



Kingdom of Bhutan

**TECHNOLOGY NEEDS ASSESSMENT AND
PROJECT IDEA REPORT
MITIGATION**

"March 2013"



National Environment Commission
Royal Government of Bhutan

TECHNOLOGY NEEDS ASSESSMENT AND TECHNOLOGY ACTION PLANS FOR CLIMATE CHANGE MITIGATION

© National Environment Commission, 2013

The publication may be reproduced in whole or part in any form for education and non-profit use without permission from the copyright holder, provided acknowledgement of the source is made.

Disclaimer

This document is an output of the Technology Needs Assessment project, funded by the Global Environment Facility (GEF) and implemented by the United Nations Environment Programme (UNEP) and the UNEP Risoe Centre (URC) in collaboration with the Regional Centre (from the corresponding region), for the benefit of the participating countries. The present report is the output of a fully country-led process and the views and information contained herein is a product of the National TNA team, led by the National Environment Commission, Royal Government of Bhutan.

Bhutan Technology Needs Assessment Project Team

1. Mr. Karma Tshering, National Coordinator, National Environment Commission
2. Mr. Jigme Thinley, Finance Officer, National Environment Commission
3. Mr. Alope Barnwal, Principal Consultant, Emergent Ventures India Pvt. Ltd
4. Mrs. Ishita Signh, Associate Consultant, Emergent Ventures India Pvt. Ltd
5. Mrs. Prima Madan, Senior Consultant, Emergent Ventures India Pvt. Ltd
6. Mr. Ugyen P. Norbu (National Consultant from Bhutan)

Supported by:



FOREWORD



དཔལ་ལྷན་འབྲུག་གཞུང་།
Royal Government of Bhutan

PRIME MINISTER

28 March, 2013.

Foreword

Bhutan, with its commitment to preserve the natural environment, has been actively participating in the fight against one of the most pressing challenges of the current times, the climate change. The country has undertaken the Technology Needs Assessment process to identify, evaluate, and prioritize technologies that fit in the overall development context of the nation while allowing the country to adapt to and mitigate climate change. At the Conference of Parties (COP) 14 in 2008, the Poznań Strategic Programme on Technology Transfer was adopted as a step towards *scaling up the level of investment in technology transfer in order to help developing countries address their needs for environmentally sound technologies*. As part of this programme, in 2010, on behalf of Global Environment Facility (GEF), the United Nations Environment Programme (UNEP) started the implementation of Technology Needs Assessment (TNA) for 36 countries.

Taking forward its commitment at the international forums, I am pleased that the National Environment Commission (NEC) Secretariat has completed the Technology Needs Assessment for Climate Change (TNA) and that it led to the formulation of a Technology Action Plan (TAP) for implementation of the prioritized technologies for adaptation and mitigation. These initiatives fit in the larger scheme of things that we are pursuing for low-carbon and climate-resilient development and will contribute to the development of the 11th Five Year Plan of the country, to be finalized soon.

As a party to the UNFCCC, Bhutan is fully committed to developing and implementing policies, programmes and projects to address the many challenges posed by climate change. We have also adopted a new Economic Development Policy in 2010, which embraces the concept and principles of green economic development. We are now formulating a national strategy for low-carbon and climate-resilient development.

Application of collective knowledge and skills is crucial in developing solutions for combating the challenges of climate change. In this regard, I am encouraged to note that various stakeholders not only from government agencies, but also from the civil society and private sector have been involved in the TNA process and have contributed extensively in selecting the prioritized technologies, identifying the key barriers to technology development and deployment, preparing the Technology Action Plans for overcoming the identified barriers and identifying the implementable project ideas for each technology. I would like to commend all the individuals and organizations that have contributed to the TNA process particularly, the TNA Taskforce members, the respective government departments and agencies and the National Environment Commission for effectively leading this exercise.

I look forward to seeing the findings and recommendations of the TNA project feed into the national strategy for combating climate change in Bhutan.

Tashi Delek !

(Jigmi Y. Thinley)
Prime Minister, and
Chairman of NEC

PREFACE

Given Bhutan's vulnerability to the impacts of climate change, the nation has accorded climate change a high priority. The nation's commitment to remain carbon neutral while ensuring overall social-economic development reflects its vision to address the challenges of climate change and move towards a sustainable future.

The challenges of addressing climate change, particularly by developing and least developed countries have been recognized at various international forums. Technology transfer as a vital instrument to overcome these challenges has been identified by the UNFCCC in Article 4.5. Subsequently, the need and importance of technology transfer has been reiterated at various Conference of Parties (COP) of the UNFCCC. At COP 14 in 2008, the Poznań Strategic Program on Technology Transfer was adopted as a step towards *scaling up the level of investment in technology transfer in order to help developing countries address their needs for environmentally sound technologies*. As part of this programme, in 2010, on behalf of Global Environment Facility (GEF), the United National Environment Programme (UNEP) started the implementation of Technology Needs Assessment (TNA) for 36 countries.

Bhutan has undertaken the TNA process to identify, evaluate, and prioritize technologies that fit in the overall development context of the nation while allowing the country to combat climate change. The National Environment Commission Secretariat is the nodal agency for the TNA project and has constituted a TNA Task Force involving representatives from various sectors to provide inputs to the TNA project and most importantly in preparing the Technology Action Plan for identified technologies.

In the Part I of the TNA report, for each prioritized sub-sector in climate change adaptation and mitigation one technology was prioritized based on a technology prioritization framework prepared through secondary research and rigorous stakeholder consultation. Part III of the TNA report, the Technology Action Plan covers each adaptation and mitigation technology, in a way to reflect the prioritized measures required to enhance technology diffusion and overcome barriers identified in Part II of the TNA report. The current Project Idea Report brings together implementable project ideas for both adaptation and mitigation, emerging out of the Technology Action Plans for each technology.

The project ideas have been identified based on inputs received from a number of stakeholders from various agencies in the government, civil society and private sector.



Ugyen Tshewang, PhD
Secretary
National Environment Commission

ACKNOWLEDGMENT

The National Environment Commission Secretariat (NECS) sincerely acknowledges the Global Environment Facility (GEF) for the financial support provided for the Technology Needs Assessment (TNA) project in Bhutan. We would also like to thank UNEP Risø Centre (URC) and Asian Institute of Technology (AIT) for their technical guidance during the course of the TNA. The NECS is particularly grateful to Mr. Gordon Mackenzie, TNA country coordinator for Bhutan, for coordinating all the activities between the NECS, AIT and URC.

We would like to thank all the TNA taskforce members for their valuable contribution in prioritization of sectors and technologies, and for their comments on the draft report.

Further, we express our sincere appreciation to Emergent Ventures India (EVI) and Norbu Samyul Consulting for facilitating the TNA process and putting together the TNA report.

ABBREVIATIONS

3 Rs	Reduce, reuse and recycle
AIT	Asian Institute of Technology
BRT	Bus Rapid Transit
DRE	Department of Renewable Energy
DOI	Department of Industries
EVI	Emergent Ventures India
FYP	Five-year plan
GHG	Greenhouse gases
GNH	Gross National Happiness
ICT	Information and Communication Technologies
ITS	Intelligent Transport System
MoWHS	Ministry of Works and Human Settlement
NAPA	National Adaptation Programme of Actions
NEC	National Environment Commission
NECS	National Environment Commission Secretariat
SNC	Second National Communication
TAP	Technology Action Plan
TNA	Technology Needs Assessment
UNFCCC	United Nations Framework Convention on Climate Change
URC	UNEP Risø Centre

LIST OF TABLES

Table 1: Proposed project activities- Solid Waste Management sector	5
Table 2: Proposed Project Activities- Transport Sector	14
Table 3: Proposed Project Activities- Solid Waste Management Sector	21

TABLE OF CONTENTS

FOREWORD	iii
PREFACE	iv
ACKNOWLEDGMENT	v
ABBREVIATIONS	vi
LIST OF TABLES	vii
TABLE OF CONTENTS	VIII
PART IV	1
Project Idea Report	1
Chapter 1 Project Idea for Solid Waste Management	2
1.1 Brief Summary	2
1.2 Specific Project Ideas	2
1.2.1 Introduction	2
1.2.2 Objectives	2
1.2.3 Project Outputs	3
1.2.4 Relationship to the country's sustainable development priorities	3
1.2.5 Project Benefits	3
1.2.6 Project Scope and Possible Implementation	4
1.2.7 Project activities and timelines	5
1.2.8 Possible Complications/Challenges	10
Chapter 2 Project Idea for Transport Sector	11
2.1 Brief summary of the Project Ideas for Transport	11
2.2 Specific Project Ideas	11
2.2.1 Introduction	11
2.2.2 Objectives	11
2.2.3 Project Outputs	12
2.2.4 Relationship to the country's sustainable development priorities	12
2.2.5 Project Benefits	12
2.2.6 Project Scope and Possible Implementation	13
2.2.7 Project activities and timelines	14
2.2.8 Possible Complications/Challenges	18
3.1 Brief summary of the Project Ideas	19
3.2 Specific Project Ideas	19
3.2.1 Introduction	19

3.2.3	Project Outputs	19
3.2.4	Relationship to the country's sustainable development priorities	20
3.2.5	Project Benefits	20
3.2.6	Project Scope and Possible Implementation.....	20
3.2.7	Project activities and timelines	21
3.2.8	Possible Complications/Challenges.....	25
Annex I. List of Stakeholders consulted		26

Part IV

Project Idea Report

Chapter 1 Project Idea for Solid Waste Management

1.1 Brief Summary

Solid waste management through composting is a matured technology and has been a key strategy to address the issue of waste and reducing associated GHG emissions from the sector in Bhutan also. There are on-going efforts being made across organizations in the country in setting up composting plants in the country. A plant has already been set up in the city of Thimphu, managed by Thimphu City Corporation. While efforts are being undertaken, there is still dearth of knowledge on various other economically viable composting techniques in the country. The plant set up in the city of Thimphu, is confronted with several issues related to difficulties of transporting waste to the plant, quantity of waste generated for successful running of the plant, marketing of the compost, etc. There is a realized need for exploring different option of composting techniques at both centralized and decentralized level, given the small demography of the country.

The proposed project idea based on other parts of the TNA report suggests a set of activities focussing on technical aspects associated with evaluating composting techniques, undertaking pilots and designing support infrastructure. The project includes an assessment of different composting techniques and financing models for implementing these techniques and documenting it in a form of guidebook. In order to have a better understanding of the kind of support infrastructure needed for setting up and managing composting projects, the project also recommends studying some models on support infrastructure (in terms of waste collection, segregation and transportation) of other countries keeping in mind few important cities of Bhutan, to start with Thimphu.

1.2 Specific Project Ideas

1.2.1 Introduction

Project title: *Promoting composting in Bhutan by assessing different techniques, building support infrastructure and undertaking pilots*

Background and rationale

In recent years, rapid rates of urbanization, rural-urban migration, changing consumption pattern and high population growth rate in Bhutan has led to rapid increase in waste generation and thereby problem of waste disposal. According to Bhutan's SNC, in 2000, GHG emissions from the waste sector in Bhutan accounted for 2.9% of the total national emissions. Emissions in waste sector have steadily risen since the past decade, especially from solid waste disposal on land. There is a growing recognition of the issue of waste disposal and Government has started to explore several avenues for efficient solid waste management in the country. The Waste Prevention and Management Act, 2009 is the guiding document for the current waste management system in Bhutan and is based on three guiding principles of Precautionary principle; Polluter pays principle and Principle of 3 Rs (reduce, reuse, recycle) and Waste Minimization Hierarchy.

With this background, and in line with the action on ground in the country, composting was finalized as the technology for development and diffusion under the current TNA process. The current report, building on the work undertaken in the other parts of the TNA exercise, proposes a project idea with a view of initiating a process towards implementing the needed measures for overcoming the barriers associated with development and implementation of composting projects in Bhutan. The project aims to facilitate deployment of composting as a key strategy for waste management by identifying and disseminating knowledge on various economically viable composting techniques, assessing the support infrastructure required and setting up a pilot model of decentralized composting projects using effective public and private partnership models.

1.2.2 Objectives

The project aims to achieve the following:

- To identify potential techniques of composting best suited to Bhutanese households along with potential financing models

Kingdom of Bhutan

- Identify the kind of support infrastructure needed for setting up and managing different composting projects.
- Demonstrate a decentralized method of composting by undertaking a pilot

1.2.3 Project Outputs

Following measurable outputs would be attained after the end of the program

- A guidebook on composting techniques and financing models for promoting composting at decentralized and centralized level A better understanding of the kind of support infrastructure needed for setting up and managing
- An assessment of support infrastructure needed for setting up and managing composting projects
- Pilots for demonstration for a decentralized composting technology at household level

1.2.4 Relationship to the country's sustainable development priorities

With the growing issue of solid waste generation and disposal, efforts are being made in exploring different solutions as well as formalizing the waste management sector in the country. The current programme evolving out the extensive stakeholder consultation as part of the TNA exercise is reflective of the views of concerned government officials as well as in line with the principles of the Bhutan's, Waste Prevention and Management Act, 2009. Bhutan has started exploring public-private partnership projects to improve solid waste management systems and even for setting up composting projects. A composting plant has been set up in Thimphu and there are plans for setting up plants in other urban towns. The National Environment Commission, responsible for overall coordination, particularly regulatory aspects of waste management in the country is in the process of developing an integrated strategy for waste management in the country of which composting is a major component.

1.2.5 Project Benefits

The project by identifying and prioritizing composting technologies along with potential financing models will facilitate setting up of composting projects in the country and overall waste management. One of the key components for successful operation of composting projects is availability of compost as a raw material, the current project through a study on developing support infrastructure for waste collection, segregation and transportation will greatly facilitate the availability of compost. The project also focuses of undertaking a pilot for demonstrating decentralized composting model in the country, this will facilitate uptake of similar projects in the country.

1.2.6 Project Scope and Possible Implementation

The project scope will be comprehensive focusing on creating knowledge on technical aspects for both central and local level authorities. The technology demonstration would be in major cities such as Thimphu. The assessment study will be conducted evaluating all potential composting technologies along with financing models for implementation, which will vary by city. The project will be undertaken in a way to contribute to the development of an integrated strategy for waste management in the country of which is currently under progress within NEC. The pilots for decentralized composting projects could be undertaken in a few select cities or a beginning could be made in the city of Thimphu where different composting techniques could be piloted.

The implementation possibility is high as it is directly linked with the integrated strategy being developed for waste management in Bhutan by the NEC. There are ongoing programs also on exploring public private partnership models for waste management by NEC and UNDP Bhutan. The project has a strong linkage with these programs also. Finally, the country is aiming at developing Nationally Appropriate Mitigation Actions (NAMAs) for the waste sector for which the findings of the proposed project idea would be highly useful.

1.2.7 Project activities and timelines

The key project activities and timelines are shown in Table 1 below

Table 1: Proposed project activities- Solid Waste Management sector

S No.	Activity	Sub-activity	Duration	Budget (USD)	Budget heads	Responsibility/Coordination agency	Measurement/Evaluation parameter	Potential Funding sources
1	Developing a guidebook on composting techniques and financing models for promoting composting at decentralized and centralized level	<p>1.1 Identify organization to undertake such a study either domestically or hire external consultants</p> <p>1.2 Prepare a list of possible composting technologies and implementation models (e.g. decentralized, centralized, hybrid). With particular focus on techniques applicable at household level.</p> <p>1.3 Undertake a cost benefit analysis of each technology/model</p> <p>1.4 Describe implementation mechanism for each</p>	6 Months	50000	<p>Cost of staff in MoWHS for project concept preparation, procurement of external consultants and management of the project</p> <p>Consultancy fees</p>	MoWHS and City Councils	<p>A publicly available report on Composting potential in Bhutanese cities to manage waste.</p> <p>A list of finalized technologies for application in the country.</p> <p>A list of possible financing models for promotion of different techniques of composting..</p>	<p>Funds allocated under Bhutan's 11th Five Year Plan; Technical assistance fund and debt fund support from ADB, World Bank and KfW.</p> <p>For funding policy measures and other measures Nationally Appropriate Mitigation Actions (NAMAs) can be developed for the transport sector in</p>

Part IV- Project Idea Report

Kingdom of Bhutan

	technique, identifying roles of involved agencies.							Bhutan. These NAMAs can then attract domestic (unilateral), bilateral and carbon finance based funding (Credited NAMAs)
	1.5 Analyze possible financing models for different techniques of composting. Explore potential of PPP models, incentive schemes from municipalities for households to promote household level composting etc.							Green Climate Fund, Least Developed Country Fund (GEF); World Bank Clean Technology Fund; UNDP MDG Carbon Facility; ADB Climate Change Fund;
	1.6 Document the results of such a study in form of Guidebook, to be made publically available.							International Climate Initiative;
2	An assessment of support infrastructure needed for setting up and managing composting projects	6 months	50,000	Staff cost/consulting costs Workshop costs; Documentation and printing costs	NEC and MoWHS		A report on specific models of support infrastructure developed for adoption by city municipalities.	
	2.1 Appoint a team within NEC or MoWHS for undertaking the study or assign external consultants for the same							
	2.2 Study successful case examples from other countries on the models of support infrastructure applied in other countries. The infrastructure could consist of methods of waste							

Part IV- Project Idea Report

Kingdom of Bhutan

collection, waste segregation and transportation to composting sites for different methods of composting.

2.3 Undertake a consultative workshop to present study findings and seek advice from experts both from within Bhutan and other countries for example, India.

2.4 The kind of support infrastructure needed should be studied at city level and by type of composting technology.

2.5 Finalize the model of support infrastructure to be developed for each identified technology

3	Undertake pilots for demonstration of a decentralized	3.1 Identify and select sites for undertaking pilot based on the selected composting technology. Pilot	12 months	75,000	Staff cost for planning, implementation and management of the pilots	NEC and Ministry of Works and Human Settlement (MoWHS)	Atleast 2 pilots conducted by the 12 months.
---	---	--	-----------	--------	--	--	--

Part IV- Project Idea Report

Kingdom of Bhutan

composting technology at household level could be conducted at an individual household level or at a community housing level

3.2 Appoint the responsible city council as the lead agency for undertaking the pilot.

3.3 Prepare techno-economic feasibility reports and detailed project reports highlighting technology, application and financial details

3.4 Prepare implementation plan including ownership models and project management models, technical skill development plans, etc

3.5 Undertake training of staff of city councils on selected composting technology and implementation model.

- Technical reports including detailed project reports

- Documentation and printing costs

Kingdom of Bhutan

3.6 Implement the pilot and monitor the pilots to draw lessons from pilot applications of the technology

1.2.8 Possible Complications/Challenges

The key challenges in the project are:

- Limited human resources in NEC and MoWHS for waste management, may slow down the process and thereby increase lag time
- Delay in getting access to fund from domestic and international sources
- A formal institutional structure for waste management in the country is currently being designed in Bhutan, in absence of a proper institutional structure and assigned roles and responsibilities there is likelihood of delay in implementation of above activities.

Chapter 2 Project Idea for Transport Sector

2.1 Brief summary of the Project Ideas for Transport

In order to overcome issues related to rising GHG emissions from the transport sector, congestion on roads and passenger safety concerns, efficient use of resources and management of traffic through use of advanced technology has become a necessity for Bhutan. In this context, Intelligent Transport Systems (ITS) used elsewhere has already proven their worth in effectively managing traffic, reducing congestion, increasing safety and attractiveness of public transport systems thereby allowing sustainable growth of transport sector as a whole and reducing GHG and other air pollutants.

The proposed project idea based on other parts of the TNA report suggests a set of activities to ensure successful implementation of ITS in the country by overcoming barriers identified in the course of the TNA exercise. The project idea primarily includes a detailed feasibility study on ITS application in Bhutan and preparation of a Detailed Project Report (DPR) for implementation of ITS project for Thimphu aimed at creating an enabling environment in the country for large scale ITS application in the country.

2.2 Specific Project Ideas

2.2.1 Introduction

Project title: Undertaking a feasibility study on ITS application in Bhutan and preparing a Detailed Project Report (DPR) for introduction of ITS in Thimphu City

Background and rationale

Transport sector accounts for highest energy related GHG emissions (44%) in Bhutan. Number of vehicles on road is increasing at a rate of 10% per annum which is leading to congestion, increased GHG emissions and creating safety issues. There has been significant shift towards private vehicles from public transport as seen in the rate of registered vehicles. Bad road quality, difficult terrain which hinders with road expansion also adds to complication in managing transport.

While supply of additional infrastructure may address the transport demand in short term, the immediate need in the country as identified by key stakeholders is the implementation of efficient transport management systems in various cities. In this context, use of intelligent transport systems (ITS) is a proven technology option applied worldwide and has also been prioritized during the TNA process in Bhutan. Based on the Technology Action Plan prepared for deployment of this technology option, the proposed project ideas includes a detailed feasibility study of ITS application in Bhutan and preparation of a Detailed Project Report (DPR) for the city of Thimphu which would primarily complement the existing Bus Rapid Transit System development plan of the city. The proposed project would create an enabling environment for deployment of ITS in the country by providing necessary information regarding the technology and application potential and also by assessing the capacity building and financial requirements. It also aims at implementing certain components of ITS as pilot projects in Thimphu based on the DPR for demonstration of technology benefits.

These technologies used elsewhere has already proven their worth in effectively managing traffic, reducing congestion, increased safety and increased attractiveness of public transport systems thereby allowing sustainable growth of transport sector as a whole and reducing GHG and other air pollutants.

2.2.2 Objectives

The project aims to achieve the following:

- Create awareness among various stakeholders including policy makers, transport authorities and traffic managers about ITS potential in transport sector in terms of managing traffic.

Kingdom of Bhutan

- Assess skills and capacity building requirements of local level officials to adopt and manage these technologies.
- Identify required policy interventions, budgetary requirements and sources of funding for ITS implementation in Thimphu.

2.2.3 Project Outputs

Following measurable outputs would be resulted after the end of the program

- Prepare a roadmap for implementation of ITS in Bhutan based on a feasibility study
- Feasibility cum Detailed Project Report (DPR) for implementation of ITS project in Thimphu city. DPR to include the following:
 - ITS technology architecture and areas for implementation based on traffic demand models and other surveys, international experience and stakeholder consultation.
 - Institutional structure for implementation and management of ITS systems.
 - Overall financial requirements for implementation and
 - Training needs for managing ITS systems.
- Implementation of a pilot project based on the DPR of Thimphu
- A tool for quantification of congestion, GHG and air pollutant reduction from ITS projects
- Enhanced capacity of transport authorities on ITS benefits and limitations through
 - ITS project orientation workshops
 - One exposure visit of transport authorities comprising of RSTA, MoIC and other city officials to a city where ITS is already being used to manage traffic

2.2.4 Relationship to the country's sustainable development priorities

The proposed project will set up the required base for achieving the transport development and management goals of the Department of Transport as envisaged in their Integrated Strategic Vision and the 11th Five Year Plan. These plans clearly indicate country's ambition to improve public transport facilities through innovative management measures including ITS. The proposed project idea will also contribute to the strengthening of the transport department and its personnel in acquiring necessary skills and resources in terms of implementing transport management systems. The transport sector has been identified as a key sector contributing to rising emission growth of the country in the communication to UNFCCC. The framework to assess the emission reduction and other co-benefits through ITS will assist the government in prioritizing the low carbon transport options in the country and develop appropriate strategies.

2.2.5 Project Benefits

The project will establish the potential of using ITS as a key transport management strategy by reducing congestion, making public transport attractive to users, increasing road safety, reducing emissions and air pollutants and also facilitating optimal use of existing resources such as land. There is limited understanding of how and where ITS technology can be utilized in Bhutan amongst key stakeholders. That is why it is important to take the first step in terms of detailed analysis of potential areas where ITS can make significant contribution as a key transport management strategy and understand its socio-environmental benefits. This project will involve detailed analysis of how ITS can solve issues currently faced by key cities in Bhutan.

The project specific benefits include the following:

- Based on the international experience of ITS implementation and feasibility studies identify right set of technologies and areas to be selected for ITS implementation in the country.

Kingdom of Bhutan

- Reduction of GHG emissions from the transport sector due to reduction in congestion, increase in network speed and enhanced use of public transport. Under the project a tool would be developed which can provide an estimation of GHG reduction due to implementation of ITS measures.
- Enhance co-benefits in terms of reduction in local air pollutants, noise pollution and accidents.
- Enhanced understanding of city transport officials on ITS technologies through the demonstration project and exposure visits to cities with ITS infrastructure.
- Finally, the project will also lead to identifying the overall financial requirements for countrywide ITS implementation so that budget outlays and international financing requirements can be determined.

2.2.6 Project Scope and Possible Implementation

The ITS feasibility study would cover the entire country while the DPR would be prepared for the city of Thimphu only. Although one city is currently included in the scope for actual implementation, the implementation model and emission and cost-benefits assessment tool developed under this project can be utilized for other cities also. The project is linked with the existing surface transport master plan which includes introduction of Bus Rapid Transit System and upgrading the overall transport management system to reduce congestion in Thimphu. Therefore, the implementation potential is very high.

2.2.7 Project activities and timelines

The key project activities and timelines are shown in Table 2 below

Table 2: Proposed Project Activities- Transport Sector

S No	Activity	Sub-activity	Duration	Budget ('000USD)	Budget heads	Responsibility/Coordination agency	Measurement/Evaluation parameter	Potential Funding sources
1	Feasibility study for implementation of ITS in Bhutan	1.1 Background research of various technologies for ITS implementation <ul style="list-style-type: none"> • pros and cons of each technology in each transport area of implementation • overall technological frameworks, • cost impacts • case studies of actual implementations, 	6 Months	100	Cost staff/consultants	of RSTA	A roadmap for ITS implementation in Bhutan. Enhanced understanding of RSTA and MoIC officials regarding the various ITS technologies and application areas.	\$ Funds allocated under Bhutan's 11 th Five Year Plan; Technical assistance fund and debt fund support from ADB, World Bank

Kingdom of Bhutan

									and KfW.
									§ For funding policy measures and other measures
									Nationally
									Appropriate
									Mitigation
									Actions (NAMAs)
) can be developed for the transport sector in
									Bhutan. These NAMAs can
2	Prepare a DPR for ITS implementation in Thimphu and implement a	2.1 Based on city traffic characteristics and travel demand model identify	12 Months	100	<ul style="list-style-type: none"> Cost of staff/consultants Travel, accommodation and other related 	RSTA		- DPR approved for implementation	

Part IV- Project Idea Report

Kingdom of Bhutan

demonstration
project

specific ITS
technologies,
systems and
integration
requirements,
technical
specifications of
systems, report
generation and
monitoring
parameters post
system
implementation.

2.2 Develop a tool
to assess the
impact of ITS
implementation
based on user
preference and
travel data
collected in
previous step. The
impact parameters
for analysis could
be safety
improvements,
network speed
reduction, increase
in public transport
utilization,

expenses

then
attract
domesti
c
(unilater
al),
bilateral
and
carbon
finance
based
funding
(Credite
d
NAMAs)

§ Green
Climate
Fund,
Least
Develop
ed
Country
Fund
(GEF);
World
Bank
Clean
Technol
ogy
Fund;

Part IV- Project Idea Report

Kingdom of Bhutan

increased in reliability of public transport systems, reduction in fuel consumption and GHG emissions.						UNDP MDG Carbon Facility; ADB Climate Change Fund; International Climate Initiative;
2.3 Develop an implementation and management framework of ITS system in Thimphu.						
2.4 Estimate financial requirements for implementation of ITS system in Thimphu						
2.5 Implementation of pilot project in Thimphu based on the DPR	12 months	Will depend on the results of the DPR and technology selected for pilot	<ul style="list-style-type: none">• Equipments• Operation and management cost		Actual implementation of the key technology components	

2.2.8 Possible Complications/Challenges

The key challenges in the project are:

- High costs of these systems in absence of any financial incentives/support may result in limited implementation of these systems
- Lack of effective coordination between planning and implementing agencies with overlapping mandates between RSTA and City Planners can pose a challenge to overcome during the course of the project implementation
- General elections are being planned this year which may result in change in relevant ministries and transport department. This may result in delay in final approval subsequently delaying the project implementation
- A proposal has been made to government to include Department of Road Safety and Transport Authority (RSTA) under the Ministry of Human Works and Settlement. The department is currently under the Ministry of Information and Communication. If the change is approved, there could be some delay in the proposed project.

Chapter 3 Project Ideas for Industries Sector

3.1 Brief summary of the Project Ideas

Diffusion of waste heat recovery technologies in Bhutan requires an enabling environment for market players and government agencies. While the technology is highly matured and widely used in industries in the region, the market for this technology in Bhutan is not ready to adopt these technologies. While the national government has already initiated action towards formulating a national energy efficiency policy covering the manufacturing sector also, market readiness measures for diffusion of waste heat recovery technologies in the country will further complement this initiative.

The proposed project idea for diffusion of waste heat recovery technologies in Bhutan includes a set of activities which will provide necessary market information such as waste heat recovery and application potential, potential technologies, etc. The project also includes setting up a demonstration project which will assist industries and government in developing diffusion strategy for the technology.

3.2 Specific Project Ideas

3.2.1 Introduction

Project Title:Development of a WHR implementation model in Bhutanese industries based on a WHR feasibility study and a demonstration project

Background and rationale

The ferroalloy and iron and steel industries in Bhutan have sufficient amount of waste heat discharge (approximately 300 degree Celsius) which can be tapped using various waste heat recovery technology options. During the sectoral stakeholder consultation meetings, the task force members suggested that for diffusion of WHR technologies, a well-defined policy for energy efficiency in industries and market enabling measures are essential. Since the awareness and technical knowledge about WHR technologies is very limited in the country, the stakeholders felt that it would be appropriate to design a program which would focus on market enabling measures and thereby develop an implementation framework.

Therefore, the proposed project idea includes a detailed feasibility study for assessing the WHR potential and appropriate technologies for the Bhutanese industries and setting up a demonstration project which will assist industries and government in developing diffusion strategy for the technology. As part of setting up the demonstration project, the project idea also includes organizing an exposure visit of relevant stakeholders to a site where WHR has been successfully implemented and operated. Based on the above key components, the proposed project aims to develop a national level implementation model for WHR technologies in the manufacturing industries sector.

3.2.2 Objectives

The project aims to achieve the following:

- Create awareness among policy makers, industries and technology suppliers about industrial waste heat recovery potential in Bhutan
- Develop an implementation framework for WHR projects in industries to promote energy efficiency in Bhutan
- Establish domestic and international linkages of industries with technology suppliers, industry experts and financial institutions for adopting energy efficiency measures

3.2.3 Project Outputs

Following measurable outputs would be attained after the end of the program

- A detailed feasibility report on WHR in Bhutanese manufacturing industries sector providing necessary information related to WHR potential, suitable technologies, cost, etc.
- One WHR pilot project in a selected ferro alloy industry in Bhutan for demonstration of benefits and of suitable technology options

Kingdom of Bhutan

- An exposure visit of a Bhutanese delegation team comprising of industries, association members, financial institutions and government officials to a WHR project site and participation in selected technology exhibitions
- Development of an implementation model for WHR technology in the country

3.2.4 Relationship to the country's sustainable development priorities

The industries sector in Bhutan is seeing a rapid growth in recent years. As these industries are highly energy intensive, there is a strong inclination of industry players and government on energy efficiency to achieve a sustainable industrial growth. This is evident in Bhutan's second national communication to UNFCCC and its carbon neutral strategy. Therefore, the proposed program is very well aligned with the national sustainable and low carbon development priorities. Further, the Department of Renewable Energy under the Ministry of Economic Affairs is aiming to develop a comprehensive energy efficiency policy of the country. The proposed project will also contribute meaningfully in this regard. By developing skilled work force in the energy efficiency sector, the project also aims to create new employment opportunities and enhanced focus on energy efficiency.

3.2.5 Project Benefits

The project will develop confidence among industries to implement WHR technologies which is a highly matured technology option but yet to be adopted by any industry in Bhutan. The pilot project will demonstrate the energy efficiency potential in industries through WHR. Various technology options are available which can tap up to 50% of the waste heat generated. The tapping of waste heat and using it in the process can reduce the external energy requirements for industries and thereby saving energy. By reducing the discharge of waste heat, reduction in SO_x, NO_x, VOCs and unwanted heat can also be achieved which will improve the atmosphere surrounding the industries. The proposed project will also provide required benefits and cost information to all the key stakeholders and decision makers.

3.2.6 Project Scope and Possible Implementation

The proposed project's scope includes all the ferro alloy and iron and steel industries in Bhutan. The project is linked with the energy efficiency baseline development project of Department of Renewable Energy, Ministry of Economic Affairs Bhutan supported by the United Nations Development Program (UNDP) which intends to develop an energy baseline of the entire country including the industry sector and formulate national energy efficiency policy of the country. The proposed project will complement the on-going project by making it more specific to manufacturing industries and waste heat recovery technologies. The recommended implementation model under the proposed project based on the demonstration project and creation of skilled professionals will ensure actual implementation and long term sustainability of the WHR projects in industries.

3.2.7 Project activities and timelines

The key project activities and timelines are shown in Table 3 below

Table 3: Proposed Project Activities- Solid Waste Management Sector

S No.	Activity	Sub-activity	Duration	Budget (USD '000)	Budget heads	Responsibility/Coordination agency	Measurement/Evaluation parameter
1	Feasibility study on Waste heat recovery in Bhutanese industries	<p>1.1 Preliminary walk through energy audit in the ferro alloy and iron and steel industries to assess baseline energy consumption and identify preliminary energy efficiency options</p> <p>1.2 Assessment of quantity, quality and location of waste heat currently being discharged to environment</p> <p>1.3 Assessment of waste heat applications in the industries</p> <p>1.4 Identification of WHR technologies appropriate to Bhutanese industries</p> <p>1.5 Benefit cost analysis and policy</p>	6 months	100	<p>- Cost of staff in Department of Renewable Energy for project concept preparation, procurement of external consultants and management of the project</p> <p>- Consultancy fees</p>	Department of Renewable Energy – Provides dedicated staff and procure services from consultants for the study	<p>WHR potential in Bhutanese industries assessed in terms of waste heat generated, potential recoverable waste heat, suitable technologies and applications of waste heat. Overall energy efficiency potential in industries sector in terms of percentage of energy saved.</p> <p>- Allocated budget under the ongoing program of energy efficiency base-lining and energy efficiency policy development</p> <p>- International climate finance through various sources such as Least Developed Countries Fund, Clean Technology Fund, and</p>

Kingdom of Bhutan

		recommendations for incentives					carbon funds such Global Carbon Fund.
2	Exposure visit to WHR technology application site	Identify potential sites where WHR technology applications have been successful and finalize few selected sites/industries for exposure visits (Multiple sites in India can be identified where a large number of successful projects are running. This may also include sending few delegates to WHR technology exhibitions in other countries) 2.1 Finalize list of delegate members for the proposed visit 2.2 Develop agenda and coordinate the actual site visit 2.3 Prepare site visit report and communication (publishing in websites, reports, etc.)	2 months (including preparation time for the trip)	30	- Cost of staff/consultants for preparing the agenda, site identification and coordination of the site visit - Travel, accommodation and other related expenses	Department of Renewable Energy and Department of Industries- Coordinate with each other in all the activities	20-30 delegates from government, industries, industry associations and financial institutions get exposed to benefits and application of WHR technologies
3	Design and set up a demonstration project on WHR	3.1 Select a suitable site/industry for WHR technology application 3.2 Prepare techno-	18 months	300	-Staff cost for planning, implementation and management	Department of Industries and Department of Renewable Energy- Coordinate and manage the	One pilot project set up in Bhutan
							- By developing NAMAs for the industries sector in Bhutan climate finance can be accessed under the supported and credited NAMA mechanisms

Kingdom of Bhutan

economic feasibility reports and detailed project reports highlighting technology, application and financial details

3.3 Prepare implementation plan including ownership models and project management models, technical skill development plans, etc.

3.4 Procure appropriate technology based on standard procurement procedures

3.5 Implementation of the project

3.6 Develop an institutional framework for delivering the training and capacity building programs

3.7 Create a website/webpage within DRE and DOI for knowledge creation on WHR and about the energy auditor training program

of the project

- Technical reports including detailed project reports

- Engineering, procurement and construction cost

- Operation and maintenance cost

project and access required funds for the project

Kingdom of Bhutan

4	Develop implementation model for WHR technologies	4.1 Design institutional structure, financing mechanisms, policy framework and technology specifications for implementation of WHR technologies in industries in Bhutan	4-6 months	50	-Staff/consultant cost	Department of Renewable Energy and Department of Industries with support from National Environment Commission Secretariat.	An implementation model approved by the Ministry of Economic Affairs and included in its policies/programs on industrial energy efficiency
---	---	---	------------	----	------------------------	--	--

3.2.8 Possible Complications/Challenges

The key challenges in the project are:

- Low potential and subsequently high cost of WHR in industries may result in limited adoption of the WHR technologies and difficulty in getting political buy-in
- Limited human resources in DRE and DOI may slow down the process and thereby increase lag time
- Delay in getting access to fund from domestic and international sources
- Delay in implementation of pilot projects due to low level of supportive infrastructure

Annex I. List of Stakeholders consulted

Several stakeholders were consulted in the process of preparation of the current Technology Action Plan Report. The list of stakeholders consulted along with their contacts is provided below.

S. No.	Name	Organization	Type of Consultation	Topics consulted for
1.	Birkha B. Chhetri, General Secretary	Association of Bhutanese Industries	Roundtable discussions and one on one interview	Industries
2.	Chhimi Dorji, Deputy Executive Engineer	Department of Hydro Meteorology Services	Roundtable discussions and one on one interview	Water, Agriculture
3.	Chhimi Rinzin, Chief Agriculture Officer	Department of Agriculture	Roundtable discussions	Agriculture
4.	Dawa Chogyel, Deputy Chief Environment Officer (EU-DOI),	Ministry of Economic Affairs	Roundtable discussions	
5.	G K Chhopel, Chief, Water Resources Division	National Environment Commission Secretariat	Roundtable discussions and one to one interview	Water
6.	Tek Nath Kararia, Civil Engineer	Thimphu Thromde	Roundtable discussions	Waste
7.	Gyembo Tenzin, Deputy Executive Engineer	Department of Agriculture	Roundtable discussions	Agriculture
8.	Jigme Nidup, Senior Environment Officer	National Environment Commission Secretariat	Roundtable discussions	Farmroads
9.	K. P Bhandari, DGM (plant)	SKW Tashi Metals	Roundtable discussions	Industries
10.	Karma Pemba, Chief Transport Officer	Road Surface and Transport Authority	Roundtable discussions and one to one interview	Transport
11.	Karma Tshethar	Department of Agriculture	Roundtable discussions	Agriculture
12.	Kunzang Choden, Senior Research Officer	Council of RNR Research in Bhutan	Roundtable discussions and one to one interactions	Water, Agriculture

Annex II

Kingdom of Bhutan

13.	Nima Dorji, Engineer	Department of Agriculture	Roundtable discussion	Water, Agriculture
14.	Namgay Thinley, Deputy Chief Horticulture Officer	Department of Agriculture	Roundtable discussion	Agriculture
15.	Prem P. Adhikari, Senior Transport Officer	Road Safety and Transport Authority	Roundtable discussion	Transport
16.	Sherab Jamtsho, Deputy Executive Engineer	Department of Renewable Energy	Roundtable discussion	Industries
17.	Subarna Sharma, General Manager	Ugen Ferro Alloy Pvt Ltd	Roundtable discussion	Industries
18.	Tashi Dorji, Head of Administration	SKW Tashi Metals	Roundtable discussion	Industries
19.	Tashi Wangdi, Senior Manager	Bhutan Ferro Alloys Ltd	Roundtable discussion	Industries
20.	Tenzin Khorlo, Chief Environment Officer	National Environment Commission Secretariat	Roundtable discussion	Waste
21.	Thinley Dorji, Chief, Compliance Monitoring Division	National Environment Commission Secretariat	Roundtable discussion	
22.	Trashi Namgyel, Hydromet Officer	Department of Hydro Meteorology Services	Roundtable discussion	Water
23.	Tshering Yangchen, Assistant Environment Officer	Thimphu Thromde	Roundtable discussion	Waste
24.	Yeshey Penjor	Independent consultant	Roundtable discussion and one to one interview	Waste
25.	Tshering Wangchuk, Program Officer		Roundtable discussion	
26.	Tshewang Lhamo, Environment Officer		Roundtable discussion	