their decontaminated and shredded plastics directly to dealers. Instead, they are required to send the plastic materials to a CTF, which will charge money for receiving the recyclable materials. The consequence is that the HCF pays twice for the management of plastics, once to decontaminate and shred it at their facility, and then again to dispose of it at the CTF. As the recycling of bio-medical plastic materials is a source of revenue, the HCFs find it illogical that its disposal should cost them money. In practice, given the resale value, most plastics may not reach the CTFs, as they are sold by the hospitals or others, either legally or illegally.

In Karnataka, the SPCB has identified authorised dealers for decontaminated and treated plastic waste from HCFs, and HCFs are selling their waste to these dealers. In Odisha, where it is also legal to sell the plastics post decontamination and shredding to authorised vendors, there is limited access to such vendors.

III. To ensure that some hospitals could sterilise their plastic materials, in accordance with the 2016 regulation furthered by the project, twenty microwave treatment units were supplied to hospitals. The capacity of the provided units was 60 kg per 24 hours, much less that the 200 to 500 kg/day of plastic generated in the hospitals that received these autoclaves. This meant that only a small portion of the infectious plastic materials could be sterilised in most hospitals, resulting in a mixture of treated and untreated plastic. Additionally, the supplied microwave technology was costly and imported. The project was requested to re-examine how the plastic waste stream from HCFs is best managed, through a cost-benefit analysis comparing the use of microwave technology with autoclaving.

The project did not undertake an evaluation of the most cost-effective approach to the management of the plastic waste stream. As the 2016 regulation sponsored by the project requires that only plastic that is both sterilised and shredded plastics can be sold to recyclers (see II above), shredders were procured for 20 large HCFs where microwave units have been installed. The shredders were to be installed during the second half of 2021. As of November 2021, shredders had only just been installed at some of the HCFs and the remainder were expected to be put in soon. Where the shredders have been installed, the HCFs staff has been trained in their use and was satisfied with the performance.

Therefore, the underlying problem has not been addressed, which is that the supplied microwave units can only treat a small percentage of the plastic waste generated by most hospitals, leaving the hospitals unable to sell most of their plastic materials, as they have insufficient capacity to sterilise it. The 2019 evaluation report "does not support the action of procuring more microwaves until significant issues with plastic waste management identified are resolved" (see page 38 of this report). Yet it was decided to provide four CTFs in the model districts with microwave units and shredders, so that contaminated plastic waste from small facilities could be treated. However, given that the CTFs are private entities, not all state governments have agreed to this arrangement. As of November 2021, this equipment had only been provided to CTFs in Karnataka and Maharashtra, two more microwave units were supplied in early 2022, well after the project completion date.

Given the microwave units' very low treatment capacity (60 kg per 24 hours), it makes little sense to have these located at centralised treatment facilities that should theoretically be handling several tonnes of plastic per day. The rationale for supplying these microwave units was that the identified supplier does not manufacture larger capacity equipment. For the purchase of larger treatment units, a new procurement order would be required, something that there was no time for the project to obtain.

IV. The barcoding system required by the 2016 BMWM Rules should allow the waste to be tracked from the point of generation through to its final treatment. As described in this report, the process was poorly understood by the HCFs and not operational. It was suggested that the project help ensure that the objectives and functions of the barcode system was clear to all stakeholders, and that the system be implemented in a manner that was practical and affordable for all.

The project has worked to improve the barcoding and waste tracking system, though there are still some gaps in the implementation. Each CTF was responsible for the implementation of its own barcoding

system to track the waste from the HCFs it served. To do this, each CTF hired an agency to develop their barcoding system and provide barcoded stickers. As a result, there is no compatibility between the various systems, making it difficult for the state authorities to monitor performance. While the larger HCFs are generally compliant with the barcoding requirements, many smaller facilities do not follow the system, again hindering monitoring and data gathering. The project's progress in this area was restricted by the MoEF&CC request that the project refrain from preparing "SOPs and guidelines for bar coding system", [21] *: as the CPCB had already prepared such documents.*

V. The regional waste treatment services were the subject of the project's components 4 and 5, these did not receive much focus in the project's first eight years. The evaluation team suggested that the project's experts examine ways to make the operation of CTFs more efficient and sustainable, by using the findings of the (then unfinished) Market Survey to optimise market strategy, resource recovery and earnings, ensuring higher BMWM budgets in hospitals that in turn allow for higher payments to the treatment facilities, and so forth. The goal was that each CTF should have an operating budget that allowed it to meet the regulatory requirements. A second concern was that the project had focused exclusively on incineration as the viable treatment technology at the CTFs. The project never examined the possibility of using non-incarceration technologies, where sterilisation of waste at CTFs using steam could be both less costly and greatly reduce the emissions of UP-POPs. The TE Team recommended that such a study be undertaken and be incorporated into the project's exit strategy, where it would serve as guidance on the future approach to BMWM in India.

The project hired a National Expert to make a detailed assessment of the five CTFs in the project's five model districts. The expert was further tasked with suggesting upgrades to these facilities and proposing a dioxin/furan monitoring programme. The detailed examination of the five CTFs indicates that these operate at low standards, and that considerable investments are required to meet regulatory requirements. In fact, the equipment is in such a poor state that the report suggests that it "is preferable to go for new CBWTF at the same location." The document advises that the monitoring for dioxins and furans should be discontinued till India develops the necessary protocols and that a sufficient number of laboratories can do the testing.

The report does not examine how the operation of CTFs could be made more sustainable, nor the potential benefits of using non-incineration treatment technology. Given that small incinerators, such as the five examined in the study, are unable to meet the current air emission requirements, an alternative technology, such as autoclaving, would seem a logical approach. Non-incineration technologies are less costly to operate and furthermore, in this project's context, offer the advantage of not being a source of UP-POPs.

7.2.2. The replication and up-scaling of project benefits

The second task to be undertaken during the extension period was to make full use of the project knowledge and to apply the understanding gained through the Market Survey, to benefit as much of the Indian healthcare sector as possible. The Market Survey was expected to provide critical market information that would help to identify the status of the domestic market in relation to provision of BMWM supplies and on incentives required to ensure a fully functional system for commercial viability of BMWM structures. The study was also expected to support the strengthening of local supply of bins, trolleys and treatment equipment in India. Finally, the market analysis was to consider the regulators, economic and market status for the disposal of BMW, with a particular focus on how CTFs could function most cost-effectively to ensure market viability of operations.

It was anticipated that findings of the Market Study, as well as the experience gained over the project's lifetime, could be used to generate tools and guidance for hospitals and CTFs. Outputs could include

[21] Email from MoEF&CC to UNIDO dated 9 December 2019.

examples of good BMWM practices for hospitals, a listing of local suppliers and sources of BMW equipment; guidelines for making BMWM budgets for various sizes of HCFs, and a manual on the local purchase of equipment and supplies. This could have covered sources for non-chlorinated and biodegradable bags for waste, local suppliers of autoclaves, templates for planning BMWM systems, guidance for how to conduct tenders and monitor quality.

The Market Survey has been completed, and each State Project Management Unit (SPMU) was provided the list of suppliers and, sources of equipment, consumables etc. The SPMUs in turn have provided this information to the State Health Departments, who identify vendors for the state run HCFs. It is understood that while some of the vendors were already a part of the list, the additional information has also been incorporated into the various vendor lists circulated by the government to hospitals. Hence, over the past two years, the project has made full use of the Market Survey and its accumulated knowledge to enlighten stakeholders. It must be observed that while the SPMUs are aware of this survey, the HCFs that were a part of this evaluation, were unaware of the survey or of any information dissemination on potential vendors outside the official government list.

The project has built up an extensive training programme in collaboration with the M.S. Ramaiah Medical College, it was deemed imported to perpetuate this system. It was recommended to upscale project benefits through additional training and greater dissemination of current training materials beyond the existing scope of the project. The activities that were suggested were a) refresher training at underperforming hospitals; b) identifying potential training partners to adopt and continue training in all states; c) conducting TOT in non-project states and d) publishing hard copy and online training materials with translation into local languages as far as funding permits for distribution to non-project hospitals.

Over the past two years, the project has expanded its already wide-ranging training programme. The training activities are now being taken up by the SPCB for healthcare facilities. The translation of training and other material into local languages has been completed and is available with the HCFs. The HCFs report that they use the materials and find them useful. The HCFs have also provided internal training for their staff; with required tailor for different staff categories doctors, nurses, ward assistants and waste workers. Under the project, online training modules are being developed. Overall, eight modules under development.

These are,

- *Overview on BMWM*
- *Segregation of BMW*
- *Collection, transportation and storage of BMW*
- *Pre-treatment of waste at HCFs*
- *Biomedical waste treatment and disposal*
- *Occupational safety*
- *Environmentally sound management of medical waste*
- *Safe management of biomedical waste in special situations*

The company LiQvid; which specialises in online course material development, was hired by the project to develop these modules. Technical inputs for the modules are provided by the team involved in preparing the offline training material at M.S. Ramaiah Medical College. Presently, the first drafts have been finished for the modules and they are being refined. Once completed, they will be translated into seven Indian local languages, to help with wider dissemination of information. However, there have been some challenges with the development of these online training modules. One difficulty has been the limited knowledge on BMWM within the LiQvid team, resulting in the need to hire SM Ramaiah Medical College experts, who in turn are not familiar with the development of online modules, leading to some initial delays. At present, LiQvid is developing the modules in their AWS platform. However, in future these modules will be hosted by the UNIDO FIC_ISID site, so further platform development activities may be required once the modules are finalised, so

that they can be hosted by the UNIDO site. LiQvid was expected to complete and hand over the modules by the end of January 2022.

*The **COVID-19 pandemic** resulted in the project's involvement in the amendment of the existing BMWM regulations and in the development of new guidelines. Work included training courses specially developed for the pandemic along with guidelines developed by the Central Pollution Control Board for the management of COVID specific BMW. When the pandemic broke out, there was confusion at HCFs as to what constituted infectious waste. This uncertainty initially resulted in all waste, including general and food waste, being identified as infectious waste, resulting in an overflow of waste at CTFs. The project provided technical support to the CPCB, in the development of amendments and guidelines for biomedical waste segregation and treatment from COVID-19 centres and hospital wards in 2020. Some of the improvements made in these new regulations are:*

- *Disallowing of chlorinated plastic liner bags for plastic waste, such as abdominal bags, chest bags and urine bags*
- *Guidelines on how to perform the verification of the two second residence time and temperatures in the secondary combustion chambers at the CTFs.*
- *Guidelines for the SPCBs to monitor regulatory compliance of CTFs*
- *Standard Operating Procedures for handling of COVID 19 related waste.*

*The evaluation team's interviews with the HCFs suggest that this training has been **very timely and useful** to deal with the infectious waste from the pandemic. An estimate of infectivity rate from COVID-19 of project HCFs, in Karnataka suggests that that only 1% of hospital staff got infected by the virus, indicating good infection control and waste management practices at their facilities. Also in Karnataka, a number of project HCFs were requested by other facilities to help improve their infection control, including BMWM during the pandemic. The above examples indicate that the training provided by the project has improved the overall management of BMW in facilities where project was active and that these interventions helped India's response to the pandemic.*

7.2.3. Preparation and implementation of a formal exit strategy

Thirdly, the 2019 evaluation team stressed the importance of devising and implementing an exit strategy during the project extension. This would require a compilation of project lessons from the model districts and pilot states to identify best practice that could be communicated at the national level. The expectation was that the exit strategy would ensure that the project's training materials continue to be updated and disseminated, that the guidance regarding the planning and the supply of equipment for BMWM systems be widely available, and that direction be given to the authorities and stakeholders on the most technically appropriate solutions that would ensure commercially viable operations for CTFs and minimise their UP-POP emissions.

The exit strategy was also to include roadmaps that detail responsibilities and identify the required resources to ensure that the applicable regulations pertaining to BMWM are gradually implement in every state and at the national level. The expectation was a national roadmap, as well as one for each project state.

No national or state roadmaps for the continued implementation of the BMW rules were developed by the project. This state of affairs can at least be partly attributed to the stance of the Indian authorities, who have lost their enthusiasm for the project and with that any desire to perpetuate the project. The MoEF&CC directly requested that the project not prepare national or state roadmaps, as it was of the opinion that "all the States have already prepared strategies for management of bio-medical waste." [22]

The project worked hard to disseminate the lesson's learnt on how to best manage BMW, including the development of the eight online training modules described in section 7.2.2. A national level webinar was

[22] Email from MoEF&CC to UNIDO dated 9 December 2019.

conducted online and a booklet describing best practices was shared with the project states. State level workshops were conducted in Karnataka, Punjab, and Maharashtra. Due to COVID 19, the workshops are yet to be held in Gujarat and Orisha. Furthermore, Karnataka has developed a best practice booklet, but the other states are yet to do so.

7.3. Overall assessment and rating table

As can be seen from the above sections, the project performance has not changed over the past two years, therefore the overall assessment and ratings also remain the same. The 2019 and 2021 ratings by evaluation criteria are given in Table 8 and the bottom line remains that the project was moderately unsatisfactory in its implementation.

7.4. Conclusion

The project paid little, if any, attention to the recommendations of the 2019 Terminal Evaluation. One recommendation was that "Additional proven expertise in effective project management [...] will be essential to the success of the extension" (page 38). There was no project restructuring and the implementation of activities continued as before.

The activities to support Components 1 and 2 of the project continued to be well implemented, providing excellent assistance to the domains of policy environment, and institutional capacity development. Though the COVID-19 pandemic delayed the project, it also allowed the project to shine both in terms of demonstrating the impact of its capacity building within BMWM and by providing direct assistance to the GoI to mitigate the impact of the pandemic. The expertise and professionalism of the M.S. Ramaiah Medical College contributed to the success of the project's capacity building packages.

The implementation of Component 3 has been less stellar, and the project never really managed to build national supply capacity for BMWM equipment (see pages 16-19).

The project never really got a grip on Components 4 and 5, which were to strengthen the waste transport and disposal system through measures that would make the operation of CTFs financially more sustainable, improve their environmental performance and establish model district to test and demonstrate the best available technologies. The PPP features of the project were not addressed as intended, resulting in minimal progress in terms of strengthening local BMW equipment supply and improved BMW treatment systems. This in turn meant that the global objective of the project, a significant reduction in UP-POP emissions, was not realised.

Component 6 was to ensure a sound project management structure, and to design and implement a monitoring and evaluation mechanism. Unfortunately, this objective was never fully achieved and the National Project Steering Committee (or other stakeholders) never attempted to rectify this shortcoming. Both the 2016 Mid-Term Evaluation and the 2019 Terminal Evaluation recommend that the project management be strengthened and that "monitoring and evaluation systems and mechanisms need to be fully deployed and implemented" (quote from the 2016 MTE).

7.5. Lessons learned

The Lessons Learned from 2019 (section 6.4) still apply. It can additionally be observed that the project never displayed a technical sound understanding of the BMWM situation in India. The project design was weak and failed to take into consideration the actual conditions in India (section 3.1). During the project implementation, there was a lack of technical expertise on BMWM, resulting in a very unfortunate choice of treatment technology (see page 18/19 on the microwave units) and an inability to address the technical and operational issues facing the CTFs. The 2011 Project Document foresaw 2 years of input from international experts over the project's planned 5-year duration, so there should have been ample

expertise available, somehow such expertise was either never given or the project failed to use it efficiently.

Given the benefit of hindsight, once the difficulties and delays faced by the project were apparent, a more determined intervention by the National Project Steering Committee would have been warranted.

ANNEXES:

Annex 1. Evaluation Terms of Reference (online link)

The Terms of Reference can be found online here.
https://www.unido.org/sites/default/files/files/2019-07/GFIND-104160_TOR_MedWaste-Draft_May%202019.pdf

Annex 2. Evaluation framework

The evaluation purpose and objectives, theory of change, and UNIDO's evaluative requirements all provide the basis for the **evaluation framework**, which in turn underpins and guides the whole approach. The framework is structured against the standard OECD-DAC criteria agreed for the evaluation (**relevance**, **efficiency**, **effectiveness**, **sustainability**).

The framework identifies **key evaluation questions**, supported by guiding **sub-questions** (**Error! R eference source not found.**). The framework was also informed by a set of indicative questions presented within the evaluation Terms of Reference (TOR): all those indicative questions have been incorporated accordingly.

Table 9:. Evaluation Framework

Key evaluation questions	Guiding sub-questions
RELEVANCE	
1. How relevant was the project to the needs and priorities of India and the participating institutions?	• To what extent was the project relevant to India's national priorities and strategies? • To what extent was the project's work relevant to the needs of participating institutions and to the Indian people? • How well did the project align with related regional and international BAT/BEP?
EFFICIENCY	
2. How efficient was project delivery?	• Was the project plan clear, appropriate and realistic? • Were project roles, responsibilities and accountabilities sufficiently clear? • How cost and time efficient was the project?
EFFECTIVENESS	
3. How well has the project performed? 4. Has the project done the right things? 5. Has the project done things right, with good value for money?	• For each project component were targets and timeframes achieved? • Have training and capacity development instruments been developed and implemented with demonstrated uptake of improved procedures? • Have CTF upgrading and transportation system indicators improved? • Have PPPs been effectively established and are operational? • How effective were the project's monitoring processes?
PROGRESS TO IMPACT	
6. What have been the project's key results (outputs, outcome and impact)? 7. To what extent have the expected results been achieved or are likely to be achieved?	• Is there valid evidence of results achieved? • Were different results achieved in different states? What are the reasons for any variance? • What is the rate of uptake of new instruments and technologies? Will these rates be sustained/ improved? • Were any results transformational? What was the key change and causes? • Were project assumptions valid?
SUSTAINABILITY	

Key evaluation questions	Guiding sub-questions
8. To what extent the achieved results will sustain after the completion of the project? 9. What are the key drivers and barriers to achieve the long-term objectives? 10. To what extent has the project helped put in place the conditions likely to address the drivers, overcome barriers and contribute to the long-term objectives?	• Have improved systems been incorporated into state budgets? • Is adequate staffing and support being applied to continue processes? • Is there evidence of uptake of BAT/BEP in neighbouring states/beyond model CTFs? • Are risk management plans established, monitored and appropriate actions in place? • What progress was made towards the conditions needed to address the long-term objectives? • What are the links between the support provided by the project (the projects activities and outputs) and the new conditions observed? • What are other rival hypotheses or factors that could account for these conditions?
LESSONS LEARNED	
11. What lessons can be drawn from the successful and unsuccessful practices in designing, implementing and managing the project?	• Is there evidence of internal learning in each state with lessons being applied? • Has UNIDO and its partners documented and addressed the lessons in potential follow-on activities?

Annex 3. Six-point rating scale

Score		Definition*	Category
6	Highly satisfactory	Level of achievement presents no shortcomings (90% - 100% achievement rate of planned expectations and targets).	SATISFACTORY
5	Satisfactory	Level of achievement presents minor shortcomings (70% - 89% achievement rate of planned expectations and targets).	
4	Moderately satisfactory	Level of achievement presents moderate shortcomings (50% - 69% achievement rate of planned expectations and targets).	
3	Moderately unsatisfactory	Level of achievement presents some significant shortcomings (30% - 49% achievement rate of planned expectations and targets).	UNSATISFACTORY
2	Unsatisfactory	Level of achievement presents major shortcomings (10% - 29% achievement rate of planned expectations and targets).	
1	Highly unsatisfactory	Level of achievement presents severe shortcomings (0% - 9% achievement rate of planned expectations and targets).	

Annex 4. List of documentation reviewed

List of documentation reviewed
An Implementation Handbook for Public Health Facilities in Gujarat. Government of Gujarat, Gandhinagar.
An Overview of the Medical Tourism Industry in Bangalore, India, Prasanna s, Saligram, Ayona Bhattacharjee, Valorie A Crooks, Ronald Labonte, Ashley Schram, Jeremy Snyder, February 2014.
Audit Report – GEF-UNIDO-MoEF Project-Karnataka 31-3-2016. S Venkatram & Co.
Back to Office Mission Report, Districts of Ahmedabad (CBMWTF & HCF), Amreli (Plastic Recycling Unit), Gandhinagar (HCF), Jamnagar (HCF), Mehsana (HCF) and Rajkot (HCF) in Gujarat, India. Mission Date - 10th-15th June, 2019. 26-6-2019 Shradha Gupta.
Back to Office Mission Report, Bhubaneswar, Odisha, India, Mission Date: 25-27 March 2019.
Back to Office Mission Report, Nashik & Mumbai, Maharashtra, India. Mission date: 14th – 18th May 2019. Shradha Gupta 23-5-2019.
Baseline Facility Data for 28 (?) hospitals in Maharashtra (2 hardcopy documents with data gathered in 2015)
Baseline Facility Data for 93 facilities in Gujarat, Karnataka and Odisha (in individual electronic files with data gathered in 2015)
Baseline Facility Data for all 28 hospitals in Punjab (23 hardcopy documents as some reports cover several hospitals - data gathered in 2015)
Bio-Medical Waste (Management and Handling) Rules, 1998. Government of India
Bio-Medical Waste (Management and Handling) Rules, 2016 and its amendments. Government of India
Compendium of Gazette Notifications of Waste Management Rules 2016 issued by the Gujarat Pollution Control Board (June 2017)
Consent and Authorisation to operate the Water Grace CTF with attachments issued by the Maharashtra Pollution Control Board (23 July 2019)
CSIR-National Environmental Engineering Research Institute, Nehru Marg, Nagpur: *End to End Survey (Situation Analysis, Technical Assessment and Techno-economic Feasibility Study) of Incinerators and Common Biomedical Waste Treatment Facilities (CBMWTFs) in the Five Selected Districts of Five Participating States of Gujarat, Karnataka, Maharashtra, Odisha and Punjab* (August, 2019)
Dr. Rajoo Singh Chhina overhead presentation "Technical Specifications of Biomedical Waste Items to be procured under the Project" (from the 15th May 2015 TWG Meeting).
Environmentally Sound Management of Bio-Medical Waste In India, Mid Term Evaluation Justification Document.
Global Environment Facility CEO Endorsement of Environmentally Sound Management of Medical Wastes in India, September 21, 2011.
Government of India *National Implementation Plan, Stockholm Convention on Persistent Organic Pollutants* (April 2011)
Guidelines for Management of Healthcare Waste as per Biomedical Waste Management Rules, 2016. Directorate General of Health Services , Ministry of Health & Family Welfare. Central Pollution Control Board Ministry of Environment, Forest & Climate Change.
Healthcare Presentation by India Brand Equity Foundation, February 2018.

List of documentation reviewed
Independent Mid-Term Evaluation of the project *Environmentally Sound Management of Medical Wastes in India* (June 2016)
Independent Terminal Evaluation of the project *Environmentally Sustainable Management of Medical Wastes in China* (April 2018)
Infection Prevention and Control published by the Gujarat Department of Health and Family Welfare (February 2017)
Information Handbook on Bio-Medical Waste Management for Administrators prepared for the project by the Department of Community Medicine, M.S. Ramaiah Medical College, Bangalore (2018)
Inputs received from State Partners on the Technical specifications for the Items proposed for supply identified Health Care Facilities under GEF-UNIDO-MoEF&CC Project on *Environmentally Sound Management of Medical Waste in India* (as of 28th January 2016) Shradha Gupta.
Minutes of Meeting of State Project Steering Committee, Odisha (ESMMW) 17-5-2014, Odisha, Bhubaneswar.
Minutes of the 1st meeting of the State Project Steering Committee on 21-10-2013 for the environmentally Sound Management of Medical Waste in Punjab.
Minutes of the 1st Meeting of the Technical Working Group for the GEF-UNIDO-MoEF&CC project titled '*Environmentally Sound Management of Medical Waste in India*' held on the 19th July 2016.
Minutes of the 2nd meeting of State Project Management Unit (SPMU), Maharashtra under GEF-UNIDO-MoEF&CC BMWM Project "*Environmentally Sound Management of Medical Waste in India*" held on 14th June, 2017,
Minutes of the 2nd meeting of the Project Management Committee for the GEF-UNIDO-MoEF project titled "Environmentally Sound Management of Medical Wastes in India" held on 20th August 2014 in the Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi.
Minutes of the 2nd meeting of the State Project Steering Committee on 31-10-2013 for the Environmentally sound Management of Medical Waste in Punjab.
Minutes of the 2nd State Project Steering Committee Meeting for GEF-UNIDO-MoEF project on *Environmentally Sound Management of Medical Waste in India* held on 6 May, 2015.
Minutes of the 2nd Meeting of the Technical Working Group for the GEF-UNIDO-MoEF&CC project titled '*Environmentally Sound Management of Medical Waste in India*' held on the 17th May 2017.
Minutes of the 3rd meeting of the State Project Steering Committee on 13-4-2015 for the Environmentally Sound Management of Medical Waste in Punjab.
Minutes of the 4th meeting of State Project Management Unit, Maharashtra under GEF-UNIDO-MoEF&CC BMWM Project '*Environmentally Sound Management of Medical Waste in India*' held on 6th August 2019.
Minutes of the 4th meeting of the State Project Steering Committee on 16-5-2018 for the Environmentally Sound Management of Medical Waste in Punjab.
Minutes of the First Meeting of the Project Management Committee (PMC) for the GEF-UNIDO-MoEF project titled "Environmentally Sound Management of Medical Wastes in India" held on 4th March 2014 at Room No. 402, Paryavaran Bhawan, CGO Complex, Lodhi Road, New Delhi - 110003.
Minutes of the First Technical Working Group (TWG) meeting held on 15th May 2015 for the GEF-UNIDO-MoEF&CC project on "Environmentally Sound Management of Medical Wastes in India."

List of documentation reviewed
Minutes of the meeting for the stake holders for the implementation of GEF-UNIDO-MOEF project on Medical Waste Management in the state held on 7-9-2013 under Chairmanship of the Hon'ble Additional chief Secretary, Forests & environment Dept, GoG.
Minutes of the meeting for UNIDO project on *Environmentally Sound Management of Medical Waste in India* held on 7th October 2015.
Minutes of the meeting held on 15th July 2015 for finalising the Technical Specifications for Colour coded bins and mobile waste collection trolleys to be procured under the GEF-UNIDO-MoEF&CC Project on *Environmentally Sound Management of Medical Waste in India*.
Minutes of the Meeting held on 20/09/2017 at 17:00 Hrs to discuss issues related to implementation of UNIDO Project (GEF-UNIDO-MoEF&CC Project) on environmentally sound Management of Medical waste in Gujarat State.
Minutes of the meeting of State Project Steering Committee (SPSC) Maharashtra under GEF-UNIDO-MoEF&CC BMWM Project '*Environmentally Sound Management of Medical Waste in India*' held on 22nd January 2019.
Minutes of the State Project Steering Committee Meeting held on 18-1-2016, Odisha, Bhubaneswar.
Minutes of the State Project Steering committee Meeting held on 24-4-2015 , Odisha, Bhubaneswar.
National Health Profile 2018, 13th Issue. Central Bureau of Health Intelligence, Directorate General of Health Services. Ministry of Health & Family Welfare, Government of India.
Operational Status of the Microwave Disinfection Device (as of 19th August 2019) provided under the project in 5 participating states.
Proceedings of the 1st State Project Steering Committee meeting of "*Environmentally Sound Management of Medical Waste in India*" Project of UNIDO held on 18th March 2016 under the chairmanship of Additional Chief Secretary, Government of Karnataka.
Proceedings of the 2nd State Project Steering Committee meeting of "*Environmentally Sound Management of Medical Waste in India*" Project of UNIDO held on 19th July 2017 under the chairmanship of Additional Chief Secretary, Government of Karnataka.
Proceedings of the 3rd STATE PROJECT STEERING COMMITTEE of GEF- MoEF&CC- UNIDO- Project titled "*Environmentally Sound Management of Medical Waste in India*" held on 27th February, 2019 at 04.30 PM under the Chairmanship of Additional Chief Secretary, Department of Forest, Ecology & Environment.
Proceedings of the Meeting held on 5th November 2014 for the GEF-UNIDO-MoEF&CC project *Environmentally Sound Management of Medical Waste in India*.
Progress of GEF-MoEF&CC-UNIDO Project on "Environmentally Sound Management of Medical Wastes in India" issued by the Karnataka Department of Health and Family Welfare (2019)
Progress of Implementation of GEF-UNIDO Funded MoEF&CC Project on Environmental Sound Management of Medical Waste State Pollution Control Board, Odisha (Up to July, 2018).
Progress Report for GEF-UNIDO funded MOEF&CC project entitled 'Environmental Sound Management of Medical Waste in India' – Maharashtra, 16-9-2016.
Project Progress Report (8th September 2019).
Punjab Pollution Control Board, Vatavaran Bhawan, Nabha Road, Patala. Status of compliance with the Bio-medical Waste Management Rules, 2016 by the Common Biomedical Waste Treatment Facilities-reg. Ref no. B-31011.BMW (50)/2018/WMD-1 dated 10-11-2018.

List of documentation reviewed
Quarterly Bulletin on bio-Medical Waste, Networking newsletter of Training component of the project Environmentally sound Management of Medical Wastes in India, Issue 1, January 2017.
Quarterly Bulletin on bio-Medical Waste, Networking newsletter of Training component of the project Environmentally sound Management of Medical Wastes in India, Issue 2, April 2017.
Quarterly Bulletin on bio-Medical Waste, Networking newsletter of Training component of the project Environmentally sound Management of Medical Wastes in India, Issue 3-4, January 2018.
Solid Waste Management Rules, 2016. Government of India
Standard Operative Procedures for Bio-Medical Waste Management prepared for the project by the Department of Community Medicine, M.S. Ramaiah Medical College, Bangalore (2018)
The Project Document *Environmentally Sound Management of Medical Wastes in India* (23 July 2011)
Trainer's Guide for Training on Biomedical Waste Management, GEF, UNIDO, MoEF&CC, 2018.
Trainers' Guide for Training on Biomedical Waste Management prepared for the project by the Department of Community Medicine, M.S. Ramaiah Medical College, Bangalore (2018)
Training Manual on Bio-Medical Waste Management for Doctors, Nurses, Nodal Officers and Waste Managers prepared for the project by the Department of Community Medicine, M.S. Ramaiah Medical College, Bangalore (2018)
Training Manual on Biomedical Waste Management for Waste Handlers prepared for the project by the Department of Community Medicine, M.S. Ramaiah Medical College, Bangalore (2018)
UNEP *Toolkit for Identification and Quantification of Releases of Dioxins, Furans and Other Unintentional POPs under Article 5 of the Stockholm Convention* (January 2013)
UNIDO Annual Project Implementation Report, Environmentally Sound Management of Medical Wastes in India, 31 October 2012.
UNIDO Annual Project Implementation Report, Environmentally Sound Management of Medical Wastes in India, 31 October 2013.
UNIDO Annual Project Implementation Report, Environmentally Sound Management of Medical Wastes in India, December 11, 2014.
UNIDO Back-To-Office Mission Report- Mission 22-28 August 2015.
UNIDO Back-To-Office Mission Report- Mission 26 Nov – 3 Dec 2016.
UNIDO Independent Mid-Term Evaluation, Environmentally Sound Management of Medical Wastes in India. 2016.
UNIDO Project of the Government of India Project Document (PRODOC) 23 July 2011.
UNIDO/Stockholm Convention Division, Report on the Stockholm Convention Division Gender Mainstreaming Consultancy, Dr Johanna Maula, Gender Expert, 26 June 2017.

Annex 5. List of stakeholders consulted

Vienna, Austria	
Name	**Job title/Position Within Organisation**
Mr. Philippe Scholtes	*UNIDO Managing Director, Programme Development and Technical Cooperation Division*
Mr. Stephan Sicars	*UNIDO Director, Department of Environment, Programme Development and Technical Cooperation Division*
Ms. Ajumi Fujino	*UNIDO Director of Strategic Office (former UNIDO Representative for India)*
Mrs. Erlinda Galvan	*UNIDO Project Manager*
Mr. Zoltan Csizer	*UNIDO Senior Advisor*
Mr. Johannes Dobinger	*UNIDO Chief of Independent Evaluation Division*
Mrs. Thuy Thu Le	*UNIDO Evaluation Officer*
Ms. Alessandra Bravin	*UNIDO Associate Procurement Officer*

New Delhi	
Name	**Job title/Position Within Organisation**
Ms. Nidhi Khare, IAS	*Joint Secretary & National Project Director, MoEF&CC*
Dr. S. P. Dhua	*UNIDO Regional Coordinator, Regional Network on Pesticides for Asia & the Pacific*
Dr. Y. P. Ramdev	*UNIDO National Technical Advisor, Regional Network on Pesticides for Asia & the Pacific and the Stockholm Convention*
Ms. Shradha Gupta	*Assistant National Project Coordinator*
Mr. Amarderp Raju	*Scientist D & waste management expert, MoEF&CC*
Dr. Dharmendra Kumar Gupta	*Director/ Scientist F, MoEF&CC*
Mr. Aditya Narayan Singh	*Additional Director (S), MoEF&CC*
Ms. Payden	*Deputy Head of WHO Country Office*
Mr. Manjeet Singh Saluja	*National Professional Officer, WHO India*

State of Gujarat	
Name	**Job title/Position Within Organisation**
Mr. V. D. Rakholia	*State Project Coordinator, Gujarat State Pollution Control Board*
Dr Kartir R Shah	*State Quality Assurance Medical Officer, Commissionerate of Health*
Mr. R. P. Buha	*Project Link Officer, Gujarat State Pollution Control Board*
Dr. Neiyali Lakheni	*Medical Superintendent, GMERS General Hospital, Gandhinagar*
Dr. Sima Bhatt	*Professor and HoD, GMERS General Hospital, Gandhinagar*
Dr. Bhaskar Thakkur	*Associate Professor, Pathology, GMERS General Hospital, Gandhinagar*
Mrs. Jaysute Patel	*Nursing Superintendent, GMERS General Hospital, Gandhinagar*
Dr. Sangeeta Patel	*AP Microbiology, GMERS General Hospital, Gandhinagar*
Dr. Sangeeta Patel	*AP Microbiology, GMERS General Hospital, Gandhinagar*
Genjlina Christian	*DNS, GMERS General Hospital, Gandhinagar*
Jiral Pael	*Infection Control Nurse, GMERS General Hospital, Gandhinagar*
P D Paronar	*SZ, GMERS General Hospital, Gandhinagar*

State of Gujarat	
Name	**Job title/Position Within Organisation**
B J Barot	*SZ, GMERS General Hospital, Gandhinagar*
Mr. Jatin Pandya	*GM (Projects & Facilities), Apollo Hospital Gandhinagar*
Mr. Vastabhia J. Keshwala	*Managing Trustee, Samarpan General Hospital*
Dr. Manish Mehta	*Medical Superintendent, P.D.U. Civil Hospital, Rajkot*
Mr. Akash Tiwari	*Quality Assurance Officer, Apollo Hospital, Gandhinagar*
Ms. Trupti Patel	*Nursing Head, Apollo Hospital, Gandhinagar*
Ms. N. Manisha	*Infection Control Nurse, Apollo Hospital, Gandhinagar*
Mr. Jatin Pandya	*Facility Manager, Apollo Hospital, Gandhinagar*
Dr. Devyanshu Mehta	*Doctor and presently in-charge, Community Health Centre, Chotila*
Dr. Bharat Pankhadia	*Doctor, Community Health Centre, Chotila*
Dr. Vishal Keshwara	*Doctor, Community Health Centre, Chotila*
Dr. Manish Mehta	*Medical Superintendent, P.D. U. Civil Hospital, Rajkot*
Mr. Hiteridra Zankharia	*Nursing Superintendent, P.D. U. Civil Hospital, Rajkot*
Dr. Isha Joshi	*ASA, P.D. U. Civil Hospital, Rajkot*
Dr. Hitesh Makwana	*ASA, P.D. U. Civil Hospital, Rajkot*
Mr. Prakash Vaghela	*Director, e-coli Waste Management*
Mr. Dipesh Patel	*Director, e-coli Waste Management*
Mr. Jignesh Patel	*Director, e-coli Waste Management*
Dr. M. M. Prabhakar	*Medical Superintendent, Civil Hospital, Ahmedabad*
Mr. B. K. Pranjapati	*Nursing Superintendent, Civil Hospital, Ahmedabad*
Mrs. Sunita Soni	*A.P. Micro/Infection Control Officer, Civil Hospital, Ahmedabad*
Ms. Seema Tirihdasani	*Infection Control Nurse, Civil Hospital, Ahmedabad*
Mr. Jainin Barot	*S.I., Civil Hospital, Ahmedabad*

Sites visited in Gujarat	
Name	**Job title/Position Within Organisation**
GMERS Medical College & Hospital, Gandhinagar District	*980 bed teaching hospital*
Apollo Hospital – Pvt. Ltd.	*284 bed private hospital*
Community Health Centre, Chotila	*66 bed facility that mostly serves out patients*
Samarpan General Hospital, Jamnagar	*Charitable Trust*
P.D.U. Civil Hospital, Rajkot	
e-coli Waste Management	*Common Treatment Facility*
Civil Hospital, Ahmedabad	*2,000 bed hospital*

State of Karnataka	
Name	**Job title/Position Within Organisation**
Dr. D. S. Ramesh	*State Nodal Officer and Project Director, Directorate of Health & Family Welfare*
Dr. Raju V	*State Technical Advisor*
Dr. Vivek Dorai	*State Project Coordinator*
Dr. Sowmiya V. Senthamizh	*State Project Assistant*
Mr. Avinash. R M	*Finance Manager, Directorate of Health & Family Welfare*
Ms. Srikanth. V	*Data Entry Operator, Directorate of Health & Family Welfare*
Dr. A.G. Prathab	*Registrar Academics, Ramaiah Medical College*

State of Karnataka	
Name	**Job title/Position Within Organisation**
Dr. Hermanth T	*Registrar Administration, Professor and Head, Department of Community Medicine, Ramaiah Medical College*
Dr. Shalini C Nooyi	*Professor, Department of Community Medicine, Ramaiah Medical College*
Dr. Lalitha K	*Project Coordinator, Professor, Department of Community Medicine, Ramaiah Medical College*
Dr. Shalini Pradeep	*Professor, Department of Community Medicine, Ramaiah Medical College*
Dr. Arjunan Isaac	*Professor, Department of Community Medicine, Ramaiah Medical College*
Dr. Suman G	*Project Coordinator, Associate Professor, Department of Community Medicine, Ramaiah Medical College*
Dr. Dinesh Rajaram	*Associate Professor, Department of Community Medicine, Ramaiah Medical College*
Dr. Nanda Kumar BS	*Associate Professor, Department of Community Medicine, Ramaiah Medical College*
Dr. Babitha Rajan	*Assistant Professor, Department of Community Medicine, Ramaiah Medical College*
Dr. Pavithra	*Assistant Professor, Department of Community Medicine, Ramaiah Medical College*
Dr. Ananthram	*Assistant Professor, Department of Community Medicine, Ramaiah Medical College*
Dr. N. S. Murthy	*Professor, Department of Community Medicine (Biostatistics), Ramaiah Medical College*
Mr. Shivaraj	*Assistant Professor, Biostatistics, Department of Community Medicine, Ramaiah Medical College*
Mrs. Radhika K	*Assistant Professor, Biostatistics, Department of Community Medicine, Ramaiah Medical College*
Mr. Dinesh Kumar	*Medical Social Workers, Department of Community Medicine, Ramaiah Medical College*
Mr. Chethan	*Medical Social Workers, Department of Community Medicine, Ramaiah Medical College*
Ms. Anjana	*Statistician, Project "Epidemiology of Childhood Injuries", Ramaiah Medical College*
Dr. Uma Maheshwar	*Medical Superintendent, Vydehi Institute of Medical Sciences & Research Centre (VIMS)*
Dr. K. Ravi Babu	*Administrative Officer and Professor, VIMS*
Dr. Girish	*Professor, Microbiology, Head of Infection Control and Biomedical Waste Management, VIMS*
Dr. Ravidra	*Professor, Community Medicine, VIMS*
Dr. Santhosh	*Assistant Professor, Microbiology, VIMS*
Mrs. N. Vijayalakshmi	*NABH-Coordinator, VIMS*
Mrs. Usha	*Infection Control Nurse, VIMS*
Dr. Nanjaraj Swamy	*Medical Superintendent, Mysore Medical College & Research Institute (MMCRI)*
Dr. Rajesh Kumar-	*Resident Medical Officer, MMCRI*
Dr. S Radhamari	*Medical Superintendent, Maternity Unit, MMCRI*
Mr. Mohinish	*District Quality Manager, MMCRI*
Dr. Raghukumar	*Administrative Medical Officer, CHC Jayanagara*

State of Karnataka	
Name	**Job title/Position Within Organisation**
Dr. Theyjesh Kumar	*Dental Surgeon, CHC Jayanagara*
Dr. Mukund	*Dermatologist, CHC Jayanagara*
Dr. Rashmi	*Anaesthetist, CHC Jayanagara*
Ms. Manjula	*Staff Nurse, CHC Jayanagara*
Mr. C. Srikanth	*Owner, Shree Consultants*
Ms. Preethi	*Project Officer, Shree Consultants*
Mr. Mashud	*Supplier of new combustion system for Shree Consultants' incinerator*
Dr. Bhaskar	*Administrative Medical Officer, General Hospital, H. D. Kote*
Ms. Meenakshi	*Staff Nurse, General Hospital, H. D. Kote*
Dr. Manjunath	*Dean & Director, Bowring & Lady Curzon Hospital (B&LCH)*
Dr. Kala Yadav	*Professor of Microbiology, B&LCH*
Ms. Aruna	*Nursing Superintendent, B&LCH*
Dr. Chetana	*Tutor, Microbiology, B&LCH*
Dr. Narayana Swamy	*District Surgeon- District Hospital Kolar*
Dr. Pusphalatha	*ENT Surgeon- DH Kolar*
Dr. Hema Bhaskar	*Microbiologist- DH Kolar*
Mr. Chetan	*District Quality Manager - DH Kolar*
Sites visited in Karnataka:	
Ramaiah Medical College	*Responsible for capacity building and training in all five project states*
Vydehi Institute of Medical Sciences & Research Centre	*1,600 bed private hospital*
Mysore Medical College	*1,050 bed public hospital*
Jayanagara Community Health Centre	*30 bed facility*
Shree Consultants	*Common Treatment Facility*
PHC Chikkanandi, H. D. Kote Taluk	*6 bed facility*
General Hospital, H. D. Kote	*70 bed hospital*
Bowring & Lady Curzon Hospital, Bangalore	*Large teaching hospital*
District Hospital, Kolar	*565 bed facility*

State of Maharashtra	
Name	**Job title/Position Within Organisation**
Dr Mrunal Patil	*Dean*
Dr B D Pawar	*Medical Superintendent*
Dr Ajit Patil	*Deputy Medical Superintendent*
Dr Nita Gangurde	*BMWM Committee Coordinator*
Sister Sarla Aher	*Matron*
Brother Prashant Jadhav	*Infection Control Nurse*
Mr Yogesh Dalvi	*Housekeeper In Charge*
Dr Jagdale	*Civil Surgeon*
Dr Nikhil Saidane	*Additional Civil Surgeon*
Dr Hemant Ostwal	*Suyash Administration Director*
Dr Pooja Ostwal	*Suyash Hospital*
Dr Sachin Mahadik	*Suyash Hospital*
Dr Sajata Khairnar	*Suyash Hospital*
Mr Madhukar Lahane	*Suyash Hospital*

State of Maharashtra	
Name	**Job title/Position Within Organisation**
Mrs Sheeja Nair	*Suyash Hospital*
Mr Jagdish Khotkar	*Suyash Hospital*
Mrs Manisha Rokade	*Suyash Hospital*
Mrs Kavita Wadekar	*Suyash Hospital*
Dr Ulhas D. Marulkar	

State of Odisha	
Name	**Job title/Position Within Organisation**
Dr. B. N. Bhol	*Chief Environmental Scientist, Orissa Pollution Control Board (OPCB)*
R. N. Prensy	*Senior Environmental Engineer, OPCB*
S K Sahu	*Senior Environmental Engineer, OPCB*
Debidutt Biswal	*Member Secretary, OPCB*
Ranjita Nanda	*Project Officer, Project Officer, Orissa*
Manisha Das	*Project Officer, SPMU, Orissa*
Sites visited in Odisha	
Mr. Bhim Ch. Marndi	*Asst. Env, Scientist, State Pollution Control Board, Balasore*
Prof. Dr. Pusparaj Samantsinghar	*Medical Superintendent, Institute of Medical Sciences & Sum Hospital*
Dr. N. K. Debata	*Consultant Hospital Infection Control, Sum Hospital*
Ms. Sonalini Kan	*Quality Manager, Sum Hospital*
Ms. Debasmita Prayadarshini	*Junior Hospital Manager, Sum Hospital*
Mr. R. P. Dus	*JHA, Sum Hospital*
Ms. Shabhamarjari Samail	*Additional Nursing Superintendent, Sum Hospital*
Rashmita Priyadarshani	*Environmental Engineer, Regional Office, SPCB, Cuttack*
Mrs. Soumya Mohanty	*Hospital Manager, SCB Medical College and Hospital, Cuttack*
Professor C B K Mohanty	*Superintendent, SCB Medical College and Hospital, Cuttack*
Dr. Bhuban Mehorana	*Emergency Officer, SCB Medical College and Hospital, Cuttack*
Gitanjali Nayak	*Project Officer, UNIDO*
Durga Drsh	*Supervisor, Cuttack, Medical Marketing Services*
Dr. Baradakanta Mishra	*CDM & PHO, DHQ Hospital Puri*
Dr. Biraja Shankar Rath	*DPHO, DHQ Hospital Puri*
Dr. Parimala Mohanty	*Nodal Officer, DHQ Hospital Puri*
Ms. Susree Saranishta	*Hospital Manager, DHQ Hospital Puri*
S. Soindaryalaxmi sahoo	*Project Officer, BMWM*
Dr. Indra Kumari Mohapatra	*DHQ Hospital Puri*
Mr. Subharansu Sekhar Mohapatra	*Proprietor, Neelanchal Nursing Home, Puri*
Dr Harsh Chandra Pandit	*Doctor-in-charge, Neelanchal Nursing Home, Puri*
Banambar Mantri	*Pharmacist, Neelanchal Nursing Home, Puri*
Dr. Fr. Paul Koonamparampath	*Director, Jyoti Hospital, Balasore*
Sister Sumarani S. D.	*Nursing Superintendent, Jyoti Hospital, Balasore*
Mr. Nataraj D. D.	*Officer in charge, Jyoti Hospital, Balasore*
Rainto Mishra	*Accountant, DHH Hospital Baripada, Mayurbhanj*
Debashish Biswal	*Engineer-in-charge, BMW Unit, DHH Hospital Baripada, Mayurbhanj*
Sumbani Pal	*BMW Project Officer, UNIDO, DHH Baripada, Mayurbhanj*

State of Odisha	
Name	**Job title/Position Within Organisation**
Dr. Prarab Sankar Dash	*General Duty Medical Officer, DHH Baripada, Mayurbhanj*
Dr. Bindini Dash	*Hospital Manager, DHH Baripada, Mayurbhanj*
Sandhyayani Marandi	*Assistant Environmental Engineer, SPCB, Balasore*
Mr. P. K. Mahapatra	*Regional Officer, SPCB, Balasore*
Dr. Shyam Sundar Khandelwal	*Proprietor, Durga Nursing Home, Baripada, Mayurbhanj*
Mr. Manish Khandelwal	*Managing Director, Durga Nursing Home, Baripada, Mayurbhanj*
Mr. Dhirender Mallick	*Technical Specialist, Durga Nursing Home, Baripada, Mayurbhanj*
Sites visited in Odisha	
Institute of Medical Sciences & Sum Hospital	*1,000 bed teaching hospital*
Sani Clean Pvt. Ltd; Tangiapada, Khurda	*The only CBMWTF in Odisha State*
Jyoti Hospital, Balasore	*100 bed charity hospital*
SCB Medical College and Hospital, Cuttack	*2,132 bedded teaching, government hospital*
DHQ Hospital, Puri	*380 bedded government hospital*
Neelanchal Hospital Puri	*10 bedded private hospital*
DHQ Hospital, Baripada, Mayurbhanj	*350 bedded government hospital*
Durga Nursing Home, Baripada, Mayurbhanj	*29 bedded private hospital*

State of Punjab	
Name	**Job title/Position Within Organisation**
Mr. Krunesh Garg	*Member Secretary, Punjab Pollution Control Board, Patiala*
Prof. S. S. Marwah	*Chairperson, Punjab Pollution Control Board, Patiala*
Mr. Pradeep Gupta	*Chief Environmental Engineer, Punjab Pollution Control Board, Patiala*
Mr. Pyush Jindal	*Punjab Pollution Control Board, Patiala*
Sites visited in Punjab	
Mrs. Neelu Ahuwalia	*Indus Hospital, Mohali*
Dr. Parminder Gill	*Indus Hospital Mohali*
Col. R. K. Bharadwaj	*Indus Hospital Mohali*
Mrs. Meenakshi Patial	*Infection Control Nurse, Indus Hospital Mohali*
Ms. Richa Sharma	*Indus Hospital, Mohali*
Mr. Harsimran Singh	*AEE, Punjab Pollution Control Board*
Dr. Seema Chopra	*Medical Officer, Government Rajindra Hospital, Patiala*
Dr. Avinash Jindal	*SMO, Government Rajindra Hospital, Patiala*
Dr. Malwinder Mala	*SMO (Men), Government Rajindra Hospital, Palatia*
Dr. Kulwani Singh	*Medical Officer, Microbiologist, Government Rajindra Hospital, Patiala*
Kuldeep Saini	*Staff Nurse, Government Rajindra Hospital, Patiala*
Mr. Surender Singh	*AEE, Panjab Pollution Control Board*
Mr. Satyajit Arrti	*AEE, Panjab Pollution Control Board*
Dr. Rajoo Singh Chhina	*STA, Punjab and Dean, Davanand Medical College and Hospital, Ludhiana*
Mr. Sunil Aggarwal	*Medicare Environmental Management Pvt. Ltd. Ludhiana*
Jatinder Kumar	*AEE, Panjab Pollution Control Board*

State of Punjab	
Name	**Job title/Position Within Organisation**
Dr. Nanjit Singh Uppal	*Director and Principal, Guru Ramdas Medical College and Hospital, Amritsar*
Dr. Paramjit Bindra	*H. R. Manager, Guru Ram Das Medical College and Hospital, Amritsar*
Dr. Shivesh Devgan	*Asst Professor, Community Medicine, Guru Ram Das Medical College and Hospital, Amritsar*
Mr. S. Kulbir Singh	*Sanitary Inspector, Guru Ram Das Medical College and Hospital, Amritsar*
Dr. Harjeit Singh	*Assistant Prof. Guru Ram Das Medical College and Hospital, Amritsar*
Mr. Sukhdev Singh	*AEE, Panjab Pollution Control Board*
Dr. J S Kullar	*Medical Superintendent, Guru Nanak Dev Hospital Amritsar*
Dr. Ashok Sidhu	*Deputy Medical Superintendent, Guru Nanak Dev Hospital Amritsar*
Dr. Sanjeev Kohli	*Nodal Officer, Guru Nanak Dev Hospital Amritsar*
Mr. Kamaldeep Singh	*PA to Medical Superintendent, Guru Nanak Dev Hospital Amritsar*
Mrs. Paramjit Kaur	*Nursing Superintendent, Guru Nanak Dev Hospital Amritsar*
Mrs. Praveen Kaur	*Staff Nurse, Guru Nanak Dev Hospital Amritsar*
Mrs. Anita Sharma	*Staff Nurse, Guru Nanak Dev Hospital Amritsar*
Mrs. Paramjit Kaur	*Staff Nurse, Guru Nanak Dev Hospital Amritsar*
Mrs. Hardeep Kaur	*Staff Nurse, Guru Nanak Dev Hospital Amritsar*
Mr. Inderpal Singh Paschira	*Managing Director, Amritsar Enviro Care Systems, Amritsar*
Sites visited in Punjab	
Indus Super Speciality Hospital, Mohali	*60 bed specialised hospital*
Rajindra Hospital and Government Medical College, Patiala	*750 bed government hospital*
Davanand Medical College & Hospital, Ludhiana	*1,700 bed teaching hospital*
Medicare Environmental Management	*CTF serving the Ludhiana area*
Lord Mahavir Civil Hospital, Ludhiana	*285 bed government hospital from 1935*
Sri Guru Ram Das Medical Institute, Amritsar	*900 bed medical science and research hospital*
Guru Nanak Dev Hospital, Amritsar	*Old 1,272 bed hospital*

De-briefing and discussion on Initial Evaluation Findings, 20 September, 2019, Delhi, India	
Name	**Job title/Position Within Organisation**
Dr. Rene' Van Verkel	*UNIDO Country Representative*
Dr. Sowmiya Senthamiza	*State Project Assistant, Karnataka*
Dr. Vivek Dorai	*State Project Coordinator, Karnataka*
Dr. Rs. S. Chhina	*State Technical Advisor, Punjab*
Mr. Kuldeep Singh	*Executive Engineer, Punjab Pollution Control Board (PPCB), Punjab*
Mr. Pyush Jindal,	*Sr. Environmental Engineer, PPCB, Punjab*
Dr. A. R. Supate	*PSO, MPCB, Maharashtra*
Mr. Sameer Hundelkar	*MPCB, Maharashtra*
Dr Lalitha K.	*MRS, Karnataka*

De-briefing and discussion on Initial Evaluation Findings, 20 September, 2019, Delhi, India	
Name	**Job title/Position Within Organisation**
Dr. Suman G.	*MRS, Karnataka*
Mr. Mahesh Agarwal	*CTF, Orissa*
Mr. Sunil Agarwal	*CTD, Ludhiana, Punjab*
MR. Srikanth C.	*CTF, Mysuru, Karnataka*
Mrs. Preethi S.	*CTF, Mysuru, Karnataka*
Mr. Sitikantha Sahu	*OPCB, Bhubaneshwar, Orissa*
Dr. B. N. Bhol	*Chief Environmental Scientist, Orissa*
Mr. Kashev Das	*UNIDO, Delhi*
Dr. S. P. Dhua	*UNIDO, Delhi*
Ms. Shradha Gupta	*UNIDO, Delhi*
Mr. Rishi Kamhih	*MoEF&CC, Delhi*
Mr. Aditya N. Singh	*MoEF&CC, Delhi*
Mr. V. D. Rakharia	*GPCB, Gandhinagar, Gujarat*
Mr. R. P. Buha	*GPCB, Gandhinagar, Gujarat*
Ms. Shilpa Pahariras	*MoEF&CC, Delhi*
Dr. Dorothy Lucks	*Team Leader, Evaluation team*
Mr. Peder Bisbjerg	*Team Member, Evaluation team*
Ms. Moho Chaturvedi	*Team Member, Evaluation team*

Annex 6. Medical facility assessment

This Annex provides descriptions of the medical facilities visited during the evaluation mission. The assessments are organised in the following annex by state. For each state, the descriptions commence with the Common Treatment Facility(ies), followed by the healthcare facilities ordered by decreasing bed capacity.

Basic information is provided for each facility, such as its occupancy rate and the number of outpatients per day (OPD) is given, as well as the type of hospital (government, private or charity).

In an effort to evaluate the impact of the project, the quality of each healthcare facility's bio-medical waste management system has been assessed, where a "high", "medium" or "low" score is given according to the findings. Furthermore, using the same scale, the satisfaction with the project's activities is given.

Name: e-coli Waste Management, Ahmedabad **Reference: Annex 6 GU-1**
Type: Common Treatment Facility

This facility was established in 2001, the site has an incinerator and stack testing has demonstrated that it meets the 0.1 ng TEQ/ Nm3 emission requirement for dioxins and furans. This incinerator has a treatment capacity of 100 kg/hour and it operates for about 18 hours per day. The incinerator is fed manually by throwing bags of waste in through a maintenance hatch, as the rather unusual lifting feed slide (see picture below left) was not operational. The opening the hatch every time waste has to be fed will allow large quantities of cold air to enter the system and upset operating conditions, thereby making it impossible for this system to meet stringent emission limits. All residues are transported to a secure landfill.

The facility uses 20 vehicles to collect waste from its 2,300 clients, whereof about 20 are hospitals with 50 or more beds. Sharps are encapsulated and sent to a secure landfill. Red bags have their contents physically verified and about 20% must be incinerated. The remainder are autoclaved, shredded and then sent for recycling. In practice, there is a sorting of these plastic materials, as only plastics with a resale value are shredded, see photo below.


The incinerator (right) and the start of the APC left


Waste is fed into the combustion chamber through this door


Water circulating in the APC, it is said that there is no waste water discharge.


Shredding plastic for recycling

Name: Civil Hospital, Ahmedabad **Reference: Annex 6 GU-2**
Type: Government hospital
No. of beds: 2,000 **Occupancy Rate:** 85% **OPD:** 3,000

This is the world's fifth largest hospital and its waste management system is operated to very high standards. It has had an excellent source separation scheme for about 20 years and operates with clean/ dirty areas within the hospital. As staff was already proficient, the hospital's staff did not participate in the training provided by the project.

The hospital received 15 trolleys, 95 sets of colour coded bins and one microwave unit from the project. The trolleys were considered too unwieldy to be useful and furthermore there were problems with their wheels. The bins were useful though their wheels tended to break. The microwave unit treats 60 kg/day of plastic waste, not much considering that the hospital generates 500 kg/day of this waste stream. The hospital was interested in gaining experience with the microwave technology and is grateful for now having such a unit.

The hospital has an information management system that tracks BMW generation by ward; needle stick injuries; employee health and so forth. The hospital plans to be mercury free by 2020.

Medical trolley with bags for waste collection

The microwave unit

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	H
Bin Segregation	H	Bins	M
Temp storage area	H	Trolley	L
Record keeping	H	Microwave	H

Name: GMERS Medical College & Hospital, Gandhinagar District **Reference: Annex 6 GU-3**

Type: Government hospital

No. of beds: 980 **Occupancy Rate**: 75-80% **OPD:** 2,000

This teaching hospital has been source separating bio-medical waste for 20 years and it manages this waste in an exemplary manner. The annual intake of 200 medical students must immediately follow a one-month introductory course that covers the main working procedures with the hospital, inclusive of BMWM practices. The hospital has an Infection Control Committee that meets on a monthly basis and three Infection Control Nurses do continuous follow-up within the hospital. The hospital followed the training provided through the Ramaiah College and received the project's training materials in 2018. The hospital prefers to use their own teaching materials regarding BMWM and Infection Control from 2016.

The hospital received a microwave unit through the project and uses it to sterilise plastic materials. Due to concerns over these plastic materials being reused, being mixed with non-sterilised waste or otherwise mishandled, all waste inclusive of the treated plastics are sent to a CTF. The hospital generates about 250 kg/day of BMW, corresponding top 0.33 kg/ occupied bed/ day. The hospital received 200 sets of colour coded bins, it was remarked as the foot pedals are difficult to use and that the staff tends to open the bins using their hands. The received trolleys were judged unwieldly and, due to their size, difficult to clean.

The wheels have broken off the bin set on the right

Clearly labelled temporary waste storage

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	M
Bin Segregation	H	Bins	M
Temp storage area	H	Trolley	M
Record keeping	H	Microwave	H

Name: Civil Hospital & Medical College, Rajkot **Reference: Annex 6 GU-4**
Type: Government teaching hospital
No. of beds: 850 **Occupancy Rate:** 100% **OPD**: 3,000

This is a teaching hospital that accepts 150 undergraduate, 100 postgraduate and about 65 interns every year. All new staff and students must follow a two-day introductory course covering areas such as needle stick injury procedures, infection control and BMWM procedures. Other training courses, lasting 3 to 4 days are conducted quarterly for all staff members. The hospital has an Infection Control Committee under the stewardship of the Medical Superintendent and it meets every 3 months.

The hospital has sorted its waste since 2006 and it generated 150 kg/day of BMW. This is collected by a CTF at a price of 22 Rupee/ kg; the hospital does regular inspection visits to the CTF and they are happy with its treatment processes. Some training at the hospital is conducted jointly by the CTF, hospital staff and the SPCB.

Three staff members received TOT training through the project in 2017. It was felt that there were improvements in the waste separation after this training. The hospital received 184 sets of colour coded bins; 24 trolleys and one microwave unit. It was noted that the wheels come off the bins. One trolley was distributed to each hospital building, this would mean that the average trolley transports 6 kg/day of waste. In reality, many of the trolleys seems to be permanently kept (and not used) close to the temporary storage area. The microwave unit does not have sufficient capacity to treat all generated plastic waste. Anyhow, there are no clear instructions from the SPCB on how to handle the sterilised plastic material, so all waste is collected by the CTF.

The hospital is mostly mercury free, there are still a few mercury containing blood pressure devices within the facility.

Project provided bins often lose their wheels. Note that the wheels are difficult to keep clean.

General waste storage

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	H
Bin Segregation	H	Bins	M
Temp storage area	M	Trolley	M
Record keeping	H	Microwave	H

Name: Samarpan General Hospital, Jamnagar **Reference: Annex 6 GU-5**
Type: Charitable Trust
No. of beds: 350 **Occupancy Rate:** 70% **OPD:** 1,100

This charity hospital was established in 1992 and is dedicated to serving poor people; the patients are only charged a fraction of the actual costs. The founders and present managers give cleanliness a high priority and the hospital has had a BMWM system for the past 15 years. Two staff members followed the Ramaiah College training in 2016, and since all nursing staff and class 4 workers have been trained. No training was provided to the doctors.
The facility received 7 sets of colour coded bins and 2 trolleys through the project. The trolleys are not used, as these are too wide to pass through the hospital's doors. The hospital generates 25 kg of BMW daily and it is currently building an improved temporary waste storage area. A local CTF, "Biomedical", collects the generated waste on a daily basis.

Project supplied bins; instructional posters provided by Gujarat (left) and the project (right)

Internal waste transport vehicle

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	H
Bin Segregation	H	Bins	M
Temp storage area	M	Trolley	M
Record keeping	H	Microwave	n/a

Name: Apollo Hospital – Pvt. Ltd **Reference: Annex 6 GU-6**
Type: Private hospital
No. of beds: 284 **Occupancy Rate:** 67% **OPD**: 450

The Apollo Hospital has been source separating their generated BMW since 2003 and, in most respects, it is a model facility. For example, it has clearly designated "clean" and "dirty" areas, so that clean items (food, linen, medical instruments, visitors) travel through designated areas, while soiled linen, waste and so forth are removed through a separate set of corridors and elevators. All is clearly signposted to ensure that the employees make no mistakes.

The hospital basically has all required regulatory systems in place according to the 2016 BMWM Rules, with the exception of rule 4 (i) that requires a bar code system be established. It generates large quantities of waste: 2.11 kg/ occupied bed/ day; a result of the facility having 89 ICU beds. Staff from the hospital followed the training provided through the project; it has appreciated the training materials and the checklists, as these have helped improve the hospital's procedures.

Medical trolley with attached bins for infectious plastic materials (top) and infectious waste (bin with yellow liner below)

A recurring issue, even in the best organised hospitals, was sharps containers placed on the floor, balanced on waste bins or otherwise kept unsafely. A better solution is to place the sharps container on the wall, as done at the Apollo Hospital.

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	H
Bin Segregation	H	Bins	M
Temp storage area	H	Trolley	M
Record keeping	H	Microwave	n/a

Name: Community Health Centre, Chotila **Reference: Annex 6 GU-7**
Type: Government hospital
No. of beds: 66 **Occupancy Rate:** 50%**OPD**: 500-600 (1,000 on Mondays)

This health centre is located along the main road from Ahmadabad to Rajkot; it serves a large rural catchment area. It is a very busy facility with a large number of outpatients and about 100 baby deliveries every month. As 9 of the 11 staff were transferred to other hospitals over the past year, the health centre no longer has a TOT trained by the Ramaiah College. The facility received 4 sets of colour coded bins and one trolley.

The health centre has a functioning BMWM system, though there are shortcomings, probably attributable to a combination of insufficient training and the excessive work load for all staff members. There is an Infection Control Committee, as well a decent record keeping for waste quantities, needle stick injuries and staff vaccinations.

Waste storage and a State produced instructional poster


The city corporation collects the hospital's general waste from here

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	n/a
Bin Segregation	M	Bins	M
Temp storage area	M	Trolley	M
Record keeping	H	Microwave	n/a

Name: Community Health Centre & Referral Hospital Adalaj, Gandhinagar District **Reference: Annex 6 GU-8**

Type: Government clinic

No. of beds: 30 **Occupancy Rate**: **OPD:** 200

This Community Health Centre has been sorting their bio-medical waste since 2011. The waste management system generally featured poor sorting of waste, for example one green bin for general waste in a corridor held bloody bandages. The staff was frequently uncertain as to how waste was handled within the health centre, this especially applied to the location of the temporary waste storage area and how the waste was transported to this location.

The facility received 2 trolleys and 6 or 7 sets of colour coded bins from the project. The hospital stated that they generate 2 - 3 kg of waste per day, so the trolleys must be considered too large to serve any purpose. The health centre complained that the bins tended to break and that the foot operated lid-lifters would jam. The facility stated that they had an Infection Control Committee in place, as well as a training system.

Plastic waste in the yellow bag

An instruction poster issued by the State Government

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	H
Bin Segregation	M	Bins	M
Temp storage area	L	Trolley	M
Record keeping	M	Microwave	n/a

Name: Shree Consultants CTF, Mysore **Reference: Annex 6 KA-1**
Type: Common Treatment Facility

This facility is one of 26 CTFs in Karnataka State. The site has an incinerator, two autoclaves and a shredder. It has been in operation since 2004 and has 15 employees. The site's incinerator operates for 5 to 6 hours per day, treating 500 to 600 kg of waste. The facility has 26 government hospitals, 13 CHCs and 32 PHCs, 142 private hospitals, 71 diagnostic clinics and 530 small practices such as clients. The facility uses a barcode system with three hospitals.

The site visit was interesting. In the meeting room, our attention was drawn to a monitor that was said to display current temperatures and emission data for the incinerator. We were informed that the incinerator was operating and that this was an instantaneous data flow. The technical expert asked what happen to the waste during the period when a new secondary combustion chamber (SCC) [23] was fitted to the incinerator. He was informed that the work had already been completed and that is had only taken two days, hence eliminating the need for treating the infections waste elsewhere.

Upon seeing the incinerator, it was noted that it was not operating. We were now informed that the data displayed in the meeting room monitor was "historic." Noting that the SCC was in the process of being replaced, the question about waste treatment in this period was repeated and it was stated that the waste was stored in the facility's storage area. A visit to this area revealed that no waste was stored. When leaving the facility, it was noted that yellow and red bags were being burnt in an open container.


The air pollution control system under a leaking roof


Burning of yellow and red bags in an open container

[23] Allowing for the required 2 second residence time demanded by the 2016 BMWM Rules.

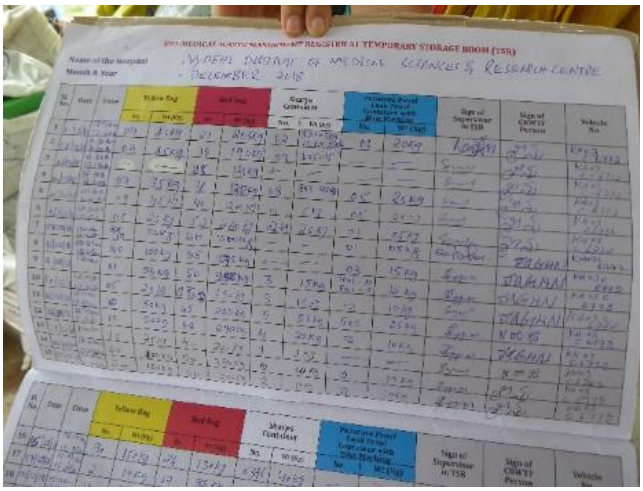
Name: Vydehi Institute of Medical Sciences & Research Centre, Bangalore **Reference: Annex 6 KA-2**

Type: Private charitable hospital

No. of beds: 1,600 **Occupancy Rate**: 80% **OPD:** 2,500

This large hospital is accredited under the National Accreditation Board for Hospitals and also scored very highly under the Kayakalp Award Scheme (93.5%). [24] The facility has weekly one-hour training sessions in occupational health and safety, as well as infection control, for both nurses and doctors. Thorough records are kept and all staff is vaccinated. Over the past years the prevalence of hospital acquired infections has greatly decreased and in August 2019 none were recorded. It was found that the hospitals bio-medical waste treatment costs decreased, as the waste segregation improved. At present the hospital generated about 400 kg/ day of BMW, or around 0.33 kg/ bed/ day.

This large facility also teaches 250 undergraduate and 56 postgraduate students. It has been mercury free since 2014.



Waste collection records

Removal of solid waste from the hospital

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	H
Bin Segregation	H	Bins	M
Temp storage area	H	Trolley	M
Record keeping	H	Microwave	H

[24] See Section 5.1 for a description of these programmes.

Name: Mysore Medical College & Research Institute, Mysore **Reference: Annex 6 KA-3**
Type: Government hospital
No. of beds: 1,050 **Occupancy Rate:** 95-98% **OPD:** 2,000

This teaching hospital has 2,000 staff and accepts 150 medical students every year. The facility is busy and overcrowded, this means that the housekeeping is not always perfect. The project supplied the facility with 128 sets of colour coded bins, 24 collection trolleys and a microwave unit. Two members of the hospital staff followed TOT provided by the Ramaiah College and since 835 staff have received training. The hospital keeps records of waste generation, needle stick injuries and has SOP in both English and Kannada language for the hospital. Health records are kept for the staff and a Hep. B and TT immunisation programme is in place (supported by the State Health Authorities).

The hospital generates about 70 kg/ day of BMW and roughly 40 kg of sharps per week. The hospital pays Shree Consultants (see Annex 6 KA-1) 1.3 million Rupee per year to collect and treat their waste. The facility received a microwave unit and uses it to sterilise infectious plastic waste (red bags). The hospital stated that no recycler has been identified to purchase the sterilised plastic and that these materials are given to Shree Consultants. Interestingly, as can be seen in one of the pictures below, only plastics that had a resale value were being microwaved. It was observed that general waste is collected in green bags and these are then emptied into a dumpster, as the city landfill does seemingly not accept waste in bags!


Broken lid on a bin supplied by the project


Plastic waste by the Microwave unit, note that only "valuable" plastic is present. It seems likely that only materials that have a resale value are being sterilised.

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	H
Bin Segregation	M	Bins	M
Temp storage area	M	Trolley	M
Record keeping	H	Microwave	H

Name: Bowring & Lady Curzon Hospital, Bangalore **Reference: Annex 6 KA-4**
Type: Government teaching hospital
No. of beds: 700 **Occupancy Rate**: 75% **OPD:** 500 - 600

This is a teaching hospital that dates back to 1868. At present it employs 120 doctors and 248 nurses. The medical college's annual uptake is 150 medical, 200 nursing, and 150 paramedical students.
The hospital has been part of the UNIDO project since 2016 and participated in the TOT in 2017. Since then, training for 30 to 40 staff members has been conducted every three months in BMWM, reaching out to doctors, nurses, paramedics and students. All new students receive a one-month introductory course that includes BMWM before they are allowed to serve within the facility. In late 2017 all staff was immunised and this has since been a standard procedure. At present about 95% of staff and students are immunised. About 80% of all staff is covered by annual medical check-ups, the exception being the doctors when generally refuse to have their health checked.

The hospital has operated a waste segregation system for the past 10 years, though the not all staff work in full compliance with the requirements. The hospital's Infection Control Committee meets every 2 - 3 months, under this committee there is also a waste management group. Each department has an assigned waste management team. Every month the hospital generates about 2 tonnes of yellow bag waste, 1.5 tonnes of red bag waste, 0.5 tonnes blue bag waste and about 60 kg of sharps. The BMWM system is well organised, the hospital has designated clean/ dirty areas, so that distinct zones (for example elevators) are used for "clean" items (fresh food, staff, etc.) and other zones are "dirty" and handle items such as waste, soiled linen, used food trays, and so forth. The hospital received 100 sets of colour coded bins and 15 trolleys from the project in 2018. The bins are in use but it seems that smaller trolleys are preferred to transport the waste (see photos below).

The hospital microwaves some of the red bag waste and the sterilised plastic is sold to an authorised recycler, Gananane Industries. The company purchases plastic bottles for 20 Rupee/ kg and pays 12 Rupee/ kg for other plastics. To date 20,860 Rupee worth of recyclable plastic has been sold by the hospital. It must be mentioned that the red bags with recyclable plastic are opened and the materials sorted prior to microwaving. This is obviously a dangerous practice that exposes the workers doing the sorting to both infectious and the risk of injury. In this manner, only plastics that can be sold to a recycler are treated. Anu Autoclave and Incineration Services. a CTF, is paid 60,000 Rupee per month to collect the balance of BMW.

The hospital plans to phase out mercury containing instrumentation by the end of 2019.


Some of the trolleys received through the project have lost their both lids and handles


Non-project trolley used for waste transport

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	H
Bin Segregation	H	Bins	M
Temp storage area	H	Trolley	M
Record keeping	H	Microwave	H

Name: District Hospital, Kolar **Reference: Annex 6 KA-5**
Type: Government hospital
No. of beds: 565 **Occupancy Rate**: 85 -90% **OPD:** 1,000

This is an older hospital (established in 1937) that is located in a very poor district. The facility received 30 sets of colour coded bins and 10 trolleys through the project. In 2018 the hospital generated the following quantities of waste:

Yellow: 5,320 kg
Red: 4,200 kg
Blue: 3.050 kg
White 820 kg

This comes to roughly 37 kg per day or 0.075 kg/ bed/ day. These quantities are low, either indicating incomplete record keeping or perhaps the acute poverty of the district. A waste generation rate between 0.20 and 0.40 kg/ occupied bed/ day could be expected. These quantities in turn also makes the number of trolleys and the capacity (volume) of the supplied bins seem on the high side.

Following training through the project in 2017, where three trainers participated, a total of 245 employees and students have received training in BMWM. Given the constraints the hospital faces, the BMWM system is quite good. The hospital clearly has trouble paying the CTF, Meera Environmental Pvt. Ltd. for the daily collection of the generated waste. It seems that Meera bills of about 44,663 Rupee per month are paid in arrears, at one stage the UNIDO even paid for three months' worth of waste collection and disposal. It could be that there are periods where the hospital is unable to afford to pay the CTF for BMW collection.


Colour coded bins supplied by the project


A sharps container

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	H
Bin Segregation	H	Bins	H
Temp storage area	H	Trolley	M
Record keeping	H	Microwave	n/a

Name: General Hospital, H. D. Kote **Reference: Annex 6 KA-6**
Type: Government hospital
No. of beds: 70 **Occupancy Rate**: >100% **OPD**: 500 - 600

This is a very busy hospital which is currently being expanded with an additional 100 beds. The facility serves a region with a population of 1.2 million and has 32 staff, plus a number of vacancies. There a 100 to 120 monthly births at the hospital.

Up till 2017, the hospital burned most generated waste and buried glass and sharps in a pit. At present the facility generates 5 to 8 kg per day of BMW; this waste is collected twice weekly by Shree Consultants (see Annex 6 KA-1) who receives 10,000 Rupee per month for this service. The hospital received colour coded bins from the project and these are in use. The received trolleys do not seem to be utilised; one trolley's lid was coming undone. The training and log books provided by the project are being put to use, though the overall system seemed to have shortcomings and some of the registers seemed to be kept for the sake of appearances.

Daily records that are always written by the same person with the same pen are suspicious!

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	
Bin Segregation	M	Bins	
Temp storage area	M	Trolley	
Record keeping	M	Microwave	

Name: Jayanagara Community Health Centre, Bangalore **Reference: Annex 6 KA-7**
Type: Government hospital
No. of beds: 30 **Occupancy Rate**: 80 - 90% **OPD**: 300

This hospital generated about 150 kg per month of BMW per month, or about 5 kg per day. The hospital received six sets of colour coded bins and a trolley through the project. Given that the hospital only generated five kilogrammes of waste per day, the supplied 60 litre bins must be considered as excessive in volume. To fill the six sets of bins to ¾ of their capacity would take about one month, assuming a waste density of 0.15 kg/litre. Likewise, it would be surprising if the supplied trolley was utilised to transport these small amounts of waste. It can also be remarked that the hospital's temporary waste storage was out of proportion with the waste generation rates. Waste is collected by the CTF on a daily basis.

The facility stated that prior to the project, there was no source separation of waste. All waste, inclusive of sharps, was taken to the local dumpsite.

Colour coded bins supplied by the project, note the broken lid

Colour coded temporary waste storage

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	H
Bin Segregation	H	Bins	M
Temp storage area	H	Trolley	M
Record keeping	H	Microwave	n/a

Name: PHC Chikkanandi, H. D. Kote Taluk **Reference: Annex 6 KA-8**
Type: Non-project clinic
No. of beds: 6 **Occupancy Rate:** n/a **OPD:** 60 - 70

This Primary Health Centre is very clean and well managed, it has an ample budget. The facility serves a population of 9,000 and only takes out patients, the exception being emergency delivery of babies. The clinic has received financing under the National Vector Borne Disease Control Programme, a long-lasting effort to prevent and control major vector borne diseases such as malaria, Japanese encephalitis and dengue.

The clinic has source separated their bio-medical waste since 2010 and has been following the 2016 BMWM Rules for the past three years. The clinic generate about 1 kg of BMW per day and this waste is collected twice weekly by a CTF at the cost of 1,200 Rupee per month. All in all, the clinic is exceptionally clean and well equipped.

Poster describing source separation of waste according to the 2016 BMWM Rules


Colour coded bins

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	n/a
Bin Segregation	H	Bins	n/a
Temp storage area	H	Trolley	n/a
Record keeping	H	Microwave	n/a

Name: Sani Clean Pvt. Ltd; Tangiapada, Khurda **Reference: Annex 6 OD-1**
Type: Common Treatment Facility

The only CTFs in Odisha State was established in 2003. The site has two incinerators, three old autoclaves, two shredders and three small on-site-pits that are used for waste disposal. These pits were filled with ground/ rain water at the time of the visit. The facility used eight vehicles to collect waste from waste generators located up to 150 km away. In 2018 the facility on average collected:

Yellow category waste:	610 kg/day
Red category waste:	350 kg/day
Blue category waste:	281 kg/day
White category waste:	71 kg/day
Expired medicine:	788 kg/day

This comes to an average of over 2.1 tonnes per day. The facility has a GPS tracking system on its vehicles and it uses bar codes to track the waste. The stack was tested for dioxin and furan emissions in August 2019 and these were recorded as 0.075 ng TEQ/ Nm^3, so within the regulatory requirements.
The blue bag waste and residues from the incinerator a buried on-site. The waterlogged pits seem to have a volume that is well below what would be required for a facility treating 2 tonnes of waste daily.


The Sani Clean facility


One of the facility's two incinerators, the waste is fed through the access door in the centre of the picture.

Name: SCB Medical College and Hospital, Cuttack **Reference: Annex 6 OD-2**
Type: Government teaching hospital
No. of beds: 2,132 **Occupancy Rate:** 125% **OPD:** 2,500

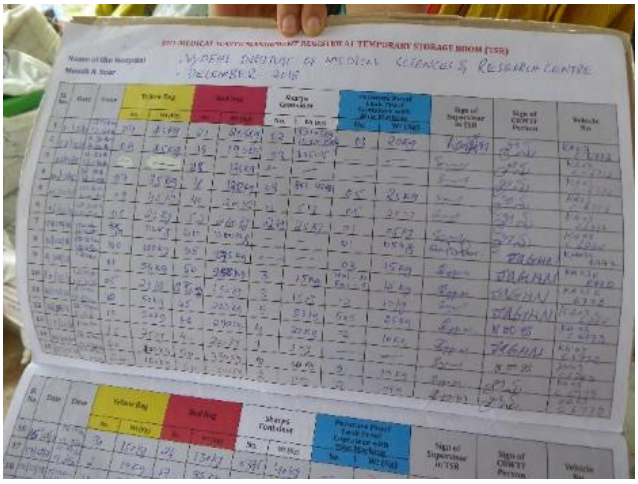
This large hospital is accredited under the National Accreditation Board for Hospitals and also scored very highly under the Kayakalp Award Scheme (93.5%). The facility has one-hour weekly training sessions in occupational health and safety, as well as infection control, for both nurses and doctors. Thorough records are kept and all staff is vaccinated. Over the past years the prevalence of hospital acquired infections has greatly decreased and in August 2019 none were recorded. It was found that the hospitals bio-medical waste treatment costs decreased, as the waste segregation improved. At present the hospital generated about 400 kg/ day of BMW, or around 0.33 kg/ bed/ day.

This large facility also teaches 250 undergraduate and 56 postgraduate students. It has been mercury free since 2014.

This large hospital has a serious overcrowding issue, with patients found on the ground and corridors. It also dengue and swine flu temporary wards when required. Overall, there are 38 departments, including non-clinical departments. The medical college was established in 1944 and presently has an intake of 250 MBBS students in a year. It also has a nursing college, laboratory technician school, pharma school and radiology and ECG technical training schools.

The hospital provides department wise seminars for BMW, which is provided by the BMW committees. The collection of segregated BMW from the wards to its final disposal has been outsourced to company which also manages the hospital's incinerator and microwave. The different types of BMW at the temporary storage facility is all kept together. This agency also collects BMW from some more government hospitals which is also disposed at the SBC Hospital facility. The hospital has its own sharp pits and deep burial pits for incinerator waste. Plastics are shredded and sold to an authorised plastic vendor. The hospital outsourcing agency maintains a BMW register at the disposal site, and estimates a total of 19,500 kg of BMW produced in a month from the hospital. In the wards, there is a common dustbin for the disposal of all waste, which is later segregated into different colour coded bins, as required by the BMWM rules 2016.

Waste collection at beds



Waste collection records

Removal of solid waste from the hospital

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	L	Training	H
Bin Segregation	M	Bins	M
Temp storage area	M	Trolley	H
Record keeping	M	Microwave	H

Name: Institute of Medical Sciences & Sum Hospital **Reference: Annex 6 OD-3**
Type: Private medical college & hospital
No. of beds: 1,000 **Occupancy Rate:** 80% **OPD:** 4,000

This is one of the top ranked university hospitals in India, teaching nurses, doctors, post graduates and super specialists. The hospital has practiced source separation since it was established in 2007 and the bio-medical waste management system is very well functioning. Both the Infection Control Committee and the BMW Committee hold with monthly meetings. The hospital organises weekly training courses and all nurses must follow a week long course prior to entering into service. Three staff members followed the TOT provided by the Ramaiah College; this training was found very similar to the hospital's own internal training programme.

The hospital generates 350 kg/ day of BMW which is sent to Sani Clean (see Annex 6 OD-1) for treatment. The project supplied the hospital with 54 sets of colour coded bins, 6 collection trolleys and a microwave unit. The hospital complained that 34 bins are already broken, and that the received trolleys are too unwieldy and furthermore they very difficult to clean. It was pointed out that such large trolleys should have a side door, which would serve both for removing bags of waste and to facilitate the cleaning. The microwave unit is considered "interesting" by the hospital faculty, as this is a technology that they were unfamiliar with. In practice, the microwave unit has too little capacity to treat the generated infectious plastic waste and, additionally, it has not been possible to find a buyer for the sterilised plastic. At present, all plastic waste from the hospital, sterilised or not, is collected as one lot by Sani Clean.

High quality bins and with bilingual instruction posters made by the hospital above them.


Medical trolley where the waste is segregated as the doctors/ nurses treat the patients at their bedside.

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	M
Bin Segregation	H	Bins	L
Temp storage area	H	Trolley	L
Record keeping	H	Microwave	H

Name: DHQ Hospital, Puri **Reference: Annex 6 OD-4**
Type: Government hospital
No. of beds: 380 **Occupancy Rate:** > 100% **OPD**: 1800-2000

This is a teaching hospital that dates back to 1868. At present it employs 120 doctors and 248 nurses. The medical college's annual uptake is 150 medical, 200 nursing, and 150 paramedical students.

The hospital has been part of the UNIDO project since 2016 and participated in the TOT in 2017. Since then, training for 30 to 40 50 staff members has been conducted every three months in BMWM, reaching out to doctors, nurses, paramedics and students. have been trained. All new students receive a one-month introductory course that includes BMWM before they are allowed to serve within the facility. In late 2017 all staff was immunised and this has since been a standard procedure. At present about 95% of staff and students are immunised. About 80% of all staff is covered by annual medical check-ups, the exception being the doctors when generally refuse to have their health checked.

The hospital plans to phase out mercury containing instrumentation by the end of 2019.

The hospital is overcrowded with problems of cleanliness. It had been doing BMW segregation prior to the 2016 notification, though since the notification it has been streamlined and improved. Other BMW related BMW programmes implemented are Kayakalp, NQAS and Lakshaya. They have is a BMW committee that provides training for BMW management and also inspects all wards on a daily basis. The hospital has translated the SOPs and other training material into the local language themselves.

Due to high turn-over of lower level staff and overcrowding source segregation is weak needing regular monitoring. A private agency manages the waste from collection at the wards to final disposal. All but anatomical waste is disinfected through an autoclave and disposed, in the hospital premises itself through either deep burial or sharp pits. Anatomical waste is to be disinfected by bleaching powder and sent elsewhere. An authorised recycler takes the disinfected blue and red bags on a weekly basis. The deep burial pits are of a depth of 5-6 feet, and the groundwater starts at 7-8 feet.

Temporary waste storage

Deep burial and sharp pits with shallow handpump in the background

Some of the trolleys received through the project have lost their both lids and handles

Non-project trolley used for waste transport

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	H
Bin Segregation	M	Bins	M
Temp storage area	M	Trolley	L
Record keeping	M	Microwave	n/a

Name: DHQ Hospital, Baripada, Mayurbhanj **Reference: Annex 6 OD-5**
Type: Government hospital
No. of beds: 350 **Occupancy Rate**: 85 -90% **OPD**: 1,000

This is an older hospital (established in 1937) that is located in a very poor district. The facility received 30 sets of colour coded bins and 10 trolleys through the project. In 2018 the hospital generated the following quantities of waste:

Yellow: 5,320 kg
Red: 4,200 kg
Blue: 3.050 kg
White 820 kg

This comes to roughly 37 kg per day or 0.10 kg/ bed/ day. These quantities are low, either indicating incomplete record keeping or perhaps the acute poverty of the district. A waste generation rate between 0.20 and 0.40 kg/ occupied bed/ day could be expected. These quantities in turn also makes the number of trolleys and the capacity (volume) of the bins seem on the high side.


Colour coded bins supplied by the project


A sharps container

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	H
Bin Segregation	H	Bins	H
Temp storage area	H	Trolley	M
Record keeping	H	Microwave	n/a

Name: Jyoti Hospital, Balasore **Reference: Annex 6 OD-6**
Type: Charity hospital
No. of beds: 100 **Occupancy Rate**: 62% **OPD**: >150

This charity hospital was established in 1999 and has source separated its waste since 2010. The hospital received both a visit and training from the Ramaiah College trainers. At present the facility conducts internal training on a monthly basis. The hospital received 14 sets of colour coded bins and two trolleys from the project. The trolleys are considered too big to serve the hospital. It could also be remarked that 14 sets of colour coded bins seem excessive for a hospital that generates about 20 kg of BMW per day, as this corresponds to a few hundred grams of waste per bin per day. Given the hospital's circumstances, the BMWM system functions well and the recordkeeping is good. In August 2019 the hospital generated:
Yellow category waste: 216 kg during the month
Red category waste: 253 kg during the month
Blue category waste: 161 kg during the month
White category waste: 9.5 kg during the month
General waste: 263 kg during the month

The hospital is outside the Balasore city limits and therefore all waste is treated on site. Most of the waste is burnt, though some sharps are placed in (waterlogged) pits and valuable plastics are seemingly sterilised in the hospital's autoclaves, presumably for resale.

The hospital only has blue bags and hence uses these for all waste categories.


Although the hospital has waste pits, most waste seems to be burnt here.

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	H
Bin Segregation	M	Bins	M
Temp storage area	M	Trolley	M
Record keeping	H	Microwave	n/a

Name: Durga Nursing Home, Baripada, Mayurbhanj **Reference: Annex 6 OD-7**
Type: Private hospital
No. of beds: 29 **Occupancy Rate:** 80 - 90% **OPD**: 300

This hospital generated about 150 kg per month of BMW per month, or about 5 kg per day. The hospital received six sets of coloured bins and a trolley through the project. Given that the hospital only generated five kilogrammes of waste per day, the supplied 60 litre bins must be considered as excessive in volume. To fill the six sets of bins to ¾ of their capacity would take about one month, assuming a waste density of 0.15 kg/litre. Likewise, it would be surprising if the supplied trolley was utilised to transport these small amounts of waste. It can also be remarked that the hospital's temporary waste storage was out of proportion with the waste generation rates. Waste is collected by the CTF on a daily basis.

The facility stated that prior to the project, there was no source separation of waste. All waste, inclusive of sharps, was taken to the local dumpsite.

This private hospital had been doing BMW segregation from 2014-15 based on the 1998 rules. They received training from this project in 2017 and 2018. Presently, they provide their staff with BMW management training every 2 to 3 months. Only about 10% of their total waste is infectious waste, with a daily generation of such at waste about 2 kgs.

The trollies provided under the project is too big for their hospital and therefore not used till now. All sharps are cut and disposed in their sharp pit after disinfection. Of the other three types of waste the red and blue bags are autoclaved, with the blue waste also disposed in the sharp pit. The recyclables of the red bags are cut and disposed with municipal waste, while the yellow bag waste is disinfected with bleaching powder and buried.

Colour coded bins supplied by the project, note the broken lid

Colour coded temporary waste storage

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	H
Bin Segregation	H	Bins	M
Temp storage area	H	Trolley	M
Record keeping	H	Microwave	n/a

Name: Neelanchal Hospital Puri **Reference: Annex 6 OD-8**
Type: Private hospital
No. of beds: 10 **Occupancy Rate:** 60 **OPD:** 60 – 70

This Primary Health Centre is very clean and well managed, it has an ample budget. The facility serves a population of 9,000 and only takes out patients, the exception being emergency delivery of babies. The clinic has received financing under the National Vector Borne Disease Control Programme, a long-lasting effort to prevent and control major vector borne diseases such as malaria, Japanese encephalitis and dengue.

The clinic has source separated their bio-medical waste since 2010 and has been following the 2016 BMWM Rules for the past three years. The clinic generate about 1 kg of BMW per day and this waste is collected twice weekly by a CTF at the cost of 1,200 Rupee per month. All in all, the clinic is exceptionally clean and well equipped.

This small hospital was badly damaged in the recent cyclone and some reconstruction was underway at the time of the visit. They have received the ToT which has been useful in understanding the new BMWM Rules. There is no specific BMW committee, as the hospital is very small with a total staff strength of 11 people. Therefore, the pathologist and one of the doctors regularly check and train the staff themselves.

The waste bins and trollies are too large for their daily needs, with the trolley not used at all. There is no good BMW management system available for small hospitals according to them, and what is available is too expensive. Therefore, post disinfection they dispose their infectious waste with other municipal solid waste. They however, have a sharp pit and a deep burial pit. The deep burial pit is used for organic waste. As the coloured bin liners are considered to be difficult to get and expensive regular bin liners of any colour are being used instead.

Colour coded bins in the open yard

Sharp pit in the premises

Poster describing source separation of waste according to the 2016 BMWM Rules


Colour coded bins

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	H
Bin Segregation	M	Bins	M
Temp storage area	n/a	Trolley	L
Record keeping	L	Microwave	n/a

Name: Medicare Environmental Management, Ludhiana **Reference: Annex 6 PU-1**
Type: Common Treatment Facility

There are four CTFs within Punjab State, according to the STA this means that there is insufficient waste treatment capacity within the state. Medicare Environmental Management is one of these four facilities, it is part of a larger group that operates 15 CTFs across India serving 19,000 healthcare establishments with a total of more than 250,000 beds. The company employs over 800 people and has a fleet of 190 vehicles to collect waste. The company is ISO: 9000, ISO: 14000, and ISO: 18000 certified.

The visited Medicare facility receives 2.5 to 3 tonnes of waste per day. It incinerates the yellow bag waste, sterilises and sells red and blue bag waste to an authorised recycler, and finally autoclaves sharps and encapsulates these in metal containers. The incinerator can treat 200 kg per hour of waste; and its dioxin and furan emissions levels were measured to below 0.1 ng TEQ/ Nm3 in 2019. The facility states that all bottom ash and sludge is sent to a hazardous waste landfill, and that the facility has no liquid discharges.

Waste collection vehicles


Two of the facility's autoclave units.

Name: Dayanand Medical College & Hospital, Ludhiana **Reference: Annex 6 PU-2**
Type: Private college and hospital
No. of beds: 1,700 **Occupancy Rate:** **OPD:**

This large hospital has an Infection Control Committee and twelve fulltime infection control nurses. The BMWM system is very well functioning and the hospital has used a bar code system with stickers for the various waste categories since 2013. The hospital generates about 1,700 kg of BMW per day and the waste generation rates are recorded for each ward.

According to the hospital, the Punjab PCB does not allow for the sale of microwaved/ sterilised plastic materials, so at present the microwave unit serves no purpose. The hospital is considering using the unit to treat soiled linen.

One of the supplied bins has lost its lid. The instructional poster was made by the hospital.

The microwave unit.

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	H
Bin Segregation	H	Bins	M
Temp storage area	H	Trolley	M
Record keeping	H	Microwave	M

Name: Guru Nanak Dev Hospital, Amritsar **Reference: Annex 6 PU-3**
Type: Government hospital and medical college
No. of beds: 1,272 **Occupancy Rate**: 90% **OPD:** 2,200

This is a large teaching hospital that accepts about 250 new students every year. The hospital has very noticeable hygiene issues with dirty corridors, paint peeling off the walls, poor lighting and garbage strewn on the grounds. The hospital generated 3,100 kg of BMW in June 2019 and this waste was collected by the Amritsar Environmental CTF for disposal.

Staff members have followed the TOT provided by the Ramaiah College, as well as training provided by the Punjab State PCB. The project supplied the hospital with about 100 sets of colour coded bins, 4 waste collection trolleys and a microwave unit. The hospital is pleased with this equipment and it can sterilise all its generated plastic materials in about 3 daily cycles in the microwave unit.

The hospital is free of mercury containing equipment.

The autoclave unit.


The temporary waste storage area.

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	L	Training	H
Bin Segregation	M	Bins	H
Temp storage area	L	Trolley	H
Record keeping	M	Microwave	H

Name: Sri Guru Ram Das Medical Institute, Amritsar **Reference: Annex 6 PU-4**
Type: Charitable medical science and research hospital
No. of beds: 900 **Occupancy Rate**: 75% **OPD:** 1,700

The medical college dates from 1997 and accepts 150 medical and 75 nursing students each year. All students are taught about BMW and infection control prior to being allowed access to the hospital. The hospital has translated the project's training materials into Punjabi and use these in the training of their students and staff. The hospital has had a sound BMWM system for many years, recently it started recorded the quantities of waste generated for each ward. In July 2019 the hospital generated 7,652 kg of waste, or about 0.27 kg/ occupied bed/ day. The waste is sent to Amritsar Environmental, a facility that the hospital staff visits frequently together with their students. The CTF is said to be well-functioning.

The hospital received 136 sets of colour coded bins and 4 waste collection trolleys. There is a tendency for the wheels to break on the bins and for their lid pedal to function poorly. The trolleys were found to be very difficult to clean, as they are very deep. The hospital has phased out all mercury containing instrumentation.


A medical trolley for patient care in the wards.

The temporary storage area.

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	H
Bin Segregation	H	Bins	M
Temp storage area	H	Trolley	M
Record keeping	H	Microwave	n/a

Name: Rajindra Hospital and Government Medical College, Patiala **Reference: Annex 6 PU-5**

Type: Government teaching hospital

No. of beds: 750 **Occupancy Rate:** 80 - 85% **OPD:** 2,000

This 1954 hospital generally has poor hygiene, with dirty corridors and low standards for BMWM. The hospital staff received training in BMWM through the Punjab PCB in September 2018, as part of the PCB's training sessions held throughout the State. For the training of their own students in BMWM, the hospital uses the PCB's training materials with some small adjustments. The facility received 83 sets of colour coded bins, 4 trolleys and a microwave unit through the project. The hospital's practice is to collect bedside BMW in small trays, the collected waste is then sorted once it is brought to the bins.

The received microwave unit overheats during the warmer months on the year and can then only manage five cycles per day during summer. Twenty to forty percent of the plastic waste is sterilised with the microwave unit. This plastic cannot be sold, so all waste plastic is collected by the CTF. The hospital has experience problems with plastic waste materials being stolen.

The hospital has limited means.

A bag with syringes seen in the autoclave room, presumably for resale.

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	L	Training	H
Bin Segregation	M	Bins	M
Temp storage area	M	Trolley	M
Record keeping	M	Microwave	M

Name: Lord Mahavir Civil Hospital, Ludhiana **Reference: Annex 6 PU-6**
Type: Government hospital
No. of beds: 285 **Occupancy Rate:** 100% **OPD:** 1,000

The Lord Mahavir Civil Hospital dates from 1935 and serves a poor community. In August 2019 the hospital generated 1,902 kg of waste as follows:

Yellow category waste:	1,251 kg during the month
Red category waste:	376 kg during the month
Blue category waste:	262 kg during the month
White category waste:	13 kg during the month

The hospital has source separated its waste for more than 10 years, it records the quantities of waste generated by each ward. The hospital's Infection Control Committee meets twice a month, the hospital also has a BMWM Committee with many of the same people as members. The hospital received 27 sets of colour coded bins and two trolleys from the project. The trolleys are judged too heavy and are not in use. This is a mercury free hospital.

The hospital does not use the project trolleys.

All waste is labelled at the point of generation.

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	M
Bin Segregation	H	Bins	M
Temp storage area	M	Trolley	L
Record keeping	H	Microwave	n/a

Name: Mohali Indus Super Speciality Hospital, **Reference: Annex 6 PU- 7**
Type: Private hospital
No. of beds: 60 **Occupancy Rate**: 100% **OPD**: 300

This modern super speciality hospital from 2008 has very high standards and generates 16 to 17 kg per day of BMW. The hospital received six sets of coloured bins and a trolley through the project. The trolley is considered unwieldly and difficult to use within the hospital. It was said that it takes four workers to move the trolley on the hospital's ramps. The hospital prefers to use plastic bins that it has procured, rather than the bins supplied by the project. So, the project supplied bins have been relegated to remote locations within the facility.

The hospital's Infection Control Committee meets on a quarterly basis, as does a separate BMWM Committee.


The hospital mostly uses its own colour coded bins.


The trolleys are too big to handle

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	H
Bin Segregation	H	Bins	L
Temp storage area	H	Trolley	L
Record keeping	H	Microwave	n/a

Name: SMBT Institute of Medical Sciences and Research Centre **Reference: Annex 6 MH-1**
Type: Private hospital
No. of beds: 360 **Occupancy Rate**: 100% **OPD**: Over 1,000

This is a large charitable hospital established in 2006 in one of the projects model districts. The hospital is currently in the process of expanding and has already added 60 beds for an increase from 300 to 360. This hospital used to have an onsite treatment facility but now the closest CTF is 75 km away. The hospital does not have a specific budget line for BMWM and so costs are taken from the contingency or welfare fund. There used to be difficulties in calculating charges but now there is a standard rate per bed from the CTF which makes this much clearer and is helpful. The hospital pays approximately 100,000 rupee which includes the provision of bins and bags with barcodes. Due to the size of the hospital they accept waste from a number of other medium sized hospital in surrounding areas. The temporary storage area at this hospital has recently been renovated with assistance from the project and is of a very high quality.

The hospital was implementing the 1998 rules and so was already segregating waste prior to project implementation but did appreciate the refresher training and bins supplied by the project. This hospital already had posters that had been translated into local languages prior to the project. This hospital is involved in the national accreditation program and therefore have annual inspections. Preparing for these inspections, including reviews of good practices, and conducting checklists represents approximately 50,000 rupee. The hospital has also entered the Kayakalp Award Scheme and received three awards for good practice.

The hospital also received sharps containers and spill kits from the project. While this was appreciated it was identified that the number of sharps containers provided as not sufficient and so some needles were still disposed of in open containers. Other resources received by the hospital form the project included 90 sets of bins and four trolleys. The number of bins was still insufficient for their needs and so they reviewed their needs and sourced local bins that both the hospital and the evaluators deemed to be of good quality.

Open containers are used for some needle disposal

Newly renovated temporary storage facility

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	H
Bin Segregation	H	Bins	H
Temp storage area	H	Trolley	H
Record keeping	H	Microwave	n/a

Name: Vasant Rao Pawar Medical hospital **Reference: Annex 6 MH-2**
Type: Private hospital
No. of beds: 810 **Occupancy Rate**: 60-70% **OPD**: 1,300

This hospital was established in 1990 and upgraded in 2000. The hospital is owned by a trust and has 150 students, 375 nurses and covers 70% tribal areas.

The project supplied this hospital with 2 trolley, 30 bins and record books. The trolleys were not felt to be of a high quality as the wheels had broken on both and attempts to repair them had been unsuccessful. In addition, there were difficulties in cleaning the bins resulting in low levels of cleanliness and hygiene. These factors compounded to result in trolleys that were not used. Similar quality issues were encountered with the bins. However, the facility did appreciate the training supplied by the project and have embedded the training materials at all levels including into the induction of new staff.

It was felt that the training has been helpful, particularly the charts that were supplied, and has resulted in improvements to attitudes and awareness relating to BMWM. In particular, improvements in the management of needle-stick injuries have been noted as a part of the project and the record books supplied.

This hospital has previously tried barcoding but feel that it is largely redundant.


Posters in local languages.


Bottom of bins are difficult to clean.

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	H
Bin Segregation	M	Bins	M
Temp storage area	M	Trolley	L
Record keeping	H	Microwave	n/a

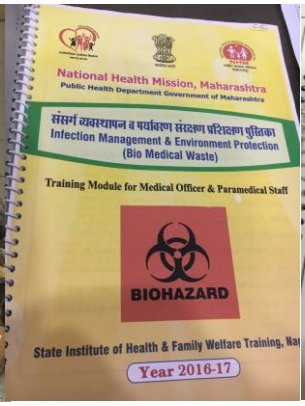
Name: Civil Hospital Nashik **Reference: Annex 6 MH-3**
Type: Government Hospital
No. of beds: 541 **Occupancy Rate**: 80% **OPD**: 800

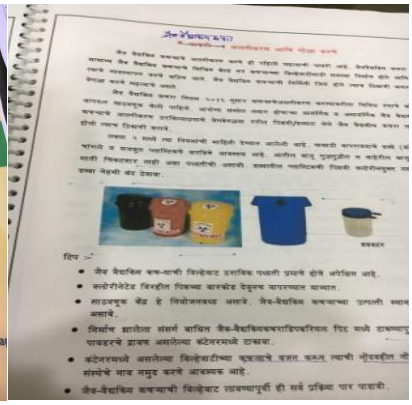
This hospital had some BMWM processes in place prior to the project. They have been recording data on medical waste for 5 years and had already had some training for class four workers in biomedical waste standard operating procedures. However, assistance provided by Ramaiah Medical College through the project identified weaknesses in standard operating procedures, particularly relating to infection control, and resulted in an overall strengthening of biomedical waste standard operating procedures.

In 2016, the facility appointed a nodal officer to assist in preparing for the Kayakalp Award Scheme and this was essential to improving BMWM. Since 2016 the facility have had training, mainly from the state institute from the Department of Health and Family Welfare, and have found this to be useful in particular the training manual that was supplied and can be used as a reference for BMWM. Furthermore, this facility also has a biomedical waste committee and infection control committee.

A number of discussions are currently underway relating to BMWM. This includes considerations to install a microwave but there have been difficulties in identifying a suitable location and so this may not occur. In addition, the hospital does not currently use barcoding but are holding discussions with the CTF about the possibility of implementing this.

Temporary Storage Facility





Training materials from previous training

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	H
Bin Segregation	H	Bins	H
Temp storage area	L	Trolley	L
Record keeping	H	Microwave	n/a

Name: Suyash Medical Foundation Pvt. Ltd. **Reference: Annex 6 MH-4**
Type: Private Hospital
No. of beds: 100 **Occupancy Rate**: 100% **OPD**: 300

This hospital was established in 2001 and is very clean, organized and well-trained as evidenced by their extensive records. Despite operating at capacity the facility cannot expand due to its inner city location.

The hospital received 25 sets of bins from the project. These are well utilized and are even taken on external health visits to facilitate segregation at the source. However, trolleys were less utilized because they are deemed to be too large for the environment.

While this facility does have a microwave and is proud of this it is rarely operating because of the electricity costs associated with operation.

Temporary storage facility – a good example of Utilizing space effectively in a small hospital.

Extensive record keeping.

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	H
Bin Segregation	H	Bins	H
Temp storage area	H	Trolley	L
Record keeping	H	Microwave	L

Name: District Hospital Ahmednagar **Reference: Annex 6 MH-5**
Type: Government Hospital
No. of beds: 274 **Occupancy Rate**: Almost 200% **OPD**: 3,000-4,000

This facility has an infection control committee but not a biomedical waste committee. There is a staff nurse in charge of BMWM at this facility but staff in general are very stretched and there are problems with retaining nurses and thus a high level of staff turnover. An ongoing concern for this facility was the recurring cost of BMWM as there is no specific budget line to cover this.

The project supplied this facility with 30 sets of bins and five trolleys. This equipment is used extensively and indeed the number of bins was found to be insufficient and so the facility has locally sourced other bins. These are not of the same standard as project bins as they are flip-top rather than pedal operated. This leads to cleanliness issues and difficulties in use increasing spillage of waste. In addition, there have been some colour coding inconsistencies and confusions where a coloured bag has been placed inside of a different coloured bin; this reduces the effectiveness of segregation efforts. Although segregation at the source in the wards does not occur.

Other aspects of the project are underutilized at this facility. While there is a microwave here it is not being used because of the costs associated with electricity and issues with water for operation. In addition, while there are barcoding procedures in place but it is not used extensively. While the trolleys supplied by the project are used to some extent the level of use is limited by the size of the buns and the overcrowded environment of the facility. As such trolleys tend to be taken around the outside of the hospital and less crowded corridors. This means that waste needs to be transferred from the bedside to the larger collection points increasing the handling of waste. Generally, the waste is not handled correctly, in some cases being thrown out of windows or carried in bags. This negates the intended impact of the project to reduce waste handing around patients.

Other processes contributing to increased handling of waste include a lack of pedal operated bins the laboratory and IV bottles and other plastics that are sold to recyclers without being treated. There is also no training records for this facility.


Untreated plastics are sold to recyclers.


Locally sourced bins – of a lesser quality than project, creates colour coding confusion.

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	L	Training	L
Bin Segregation	L	Bins	L
Temp storage area	L	Trolley	L
Record keeping	L	Microwave	L

Name: Rural Hospital Trimbakeshwar **Reference: Annex 6 MH-7**
Type: Government Hospital
No. of beds: 50 **Occupancy Rate**: 100% **OPD**: 500

This facility was originally not a part of the project but was later included because of its location in one of the project model districts. The facility was expanded in 2015 with the addition of a new ward which increased the number of beds from 20 to 50 and increased OPD rates from 300 to 500 in the last three years.

The hospital manager for this facility had previously received training at another project facility and so had some knowledge that was brought to this facility. However, the facility did receive more training in 2017 and this was greatly appreciated, especially given that this facility was not originally part of the project.

This facility does not have a microwave but were supplied with a trolley by the project although this is not extensively used.

Underutilised trolley

Sharps containers were not well maintained or clean

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	M	Training	H
Bin Segregation	H	Bins	H
Temp storage area	H	Trolley	M
Record keeping	H	Microwave	n/a

Name: Jupiter Lifeline Hospital Ltd. **Reference: Annex 6 MH-9**
Type: Government Hospital
No. of beds: 375 **Occupancy Rate**: 72% **OPD**: 600

This facility was established in 2002 as a high level specialist hospital. This hospital has undergone national accreditation and has had detailed training from the beginning of the preparation for registration. BMWM is well integrated into training activities, it is included in both induction and ongoing training. Training relating to BMWM is continually updated and it was noted that discussions relating to the legal issues associated with BMWM was most useful. Furthermore, training has been differentiated for different staff types and there is a monthly training regime for all staff.

This facility has an infection control society and so there is an emphasis on infection control. The facility regularly monitors their own bins and swabs them to protect against outbreaks of infection. There is also a laboratory onsite that deals with the facility's own testing requirements.

The project provided this facility with 54 sets of bins. 30 of these bins were broken on arrival and it was very difficult to get them fixed so they were disposed of. In addition the bins supplied by the project were too big to be used in the wards and so the facility locally sourced smaller bins. However, these were of lesser quality than the project bins making use difficult. The smaller size of the locally sourced bins as well as the tendency of these bins to tip over when being used contributes to a higher level of spillage. In addition, the need for an additional bin size has resulted in a higher level of handling of waste as it is transferred from bedside to smaller bins to project bins to trolleys.

The facility also received six trolleys from the project which are not utilized in this hospital because they are not compatible with the hospital kind. This facility has elevators and the trolleys are too big as such they are only used for four rounds of collection a day. Smaller handcarts are used for more regular collection to avoid build of waste but this increases the level of handing required.


Project bins used at main collections points


Lesser quality locally sourced bins

Qualitative Assessment

Quality Assessment Criteria (High/Medium/Low):		Satisfaction with project support (High/Medium/Low):	
At source segregation	H	Training	H
Bin Segregation	H	Bins	L
Temp storage area	H	Trolley	L
Record keeping	H	Microwave	n/a

Name: Water Grace CTF **Reference: Annex 6 MH-9**
Type: Common Treatment Facility

This facility covers a 200 km^2 radius including 1,092 facilities and 10,831 beds with six vehicles. The facility currently runs at approximately 60% capacity and is in the process of upgrading the incinerator in line with the 2016 rules. The equipment for this upgrade has been purchased but is yet to be installed. The facility is also trying to encourage increased use of barcoding.

In addition, the project is investigating the feasibility of relocating to another site but the cost of this is estimated to be approximately Rs 6 million and so is not likely to occur in the short term.

This facility shreds and autoclaves all plastics which are then sent to the municipal government for recycling. There is some confusion in waste collection between green (wet) and blue (dry) waste.

Waste awaiting treatment

CTF Equipment

Annex 7. Project Logical Framework

Interventions	Objectively Verifiable Indicators	Sources of Verification	Assumptions and Risks
To reduce and ultimately eliminate the releases of UP-POPs and other globally harmful pollutants into the environment in incineration of medical waste, and assist India in implementing its relevant obligations under the Stockholm Convention. The proposed project will promote the country-wide adoption of BAT/BEP in the health care institutions of widely differing in their complexity and size as well as in the evolving medical waste management infrastructure and industry in a manner that reduces adverse environmental impacts of UP-POPs and protects human health.	In the 5 selected demonstration states (Gujarat, Karnataka, Maharasthra, Orissa and Punjab) about 50g TEQ/year reduction of PCDD/PCDF releases are to be achieved.	Regular project reports of accredited dioxin laboratory on specific monitoring programs of medical waste incinerators in demonstration states	Infrastructure and logistical support is in place and operational for performing sampling, transport of samples and analytical determination of dioxin
Outcome 1: Enabling and harmonized environmental and health-care policy and regulatory instruments through appropriate networking for creation and promotion of environmentally sound management of medical waste, disposal sector and market			
Output 1.1: Augmented inter-ministerial network for Ministries of Environment and Forest, and Health for harmonizing environmental and health-care policy and regulatory instruments			
Activity 1.1.1: Augment membership for inter-ministerial networking at central level for harmonizing environmental and health care policy and regulations relevant to medical waste management and disposal. ***Activity 1.1.2*:** Augment membership for state level networking for harmonizing environmental and health care policy and regulations relevant to medical waste management and disposal. ***Activity 1.1.3:*** Gaps analysis of Stockholm Convention requirements and existing legal/regulatory framework. ***Activity 1.1.4:*** Reconsiderations made for new and/or modified laws, regulations and guidelines to implement Stockholm Convention requirements relevant to medical waste management and disposal.	◆Terms of Reference of inter-ministerial network for Ministries of Environment and Forest, and Health ◆Terms of Reference of state level networking ◆Number of identified gaps between Stockholm Convention requirements and existing legal/regulatory framework ◆Number of proposed new and/or revised laws, regulations and guidelines to implement Stockholm Convention requirements	◆Regular meeting reports on activities of inter-ministerial network ◆Regular meeting reports on activities of state level networking ◆Report on gaps analysis ◆Report on recommendations on new and/or revised laws, regulations and guidelines	◆Timely establishment of networking at central and state levels ◆Gaps identified and agreed upon in time ◆Based on the gaps analysis the new and/or revised laws, regulations and guidelines are formulated without delay

Interventions	Objectively Verifiable Indicators	Sources of Verification	Assumptions and Risks
Output 1.2: Regulatory, economic and market incentives introduced for creation and promotion of environmentally sound management of medical waste, disposal sector and market			
Activity 1.2.1: Domestic market analysis of medical waste management and disposal. ***Activity 1.2.2***: Revisit regulatory, economic and market incentives for environmentally sound management and disposal of medical wastes.	◆Number of domestic and/or local vendors identified by the market analysis ◆Number of incentives formulated	◆Report on domestic market analysis ◆Report on incentives	◆Market analysis conducive to introduce incentives ◆Government introduces incentives creating an enabling environment for domestic waste disposal sector
Output 1.3: Policy and regulatory enforcement mechanisms are in place			
Activity 1.3.1: Revisit existing State enforcement mechanisms of medical waste management and disposal related laws and regulations. ***Activity 1.3.2:*** Synergize State implementation measures with National and Stockholm Convention requirements. ***Activity 1.3.3:*** Support State governments to adopt amended and/or new measures ensuring environmentally sound management and disposal of medical waste.	◆State enforcement of medical waste management and disposal related laws and regulations evaluated in 5 selected states ◆Number of gaps identified in 5 selected states ◆Number of new measures adopted and amount of medical waste managed and disposed of in environmentally sound manner in 5 selected stated	◆ Analysis report ◆ Activity reports, copies / summaries of new State measures adopted	◆ States may not be able to enforce implementing medical waste management and disposal requirements
Outcome 2: Institutional capacity for environmentally sound management (ESM) of medical waste strengthened, in particular in large, medium and small health-care facilities			
Output 2.1: Enhanced existing institutional and technical capacity in 4 large health-care facilities in each of the 5 selected states namely Gujarat, Karnataka, Maharasthra, Orissa and Punjab			
Activity 2.1.1: Facilitate interventions based on situation analysis of medical waste management system in 4 large health-care facilities in each of the 5 selected states. ***Activity 2.1.2:*** Facilitate interventions based on situation analysis and evaluation of Common Treatment Facilities (CBWTFs) in each 5 selected states.	◆Situation analysis of medical waste management system ◆Situation analysis and evaluation of Common Treatment Facilities (CBWTFs) ◆Number of stakeholders identified	◆Situation analysis reports ◆Evaluation reports ◆Capacity building program reports ◆Training workshop reports	◆ Low level participation and support of key stakeholders for implementing the project in 4 large health-care facilities in 5 selected states

Interventions	Objectively Verifiable Indicators	Sources of Verification	Assumptions and Risks
Activity 2.1.3: Identify stakeholders to be targeted in institutional and technical capacity building and their capacity building needs. ***Activity 2.1.4:*** Organize one training workshop in each of 5 selected states in institutional and technical capacity building	◆Stakeholders capacity building needs identified ◆Training workshops held in each of 5 selected states		
Output 2.2: Institutional capacity building in 8 medium and 16 small health-care facilities in each of 5 selected states			
Activity 2.2.1: Identify areas of concerns and assess training requirements for institutional capacity building at various levels of medium and small health-care facilities. ***Activity 2.2.2:*** Prepare training materials including SOPs on institutional capacity building for environmentally sound medical waste management and disposal. ***Activity 2.2.3***: Organize training workshops for institutional capacity building to medium and small health-care facilities in 5 selected states.	◆Review of training requirements ◆Training materials prepared ◆Number of workshops and participants ◆Number of individuals trained	◆ Training materials ◆ Training reports	◆ Training is practical enough to create useful capabilities for new job opportunities
Output 2.3: Strengthened technical capabilities for ESM of medical wastes in 8 medium and 16 small health-care facilities in each of 5 selected states (Gujarat, Karnataka, Maharashtra, Orissa and Punjab			
Activity 2.3.1: Identify areas of concerns and assess training requirements for technical capacity building at various levels of medium and small health-care facilities. ***Activity 2.3.2:*** Prepare training materials and promote regular training activities for technical capacity building in environmentally sound medical waste management and disposal. ***Activity 2.3.3:*** Organize training workshops for technical capacity building to medium and small health-care facilities in 5 selected states.	◆Review of training requirements ◆Training materials prepared ◆Number of workshops and participants ◆Number of individuals trained	◆ Training materials ◆ Training reports	◆ Stakeholders unwilling to participate in training activities

Interventions	Objectively Verifiable Indicators	Sources of Verification	Assumptions and Risks
Output 2.4: Five (5) targeted awareness raising campaigns for the least educated through their community leaders in 5 selected states			
Activity 2.4.1: Identify target population for awareness raising campaigns ***Activity 2.4.2:*** Prepare targeted awareness raising materials and translate into local languages ***Activity 2.4.3:*** Organize awareness raising campaigns	◆Awareness raising materials formulated ◆5 awareness raising reports prepared ◆Number covered member of Standing Committee – Health and Zilla Panchayath and Town/City Municipality/Corporation where demonstration sites and CBWTFs are located	◆Awareness raising materials ◆Campaign reports	Campaign logistics are supported by medical students
Outcome 3: Facilitating and promoting PPP to improve support and supply capacities in medical waste management within the health-care facility perimeter			
Output 3.1: Specific training curriculum on medical wastes management for 150,000 medical students of 297 medical colleges spread over 4.5 years of the course			
Activity 3.1.1: Prepare curriculum and training modules in medical waste management for medical students ***Activity 3.1.2:*** Develop practical training courses in medical waste management for medical students ***Activity 3.1.3***: Strengthen the subject of medical waste management into the medical curriculum ***Activity 3.1.4***: Strengthen practical training courses in medical waste management into the medical curriculum	◆Curriculum and training modules prepared ◆Practical training course materials prepared ◆Medical curriculum ◆Number of students trained ◆Number of medical colleges involved	◆Training modules ◆Amended medical curriculum ◆Study certificates ◆Medical college certificates ◆Training activity reports	◆ Project resources inadequate
Output 3.2: Enhanced effectiveness and efficiency of segregation of medical wastes at source			
Activity 3.2.1: Develop methodology for improving and increasing segregation of medical waste streams at source in the health-care institutions of widely differing in their complexity and size	◆ Protocols developed on segregation of medical waste at source ◆ Regulations on use of standardized color codes for medical waste collection are in effect	◆ Copy of protocols ◆ Copy of regulations	◆ Stakeholders implement best environmental practices (BEP)

Interventions	Objectively Verifiable Indicators	Sources of Verification	Assumptions and Risks
Output 3.3: Established protocols for medical waste movement in health-care facilities from source to collection points			
Activity 3.3.1: Develop standard operating procedures (SOPs) for identification of medical waste in health-care facilities ***Activity 3.3.2:*** Develop SOPs for tracking and record keeping of medical waste in health-care facilities ***Activity 3.3.3:*** Develop SOPs for medical waste collection and transport within heath-care facilities to collection points ***Activity 3.3.4:*** Develop SOPs for cleaning and maintaining the medical waste storage in health-care facilities ***Activity 3.3.5***: Train technical personnel in management system requirements and procedures	◆SOPs prepared for waste identification ◆ SOPs prepared for waste tracking ◆Number of personnel trained ◆Number of health- care facilities participated ◆SOPs prepared for waste collection and transport ◆SOPs prepared for waste storage	◆ Copy of SOPs ◆ Training activity reports	◆ Health-care facility layout allows environmentally sound and safe flow of medical wastes from source to collection points
Output 3.4: Five (5) PPPs (one in each selected states) promoted to provide uninterrupted services and supplies, supporting and meeting demands of medical waste management in health-care facilities			
Activity 3.4.1: Identify relevant areas and partners for PPP ***Activity 3.4.2***: Develop PPP for developing appropriate curriculum and syllabus for undergraduates and postgraduates in medical waste management ***Activity 3.4.3***: Develop PPP for providing uninterrupted services and supplies in medical waste management	◆PPP agreements developed and signed in 5 relevant areas ◆List of PPP partners	◆ Copies of PPP agreements ◆ PPP activity reports	◆ The project goals and the services provided through the project are appealing to private sector
Output 3.5: Significant reduction of volume of medical wastes at source by introducing alternative techniques			
Activity 3.5.1: Properly segregate and disinfect / decontaminate microbiological and biotechnological wastes, sharps, soiled wastes, solid and liquid wastes.	◆Percentage of medical waste segregated and disinfected / decontaminated ◆	◆ Annual progress reports from 5 states ◆ Individual activity reports from all participating health-care facilities	◆ Delays in procurement of equipment will delay introduction of alternative techniques

Interventions	Objectively Verifiable Indicators	Sources of Verification	Assumptions and Risks
Activity 3.5.2: Disinfect / decontaminate, destructure and reprocess solid wastes especially plastic wastes ***Activity 3.5.3:*** Compact disinfected / decontaminated bulky wastes ***Activity 3.5.4***: Train technical staff in alternative techniques	• Percentage of medical waste disinfected / decontaminated, destructured and reprocessed • Percentage of medical waste compacted • Number of personnel trained • Number of healthcare facilities participated	Training reports	
Outcome 4: Facilitating and promoting PPP to improve local technological and manufacturing capacities in medical waste transport and disposal sectors with specific reference to avoid generation of PCDD/PCDF and other unintentionally produced POPs releases by applying BAT/BEP measures			
Output 4.1: Five (5) PPPs promoted (one in each selected states) to enhance new domestic technological and manufacturing capacities in medical waste transport and disposal sectors			
Activity 4.1.1: Identify relevant areas and partners for one PPP in each of 5 selected states ***Activity 4.1.2:*** Develop PPP for transport of medical waste from health-care facilities to CBWTFs ***Activity 4.1.3:*** Develop PPP for medical waste disposal ***Activity 4.1.4:*** Develop PPP for medical waste disposal technology ***Activity 4.1.5:*** Develop PPP for manufacturing medical waste disposal equipment	•PPP agreements developed and signed in 5 relevant areas •List of PPP partners	• Copies of PPP agreements • PPP activity reports	• The project goals and the services provided through the project are appealing to private sector
Output 4.2: Enhanced environmental protection standards for medical waste disposal technologies complying with BAT/BEP requirements			
Activity 4.2.1: Minimize risk for personnel, the general public and the environment by using personal protective equipment (PPE) and optimizing package type and size for different waste streams	• Environmental protection protocols issued • Occupational safety protocols issued • Using PPE made mandatory	• Copies of protocols • Training records	• Health-care facility layout allows environmentally sound and safe flow of medical wastes from source to collection points

Interventions	Objectively Verifiable Indicators	Sources of Verification	Assumptions and Risks
Activity 4.2.2: Establish safe routes for the transportation of the waste within the perimeter of health-care facility ***Activity 4.2.3:*** Ensure cleanliness and safety of deposit areas in the wards and for storage area ***Activity 4.2.4:*** Use PPE and keep safety measures in operating alternative technologies for medical waste disposal ***Activity 4.2.5:*** Train technical personnel in BEP requirements	• Number of personnel trained • Number of health-care facilities participated		
Output 4.3: Established achievable release limits of PCDD/PCDF in respect of medical waste disposal technologies			
Activity 4.3.1: Identify and select appropriate medical waste incinerators as pilots, one in each of 5 selected states ***Activity 4.3.2:*** Enhancing and optimization of incineration technologies of pilots ***Activity 4.3.3:*** Adaptation of appropriate and affordable BAT technologies and techniques of pilots ***Activity 4.3.4:*** Establish achievable release limits of PCDD/PCDF for flue gas and scrubber effluent ***Activity 4.3.5:*** Design and initiate monitoring program to measure PCDD/PCDF releases ***Activity 4.3.6:*** Train technical personnel	• Description of optimized BAT technology • Monitoring programs developed • Results of PCDD/PCDF measurements • PCDD/PCDF release limits established • Number of CBWTFs participated • Number of technical personnel trained	• Annual reports of CBWTFs • Annual reports of accredited dioxin laboratories • Training activity reports	• Introduction of BAT would not lead to the required decrease of PCDD/PCDF releases
Output 4.4: Significant reduction of volume of medical wastes by introducing alternative BAT/BEP compliance technologies			
Activity 4.4.1: Reduce volume of medical waste by properly segregating and disinfecting / decontaminating microbiological and biotechnological wastes, sharps, soiled wastes, solid and liquid wastes	• Volume reduction achieved by medical waste decontamination • Volume reduction achieved by medical waste shredding	• Annual progress reports from 5 states • Individual activity reports from all participating health-care facilities • Reports on trainings	• Delays in procurement of equipment will delay in introducing alternative techniques

Interventions	Objectively Verifiable Indicators	Sources of Verification	Assumptions and Risks
Activity 4.4.2: Reduce volume of medical waste by disinfecting / decontaminating, destructuring and reprocessing of solid wastes especially destructed / shredded plastic wastes ***Activity 4.4.3:*** Reduce volume of medical waste by compacting decontaminated bulky waste ***Activity 4.4.4***: Train technical staff in alternative techniques	◆Volume reduction achieved by medical waste compacting ◆Number of technical staff trained on alternative techniques	◆	◆
Outcome 5: Demonstration of participatory funded and integrated systems for medical waste management and disposal in 5 selected states			
Output 5.1: Established participatory funding system for medical waste management and disposal			
Activity 5.1.1: Identify appropriate areas and partners for establishing participatory funding systems ***Activity 5.1.2:*** Establish training in medical waste management and disposal through participatory funding ***Activity 5.1.3:*** Establish participatory funding of medical waste management in large health-care facilities ***Activity 5.1.4:*** Establish participatory funding of medical waste disposal	◆ Five MOUs prepared and signed for participatory funding ◆ Annual progress reports on demonstration activities prepared	◆ Copies of MOUs ◆ Annual progress reports	◆The integrated medical waste management systems proposed through the project are appealing to public, private and governmental sector
Output 5.2: Established integrated system for medical waste management and disposal			
Activity 5.2.1: Identify potential areas for establishing integrated medical waste management ***Activity 5.2.2:*** Identify potential areas for establishing integrated medical waste disposal ***Activity 5.2.3:*** Establish integrated system for medical waste management ***Activity 5.2.4:*** Establish integrated system for medical waste disposal	◆ TORs of integrated medical waste management and disposal systems prepared ◆ 5 integrated systems established and operational	◆ Copies of TORs ◆ Annual progress reports of 5 integrated systems	◆ Logistical challenges hamper establishing integrated systems at district level

Interventions	Objectively Verifiable Indicators	Sources of Verification	Assumptions and Risks
Output 5.3: Guidance manual developed for district administrators on integrated system for medical waste management and disposal			
Activity 5.3.1: Formulate guidance manual for integrated medical waste management system ***Activity 5.3.2:*** Formulate guidance manual for integrated medical waste disposal system ***Activity 5.3.3:*** Provide training for district administrators	• Guidance manuals formulated • Training modules prepared • Number of district administrators trained	• Copies of guidance manuals • Copies of training modules • Training activity reports	• District administrators actively participate in training
Output 5.4: Demonstration of participatory funded and integrated system for medical waste management and disposal in 5 selected states			
Activity 5.4.1: Identify and select one demonstration district in each 5 selected states ***Activity 5.4.2:*** Establish one demonstration district in each 5 selected states	• Annual progress reports on demonstration in each 5 selected states prepared	• Progress reports	• Participatory funds are fully and timely available
Output 5.5: Country-wide dissemination of experience gained and lessons learned through extensive communication and demonstration programme			
Activity 5.5.1: Prepare an action plan for country-wide dissemination ***Activity 5.5.2:*** Organize workshop in each 5 regions of India to disseminate experience gained and lessons learned ***Activity 5.5.3:*** Organize demonstration programs for each 5 regions of India to disseminate experience gained and lessons learned	• Action plan for country-wide dissemination prepared • Five workshop reports • Five demonstration program report	• Action plan • Workshop reports • Demonstration program report	Stakeholders are timely identified and invited country- wide for workshops and demonstration events
Outcome 6: Project management and monitoring & evaluation			
Output 6.1: Project management structure established			
Activity 6.1.1: Establish National Project Coordination Unit (NPCU) and appoint project leadership staff	• NPCU established and staffed • PSC augmented • NSC established	• List of NPCU staff • List of PSC members •	• Changes in project input prices and exchange rates may increase project costs

Interventions	Objectively Verifiable Indicators	Sources of Verification	Assumptions and Risks
Activity 6.1.2: Augment Project Steering Committee (PSC) ***Activity 6.1.3:*** Establish National Steering Committee (NSC) ***Activity 6.1.4:*** Establish State Steering Committee (SSC) in each 5 selected states ***Activity 6.1.5***: Recruit project advisor(s), policy experts and technical experts in medical waste management and disposal, project evaluation and program development ***Activity 6.1.6***: Hold project management training for project management staff ***Activity 6.1.7***: Establish SPMUs within participating organizations and sign MoAs as agreement on participation to the project	• SSC established and nodal officers identified in each 5 selected states • Project experts recruited • Project Management training held • Stakeholder SPMUs established and staffed • MIS established	• Terms of references for experts, copy of appointment notice • Copy of training materials, training reports • Contact list for stakeholder SPMUs • MIS specifications and user instruction	
Output 6.2: An M&E mechanism designed and implemented according			
Activity 6.2.1: Prepare and hold Inception Workshop ***Activity 6.2.2:*** Measure impact indicators ***Activity 6.2.3***: Carry out annual project financial audits ***Activity 6.2.4:*** Prepare Annual Project Reports and Project Implementation Reports ***Activity 6.2.5:*** Hold annual tripartite review meetings ***Activity 6.2.6:*** Carry out mid-term external evaluation ***Activity 6.2.7***: Hold biannual National Steering Committee meeting ***Activity 6.2.8:*** Carry out final external evaluation ***Activity 6.2.9***: Complete Terminal Report	• Inception Workshop held • Detailed workplan prepared • Updated impact indicators • Financial audit completed • Annual reports and PIRs completed • Annual TPR meetings held • Mid-term evaluation completed • Bi-annual NSC meeting held • Final external evaluation held • Project Terminal Report completed	• Monitoring reports • Inception report • Progress Reports • Copy of audit reports • Copies of annual reports and PIRs • TPR meeting proceedings • Copy of mid-term evaluation report • PSC/NSC meeting reports • Copy of final external evaluation report • Copy of project terminal report	• Delays in project implementation and low quality performance

Annex 8. List of Programme Hospitals

Legend

	New Hospitals added
	Additional hospitals as part of 'model districts' approach
	On original list but dropped

						MICROWAVE DISINFECTION DEVICE	
#	**REGION**	**UNIDO MEDICAL WASTE - LIST OF HOSPITALS**	**No. of Beds**	**Govt./ Pvt./ Charitable**	**L/M/S**	**No of Cycles Completed**	**Average Cycles per month (assumption: 25 working days/month)**
1	GUJARAT	Adventist Wokhardt Heart Hospital, opp. K. P. Commerce College Nr. Chopati, At. & Dist. Surat – 395001	60	Pvt.	S		
2	GUJARAT	Anand Hospital, College road, At: Rajpipala, Dist.: Narmada	30	Pvt.	S		
3	GUJARAT	GMERS Medical College & Hospital, S.G.Highway – Sola- Ahmadabad.	750	Govt.	L		
4	GUJARAT	Bajarangdas Bapa Hospital- Bhavnagar, Panwadi Chowk, At. & Dist. Bhavnagar	85	Trust.	S		
5	GUJARAT	Civil Hospital Himatnagar, At. Po. & Dist. Himatnagar	335	Govt.	M		
6	GUJARAT	CHC Chotila, NH no. 8, opp. Nagin Guest house, At. Po. Chotila, Dist.: Surendranagar	66	Govt.	S		
7	GUJARAT	CHC – Mandvi, Sub district Hospital, N.H. no. 8A, Bazar road, At. Mandvi, Dist. Kutchh	99	Govt.	S		
8	GUJARAT	CHC of Tharad Taluka, At. Tharad, Dist.: Banaskantha	50	Govt.	S		
9	GUJARAT	CHC – Viramgam Taluka, At:Viramgam, Dist. Ahmadabad	50	Govt.	S		
10	GUJARAT	Dharpur Medical College Hospital, At. Post- Dharpur, Diat:- Patan	650	Govt.	L		
11	GUJARAT	GMERS Medical College Hospital, Halar road, At. Po. Nanakvada, Dist. Valsad	650	Govt.	L		
12	GUJARAT	Civil Hospital, Mochi Bazar, At. & Dist. Rajkot – 360001 (PDU Hospital)	850	Govt.	L	365	100
13	GUJARAT	Gotri Medical College Hospital, At. Po. Gotri, Dist. Vadodara	650	Govt.	L		

						MICROWAVE DISINFECTION DEVICE	
#	REGION	UNIDO MEDICAL WASTE - LIST OF HOSPITALS	No. of Beds	Govt./ Pvt./ Charitable	L/M/S	No of Cycles Completed	Average Cycles per month (assumption: 25 working days/month)
14	GUJARAT	Government Hospital Mehsana, Near S.T. Depot, At. Po. Mehsana Dist. Mehsana	243	Govt.	M		
15	GUJARAT	Government Hospital Porbandar, Near S. T. Bus Depot, At. Po. Porbandar, Dist. Porbandar	241	Govt.	M		
16	GUJARAT	Government Hospital Rajpipala, opp. Vijay Maternity Hospital, Palace road, At. Po. Rajpipala, Dist. Narmada	150	Govt.	M		
17	GUJARAT	Hatkesh Hospital, Nr. Bhutnath temple, college road, At. & Dist. Junagadh	50	Trust.	S		
18	GUJARAT	HI – Tech Hospital, plot no. 1180, Sector 3D, GH road, At. Po. & Dist.: Gandhinagar	50	Pvt.	S		
19	GUJARAT	Civil Hospital, At. & Dist. Vadodara – 390001 (SSG)	1513	Govt.	L		
20	GUJARAT	Padam Kuvarba General Hospital, Gundawadi, Palace road, Rajkot	115	Govt.	M		
21	GUJARAT	PHC of Chotila Taluka, At: Piparali, Dist.: Surendranagar	1	Govt.	S		
22	GUJARAT	PHC of Mandvi Taluka, at :- Godhra, Dist. Kutchh	6	Govt.	S		
23	GUJARAT	PHC of Tharad Taluka, At: Bhordu, Ta. Tharad, Dist.: Banaskantha	6	Govt.	S		
24	GUJARAT	PHC – Viramgam Taluka, At: Manipura, Dist. Ahmadabad	6	Govt.	S		
25	GUJARAT	PHC Rupal, Randheja – Rupal road, At. Rupal, Dist. Gandhinagar	6	Govt.	S		
26	GUJARAT	Samarpan Hospital, Ajanta Society, Dwarka Highway, At. & Dist. Jamnagar,	200	Trust.	M		
27	GUJARAT	Subhechha Multispecialty Hospital, 409 – 412 Shrinagar Society, Nr. Urmi Char rasta, At. Akota, Dist. Vadodara	45	Pvt.	S		
28	GUJARAT	Civil Hospital- Ahmedabad, Asharva - Ahmedabad	2000	Govt.	L		
32	GUJARAT MDH	GMERS Medical College & Hospital, Sector 12, At. & Dist. Gandhinagar	900	Govt.	L	129	50
34	GUJARAT MDH	Apollo Hospitals, plot no. 1A, Bhat GIDC Estate, Dist. Gandhinagar	282	Pvt.	M		

						MICROWAVE DISINFECTION DEVICE	
#	REGION	UNIDO MEDICAL WASTE - LIST OF HOSPITALS	No. of Beds	Govt./ Pvt./ Charitable	L/M/S	No of Cycles Completed	Average Cycles per month (assumption: 25 working days/month)
35	GUJARAT MDH	Aashka Hospitals Pvt. Ltd. At. Saragasan, Dist. Gandhinagar	150	Pvt.	M		
36	GUJARAT MDH	Kanoria Hospital & Research Centre, At. Bhat, Dist. Gandhinagar	60	Pvt.	S	415	83
37	GUJARAT MDH	Community Health Centre & Referral Hospital, At. Adalaj, Dist. Gandhinagar	30	Govt.	S		
38	GUJARAT MDH	Anand Hospital, 205 -212, Radhe Square, Nr. Reliance Chowkdi, At. Kudasan, Dist. Gandhinagar	24	Pvt.	S		
39	GUJARAT MDH	Akshar Hospital, plot no. 937/2, Sector -7/C, opp. S. T. Depot, At. & Dist. Gandhinagar	11	Pvt.	S		
41	GUJARAT MDH	PHC Rupal, Randheja – Rupal road, At. Rupal, Dist. Gandhinagar	6	Govt.	S		
40	GUJARAT MDH	HI – Tech Hospital, plot no. 1180, Sector 3D, GH road, At. Po. & Dist.: Gandhinagar	50	Pvt.	S		
29	GUJARAT	Civil Hospital, Asarwa, Ahmedabad					
30	GUJARAT	Civil Hospital, Sola, Ahmedabad					
33	GUJARAT MDH	Civil Hospital, Gandhinagar					
	GUJARAT MDH	GMERS Sola Medical College, Sola Ahmedabad					
	GUJARAT MDH	New Civil Hospital, Surat					
34	KARNATAKA	Karnataka Institute of Medical Sciences, Hubli.	1200	Govt.	L	500	150
35	KARNATAKA	Bowring & Lady Curzon Hospital, Bangalore.	686	Govt.	L	1244	150
36	KARNATAKA	Vaidehi Institute of Medical Science, Bangalore	1600	Pvt.	L	382	125
37	KARNATAKA	Mysore Medical College and Research Institute, Mysore.	1460	Govt.	L	642	125
38	KARNATAKA	District Hospital Kolar.	400	Govt.	M		
39	KARNATAKA	District Hospital Ramanagar.	100	Govt.	M		
40	KARNATAKA	District Hospital Dharwad	250	Govt.	M		
41	KARNATAKA	District Hospital Chitradurga	450	Govt.	M		
42	KARNATAKA	District Hospital Haveri.	300	Govt.	M		
43	KARNATAKA	Taluk Hospital Sira, Tumkur District.	100	Govt.	M		

						MICROWAVE DISINFECTION DEVICE	
#	REGION	UNIDO MEDICAL WASTE - LIST OF HOSPITALS	No. of Beds	Govt./ Pvt./ Charitable	L/M/S	No of Cycles Completed	Average Cycles per month (assumption: 25 working days/month)
44	KARNATAKA	Taluk Hospital Sagara, Shimoga District	100	Govt.	M		
45	KARNATAKA	Taluk Hospital Gokak, Belgaum District.	110	Govt.	M		
46	KARNATAKA	Taluk Hospital Chintamani, Chikkaballapur District	100	Govt.	S		
47	KARNATAKA	Taluk Hospital Sirsi, Uttara Kannada District	100	Govt.	S		
48	KARNATAKA	Taluk Hospital Nanjangud, Mysore District.	100	Govt.	S		
49	KARNATAKA	Taluk Hospital Linagasagur, Raichur District.	100	Govt.	S		
50	KARNATAKA	Taluk Hospital Kundapura, Udupi District.	100	Govt.	S		
51	KARNATAKA	Taluk Hospital Hanagal, Haveri District.	100	Govt.	S		
52	KARNATAKA	Taluk Hospital Hunasur, Mysore District.	100	Govt.	S		
53	KARNATAKA	Taluk Hospital Hospet, Bellary District.	100	Govt.	S		
54	KARNATAKA	Taluk Hospital Jewargi, Gulbarga District	50	Govt.	S		
55	KARNATAKA	Taluk Hospital Kanakapura, Ramanagar District.	100	Govt.	S		
56	KARNATAKA	Taluk Hospital Srinivaspura, Kolar District.	40	Govt.	S		
57	KARNATAKA	Taluk Hospital Savadatti, Belgaum District.	110	Govt.	M		
58	KARNATAKA	Taluk Hospital Basavakalyana, Bidar District.	100	Govt.	S		
59	KARNATAKA	Taluk Hospital H D Kote, Mysore District.	100	Govt.	S		
60	KARNATAKA	CHC Santemarahalli, Chamarajanagar District.	30	Govt.	S		
61	KARNATAKA	CHC Nayakanahatti, Chitradurga District.	50	Govt.	S		
62	KARNATAKA	CHC Bankapura, Haveri District.	30	Govt.	S		
63	KARNATAKA	CHC Jayanagara, Mysore City.	30	Govt.	S		
64	KARNATAKA	PHC Koppa, Periyapatna Taluk, Mysore District.	6	Govt.	S		
		Bangalore Medical College & General Hospital. Bangalore					

						MICROWAVE DISINFECTION DEVICE	
#	REGION	UNIDO MEDICAL WASTE - LIST OF HOSPITALS	No. of Beds	Govt./ Pvt./ Charitable	L/M/S	No of Cycles Completed	Average Cycles per month (assumption: 25 working days/month)
		MS Ramaiah Medical College and Hospital. Bangalore					
		Citi Central Hospital. Davcngcrc					
		Taluk hospital NK. Pura. Chikamagalur					
		Central Hospital. SW Railway. Hubli					
		14) Taluk hospital. Shahapura. Yadgi ri					
		19) Taluk hospital Na ragunda. Gadag					
		25) Rotary Blood Rank , Shimoga					
		16) Taluk hospital Channagiri Davangcre.					
		17) Taluk hospital Sullia. Dakshina Kannada.					
		13) CHC Gurumitakal. Yadagiri					
		27) Oswal Hospital. Bangarpet					
		28) Puttur City Hospital Pvt., J ,td Dakshin Kannada					
		26) Chyavana Clinical Laborator y. Udipi					
65	ODISHA	SCB Medical College & Hospital, Cuttack	1707	Govt.	L	178	150
66	ODISHA	MKCG Medical College & Hospital, Berhampur, Ganjam	1062	Govt.	L	965	200
67	ODISHA	V. S. S Medical College & Hospital Burla, Sambalpur	1006	Govt.	L	700	150
68	ODISHA	Institute of Medical Science and Sum Hospital, Bhubaneswar	500	Pvt.	L	722	150
69	ODISHA	District Head Quarter Hospital, Bolangir	184	Govt.	M		
70	ODISHA	District Head Quarter Hospital, Grand Road, Puri	220	Govt.	M		
71	ODISHA	District Head Quarter Hospital, Badipada, Mayurbhanj	350	Govt.	M		
72	ODISHA	District Head Quarter Hospital, Kalahandi	165	Govt.	M		
73	ODISHA	District Head Quarter Hospital, Sundargarh	197	Govt.	M		
74	ODISHA	District Head Quarter Hospital, Bhadrak	190	Govt.	M		

						MICROWAVE DISINFECTION DEVICE	
#	REGION	UNIDO MEDICAL WASTE - LIST OF HOSPITALS	No. of Beds	Govt./ Pvt./ Charitable	L/M/S	No of Cycles Completed	Average Cycles per month (assumption: 25 working days/month)
75	ODISHA	Nehru Shatabdi Hospital, MCL, Talcher, Angul	300	Pvt.	M		
76	ODISHA	Christian Hospital, Bisham Katak, Raygada	200	Charitable	M		
77	ODISHA	Chandan Nursing home, Angul	24	Pvt.	S		
78	ODISHA	Vimala Health Centre, Rayagada	10	Charitable	S		
79	ODISHA	Durga Nursing Home, Mayurbhanj	40	Pvt.	S		
80	ODISHA	Sanjivani Family Hospital, Sambalpur	45	Pvt.	S		
81	ODISHA	Samaleswari Diagnostic Centre, Burla, Sambalpur	60	Pvt.	S		
82	ODISHA	M/S Arete Care Ltd., Angul	16	Pvt.	S		
83	ODISHA	Neelachal Hospital, Puri	16	Pvt.	S		
84	ODISHA	CHC, Salipur, Cuttack	16	Govt.	S		
85	ODISHA	CHC, Saintala, Balangir	16	Govt.	S		
86	ODISHA	CHC, Muniguda, Raygada	30	Govt.	S		
87	ODISHA	CHC, Soro, Baleswar	50	Govt.	S		
88	ODISHA	PHC, Nishintkoili, Cuttack	6	Govt.	S		
89	ODISHA	PHC, Chudapali, Bolangir	6	Govt.	S		
90	ODISHA	Jyothi Hospital, Balasore	60	Charitable	S		
91	ODISHA	PHC, Anantpur, Balasore	6	Govt.	S		
	ODISHA	Red Cross Blood Bank, Berhampur					
92	PUNJAB	Guru Nanak Dev Hospital, Amritsar	891	Govt.	L		
93	PUNJAB	Christian Medical College & Hospital, Ludhiana	700	Pvt.	L	1822	200
94	PUNJAB	Dayanand Medical College & Hospital, Ludhiana	1625	Pvt.	L	1571	175
95	PUNJAB	Govt. Rajindra Hospital, Patiala	1287	Govt.	L	1417	150
96	PUNJAB	Guru Ram Dass Hospital, Amritsar	765	Pvt.	M	854	81
97	PUNJAB	Civil Hospital, Jalandhar	470	Govt.	M		
98	PUNJAB	Mohan Dai Oswal Cancer Treatment & Research Foundation, Ludhiana	300	Pvt.	M		
99	PUNJAB	Civil Hospital, Ludhiana	250	Govt.	M		

						MICROWAVE DISINFECTION DEVICE	
#	REGION	UNIDO MEDICAL WASTE - LIST OF HOSPITALS	No. of Beds	Govt./ Pvt./ Charitable	L/M/S	No of Cycles Completed	Average Cycles per month (assumption: 25 working days/month)
100	PUNJAB	Max Super Specialty Hospital, Bathinda	200	Pvt.	M		
101	PUNJAB	S.G.L Charitable Hospital, Garha Road, Jalandhar	350	Pvt.	M		
102	PUNJAB	Civil Hospital, Bathinda	200	Govt.	M		
103	PUNJAB	Guru Gobind Singh Medical College & Hospital, Faridkot	824	Govt.	M		
104	PUNJAB	Civil hospital, Talwandi Sabo, Bathinda	50	Govt.	S		
105	PUNJAB	Indus Hospital, Phase I, Mohali	64	Pvt.	S		
106	PUNJAB	Civil Hospital, Mohali	200	Govt.	S		
107	PUNJAB	Civil Hospital, Kharar	50	Govt.	S		
108	PUNJAB	Civil Hospital, Samrala	50	Govt.	S		
109	PUNJAB	SDH, Baba Bakalan	50	Govt	S		
110	PUNJAB	Civil Hospital, Moga	100	Govt.	S		
111	PUNJAB	Baba Jaswant Singh Dental College & Hospital Ludhiana - INCLUDED 200 DENTAL CHAIRS	10	Pvt.	S		
112	PUNJAB	Civil Hospital, Ferozepur	100	Govt.	S		
113	PUNJAB	Civil Hospital, Pathankot	100	Govt.	S		
114	PUNJAB	Civil Hospital, Badal, Distt. Mukatsar	100	Govt.	S		
115	PUNJAB	Primary Health Centre, Bugal Bhadani, Pathankot	30	Govt.	S		
116	PUNJAB	KD Hospital, 7 circular Road, Amritsar	120	Pvt.	S		
117	PUNJAB	CHC, Payal, Distt. Ludhiana	30	Govt.	S		
118	PUNJAB	Sub Divisional Hospital, Vill. Ghuda, Bathinda	50	Govt.	S		
119	PUNJAB	Civil Hospital, Anandpur Sahib	100	Govt.	S		

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#	REGION	UNIDO MEDICAL WASTE - LIST OF HOSPITALS	No. of Beds	Govt./ Pvt./ Charitable	L/M/S	No of Cycles Completed	Average Cycles per month (assumption: 25 working days/month)
120	PUNJAB MDH	Dayanand Medical College & Hospital, Ludhiana (The hospital is also a part of the 28 hospitals)	1625	Pvt.	L		
121	PUNJAB MDH	ESIC Hospital, Ludhiana	262	Govt.	M		
122	PUNJAB MDH	Sant Nihal Singh Pahwa Charitable Hospital, Ludhiana	150	Pvt.	M		
123	PUNJAB MDH	Civil Hospital, Raikot	50	Govt.	S		
124	PUNJAB MDH	Civil Hospital, Khanna	75	Govt.	S		
125	PUNJAB MDH	Civil Hospital, Jagraon	50	Govt.	S		
126	PUNJAB MDH	Primary Health Centre, Mullanpur, Mandi Mullanpur	6	Govt.	S		
127	PUNJAB MDH	Primary Health Centre, Manuke, Jagraon	0	Govt.	S		
128	PUNJAB MDH	Community Health Centre, Sudhar, Distt. Ludhiana	30	Govt.	S		
		Super Religare Laboratories, Beas Hospital,					
129	MAHARASTRA	Jawaharlal Nehru Medical College, Sawangi Meghe, Wardha	1300		L	1800	275
130	MAHARASTRA	Civil Hospital Chandrapur, Main Road, Kasturba Ward, Chandrapur.	320		M		
131	MAHARASTRA	District Hospital Ahmednagar, Near Manmad Road, Patrkar Chawk, Ahmednagar.	290		M	105	50
132	MAHARASTRA	Dr.D.Y.Patil Hospital and Research Center, Kadamwadi, Kolhapur	810		L		
133	MAHARASTRA	MMRRDI Seth Nandalal Dhoot Hospital, Plot No. A-1, MIDC Area, Chikalthana, Aurangabad-431 210	200		M		
134	MAHARASTRA	Jupiter Lifeline Hospiatl Litd, Eastern Express Higway, Thane (QW),400 601	287		M		
135	MAHARASTRA	Ashwini Sahakari Rugnalaya Ani Sanshodhan Kendra Nyt., Solapur Survey no. 7107/1 Tank plot no. 180, North sadar bazar, Near bhagatsingh market, Solapur-413003	305		M		

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#	REGION	UNIDO MEDICAL WASTE - LIST OF HOSPITALS	No. of Beds	Govt./ Pvt./ Charitable	L/M/S	No of Cycles Completed	Average Cycles per month (assumption: 25 working days/month)
136	MAHARASTRA	Rural Hospital Tiosa, Tq. Tiosa, Dist. Amravati.	30		S		
137	MAHARASTRA	Baheti Multispecialty Hospital, Ambapeth, Amravati. 444 601	20		S		
138	MAHARASTRA	Getwell Hospital & Research Institute, 20/1, Dr.Khare Marg, Dhantoli, Nagpur-440 012.	65		S		
139	MAHARASTRA	Rural Hospital Raipathan, Dist. Ratnagiri	30		S		
140	MAHARASTRA	Jable Hospital, Bhargav Peth, Near Vashishti Bridge, Chiplun, Ratnagiri.	10		S		
141	MAHARASTRA	Sub-District Hospital Warora, Near Nagar Parishad, Main Road Warora, Dist. Chandrapur.	50		S		
142	MAHARASTRA	ICON Hospital Pvt. Ltd., Mahaveer Nagar, Manpada Road, Dombivali East	65		S		
143	MAHARASTRA	Barhale Medical Center Pvt.Ltd., Shanti Nursing Home, Kanchenwadi, Paithan Road, Aurangabad	80		S		
144	MAHARASTRA	Rajebahadur Hospital & Research Center Pvt.Ltd. Rajebahadur Colony, tilak Road, Shalimar, Nasik	70		S		
145	MAHARASTRA	Rural Hospital Murbad, Murbad, Dist.Thane	30		S		
146	MAHARASTRA	Rural Hospital,Junner, Tq. Junner, Dist.Pune	**30**		S		
147	MAHARASTRA	Sub-District Hospital Roha Dist. Raigad	50		S		
148	MAHARASTRA	Dhanwantari Hospital & Research Center, D.L. Vaidya Roadm Near Shiv Sena Bhavan, Dadar, Mumbai-400 028	53		S		
149	MAHARASTRA	Ashwinin Rugnalaya, Solapur				1092	175
150	MAHARASTRA	District Hospital, Nasik	541		L		
151	MAHARASTRA	Wockhardt Hopsital, Wadal Naka, Nasik.	180		M		
152	MAHARASTRA	SMBT Institute of Medical Sciences & Research Center, Igatpuri, Nasik	300		M		

						MICROWAVE DISINFECTION DEVICE	
#	REGION	UNIDO MEDICAL WASTE - LIST OF HOSPITALS	No. of Beds	Govt./ Pvt./ Charitable	L/M/S	No of Cycles Completed	Average Cycles per month (assumption: 25 working days/month)
153	MAHARASTRA	General Hospital Bhandara - SantKabir ward - Bhandara – 441904	482		M		
154	MAHARASTRA	Public Health Centre, Yellambghat Tal. & Dist. Beed,	6		S		
155	MAHARASTRA	Sub-District Hospital Dahanu, Tq. Dahanu, Dist. Palghar	100		S		
156	MAHARASTRA MDH	Vasantrao pawar medical Hospital & Reseach center Nashik-Vasantdada nagar,Adgaon Shivar, Agra Road Nashik	1000		L		
157	MAHARASTRA MDH	Apollo Hospital - Swami Narayan Nagar, Panchavati, Nasik	118		M		
158	MAHARASTRA MDH	Suyash Medical Foundation Pvt.Ltd. - 594, Abhiyabai Holkar Marg, Near Mahamarg Bus Stand, Mumbai Naka, Nasik	100		M		
159	MAHARASTRA MDH	Sub-District hospital kalwan-Kalwan-Deola Road, Ganesh Nagar Deola Road, Kalwan	60		S		
160	MAHARASTRA MDH	Prayas hospital Malegaon- Opp. K.B.H. High School, College Road, Malegaon Dist Nashik	50		S		
161	MAHARASTRA MDH	Rural hospital Trimbakeshwar- At Post Trimbakeshwar Dist Nashik	30		S		
162	MAHARASTRA MDH	Rural hospital Igatpuri- Golibar Maidan, Shree Swami Samarth Nagar, Igatpuri	30		S		
163	MAHARASTRA MDH	Curie Manavta Cancer Center - Opp. Mahamarg Bus Stand, Mumbai Naka, Nasik	50		S		
164	MAHARASTRA MDH	Sub-District hospital Chandwad - Chandwad, Nasik	70		S		
	MAHARASTRA MDH	Sub District Hospital, Murbad, Kalyan (S)					
	MAHARASTRA MDH	Barhale Medical; Center Pvt. Ltd., Paithan Road, Aurangabad (S)					
	MAHARASTRA MDH	Dhirubhai Ambani, Lodivali, Khalapur, Dist. Raigad					
	MAHARASTRA MDH	KEM Hospital, Parel, Mumbai (L)					
	MAHARASTRA MDH	Govt. Medical College & Hospital, Nagpur (L)					

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#	REGION	UNIDO MEDICAL WASTE - LIST OF HOSPITALS	No. of Beds	Govt./ Pvt./ Charitable	L/M/S	No of Cycles Completed	Average Cycles per month (assumption: 25 working days/month)
	MAHARASTRA MDH	Ruby Hall Clinic, Pune (L)					
	MAHARASTRA MDH	General Hospital, Bhandar, Nagpur (M)					
	MAHARASTRA MDH	ESIS Hospital, Sector 5 Vashi, Navi Mumbai(M)					

Annex 9. Similar BMWM projects

The design of this project builds on earlier POPs and mercury projects, most notably the projects described below.

Environmentally Sustainable Management of Medical Wastes in China (GEF ID: # 2927)
The GEF financed and UNIDO supported project had the main objective to "minimize the generation and emissions of unintentionally produced POPs (principally PCDDs/PCDFs) from the medical waste treatment sector". The project was approved for implementation in 2007 and closed in June 2017. The China project was similar in scope and budget to this Indian project, though more ambitious. The terminal evaluation found that the project was successful and commended it for a massive training effort "on all the aspects of HCW management (regulatory, disposal, segregation etc.) implying both classroom and on-duty training, involving the establishment of 3 training centres on HCW disposal, 7 training centres on BEP in healthcare waste facilities, one technology transfer center and around 50,000 people trained." [25] The project also tested advanced technologies for the disposal of medical waste, covering air pollution treatment for both for incineration and non-incineration technologies. The project tested BAT technologies covering one rotary kiln incinerator, two pyrolytic plants, one chemical disinfection plant, one autoclave facility, and one combined microwave and steam-disinfection plant.

The Global Healthcare Waste Project (GEF ID # 1802)
The Global Healthcare Waste Project officially began in August 2008, though most of the national projects were delayed in starting the implementation phase. The project objective was to help Argentina, India, Latvia, Lebanon, Philippines, Senegal and Vietnam in developing and sustaining best healthcare waste management practices in a way that is both locally appropriate and globally replicable. The rationale was that the health sector is a major source of dioxins and mercury in the global environment, primarily due to medical waste incineration and the breakage and improper disposal of mercury-containing devices. Hospitals in the project countries were to be equipped with non-incineration waste treatment technology and non-mercury medical devices.

In an eighth country, Tanzania, the project worked with the University of Dar es Salaam to design, develop, test and disseminate affordable and effective alternative healthcare waste treatment technologies appropriate to conditions in much of sub-Saharan Africa, where the focus was on developing a robust autoclave and other appropriate waste treatment technology.

The Project to reduce UPOPs releases in African Countries (GEF ID # 5322)
The project Promotion of BAT and BEP to Reduce POPs Releases from Waste Open Burning in the Participating African Countries of COMESA-SADC Sub regions seeks to minimise the emission of unintentionally produced POPs caused by open burning through introduction of best available techniques and best environmental practices (BAT/BEP) measures at selected priority demonstration sites. The project started in 2016 and covers the countries of Botswana, Ethiopia, Lesotho, Madagascar, Mozambique, Sudan, Swaziland, Tanzania, Uganda, and Zambia.

Project on POPs and mercury in Kyrgyzstan (GEF ID # 5068)
In 2005 the Swiss Red Cross collaborated with the Ministry of Health to address nosocomial infections. The Swiss project undertook two pilot projects and the conclusion was that a good healthcare waste management system greatly contributed to reducing such infections in hospitals. This led to a project between the Swiss Red Cross and the Public Centre for Infection Control covering 10 hospitals in the Naryn and Talas Regions.

[25] Independent Terminal Evaluation of the project Environmentally Sustainable Management of Medical Wastes in China (April 2018)

Building on earlier work with healthcare waste management in Kyrgyzstan, the GEF financed project Protect human health and the environment from unintentional releases of POPs and mercury from the unsound disposal of healthcare waste in Kyrgyzstan was implemented by UNDP from 2014 to 2018. The project's overarching goal, was to "Implement Best Environmental Practices (BEP) and Best Available Technologies (BAT) in the healthcare sector to assist Kyrgyzstan in meeting its obligations under the Stockholm Convention to reduce UPOPs as well as Mercury releases." [26] Today all hospitals with over 25 beds in Kyrgyzstan have a healthcare waste management system, as do many other smaller HCW waste generators. The system implemented in Kyrgyzstan has proven very successful and sustainable, offering a tremendous benefit in terms of a greatly decreased occurrence of nosocomial infections within the health sector.

Reducing UPOPs and Mercury Releases from the Health Sector in Africa (GEF ID # 4611)
This project aims to reduce the emission of UPOPs as well as Mercury releases. The project started in October 2015 and is scheduled for completion on 12 April 2020. This is a GEF funded project that has a budget of just above 6.5 million USD. The project is being implemented by the UNDP, in partnership with the WHO and the NGO Health Care Without Harm. The objective is to implement Best Environmental Practices (BEP) and Best Available Technologies (BAT) to reduce harmful releases from the health sector. This is being achieved through the introduction of non-incineration healthcare waste treatment technologies and mercury-free medical devices at healthcare facilities in four countries: Ghana, Madagascar, Tanzania and Zambia.

[26] Project objective quoted from the Project Document.