GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

Naoko Ishii
CEO and Chairperson

February 25, 2015

Dear Council Member:

UNIDO as the Implementing Agency for the project entitled: ***India: Organic Waste Streams for Industrial Renewable Energy Applications in India***, has submitted the attached proposed project document for CEO endorsement prior to final approval of the project document in accordance with UNIDO procedures.

The Secretariat has reviewed the project document. It is consistent with the proposal approved by Council in April 2013 and the proposed project remains consistent with the Instrument and GEF policies and procedures. The attached explanation prepared by UNIDO satisfactorily details how Council's comments and those of the STAP have been addressed. I am, therefore, endorsing the project document.

We have today posted the proposed project document on the GEF website at www.TheGEF.org. If you do not have access to the Web, you may request the local field office of UNDP or the World Bank to download the document for you. Alternatively, you may request a copy of the document from the Secretariat. If you make such a request, please confirm for us your current mailing address.

Sincerely,

Naoko Ishii

Attachment: GEFSEC Project Review Document
Copy to: Country Operational Focal Point, GEF Agencies, STAP, Trustee

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REQUEST FOR CEO ENDORSEMENT

PROJECT TYPE: FULL-SIZED PROJECT
TYPE OF TRUST FUND: GEF TRUST FUND

PART I: PROJECT INFORMATION

Project Title: Organic waste streams for industrial renewable energy applications in India			
Country(ies):	India	GEF Project ID:[1]	5087
GEF Agency(ies):	UNIDO	GEF Agency Project ID:	120095
Other Executing Partner(s):	Ministry of New and Renewable Energy (MNRE)	Submission Date: Resubmission Date:	10-01-2014 02-09-2015
GEF Focal Area (s):	Climate change	Project Duration(Months)	60 months
➢		Project Agency Fee ($):	316,635

A. FOCAL AREA STRATEGY FRAMEWORK[2]

Focal Area Objectives	Expected FA Outcomes	Expected FA Outputs	Trust Fund	Grant Amount ($)	Cofinancing ($)
CCM-3	Outcome 3.1: Favourable policy framework created for renewable energy (RE) investments in industrial and commercial applications	Output 3.1: RE policy and regulation in place	GEF TF	1,633,000	8,015,000
	Outcome 3.2: Investment in RE Technologies increased	Output 3.2: Electricity and heat produced from renewable sources	GEF TF	1,700,000	10,200,000
		Total project costs		3,333,000	18,215,000

B. PROJECT FRAMEWORK

Project Objective: The proposed project will focus on using organic waste streams for industrial renewable energy (RE) applications in SMEs, in support of the energy policy priorities, with the overall aim for promoting application of innovative and adaptive technology in the target SME sectors to reduce their dependency on fossil fuels.

Project Component (PC)	Grant Type	Expected Outcomes	Expected Outputs	Trust Fund	Grant Amount ($)	Confirmed Cofinancing ($)
1. Strengthening the policy and institutional framework	TA	1.1 Enhanced use of organic waste streams for industrial RE applications in target SME sectors through a strategic roadmap	1.1.1 An updated and tailored roadmap for increased use of waste-to-energy practices in the target SME sectors	GEF TF	200,000	1,000,000
2. Demonstration of the most relevant financially feasible technologies in selected sectors	TA	2.1 Demonstrated technical and financial viability of 2-4	2.1.1 Techno-financial and strategic assessment of most suitable business models 2.1.2 A 'Consolidation	GEF TF	549,000[3]	2,745,000

[1] Project ID number will be assigned by GEFSEC.
[2] Refer to the Focal Area Results Framework and LDCF/SCCF Framework when completing Table A.
[3] The clarification and justification on the TA budget shift from PC3 to PC2 compared to PIF is provided in Section A.5.1

		projects in the range of 0.25 – 2 MW (or equivalent thermal energy).	Matrix' on appropriate financial models and schemes suitable for innovative technology financing in SMEs 2.1.3 At least 4 detailed technology packages with specifications for identified technologies for target sectors (food processing, poultry, cattle and sugar-press mud) and applications (e.g. thermal, power, bio-CNG)			
	INV		2.1.4. 2-4 organic waste to energy projects using 2-4 innovative technologies with a capacity of 3.7 MW installed and operating in selected SME sectors	GEF TF	1,700,000	10,200,000
3. Scale up of technologies in organic waste to energy applications in industry	TA	3.1 Sustainable replication model for effective scaling up of different technologies across target industries	3.1.1 Development of database and tools to identify and help SMEs to invest in innovative biogas projects 3.1.2 Specific financing mechanism established to reduce risk for investing in innovative biogas projects and sources of funds secured to ensure a healthy project pipeline 3.1.3 Framework for Service Support Networks in different sectors/clusters set up 3.1.4 Quality standards, performance guidelines, and a standardization framework for innovative biogas projects in SMEs in place	GEF TF	316,000	1,580,000
4. Capacity building of public and private sector stakeholders	TA	4.1 Enhanced capacity of key players in target industries, promotion of knowledge and information sharing and dissemination of best practices	4.1.1 Enhanced awareness and knowledge in key players in target 30 – 50 SMEs, 20 – 30 banks/FIs, technical institutions, manufacturers and other service providers in each of the selected states. 4.1.2 Knowledge products developed that are targeted at anaerobic digestion in industrial sector, including those to facilitate technology transfer. 4.1.3 Capacity building	GEF TF	350,000	1,750,000

			mechanism for O&M, technical and service roles is established at state level to develop and retain skilled workforce for innovative biogas applications			
5. Monitoring and Evaluation and Knowledge Management	TA	5.1 Project's progress towards goals confirmed and/or necessary adjustments made	5.1.1 Periodic evaluation, documentation, and mid-course corrective measures (if any); knowledge sharing with project partners	GEF TF	60,000	150,000
Subtotal					3,175,000	17,425,000
Project management Cost (PMC)[4]					158,000	790,000
Total project costs					3,333,000	18,215,000

C. SOURCES OF CONFIRMED COFINANCING FOR THE PROJECT BY SOURCE AND BY NAME ($)

Please include letters confirming cofinancing for the project with this form

Sources of Co-financing	Name of Co-financier (source)	Type of Cofinancing	Cofinancing Amount ($)
National Government	MNRE	Cash (grant) / In-Kind	5,277,000
National financing sector	SIDBI	Cash (loan)	6,394,000
National financing sector	Axis Bank Ltd	Cash (loan)	6,394,000
GEF Agency	UNIDO	Cash (grant)	75,000
GEF Agency	UNIDO	In-kind	75,000
Total Co-financing			18,215,000

D. TRUST FUND RESOURCES REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY[1]

GEF Agency	Type of Trust Fund	Focal Area	Country Name/ Global	(in $)		
				Grant Amount (a)	Agency Fee (b)[2]	Total c=a+b
Total Grant Resources						

[1] In case of a single focal area, single country, single GEF Agency project, and single trust fund project, no need to provide information for this table. PMC amount from Table B should be included proportionately to the focal area amount in this table.

[2] Indicate fees related to this project.

F. CONSULTANTS WORKING FOR TECHNICAL ASSISTANCE COMPONENTS:

Component	Grant Amount ($)	Cofinancing ($)	Project Total ($)
International Consultants	135,000	135,000	270,000
National/Local Consultants	621,667	1,678,333	2,300,000

G. DOES THE PROJECT INCLUDE A "NON-GRANT" INSTRUMENT? No

(If non-grant instruments are used, provide in Annex D an indicative calendar of expected reflows to your Agency and to the GEF/LDCF/SCCF/NPIF Trust Fund).

[4] PMC should be charged proportionately to focal areas based on focal area project grant amount in Table D below.

PART II: PROJECT JUSTIFICATION

A. DESCRIBE ANY CHANGES IN ALIGNMENT WITH THE PROJECT DESIGN OF THE ORIGINAL PIF[5]

A.1 National strategies and plans or reports and assessments under relevant conventions, if applicable, i.e. NAPAS, NAPs, NBSAPs, national communications, TNAs, NCSA, NIPs, PRSPs, NPFE, Biennial Update Reports, etc.

The project reflects the Government's priorities to promote sustainable development as set out in the National Action Plan on Climate Change (NAPCC). In aiming to mitigate Greenhouse Gas (GHG) emissions from the use of organic waste for energy in industrial applications the project is consistent with the Second National Communication of India, submitted to the UNFCCC in 2012, which identifies energy production and use as a target area to reduce emissions. At the 15th Conference of Parties in 2009, India emphasized the need for implementing a comprehensive domestic response to reduce the emissions intensity of GDP by 20-25% by 2020, compared to 2005 levels. The project is also consistent with the resulting 12th Five-year plan (2012-2017) which has, as one of its key pillars, a low-carbon growth strategy.

The NAPCC identifies measures to promote India's development objectives while also resulting in co-benefits in terms of addressing climate change. Broadly, the NAPCC is based on the following seven guiding principles:

1. Protecting the poor and vulnerable sections of society through an inclusive and sustainable development strategy, sensitive to climate change.
2. Achieving national growth objectives through a qualitative change in direction that enhances ecological sustainability, leading to further mitigation of greenhouse gas emissions.
3. Devising efficient and cost-effective strategies for end user Demand Side Management.
4. Deploying appropriate technologies for both adaptation and mitigation of greenhouse gases emissions extensively as well as at an accelerated pace.
5. Engineering new and innovative forms of market, regulatory and voluntary mechanisms to promote sustainable development.
6. Effecting implementation of programmes through unique linkages, including with civil society and local government institutions and through public private-partnership.
7. Welcoming international cooperation for research, development, sharing and transfer of technologies enabled by additional funding and a global IPR regime that facilitates technology transfer to developing countries.

There are eight National Missions which form the core of the NAPCC, representing "multi-pronged, long-term and integrated strategies for achieving key goals in the context of climate change". This project is consistent with, and supportive of, the National Mission for Enhanced Energy Efficiency (NMEEE), one of these eight National Missions. Apart from its focus on improvements in process energy efficiency, the type of RE proposed (i.e. waste utilization, fuel switch from fossil fuels to organic waste) also serves the goal of the NMEEE. The GHG mitigation options in the industrial sector suggested by the NMEEE include cross-cutting technologies and fuel switch. The latter option includes switching from fossil fuels to produce gas from biomass fuels for various applications, e.g. thermal, power, bio-CNG. The identification of opportunities that facilitate the use of existing resources and continued economic development through differentiated sectoral policies will assist India in reducing its vulnerability to climate change. The NMEEE puts emphasis on activities related to cluster development, particularly in SMEs. The project, with its focus on an increased use of existing organic waste streams in SMEs will clearly serve these objectives.

MNRE executed a project aiming at development of high-rate biomethanation processes as means of reducing greenhouse gas emissions, which commenced in 1994 and completed in 2005. Implemented by UNDP, this project aimed at emission reduction and control in India by applying state-of-the-art bio-methanation technology to a number of waste substrates from various sectors including municipal, agricultural and industrial. The objective was to develop a national strategy for biogas generation and utilization, demonstrate a variety of technologies and educate the various stakeholders about the benefits of energy generation from waste products. This particular project

[5] For questions A.1 –A.7 in Part II, if there are no changes since PIF and if not specifically requested in the review sheet at PIF stage, then no need to respond, please enter "NA" after the respective question.

provided a big boost to the MNRE waste to energy (WTE) project. By the end of the project, various domestic consultants and technology providers had appeared in India. These technologies started gaining traction in the Indian market and with wide scale adoption, costs began to fall.

As a part of the policy recommendations, a National Master Plan (NMP) for Waste to Energy was also prepared under which the potential of WTE projects in various industries and from city waste was estimated. This document was released in 2005 and has not been updated since. There is also a government support programme (*baseline project*), which includes incentive schemes for industrial waste, for CHP and for bio-methanation; yet it is acknowledged that this – despite its importance – provides an insufficient signal for sectors, and especially SMEs, to invest in state-of-the-art innovative technologies. Specific barriers remain at the financial level, as well as on technical and capacity building level. Due to a lack of a tailored policy framework and absence of nation-wide capacity building efforts, the replication of the innovative waste-to-energy bio-methanation application is being affected.

A.2. GEF focal area and/or fund(s) strategies, eligibility criteria and priorities

The project will contribute to the GEF Climate Change Strategic Objective 3: Promote investment in renewable energy technologies. The project aims to transform the market for using organic waste for SME industrial energy applications in India. It aims to do this through triggering investment in organic waste-to industrial energy projects, through market demonstration, development of appropriate financial instruments, development of technical specifications, capacity building and by strenghtening the policy and regulatory environment. Setting up the market environment that allows and promotes the use and replication of such technologies will lead to significant GHG emission reductions and help India in its transformation towards low carbon development.

A.3 The GEF Agency's comparative advantage:

Since its establishment, UNIDO has built up a long track record assisting countries to implement industrial support programmes. UNIDO's Energy and Climate Change Branch pursues the integration of low-carbon objectives into industrial development policies and activities, especially with respect to small- and medium-sized industries. In particular, UNIDO helps its clients solve two fundamental problems: (i) de-linking intensity of energy and material use from economic growth, and (ii) reducing the environmental damage that occurs with energy and material use. Within UNIDO, potential synergies with relevant programmes, such as the Environmental Management, Business, Investment and Technology, Trade Capacity-Building and Agri-Business Development, will be established

GEF council document GEF/C.31/5 states that UNIDO's overall comparative advantage is that it can involve the industrial / private sector in projects. This is also the case in the proposed project, where the focus will be on facilitating a low carbon development pathway for agro-industries in India. Critical factors for the success of the project are the implementation of the technical solutions which are tailored to the local needs of India's four sub-industrial sectors, and the creation of a vibrant local supply chain, so that equipment components are produced cost-effectively, system construction and costs are in keeping with the local economy, and operation and maintenance are timely and affordable. UNIDO's experience in working with the industrial sector in general and small and medium-sized enterprises in particular, is therefore critical for the achievement of the objectives set forth in this project. Furthermore, the document illustrates the comparative advantages of UNIDO services in sustainable energy and climate change as increasing productivity and competitiveness through the introduction of state-of-the- art renewable energy technologies; and reducing GHG emissions through capacity building.

UNIDO has widespread experience to interact with all levels of stakeholders from the private and public sector as well as CSOs. The proposed GEF project draws on this experience by strengthening the competitiveness of local industries and by introducing renewable energy technologies. UNIDO gives special attention to mainstream gender equality throughout its technical cooperation project portfolio, and with local productive activities in India often carried out by women, this is expected to prove a very important aspect of this project.

To ensure up-to-date know-how, UNIDO actively collaborates with a number of energy technology centers, networks and learning platforms worldwide, such as the International Centre for Science and High Technology in Trieste, the National Cleaner Production Centers (46 countries) and the Green Industry Platform to form strategic partnerships to promote knowledge management and best practices for technology transfer.

UNIDO is well-placed to implement this project with its global network of experts and experience from its relevant (GEF funded) project portfolio.

The proposed project will build on the ongoing efforts of MNRE under GEF4, specifically GEF / UNIDO's project "Promoting Energy Efficiency and Renewable Energy in Selected Micro, Small and Medium Enterprises (MSME) clusters in India", which, apart from its main focus on EE, also has a (limited) RE – including biomass – component.

The 12 target clusters are: Brass (2 clusters, focus on EE only), Ceramic (3 clusters, focus on EE only), Dairy (2 clusters, focus on EE and solar), Foundry (3 clusters, focus on EE, and biomass in 1 of 3 clusters), Hand Tools (2 clusters, focus on EE and solar in 1 of 2 clusters). The RE component focuses on the provision of low temperature process heat and with only one cluster with a potential biomass component (i.e. biomass in foundry); as such there is no direct overlap in terms of sectors, clusters and renewable energy sources, yet the best practices and lessons learned from the project will provide valuable input to the implementation of the proposed project. The UNIDO GEF-5 project "Promoting business models for increasing penetration and scaling up of solar energy in India" (recently approved) focuses on medium to high temperature applications for both heating and cooling in industry, a type of technology which is advancing rapidly and most promisingly, yet which thus far has not fully demonstrated its technological preparedness for wide-scale application. The current project on organic waste streams is expected to target different sectors and clusters from those targeted in the mentioned solar project.

More details on UNIDO's thematic expertise on bio-energy are provided in section A.7.

A.4 The baseline project and the problem that it seeks to address:

A.4.1 Energy and waste situation in India

India's energy use has been increasing rapidly as a result of economic growth in the last decade. In the period from 2005-6 to 2011 India's GDP growth averaged an unprecedented to 8.4% a year. Although more recently it has slowed down, the growth is still impressive at 5% in the year 2012 and the Government of India (GoI) forecasts growth rates of between 6.2 and 6.7% for 2013-14. Demand for energy has increased at a higher rate because of the economic growth in energy intensive sectors. High growth of these sectors has resulted in a high elasticity of energy consumption and a high environmental impact in terms of emissions with respect to GDP.

India lacks sufficient domestic energy resources to meet its demand and about 30% of India's total energy needs are met through imports. Crude oil is mainly used in transportation, whereas natural gas is used in industries and power generation. Coal is extensively used in power generation and industrial heating applications. According to the International Energy Agency, coal/peat accounts for nearly 40% of India's total energy consumption, followed by nearly 27% for combustible renewable and waste and 24% for oil. The demand and supply imbalance in energy sources is large in India, with official peak deficits in the electricity sector in the order of 12.7%[6], which is likely to increase in the future. With the electricity supply shortages, large quantities of diesel and furnace oil are being used by all sectors – industrial, commercial, institutional and residential.

In recent years, the government has recognized the energy security concerns of the nation and placed more importance on energy independence. Various initiatives have been taken towards establishing energy efficient technologies, energy conservation measures and regulatory frameworks, while diversifying energy sources to meet national goals and simultaneously addressing climate change concerns.

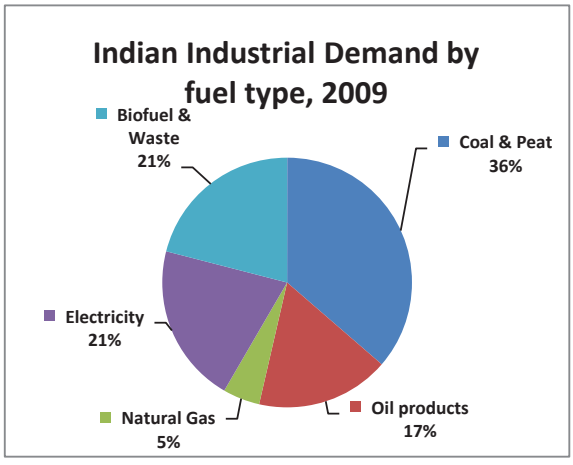


Figure 1: Indian Industrial Demand by fuel type

Industrial energy consumption is responsible for 28%[7] of India's total energy consumption, yet electricity is a relatively small constituent of this industrial energy demand. In 2009 only 21% of industrial energy demand was in the form of electricity, as shown in the following figure. The rest of the demand was met by coal, biomass, oil products and gas, indicating that a large amount of energy in the industrial sector is used to provide thermal energy/heat. Oil products accounted for 17% of total industrial demand. The consumption of oil in the industrial sector stands at close to 40 million tonnes, 40-50% of which provides thermal energy with a temperature range below 250˚C, equal to around 15 million tonnes of fuel oil per annum[8]. With the economy and the industrial sector poised for rapid growth, one of the defining developmental challenges is to meet the consequent demand for energy in an inclusive, economical and environmentally sustainable manner. Since India depends on fossil fuels to meet its energy needs and with increased

[6] CEA Annual Report 2009-10

[7] Source: http://www.iea.org/stats/balancetable.asp?COUNTRY_CODE=IN

[8] http://mnre.gov.in/file-manager/UserFiles/solar_energy_potential_in_industries.pdf

volatility in prices in fuel markets an increased use of renewable energy can help maintain the country's energy security and reduce its exposure to price rises. India's significant untapped renewable energy potential is expected to pave the way for a secure, affordable and environmentally sustainable energy future for the country.

Industries in India generate large amounts of waste, and with the Indian economy expanding waste generation will consequently increase. Industries generate waste of different types, ranging from organic biodegradable waste to inorganic, metallic, plastic, hazardous wastes, liquid effluents, flue gas streams containing particulates and waste heat. Barring a few industries, mostly large sized, most of the industries dispose of the waste as effluents or dump it to degrade in the natural course, the main reasons being the uneconomical treatment for safe disposal or recovery of energy. If there is local demand for the waste then it is also sometimes used locally, e.g. by farmers. In recent years some of the waste streams have been treated in the wake of strong pollution control laws and their stricter enforcement.

There is clear legislation on waste disposal to avoid environmental pollution from industrial operations or municipal waste. For industries there are standards set by Control Pollution Control Board on the concentrations not to be exceeded for disposal on land or water. These standards specify limits of BOD, pH, oil and grease, suspended solids as well as quantities of wastewater. These levels are summarized in the technical annexes. In the case of larger industries where waste quantities are larger, some industries have realized the economic value of the waste and no longer treat their waste as waste but as by-products. That said, enforcement of the environmental legislation is not universal and so many companies, particularly SMEs, continue to dump the waste illegally.

A.4.2 Use of organic waste-to-energy technologies in Indian industry

Industries in India generate large amounts of waste and are energy intensive. As the Indian economy expands waste generation and energy demand will also increase. Much of the waste is organic and can be used for energy. There are a number of technologies in commercial use which convert organic waste to energy. These include biochemical conversion technologies such as bio-methanation, and thermo-chemical technologies including pyrolysis, incineration, gasification and combustion. Under the Clean Development Mechanism (CDM) there has been a large number of industrial organic waste to energy projects registered. The majority of these projects typically have a capacity of over 5 MW, with projects involving rice husk or bagasse in organized industry as large as 15 MW; for poultry litter waste plants the most frequently observed size is around 3 MW. Most projects provide grid-connected renewable electricity (106 registered) and some thermal energy (56). The technology employed by agro-residue based projects is mostly combustion which could also include cogeneration depending on use of steam e.g. for rice or sugar mills. For poultry litter the technologies employed have been bio-methanation and gasification. Each of these technologies has very different characteristics. The choice of technology depends on the nature and calorific value of the waste and the desired output. In general bio-methanation works well with liquids and semi-solids, while gasification/pyrolysis and combustion are suitable for solids and semi-solids.

Following consultation with GoI and stakeholders it has been decided to focus on bio-methanation (also referred to as biogas or anaerobic digestion (AD)) for this project. This is due to the large potential which is untapped by industry, because it is typically more economic than other technologies and because it is a technology area in which significant and promising innovation has been observed, both at the upstream and downstream level (see Section A.4.3 for more details on examples of recent innovation). The benefits of AD are multiple: emission reductions, diversity of fuel supply and energy security, reduction in fuel costs and reliance on fossil fuels, a reliable energy supply, economic growth, job creation, as well as the global potential for technology transfer and innovation.

A.4.3 Status of international biogas technologies in major countries

Internationally there is significant experience with the use of organic wastes for biogas. In addition to its use at landfill and sewage works there are many on-site plants at livestock farms and industries. The largest biogas market is the European Union (EU), with over 13,800 systems totaling over 7,400 MW. Germany has the largest number of biogas plants in operation in the EU (8700 in 2012), these are mainly farm based systems encouraged by the higher feed-in tariffs scheme for smaller scale plants. Agricultural biogas plants in the EU outnumber industrial biogas plants by the ratio of 3 to 1.

Centralised biogas plants are well established in Denmark, which has the largest concentration in the EU, with capacity ranging from 25 to 500 tonnes of biomass per day and producing between 1,000m^3 and 15,000m^3 of biogas per day. Apart from manure the plants digest other sources of organic waste; the plants normally used a mixture of approximately 75% manure and 25% organic waste. The organic wastes used are gastrointestinal substances from slaughterhouses, waste from the fishing industry, food industry, tanneries, breweries, dairies, oil mills, municipal sewage and households. Organic waste co-digested with the animal manure can increase the gas yields from the digesters. In the US and the UK anaerobic digestion is common in waste-water treatment, whereas in agricultural,

community and industrial sectors the application remains limited, even though a rapid increase is being observed especially in UK, due to policy incentives such as feed-in tariffs. In the EU in general, biogas production is forecasted to double between 2010 and 2020. China and India have the largest number of domestic biogas plants in the world with 43 million and 4.4 million respectively.

The type of technology used is determined by the waste characteristics. Types are defined by wet and dry processes, continuous and batch process, single-stage or multi-stage, and mesophilic (32-42ºC) or thermophilic (45-47ºC) processes. Single-stage digesters are simple to design, build, and operate. The organic loading rate (OLR) of single-stage digesters is limited by the ability of methanogenic organisms to tolerate the sudden decline in pH that results from rapid acid production during hydrolysis and acidification. Having more than one phase of digester can also increase yields with different stages of the digestion process taking place separately. For example two-stage digesters separate the initial hydrolysis and acid-producing fermentation from methanogenesis, which allows for higher loading rates but requires additional reactors and handling systems. In Europe, about 90 percent of the installed AD plants are based on single-stage type systems while 10 percent are based on the two-stage system. The applications, advantages and disadvantages of the technologies are set out in ANNEX 1.

AD systems can be further divided into dry and wet systems. Traditionally there have been more wet digesters than dry, but the installation of dry digesters has been increasing as it provides higher biogas and limited leachate in comparison to the same sized wet digester. However, although the dry AD process has attracted increased attention, the process has some disadvantages with longer retention time, incomplete mixing, accumulation of volatile fatty acids and the requirement of a larger amount of inoculum to get it going.

Plants can be operated either on a batch process or continuously. Batch reactors are exclusively used for solid feedstocks. Continuous digesters are supplied with new feedstock on a regular basis with a corresponding volume of digestate removed. The volume in the digester remains constant. Larger digesters can be fed at intervals of less than one hour, with smaller ones being fed once or twice a day. Continuous reactors are either plug-flow or continuous stirred tank reactor (CSTR) systems with plug flow systems used for more solid feedstocks. Internationally 90% of reactors for digestion of solid substrates, sludges and slurries are CSTR type digesters since it suits many of the currently available feedstocks. In Europe biogas plants in agriculture include CSTR, plug flow reactor and batch reactors whereas for the industrial biogas plants technologies such as Up-flow anaerobic sludge blankets (UASB), CSTR, up-flow fixed bed, down flow bed reactors are used. In the USA there are also many on-farm biogas plants in operation used to treat slurry, manure and wastewater from that farm, and generally do not use co-digestion. The main type of the technology applied in China for centralized large-scale biogas project is the USR.

International development and research is targeted at increasing biogas yields and the efficiency of the digesters through pre-treatment, the introduction of multi-stages, mixing optimisation, process control and co-digestion. In addition there is much work focused on the downstream upgrading of the biogas as well as looking at 'new' feedstock types. For example pre-treatment technologies are being investigated which will allow access to the lignocellulose to increase the rate of biogas production and to improve the mixing qualities of the substrates. These techniques are often associated with high energy input, high equipment costs or large volume of chemicals so further research is required to understand the advantages and disadvantages, and to bring the technologies to a financially feasible level.

Other innovations include the production of hydrogen fuel from biogas through steam reforming. Hydrogen production from biogas has been done at laboratory and demonstration scale and has not been fully commercialised. Therefore hydrogen as a clean fuel can be obtained as futuristic stream through innovative methods.

In most countries the biogas produced is mainly used for generation of heat and electricity with exceptions for Sweden and Switzerland where approximately half of the produced biogas is used as vehicle fuel. Gas is also fed into national gas networks in nine EU countries.

A.4.4 Baseline scenario

A.4.4.1 Status of biogas technologies in India

There exists a potential for generation of 4000 MW of power from urban and industrial wastes in the country. [9]Another estimate suggests that based on the industrial waste that would be generated in the year 2017, the potential for power generation in 2017 would be 1997 MW. The sectors included here are Distillery, Paper, Sugar (pressmud), Maize Starch, Dairy, Sugar (liquid), Poultry Farms, Slaughter House, Tapioca Starch and Tannery.[10]

[9] http://mnre.gov.in/file-manager/annual-report/2013-2014/EN/reuica.html#10

[10] http://www.seas.columbia.edu/earth/wtert/sofos/Natl_%20Master_%20Plan_of_India.pdf

In 2013 the waste to energy generation in the country was 115.57 MW, which was increased to 136.33 MW by September 2014. These include installations based on both urban and industrial waste. Under the baseline project around 118 waste-to-energy projects have been developed in India in various industries such as starch, food processing, sugar, palm oil extraction, cattle, poultry, and on municipal solid waste. Also, a total of 12 projects with an aggregate capacity of 20 MW based on urban and industrial wastes are under installation in India. These projects are based on cattle dung, starchy industry waste and poultry litter. The number of projects installed in the priority industrial sectors of this project is shown in the table 2 below, with power generating capacity ranges giving actual size of project. These make up only a small proportion of the potential in these sectors.

Table 1: Energy to waste projects in target sectors (up to 31st March 2013 - for a complete list see technical annexes)

Industrial sector	Number of demonstration projects	Power generating capacity range(MW)
Sugar	31*	0.7-8.3
Poultry	5	1.5-8
Cattle	3	0.5-1
Fruit & Vegetable Processing	3	0.3-2.7

* Sugar projects developed to date have been based on the spent wash waste rather than press-mud which is the focus of this project. Only 1 project has been developed with press-mud in India.

Several visits were to different parts of the country to understand what the current practices of waste to energy are and how is the generated energy being consumed. The majority of AD projects installed to date in industry in India use the biogas for power generation. However there are also (a few) projects where heat is generated or where bio-CNG is being produced. The following biogas technologies are mainly in use in India: Khadi and Village Industries Commission (KVIC), UASB and CSTR are the more commonly used. Introducing some international best practice, such as pre-treatment, dry fermentation and especially co-digestion, could increase biogas yields in India. Although there are dry fermentation suppliers in India there are only a few projects in India and there is scope for greater uptake of dry fermentation where there is stackable feedstock with high dry matter content.

There has been initial experience with co-digestion in India yet the uptake remains limited and few centralised plants exist. Where co-digestion is used it has been done informally such as in the case above where cattle dung is mixed with poultry litter. In other cases vegetable waste is also digested with cattle dung in many KVIC digesters. CSTR models have been running successfully on mix feed in Gujarat, as informed by one of the technology provider. However few projects are actually designed to use mix feeds despite the potential to improve the efficiency of the bio-methanation process and to extend the operating period for seasonal producing industries.

Co-digestion through the combination of different feedstocks could unlock a significant potential which currently remains largely untapped. The main reasons are a lack of awareness on the potential, a lack of detailed information on where co-feeds are available, a lack of an appropriate business model to centralize the co0feeds, and some uncertainty on the impact of combining different co-feeds on the quality and continuity of the biogas. These barriers are further described in following sections. Detailed information on the current state of biogas technology can be found in ANNEX1.

Although there is experience with biogas in India, it is predominately limited to large scale industries (or domestic biogas) with less than 34% of the 118 WTE projects below the 1 MWth size. Outside of the projects which have received international or government support the projects have used low cost technology and have consequentially low performance. There is still a need for further demonstration projects which focus on SMEs since SMEs need to see examples in companies of similar conditions (even if the technology used is the same). Four target sectors (sugar press-mud, fruit and vegetable processing, cattle and poultry) have been selected where, despite large potential, the sectors remain largely unexploited for energy conversion and there is therefore need for demonstrations. Small anaerobic digesters are not widely used in the Indian industries due to the challenges associated with economies of scale. Economic incentives for application of waste-to-energy technologies are present when either large percentage of electricity can be replaced or application of downstream technologies produces a range of bi-products such as bio-CNG, sulphur and many others which present further financial benefits. Captive electricity consumption do not present attractive economics and installation of the cost-intensive downstream processing technology for a small scale installation further weaken that.

The quality of the biogas produced varies but generally biogas is produced from each of these technologies of about 50-60% methane. There are a number of uses for this biogas:

i) Heat generation on site: this can be the best application of raw biogas or purified biogas as it involves minimal conversion losses and can result in attractive return on investment when offsetting furnace oil;

ii) Power generation: energy recovery in the form of electricity is one of the most commonly used applications to offset diesel and electricity costs and increase reliability during power cuts. Biogas can be used to operate a dual fuel or 100% biogas engine and can replace up to 80% of diesel in dual fuel engines. It is also possible to operate in a co-generation mode to produce heat for processes or to heat the digester;

iii) Refrigeration: can be used for cooling applications in operating the chilling machines;

iv) Heating and cooking via a gas network; and

iv) Bio-Gas Purification/Enrichment, Compression and Bottling to form compressed Bio-Gas (CBG) also called Bio-CNG: bio-CNG can be used for heating and cooking applications either on site or by local SMEs or households to offset LPG. It can also be used for transport.

During the PPG the need for technology transfer of international best practice became apparent and since these technologies are more expensive than the indigenous technologies it is now proposed to support 2-4 highly replicable demonstration projects (rather than the originally envisaged 7-10 projects). The scale of these projects will still be between 0.25-2 MW.

A.4.4.2 Government programmes for biogas in India (baseline project)

The National Master Plan (NMP) for development of waste-to-energy in India was developed in 2002 by MNRE under the UNDP-GEF bio-methanation project identified 14 organic waste producing industries where there was potential for renewable energy totalling 1997 MW_e by 2017. The analysis showed that bio-methanation could be technically and commercially viable in food processing, paper and pulp, breweries, distilleries, tanneries, cattle, poultry, and cassava sectors.

There are a number of on-going initiatives in India which support the biogas industry and this is the baseline framework, as detailed below. There is no focus, or targettting, specifically at SMEs and there are no incentives for innovation (or technology transfer) that could significantly improve the performance of the biogas projects. This project aims to build upon these on-going intiatives to address this gap.

The NMP forms the baseline project since it provided the ground work for the organic waste to energy (OWTE) developments in India. In line with the NMP, MNRE has undertaken a number of programmes in the area of recovery of energy from urban and industrial wastes, including incentive schemes to trigger and accelerate the deployment of biogas projects. The current government support programme (energy from urban, industrial and agricultural wastes/residues during 12th Plan period[11]) includes incentive schemes for industrial waste (up to 20% capital grant with an upper cap, or 40% in sewage treatment plants) has expanded the remit to include biogas only projects, subject to a number of eligibility criteria, conditions and caps. The programme is implemented through state nodal agencies and is applicable to developers setting up of waste to energy projects on the basis of Build, Own and Operate (BOO), Build, Own, Operate and Transfer (BOOT), Build, Operate and Transfer (BOT) and Build, Operate, Lease and Transfer (BOLT).

The major success of MNRE programmes has been on power production though, and the uptake has been predominantly by large-scale industries. To date there has been limited uptake by SMEs which, due to their small-scale nature, often require additional tailored support especially for introduction of innovative technologies. This MNRE programme will act as the incentive scheme which the proposed project will build on to make SME sectors absorb innovative biogas technologies, and as such will constitute MNRE's cash cofinancing to the proposed project.

As for small-scale projects, there are three national programmes supporting biogas and waste to energy which are run by MNRE. These programmes primarily target small scale biogas (family size and <250kW). Further details of all these programmes are included in ANNEX 1.

A.4.5 The problem that the project seeks to address – key barriers to the uptake of innovative upstream and downstream biogas technologies in target SME sectors in India

[11] http://www.mnre.gov.in/file-manager/offgrid-wastetoenergy/programme_energy-urban-industrial-agriculture-wastes-2013-14.pdf

Although bio-methanation plants are now more prevalent in India many of the projects are either very small (domestic scale) or installed at large scale industries. Outside of the projects, which have received international or government support, the projects have used low cost technology and often have had suboptimal performance. This is due to a lack of experience in planning and operation of the bio-methanation plants – all too often the experiences from the small-scale digesters is used, even when not relevant. There is a lack of life-cycle cost benefit analysis behind the investment decisions. If this was carried out there would be a clear rationale to invest in better quality equipment against better returns in future years.

A.4.5.1 Target technologies under the proposed project

The technology focus for the proposed project will be on bio-methanation (also referred to as biogas or anaerobic digestion (AD), based on the already ongoing support for this technology, and the large potential which is untapped by industry. Biogas technologies have recently been experiencing a revival, with significant and promising innovation taking place, both at the upstream and downstream level. This project will assist SME sectors in India take advantage of these international developments. The demonstration part of the project will focus on co-digestion projects and the introduction of international innovations. In line with MNRE's focus on maximising innovation, the target technologies are deliberately not being specified at this point to allow the selection of technology to be as flexible and innovative as possible. As set out earlier there are a number of international advancements in the overall bio-methanation process that either improve the performance of the technology (through pre-treatment technologies or biogas production technologies, i.e. upstream technologies) or improve the economics through the upgrading/value addition of the outputs or products (downstream technologies). Selection of the technology would be based on both the performance of technology in the Indian industries and improvement in the economics of the bio-methanation processes through technology application and adaptation. As part of the PPG an assessment of these technologies was undertaken and is included in ANNEX1. Possible pre-treatment technologies that increase the biogas yield include extrusion, grit removal, size reduction, pasteurization and nitrogen extraction. Biogas technologies not common in India which could be introduced include those using co-digestion, dry fermentation and plug flow digesters. Downstream technologies include those that increase the methane purity of the biogas and the production of hydrogen as an additional by-product.

A.4.5.2 Identification of priority sectors and approach

As part of the PPG phase of the proposed project the 14 sectors as identified under the NMP were closely studied to select priority SME sectors and clusters with the most promising potential for the use of organic waste streams. It was found that distilleries are already using anaerobic digestion; a number of industries have waste treatment systems that must be in compliance with the Central Pollution Control Board's norms (tanneries, pulp and paper, breweries); and other sectors were deemed not suitable due to seasonality or suitability of waste stream (rice and milk processing); alternative waste uses (oil processing); low levels of waste (catering); or social and technical challenges (slaughterhouse waste). This PPG work resulted in the identification of four prioritised sectors where, despite large potential, the existing resource remains unexploited for energy conversion. The four sectors are the ***poultry, sugar, fruit and vegetable and cattle sectors.*** As part of the PPG energy audits were carried out at 12 representative industries and the potential for the use of bio-methanation was assessed. The key states and industry clusters for each of these priority sectors are shown in the figure below; table 1 shows the estimated national potential for energy generation in these four sectors.

	ry
★	**Sugar**
▲	**Fruit & Vegetable Processing**
▬	**Poultry**
●	**Cattle**

Figure 2: Key states and industry clusters for priority sectors

Table 2: Estimated national potential for energy generation from organic waste in the four sectors

Sectors	Type of waste	No of units/ cattle/poultry in India	Avg size of unit	Waste generation	Biogas generation (m^3/tonne)	Energy recovery potential (MWh/annum)	Potential states
Poultry (Solid Waste)	Litter	500 million birds[C]	12000 birds	2.5-9 tonnes/day/unit	50-100	4.7 million	Haryana (Jhajjar, Panipat,Sonepat, Gurgaon) Andhra Pradesh
Sugar Liquid Waste Solid Waste	Press mud	529[a]	3000 tonnes/day cane crushed	100-520 tonnes/day/unit	80-100	1-2 million	Uttar Pradesh (Muzaffarnagar, Moradabad, Bijnor, Rampur, Bareilly) Maharashtra (Solapur, Osmanabad, Pune)
Fruits & Vegetable processing	Peels and pulp	Fruits- 74.8 million MT Vegetables- 146 million MT[b]	Large range	Small: 3-4tonnes/day Medium: 150 tonnes/day	100-120	2.30 million	Maharashtra(Pune, Satara, Sangli, Mumbai) Andhra Pradesh (Chittoor) Tamil Nadu (Krishnagiri) Himachal Pradesh
Cattle Farms (Cow Sheds)	Dung	300 million cattle[C]	2000-10000	12-24 tonnes/day/unit	40-50	60 million	Haryana (Hisar, Rohtak) Delhi NCR Madhya Pradesh Rajasthan

Sources: [a] sugar industry, co-generation & distillery promotion policy 2013, Department of Sugar Industries and Cane Development, Government of Uttar Pradesh; [b] http://nhb.gov.in/area-pro/database-2011.pdf; [C] Development of Biogas and Biofuels in India, workshop on Indo-Asian cooperation in renewable energy by Dr. Anil Dhussa (MNRE) 2012

There has been little uptake by SMEs since they are too large for the small scale programmes and lack the capacity to make use of the urban, industrial and agricultural waste programme. In addition it is acknowledged that this programme – despite its importance – provides an insufficient signal for sectors to invest in innovative technologies. Support is focused at "standard" technologies and power generation. As described earlier, internationally, there are developments in dry fermentation, in upstream pre-treatment and downstream treatments as well as a growing demand for co-digestion projects; all of which can improve the performance of the biogas projects. Under the Indian baseline project there is limited innovation, limited use of dry fermentation, of pre-treatment or downstream technologies such as CO_2 extraction, elemental sulphur recovery or processed bio-manure extraction.The focus of the proposed project will therefore be to trigger and assist SMEs to absorb promising innovative technologies which can increase biogas yields, enable downstream diversification and have a replication effect across agro-industrial sectors.

Additional information on the sectoral focus and examples of target enterprises is provided in ANNEX 1 and ANNEX 4.

A.4.5.3 Stakeholder consultation workshops in target sectors to verify key barriers and challenges

During the PPG consultation was carried out to understand the reasons behind the lack of development in this field. This was carried out through workshops, questionnaires, site visits and phone calls and included the following consultee groups:

- Industry associations (All India Food Processing Association, New-Delhi, Poultry Federation of India, Gurgaon, and the Indian Sugar Mills Association, New-Delhi);
- Financial institutions (SIDBI, SBI Capital Markets Ltd, Axis Bank Ltd, Infrastructure Leasing & Financing Services Ltd)
- Technology providers (MAILHEM Engineering Pvt, Enkem Enegineering Pvt, Spectrum Renewable Energy Ltd, Praj Industries etc)
- Industry (Kaventer, Field Fresh Foods Ltd, Pepsi, Jubiliant)

The four stakeholder consultation workshops were carried out in different parts of India: at **Pune** (Cluster of Sugar and Fruit processing industries), **Delhi** (Cluster of Cattle, poultry and sugar industries), **Chandigarh** (Cluster of

Poultry and Fruit processing industries) and **Belgaum** (Cluster of Sugar and poultry industries). Each workshop had 30-50 participants comprising representatives from ministry officials, technology suppliers, user groups, financial institutions and bio-energy consultants. A list of workshop participants is given in detail in the ANNEX 2 and ANNEX 3.

The presentations made in the workshops were focused on the status of existing anaerobic digestion technologies, industry waste generation potential, key barriers, and financial models for conversion of industrial waste to energy etc. Stakeholders actively participated in the workshops and interacted with the panellists, further providing their feedback on the topics discussed in the workshop.

Feedback from the workshop was divided into 4 broad categories; on technical, financial, policy and capacity building and awareness. The following table provides an outline of this feedback on the continued barriers and challenges. Further details of these barriers are provided in ANNEX 1 and ANNEX 2. It should be noted that some barriers are more prevalent in certain industries; for instance the issue of seasonality for sugar press mud is less critical than in the fruit and vegetable sector since the feedstock can be stored. The barriers below are the primary, or key, barriers which are critical to address for the increased uptake of biogas and which will be tackled in this project. There are also secondary barriers, detailed in the ANNEX 1, which will be addressed wherever relevant in relation to the primary barriers.

Table 2: Key barriers as identified during PPG phase

Primary Barriers	Detail	Mitigation activities
Capacity / Institutional		
Limited awareness and capacity among industrial SME professionals (energy auditors, engineers, senior management)	There is a real lack of awareness of opportunities for biogas technologies and the related benefits; this was particularly true in the sugar and poultry industry. For example even in case of power shortages industry owners are typically not aware they have the resource to generate their own power	A widespread capacity building and awareness raising targeted at the four priority industrial sectors
Limited demonstration examples	Few examples of biogas demonstrated for industry SMEs. Lack of publicity of existing success stories. Most industrial examples are large scale and power generation only. Few examples of centralised or co-digestion systems	Demonstration projects introducing co-digestion and innovative technologies to trigger wide replication
Lack of skilled manpower	Equipment servicing and post installation services need to be strengthened	Training targeted at operation and maintenance
Technological		
Seasonality and low waste volumes	Where waste is only produced seasonally or where plants are too small the discontinued or low waste volumes hampers the economic viability of projects; a centralized system could provide an economic solution. A centralised approach requires waste is of the correct characteristics for co-digestion Management and transportation of waste requires clear guidelines (incl. on hygiene and disease control)	Demonstration projects on co-digestion in centralised projects Capacity building and awareness to recognise the opportunity and reduce (perceived) risk Training on co-digestion to target management, pre-treatment of waste and resource variation
Lack of innovation	Limited state of the art – most projects use indigenous technology Low exposure to international advances in technology Limited interest from international players in the Indian market	Demonstration projects to focus on international innovations which will increase awareness and benefits of new technologies
Lack of design and construction experience / poor experiences	Lack of international biogas plant design and construction experience, which led to safety issues, poor construction and underperformance of plants, as well as a negative image for the technology. Previous bad experience has provided disincentives for investment due to poor operation, low efficiency and feedstock problems	Training to be provided for professional project design and construction people. Demonstration projects to provide 'best practice' examples
Financial		
For industry	High capital costs and limited availability of equity and loans (e.g. 40% equity expected + corporate guarantee) Low return on investment (for cheap existing fuels) High operation and maintenance costs	Incentives to trigger initial innovative projects and demonstrate positive cost-benefit analysis Sustainable financing mechanism in place to reduce risk (e.g. a partial risk guarantee) and enable sustainable replication across sectors
For financing sector	Lack of data and high perceived risks from FI Lack of capacity to assess projects Lack of knowledge of the potential customers	Training and due diligence guidelines targeted at FIs to help them better understand benefits and reduce (perceived) risks of AD projects
Policy		
Insufficient tailored incentives for target sectors/SMEs No standards/guidelines for centralised or co-digestion	There is no bioenergy mission in India and no tailored action plan. The NMP was initially intended to be a living document but it has not been updated since its publication in 2005	Updated NMP and roadmap up to 2027 focusing on centralised and co-digestion approaches for AD in SMEs; Needs assessment and roadmap for quality infrastructure (QI) for AD plants developed

A.5. Incremental /Additional cost reasoning: describe the incremental (GEF Trust Fund/NPIF) or additional (LDCF/SCCF) activities requested for GEF/LDCF/SCCF/NPIF financing and the associated global environmental benefits (GEF Trust Fund) or associated adaptation benefits (LDCF/SCCF) to be delivered by the project:

A.5.1 Value added through incremental reasoning

Sector analysis, review of existing barriers, meetings with various stakeholder groups and discussions with other agencies regarding organic waste for industrial processes - all carried out during the project preparation phase - have shown the strong relevance of the GEF-UNIDO project, its additionality, incremental reasoning, cost effectiveness and complementarity to ongoing and planned national and international programmes to promote and support increased solar energy use for industrial heat in India.

GEF funding is being requested to provide the incremental policy, technical and financial inputs required to support and effectively leverage national efforts in facilitating the increased up-take of bio-methanation by SME industries, using their organic waste. The funds will help in the introduction of innovation, will stimulate the creation of a SME industrial biogas market and support GHG emission reductions. GEF financing will provide the necessary catalytic support to create and sustain a market environment conducive to investments in biogas. Specifically, GEF will be used to demonstrate the technical and commercial viability of selected and high replicable innovative biogas projects at SMEs. The demonstration effect will be significant in helping to remove barriers currently preventing SME industries from implementing projects. GEF financing will provide technical assistance to develop technical guidelines and manuals, will support further replication projects and will help establish a new financing facility for industrial biogas. Further, GEF financing would provide technical assistance for institutional strengthening, capacity building and awareness raising to create a supportive institutional framework. Finally GEF support will contribute to project management and co-ordination. In so doing the project would multiply the impact and global environmental returns of resources allocated to bio-methanation by the Government as well as by other international initiatives and programmes.

Baseline

The four targeted industrial sectors rely on electricity and almost entirely on fossil fuels and traditional biomass to meet their heat energy requirements. The high cost of fossil fuels and the fluctuating and volatile oil market create a significant burden on industry and in some locations the grid is unstable so units run their own diesel generators. The reliance on fossil fuels for heat and some electricity results in relatively high greenhouse gas emissions. Although there is experience with bio-methanation, it is predominately limited to large scale industries. There are about 42 (2013 figure) installations countrywide in the identified four sectors. The NMP established targets for use of waste for energy but without clear targets for biogas in SMEs and with little specific support for the SMEs. Any project that is taken forward only focuses on indigenous technology. There is little innovation in the bio-methanation sector in India. There are significant limitations in terms of the capacity of the stakeholders to facilitate a SME biogas market. Industrial units are unaware of the opportunities and the finance institutions do not have experience of industrial biogas and therefore do not understand the risks and opportunities, particularly for SMEs, and therefore are not lending to potential projects. The Government is well aware of its resource and capability constraints and for this reason is seeking international support from both multilateral and bilateral donors.

In the absence of the proposed GEF-UNIDO project the industrial biogas market will only continue to develop with indigenous technologies for the large scale industries with little inroads into SMEs, despite the huge potential and benefits available, whilst international best practice in biogas will remain foreign to India. The level of investment from SMEs will remain low and further diesel and furnace oil fuelled boilers will be installed with their associated GHG emissions and waste will continue not to be managed. Many industries will continue to be wholly reliant on fossil fuels and impacted by changes in world oil prices. The vast majority of potential stakeholders will continue to suffer from lack of information, understanding and technical capacity of the biogas opportunities. There will be few demonstration projects showing what is technically feasible and financially viable at SMEs. Without support no new supporting policy roadmap or recommendations can be prepared since there is a lack of resources to enable it to happen.

In conclusion, in the short-term, the baseline scenario would not be able to address the barriers to the uptake by SMEs of organic waste to energy biogas projects and therefore there will be little change in the investment in biogas. The underlying critical problems of the lack of awareness of opportunity, lack of adequate institutional capacity and good technical expertise and skills on the market would remain unresolved. The SME potential for organic waste to energy would not be realised; further fossil fuelled heat generation would be built with consequent GHG emissions that could otherwise be avoided and waste would continue to result in environmental problems.

GEF Project Alternative scenario

At the policy level the project would provide the additional technical assistance needed to strengthen the policy support frameworks to provide the assurances required to facilitate investment in organic waste to energy projects up to 2027. GEF financing is sought to support the development of a revised National Master Plan for organic waste to energy setting out the potential, priorities, technologies and areas for research and development, financing options, funding and costs. In addition funding is sought to develop the strategic roadmap to support the NMP and to develop a certificate of authenticity from government for support programmes.

At the biogas project implementation level the project would provide project-specific technical assistance and financing support through Project Component 2 and 3 by facilitating the implementation of selected highly innovative biogas demonstration projects in SME with high replication potential in India. GEF financing is sought to provide assistance to approximately 2-4 pilot biogas projects in four industrial sectors to introduce innovative technologies and models, leading to the installation of an estimated 3-4 MW (or equivalent) of projects. The GEF financing would facilitate these projects to get off the ground and will introduce international best practice by leveraging co-finance and where necessary providing technical assistance. Without the GEF support these projects would not go ahead and innovative technologies will not be introduced. GEF would support incentives for innovative technologies and if possible a partial risk guarantee (PRG) fund to facilitate bank loans, where banks would not otherwise lend. The realisation of these projects would generate Indian case studies and demonstrate success stories which will then be disseminated through the other project activities. This is expected to fuel the interest in organic waste to energy projects and reduce the associated perceived investment risk. Since some of the GEF funding will be used as guarantees, the resulting financing facility will continue to offer PRGs beyond the first 2-4 demonstration projects and will continue beyond the end of the project.

At the institutional level, through an extensive technical assistance, knowledge and capacity building programme the GEF financing would add the technical assistance needed to strengthen local expertise, knowledge and capacity in developing, implementing and maintaining effective SME organic waste to energy projects. New technical specifications will be developed along with guidance and manuals as well as guides to develop markets for new (biogas) products.

At the market level the project would target all players. To financiers**,** managers and engineers, the project will provide the knowledge to fully understand the economic and environmental benefits of organic waste to energy projects; and the technical capacity and tools to take such projects forward. Industry wide and increased awareness of organic waste to energy project potential and benefits delivered by the project will boost demand for biogas projects from SMEs generating the pull for market creation. Providing assurances to financiers and demonstrating success will encourage further financing institutions to lend. Creation of the basis of an on-going sustainable training programme will enable the market to continue to develop and create technicians and engineers able to service the future growing market.

Considering the proposed structure of the GEF-UNIDO project, its implementation will provide critical contributions for the creation of a market environment that will facilitate greater investment by Indian SMEs in organic waste to energy projects.

A5.2 Proposed additional GEF activities (including detailed design)

The proposed project will focus on industrial organic waste streams for conversion to usable forms of energy for application in SME units and/or clusters of units, with the primary focus being conversion to (process) heat on site or for heat purposes for local SMEs (e.g. via bio-CNG or other downstream value addition), yet wherever feasible and appropriate power will also be added. The aim is to introduce these technologies to target SME sectors and address the specific challenges outlined above. The main objective of the proposed project will be to facilitate the innovative technology investments in up to four target industrial sectors where there is good potential for recovery of energy from organic waste, ideally through co-digestion combining industrial organic waste streams and agro-residues from different sectors. Suitable financial and institutional mechanisms for mainstreaming the uptake of such interventions in SMEs will be piloted. To date only large scale industries in India have benefitted from these technologies and the added value of this project will be to bring these technologies to SME sectors, and propose refined support instruments to achieve this goal. Without GEF intervention these technologies are unlikely to enter SME sectors, even where useful organic waste streams are available and companies can demonstrate financial health. The project will act as a trigger to demonstration and rapid replication in the take-up of the technology. The project will be synergetic with previous GEF programs undertaken by UNIDO and UNDP and would address an important sector hitherto omitted.

The project is structured in four components as set out below:

- POLICY Component 1 will strengthen the policies and regulatory framework to effectively promote and support SMEs to invest in organic waste to energy technology

- TECHNOLOGY DEMONSTRATION Component 2 through incentives for innovative biogas technologies will trigger investment in 2-4 highly innovative bio-methanation projects to demonstrate their technical feasibility and commercial viability as well as complete tailored guidelines for SMEs. These will build the confidence of both industry and finance sector, create best practice examples to pave the way for replication in the scale-up component, thanks to experience gained, reduced (perceived) risk and increased capacity and awareness at multiple levels, i.e. industry (both at operational and decision-making level) and finance

- SCALE-UP Component 3 will then put in place a replication mechanism to mainstream the application of bio-methanation for SMEs by establishing a financing facility to reduce (perceived) risk, develop business models and adopt quality standards to further build trust in the technology

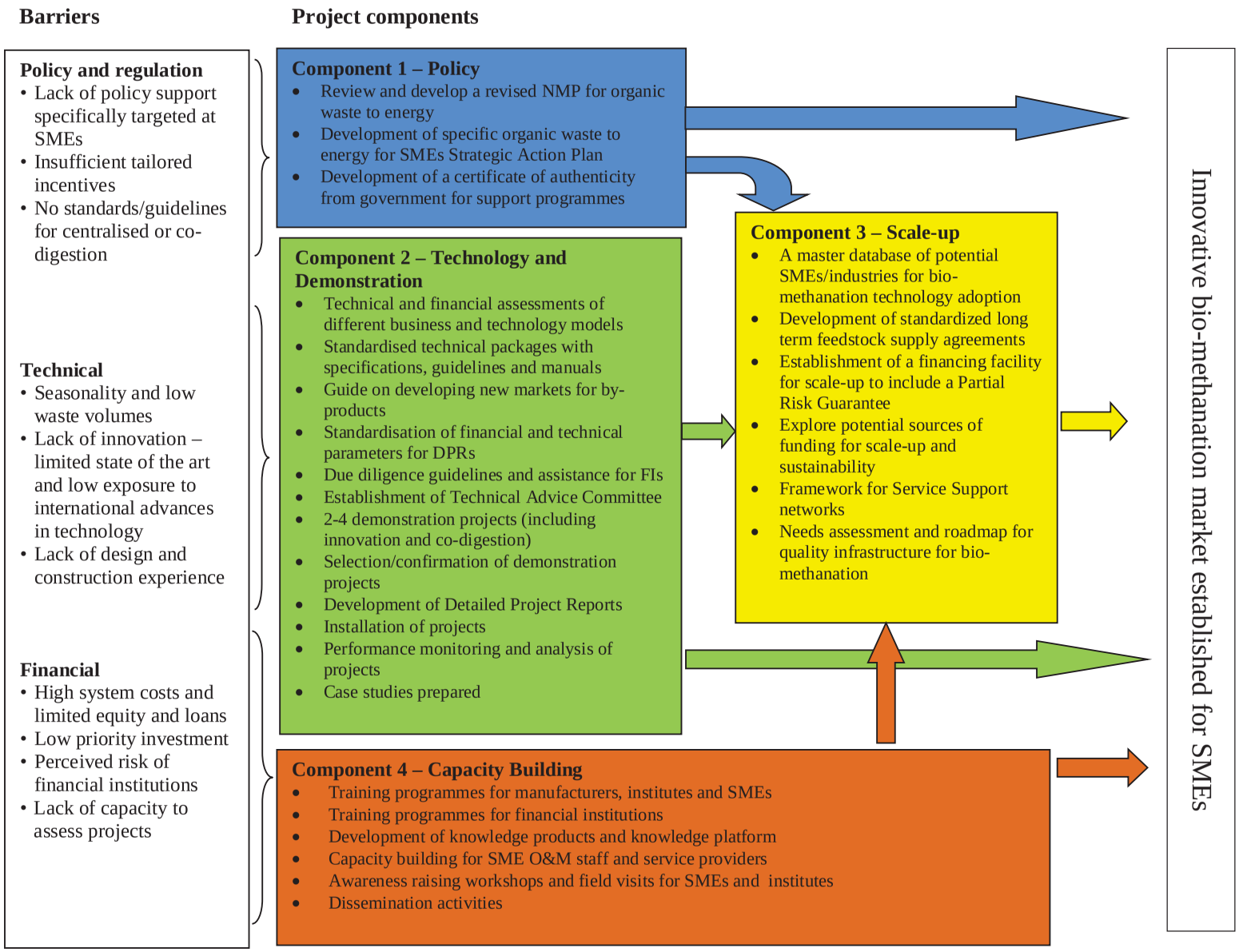
- CAPACITY BUILDING Component 4 will strengthen the institutional capacity as well as address the insufficient technical capacity training, awareness and the development of knowledge products, in support of reducing (perceived) risk of both industry and finance sector; activities under this component should take off in parallel with component 2 on technology demonstration in order to jointly prepare for the scale up / mainstreaming phase in the second half of the project and beyond

The figure below shows how the project components interact together in facilitating the development of sustainable market for the use of organic waste for energy in SMEs in India. The following section provides more details of each of the project components.

Clarification and justification on technical assistance (TA) budget shift from component 3 to component 2 compared to PIF

The clearer focus on most promising state-of-the art innovative biogas technologies within Component 2's demonstration projects has meant that the potential beneficiaries need a greater level of technical assistance than was envisaged at PIF stage, to prepare and realise their projects. This TA will not only help the demonstration projects but will also identify innovative technologies which are highly replicable. The TA will prepare the technical specifications, manuals and guidelines to provide industries with step by step support, which will then serve as tools for industries to develop their own projects under of Component 3's scale up. Therefore the TA budget assigned to Component 3 which has been reallocated to Component 2 will still support the delivery of Component 3 outcomes.

Figure 3: Proposed project components and their interaction with stakeholders



Description of each component and sub-component

COMPONENT 1: Strengthening the policy and institutional framework through a strengthened policy and regulatory framework

The Policy component of the proposed program will develop tailored actions to promote project uptake in target SME sectors. Although MNRE has promoted programmes in the area, the focus has been primarily on power and large-scale industries. The work will develop tailored recommendations on interventions for creating favourable financial, promotional policies and strategies to increase the use of organic waste for energy in industry. GEF funding in the policy component will be used to bring best practice and international experience in order to refine the existing NMP framework, with the co-financing for this exercise to come from national Government and key stakeholders.

Long term ownership and sustainability is ensured through working closely with MNRE on the development of the NMP and road map. GEF inputs will assist and support MNRE in their development and beyond this project MNRE will be responsible for the implementation of the outputs.

Output	Activities
1.1.1 An updated and tailored roadmap for increased use of waste-to-energy practices in the target SME sectors	1.1.1.1 Review and develop a revised NMP for organic waste to energy with a focus on SME sectors 1.1.1.2 Development of a specific organic waste to energy for SMEs Strategic Action Plan or Roadmap between government and sector to achieve NMP goals 1.1.1.3 Develop a certificate of authenticity from government for support programmes

1.1.1 An updated and tailored roadmap for increased use of waste-to-energy practices in the target SME sectors

1.1.1.1 Review and develop a revised NMP for organic waste to energy

The NMP developed in 2002 was expected to also serve as a road map to cost effectively implement projects until 2017 in the urban and industrial sectors. The NMP and the associated Strategic Action Plan were to have been flexible documents which would have been reviewed and updated regularly based on the experience gained as well as on performance evaluation. The first action plan was prepared for the period 2004 to 2007 and has not been updated since, nor has the NMP been reviewed. The NMP paved the way for the development of bio-methanation over the last ten years and, as a result, capacity was built up and the number of technology suppliers has increased. This provides the perfect starting point for this project; to take bio-methanation forward beyond 2017 and to focus on SMEs and innovative technologies. It is therefore time to review the NMP and to make recommendations for its update and extend its validity to the end of the 14th five year plan (2027).

The NMP will focus on organic waste to energy in the urban and industrial SME sectors since they are linked and there are increasing opportunities for co-digestion. The new NMP will set out the potential up to 2027, priorities, technologies and areas for research and development, financing options, funding and costs.

1.1.1.2 Development of a specific organic waste to energy for SMEs Strategic Action Plan or Roadmap between government and sector to achieve NMP goals

The Strategic Action Plan (SAP) to be developed will: provide details of activities to be undertaken within a time frame, identify agencies to carry out these activities and provide estimates of financial requirements for their successful implementation. The plan will include activities associated with policy; technical assistance; financial assistance; and Research and Development.

The policy related work will review options for policies to increase the uptake of OWTE projects by SMEs and make recommendations to MNRE. Options that could be considered could include a directive to submit a comprehensive utilisation plan taking into account the social component of projects; directives on the use of waste and appropriate policy to be formulated to provide for the use of bio-CNG in transport. Policy workshops will be held with relevant ministries and other stakeholders to discuss the recommendations and associated budgets. Suitable activities in technical assistance and awareness raising will be identified for the plan, possibly building on the activities of this project in Component 4.

As part of the R&D a study and status of the current R&D in the sector in India (and internationally) is proposed thereby identifying areas for priority research and funding. This may also lead to possible demonstration and

commercialization of these technologies or techniques, and prioritise needs for international technology transfer. The SAP will include a budget for each of these activities over the next 12 years.

1.1.1.3 Develop a certificate of authenticity from government for support programmes

Under the current support programme MNRE agrees to provide grants to bio-methanation project owners/developers only once they have secured their finance. The grant is then disbursed once the plant has been commissioned. However knowing that the project has been accepted by the government grant programme would provide the financial institutions with additional confidence to provide the finance. Therefore it is proposed to develop a certificate of authenticity from MNRE prior to financial close.

Long-term sustainability of global environmental benefits and institutional continuity through national ownership for Project Component 1 – Strengthening the policy and institutional framework

A renewed National Master Plan and Roadmap for organic waste to energy will ensure that these technologies remain a focus beyond the timeframe of the project and will also ensure the steps are outlined for future R&D to ensure that Indian manufacturers and academic institutions are at the forefront of technology development in this area. Certificates for those participating in MNRE incentive schemes will continue to facilitate finance beyond the end of the project.

The organisation for long-term national ownership for the policy component will be MNRE.

COMPONENT 2: Demonstration of financially feasible technologies in selected sectors

This component will prepare detailed technical specifications for the target technologies in four relevant sectors and will provide guidance and manuals for industrial owners on the business models and how to develop markets for products not used on site (e.g. bio-CNG or manure). Assistance will also be provided to the financial institutions by providing due diligence guidelines for the technology to help increase understanding and reduce perceived risk of projects. Further, demonstration projects will be identified, finance facilitated and monitored so as to draw lessons to improve the financial model. Co-digestion and a cluster approach (i.e. using industrial waste from many SME units in clusters to generate energy) will be encouraged, thus reaching critical size and help increasing effectiveness of the investment and enable pooling of resources. This approach will be essential since the investment and scale factors can make a difference for the viability of the technology investment; also given differences between industrial sectors, tailored strategies are expected to be required for different sectors.

The proposed activities have been designed to ensure that the preparation, implementation and operation of these projects will build up the capacity of the stakeholder groups to ensure replication. Specifically MNRE will have the long term national ownership for such projects, building on its existing experience. Financing partners such as IREDA and or SIDBI are expected to be responsible for the management and disbursement of the incentives and as necessary will receive targeted capacity building on the biogas technologies. IREDA and SIDBI offer loans for renewable energy projects so beyond this project finance would be available. Other stakeholders who will be integrally involved in this Component include the industry associations. The associations' experiences will help to inform its members of the opportunities available and will allow it to promote co-operation between factories. Inclusion of CSOs, especially the environmental CSOs is important at this stage such that it creates awareness of such environment friendly activities in the area and also promotes the market for the products produced through downstream processing of the waste. Finally further sustainability and replication is ensured through the interaction with the financial institutions. Discussions on securing finance, preparation of due-diligence guidelines and the banks' experience of extending loans to this sector in the demonstration projects, will help to reduce perceived risk and encourage future lending.

Output	Activities
2.1.1 Techno-financial and strategic assessment of most suitable business models	2.1.1.1 Technical and financial assessment of the different business and technology models in each of the four sectors
2.1.2 A 'Consolidation Matrix' on appropriate financial models and schemes suitable for financing for these applications.	2.1.2.1 Development of techno-economic due diligence guidelines for organic waste to energy for financial project approval per industrial sector and a matrix identifying appropriate finance models and schemes for each industrial sector 2.1.2.2 Establishment of an Expert Appraisal Group (EAG) and technology guidance for the EAG review
2.1.3 Detailed information technology packages with	2.1.3.1 Development of standardised technology packages with specifications, manuals and guidelines for four SME industrial sectors

specifications for identified technologies for target sectors (food processing, poultry, cattle and sugar-press mud) and applications (thermal, power, bio-CNG)	2.1.3.2 Guide on developing markets for by-products 2.1.3.3 Standardisation of financial and technical parameters for reporting in feasibilities and DPRs
2.1.4 2-4 innovative organic waste to energy projects installed and operating in selected SME sectors	2.1.4.1 Selection of demonstration projects Selection criteria and procedure for demonstration projects. Generating expressions of interest from potential beneficiaries Selection of eligible projects Preparation of DPR and selection of demonstration projects. 2.1.4.2 Installation and commissioning of demonstration projects 2.1.4.3 Performance Monitoring and analysis of installed projects 2.1.4.4 Documentation of results of demonstration projects and preparation of case studies.

2.1.1 Techno-financial and strategic assessment of suitable most suitable business models

2.1.1.1 Technical and financial assessment of the different business and technology models in each of the four sectors

Each sector has its characteristics, which influence the appropriateness of a particular business and technical model. Thus, closely analyzing the business and technical models based on a good understanding of the respective target sectors can help to ensure maximum success rate with respect to the business and technical model selected. An assessment will be carried out of the various business and technology models available to the four selected industrial sectors. In particular this will review the available innovative technologies and their appropriateness for each sector and where operation is seasonable the assessment will focus on the opportunities for co-digestion. The focus will be on identifying most suitable business models that will be appropriate for the four sectors. This will take into account the practicalities of buying/selling waste for a co-digestion plant, the optimal characteristics for the different wastes for a co-digestion plant, as well as an assessment of the technical and financial benefits and dis-benefits of the options for use of the biogas – for on-site thermal use, on-site power, exported power and bio-CNG in the different sectors, and how results may change in a cluster or where there is other feedstock available. The assessments will also review the pros and cons of the different business models possible for each of these technical options, e.g. project owner owned and operated, ESCO, cluster group owned, BOO, BOOT etc.

2.1.2 A Consolidation matrix on appropriate financial models and schemes suitable for financing for these applications

2.1.2.1 Development of due diligence guidelines for organic waste to energy for financial project approval per industrial sector and a matrix identifying appropriate finance models and schemes for each industrial sector

During the PPG it was clear that financial institutions do not fully understand bio-methanation projects and therefore offer unaffordable finance (based on their perceived risks). Therefore there is a need for help in the due diligence of such projects. For the first projects to be assessed (the 2-4 demonstration projects) direct assistance will be provided to the FIs in carrying out their due diligence to help reduce their concerns. As part of this work technical and financial due diligence guidelines will be developed and provided to all FIs interested in bio-methanation projects. These will provide details of the technologies and models available, what to look out for and will include a checklist of the FIs to use. Based on this and the outputs from the previous activity a matrix will be developed identifying appropriate finance models and schemes for each industrial sector for the suitable business and technology models identified.

2.1.2.2 Establishment of an Expert Appraisal Group and technology guidance for the EAG review

It is proposed to establish an Expert Appraisal Group (EAG) to provide objective advice and assessment of the potential bio-methanation projects. Such independent committee will be able to provide feedback on the technical merits of the projects to a) the PMU for a GEF incentive; b) to MNRE for allocation of grants; and c) the financing institutes. This will be needed for the demonstration projects but it will also provide additional assurances to the FIs and PMU for further projects using the financial scheme in the future. The EAG is indicatively expected to be made up of 5 experts. The first task will be to select these experts through a competitive process and then to prepare

technology guidance notes for the EAG reviews. These guidance notes will be prepared in consultation with the three groups of organisations who will use the outputs from the EAG.

2.1.3 Detailed information technology packages with specifications for identified technologies for target sectors (food processing, poultry, cattle and sugar-press mud) and applications (thermal, power, bio-CNG)

2.1.3.1 Development of standardised technology packages with specifications, manuals and guidelines for four SME industrial sectors

This activity would develop a bio-methanation technology manual elaborating on the basic information that would be required for the unit owner to decide whether the unit should opt for a system and then a step by step guide on how to take it forward. The manuals would be industry specific (for the four sectors) consisting of the following parts:

- Technical: detailed guidelines for selection of bio-methanation technology, information on technology development status, waste characteristics, options of use of energy, technology packages, design and integration issues, flow diagrams, installation, construction and commissioning requirements and O&M practices. During the PPG phase, 12 pre-feasibility reports were prepared, based on energy audits and field visits. The prefeasibility reports establish the fact that a fixed integration procedure and specification cannot be proposed that is applicable for all processes or industries. That said there are a number of common features that could be included in a technology package;
- For a number of processes in the four different industries a technology package will be designed which will include the limits of applicability, issues on how to integrate bio-methanation into the existing energy systems, its limitations and how to optimize the design. The packages will include a description of the processes and requirements and flow diagrams. One feature of these packages will be a modular approach so that they are applicable to industries of different scales. These packages will be developed in consultation with the technology suppliers and will use the demonstration projects as examples.
- Equipment:- equipment lists, technology manufacturers/suppliers, balance of system manufacturers/suppliers;
- Financial: capital costs, operating costs, cost of delivered energy, benefits, financing mechanisms and incentives available, financial analysis;
- Business models: outlining the various options available to an industrial owner with a focus on co-digestion (using the information generated in other component 2 activities; and
- Case studies - results of some successful installations.

These manuals will be targeted at the industries identified in the database in Project Component 3 and in line with Project Component 4, will be circulated through the Industry Associations and clusters and will be available on the project website. The aim is that it gives as much information as possible to the industry users to enable them to make an informed decision in favour of the use of organic waste for energy.

2.1.3.2 Guide on developing markets for by-products

In many of the business models the project owner will be producing ‘new’ products such as organic fertilizer or bio-CNG which it will need to market to realise the full market value. Since these products are not the company’s core business they do not know how to market the products locally. This guide will provide a step by step guide to project owners on how to identify and develop the market; from identifying local farmers and SME users of LPG to how to engage with them and how to price the products.

2.1.3.3 Standardization of financial and technical parameters for reporting in feasibilities and DPRs

A guide will be prepared to help project owners to present the correct information to the financial institutions. This will include any particular guidelines pertaining to the DPR preparation as well as specific financial information that the FIs are likely to request. Since this will be carried out at the same time as the development of due diligence guidelines for the FIs the two will be aligned. The guide will also refer back to the MNRE guidelines and criteria for applying for an incentive.

2.1.4 2-4 organic waste to energy projects installed and operating in selected SME sectors

Under this activity between 2 and 4 OWTE projects will be installed and operated. The target capacity range will be 0.25 to 2 MW, which is highly relevant for the SME sector. The demonstration projects will reflect the waste supply situation seen in the four industrial sectors and the need for importing some international best practice into India. During the PPG this clear need for technology transfer of international best practice became apparent and

since these technologies are more expensive than the indigenous technologies it is now proposed to support 2-4 highly replicable demonstration projects (rather than the originally envisaged 7-10 projects).

There will be a mix of on-site based bio-methanation plants plus co-digestion, centralized or cluster based projects. Where sufficient waste is available from one industry an on-site plant can ensure availability of waste (with no fee to be paid) and waste homogeneity. However one of the main problems faced by the SME sector is that the quantity of waste generated by individual units does not make energy recovery from them cost effective. It is therefore proposed to address these with co-digestion plants (to extend the operational period) and at cluster level to increase the quantity of waste. For example pressmud from the sugar industry can be stored and used throughout the year. Poultry and cattle farms waste can be used for cluster based waste to energy models, because of: the close proximity of such farms, low capacity of SMEs to deal with high investment cost and the small capacity of biogas plants if considered individually.

In addition to co-digestion and centralized plants the 2-4 demonstration projects will showcase the latest (proven) innovative technologies which have a high replication potential in India. These could include dry fermentation, multi-stage digestion, biogas enrichment and pre-treatment technologies such as grit removal system, nitrogen extraction.

2.1.4.1 Selection of demonstration projects

As detailed above the specific technologies or development model have been purposely left open to ensure maximum flexibility for the introduction of innovative technology. Therefore the selection process of demonstration projects will be driven by MNRE and endorsed by the Project Steering Committee. The process will include a call for proposals as detailed below.

2.1.4.1a) Selection criteria and procedure for demonstration projects

At the start of the project, specific criteria will be finalised relating to the technical, financial, legal and environmental aspects of the projects. The technology will be prescribed by the specifics of the project. An overview of the draft eligibility criteria is included below:

- Level of innovation (in integration, technology, type of business model)
- Level of co-operation (co-digestion/cluster based)
- Emission reduction potential
- Replication potential
- Cost-benefit analysis
- Technical feasibility
- Willingness from the project owner to co-finance; as well as
- General creditworthiness criteria used by different banks
- Specific financial indicators as part of the loan evaluation.

These will be further developed in consultation with technical experts and banks to ensure that the projects will also meet the credit criteria used by different banks for these investment categories. In addition to the criteria a scoring system will be finalised with better results provided for innovation and for co-digestion projects.

2.1.4.1b) Generating expressions of interest from potential beneficiaries

MNRE with support from the project will invite Expressions of interest (EoI) from industries interested in hosting a demonstration project and which meet the eligibility criteria. This will be done through the national press as well as at workshops. The beneficiaries of the PPG studies are expected to form at least a couple of the demonstration projects. These industries will be approached directly and invited to submit an EoI. Only those that have short paybacks are likely to be interested to take their projects forward. The EoI document will be uploaded on the MNRE and project websites and would also be advertised in newspapers and reputed magazines.

2.1.4.1c) Selection of eligible projects

MNRE with support from the project (i.e. through the Project Management Unit and Expert Appraisal Group) will assess and score the EoIs against the selection criteria. If the project is successful at this stage then the enterprise will enter into discussions regarding technical assistance for the preparation of feasibility studies, bankable plans and the possible GEF-UNIDO subsidy.

The level of incentive (the incentive intensity) has not been fixed since it will depend on the level of innovation in technology and model (and its costs). During the project inception clear recommendations will be developed for calculating the incentive intensity for the different potential technologies and models. For the demonstration projects

the cofinancing will consist of the MNRE support scheme (i.e. the baseline project which acts as the confirmed cofinancing from government side), private sector contribution and bank loans; the GEF contribution will be used as an initial innovation incentive to introduce the use of new technologies. A partial risk guarantee scheme has also been designed, and is detailed under Component 3 based on the incremental cost principle, which could be used to access bank finance.

The following table provides an indication of the sort of projects that might be supported (based on the work from the PPG).

Demonstration project	Size (kW/ MW/or equivalent)	Use of biogas	Potential technology/ business model innovations
Sugar press mud	1.4 MW	Bio-CNG	CSTR technology with downstream-technologies
Food processing plus other	2 MW	Thermal use	Co-digestion, extrusion and dry fermentation with downstream-technologies
Poultry	50 kW	Power/Bio-CNG	Cluster, nitrogen extraction and dry fermentation with downstream-technologies
Cattle	250 kW	Power/Bio-CNG	KVIC/MUASB technology and grit removal system plus downstream-technologies

2.1.4.1 d) Preparation of DPR and ranking of demonstration projects

For each of these projects a Detailed Project Report will be prepared and will be submitted to MNRE for appraisal by the PMU and EAG, as well as by the Financial Institution which is likely to provide them with a loan. MNRE will decide on its support scheme and, in consultation with project partners, on incentive intensity for the innovation incentive, based on transparent and objective criteria. Due diligence assistance will be provided in the process where required. Once the project has been approved by MNRE and/or PSC as a demonstration project, the PMU/EAG may request that the innovation incentive can be released for a percentage up to 20% of the costs to the relevant FI and MNRE (or PMU on behalf of MNRE) issues a Certificate to the FI to confirm that MNRE will provide a grant on the project's commissioning plus 3 months operation.

2.1.4.2 Installation and commissioning of demonstration projects

Following the agreement on finance for the projects, the installation and commissioning will be undertaken by the technology supplier and the beneficiary industry as detailed in the DPR. The National Project Manager will be responsible for over-seeing each of the demonstration projects. Regular reporting on the progress of each project will be required. Following the commissioning of the project the unit owner will submit a completion report to the Project implementation unit. A template for the Completion Report will be provided to the unit owner and will include details of the installation, photos and also at least one month's performance data for the system. Representatives for the Project implementation unit may also wish to visit the demonstration projects to verify the reports. On receipt of this Completion Report 100% of the GEF contribution will be released to the project owner.

2.1.4.2 a) Technology import

The process of bringing international AD technologies to India has a number of possibilities, but for demonstration purposes in different sectors the following approach could be pursued:

Some digester technologies[12] can be imported on a turnkey basis through a global tendering mechanism. Pre-treatment technologies like grit removal system, nitrogen extraction system etc. can be imported on turnkey basis if associated with the above digester technologies. If it has to be imported as standalone system then there are again two routes; through technology transfer or can be directly bought. For downstream technologies also the same method can be adopted. A list of potential technologies is given in ANNEX 1.

A technology assessment mechanism consisting of competent groups will render advice in all cases of technology import relating to highly sophisticated technology and large investments. This activity can be organized through technology institutions (e.g. IIT, IISc, etc.), which will provide assistance for design, critical aspects of construction, supervision, commissioning, trouble-shooting, monitoring and evaluation of projects at demonstration stage. In the case of technology imports for the demonstration projects, the technology institutions also assist the Expert Appraisal Committee/MNRE in technology assessment, technology absorption and translation of designs to Indian conditions.

[12] Examples include DRANCO, KOMPOGAS, VALORGA, BTA process (non-exhaustive)

2.1.4.3 Performance monitoring and analysis of installed projects

An independent consultant will carry out the evaluation of the demonstration projects. PMU/UNIDO will coordinate the evaluation process. Each project evaluation should follow the same reporting structure developed and established for this project and in line with similar GEF projects. The performance will be monitored based on GEF monitoring guidelines, specify the data collection methodology, instruments used, performance parameters to be calculated and the procedures for calculation and presentation of results. The indicators against which the project will be monitored will also be finalised. This will include as a minimum: monitoring and verifying the energy generated and GHG emissions avoided directly due to the GEF project; assessing the operational record of the projects, assessing the commercial operation of the project; identifying any problems; compiling lessons learnt, assessing the socio-economic benefits of the projects to the target beneficiaries; and recommendations from lessons learned and implication/strategy for scaling up or replication. Where applicable one of the key areas to be assessed will be alternative business models, for example cluster approaches, co-digestion, ESCOs or BOO, and the lessons learned will feed into the development of clear replication business models for the use of organic waste for energy for SMEs.

2.1.4.4 Documentation of results of demonstration projects and preparation of case studies

For each project a case study will be prepared for dissemination purposes. The case studies should be designed in such a way that they are easily accessible by different stakeholder groups. These will also be included on the project website established as part of the project management activities. The dissemination programme will also form part of the project management component.

Long-term sustainability of global environmental benefits and institutional continuity through national ownership for Project Component 2 – Technology demonstration

The packages and manuals developed, as part of this component will help industrial unit owners to truly understand the options available to them and to make informed choices therefore increasing the replication potential of the project. The packages and manuals will continue to be available on the MNRE website and through the service support centres beyond the project ensuring their continued availability.

Demonstrating the technical feasibility and commercial viability of SME based organic waste to energy projects provides national examples that can be replicated across the country. The pilots will be selected on a number of criteria including their GHG emission reductions and their replicability as outlined earlier. The four industrial sectors being targeted have many units across India where the technology could be installed. Not only will the demonstration projects show what is possible and the examples be disseminated widely in the country, but the implementation and operation of these projects will build up the technical capacity within the stakeholder groups to help in the replication of these projects. Given the commercial interest in these projects, the different proponents will have an interest in keeping the projects running and hence sustain the global environmental benefits beyond the life of the project.

The organisations for long-term national ownership for the technology demonstration component will be the industry owners, industry associations, state government and MNRE.

COMPONENT 3: Scale up of technologies in organic waste to energy applications in industry (scale-up)

Based on the experience of the technology demonstration phase, a financing scheme will be established; tailored towards effective replication and scale-up. This component will include development of a sustainable financing facility and the development or modification of biogas component standards. The learning from demonstration units through detailed reports and performance feedback will help in improvement and tuning of technologies and the processes. Ultimate success of the project would be evident if organic industrial wastes are not disposed of by the industry and instead are made use of for energy.

The planned outputs and activities under component 3 need to be viewed as indicative in as much as the results from the demonstration phase will refine or possibly significantly alter the scope of activities required to ensure a sustained scale-up phase. The activities will therefore be revisited after the demonstration phase has yielded sufficient experience; this evaluation is expected to coincide with the mid-term project review.

Output	Activities
3.1.1 Development of database and tools to identify and help SMEs to invest in innovative biogas projects	3.1.1.1 A master database of potential SMEs/ Industries for bio-methanation technology adoption 3.1.1.2 Development of standardized long term feedstock supply

	agreements
3.1.2 Specific financing mechanism developed and established to reduce risk for investing in innovative biogas projects and sources of funds secured to ensure a healthy project pipeline	3.1.2.1 Establishment of a financing facility to include the use of a partial risk guarantee fund 3.1.2.2 Exploring potential sources of funds for scale-up and sustainability
3.1.3 Framework for Service Support Networks in different sectors/clusters set up	3.1.4.1 Framework for Service support networks
3.1.4 Quality standards, performance guidelines, and a standardization framework for innovative biogas projects in SMEs in place	3.1.5.1 Needs assessment and roadmap for quality infrastructure for bio-methanation plants in SMEs (both for technology and for the outputs from technology)

3.1.1 Development of database and tools to identify and help SMEs to invest in innovative biogas projects

3.1.1.1 A master database of potential SMEs/ Industries for bio-methanation technology adoption

A master database will be developed which will show the potential for SME industries to adopt bio-methanation technology. A database will not only provide a list of organisations to be targeted as recipients for the capacity building and awareness raising it also, importantly, shows the financial institutions the potential for financial products to be offered in this sector. The database will be prepared through extensive primary survey and data collection. The idea is that this database is shared not only with MNRE and the PMU, but also with the partner banks/FIs so that customised information and requests could be sent to the potential industries asking them to submit a detailed proposal.

Parameters to be encompassed in the database include:

- State-wise waste availability
- Type of waste availability
- Scale categorization (Small/Medium/Large)
- Present Energy Generation (sector-based)

3.1.1.2 Development of standardized long term feedstock supply agreements

Standardised agreements can help reduce transaction costs, reduce negotiation time and provide confidence to the market. Where co-digestion is proposed it is particularly important to be able to have a common understanding of the expectations for both the supplier and the buyer of the waste. Although, as a greater number of bio-methanation projects go forward and many of these source their feedstock from other plants, long term feedstock supply agreements will be developed, the aim of this activity is to develop a standardized agreement that can be used and edited on a case by case basis. It will include clauses to protect both the buyer and the seller and will provide greater transparency to the market. It will also provide confidence to the FIs when reviewing projects to lend to.

3.1.2 Specific financing mechanism developed and established to reduce risk for investing in innovative biogas projects and sources of funds secured to ensure a healthy project pipeline

3.1.2.1 Establishment of a financing facility to include the use of a partial risk guarantee fund.

As set out in Component 2 the 2-4 demonstration projects will receive a GEF innovation incentive in line with the level of technology or business innovation proposed. However for the longer term sustainability of the market an innovative fund arrangement has been designed to finance OWTE projects. This is expected to include an incentive element, a 'Risk Guarantee Fund', an interest holiday, the MNRE Grant and a Standard Bank Loan Product. The proposed funding arrangement is shown in the figure below. During the PPG a number of different financing options were reviewed and discussed with the developers, potential project owners and the FIs. It was clear from these discussions that incentives are required for demonstration of particularly innovative technologies but for other projects they undermine the market. Therefore alternatives were explored for the scale-up. During one-to-one discussions and at the workshops, all the stakeholders agreed that such a funding mechanism would need to address the current barriers to financing (lack of equity and availability of finance).

It is proposed that a new facility is established that can provide the following financing assistance:

i) A partial risk guarantee, which would enable a large loan to be available to the developer so reducing their equity requirements;

ii) A one year interest repayment holiday allows the projects to be established prior to payback; and

iii) An innovation incentive may be available for specific imported or innovative technology.

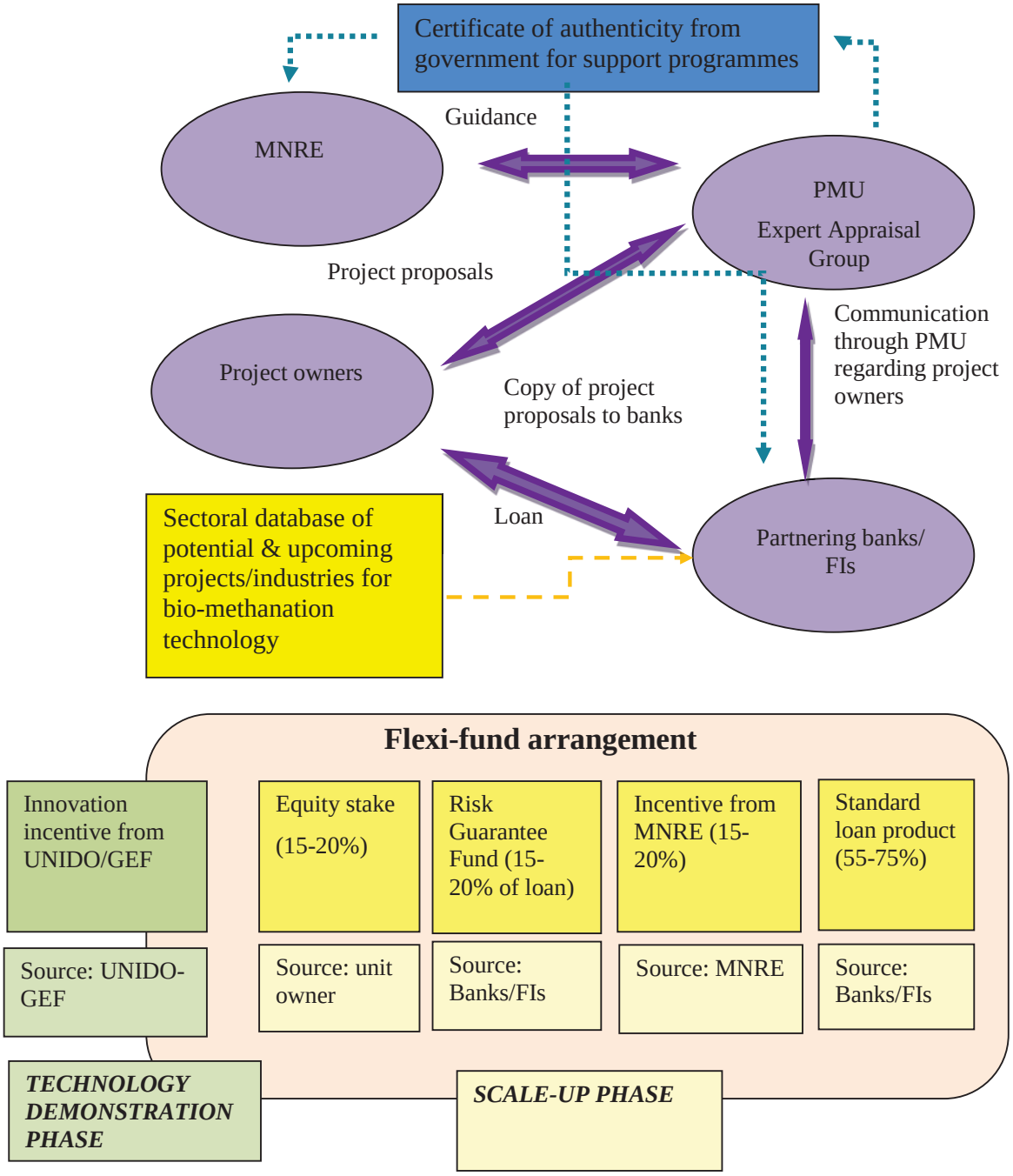


Figure 4 Planned funding arrangement for demonstration and scale-up

The fund will be managed by a finance institution such as SIDBI or IREDA or similar, which will be able to offer loans themselves or may provide the guarantees and fund to other participating banks. The number of banks is not limited but initially includes Axis and SIDBI, both of whom have expressed an interest in providing finance to this sector. The financial institutions working in the implementation set up are crucial to the success of the program. The reach of these financial institutions in the Indian financial set up will play important role in scaling up the initiative at the national level in order to meet the overall goals of India's NAPCC.

The operation of this proposed fund would be as follows:

- Under the Project Management Unit (PMU) an Expert Appraisal Group (EAG) would be established (tentatively comprising MNRE, FI representatives, experts). Interested project owners or developers submit a detailed project proposal to the EAG with a copy to the partner bank, and complete the MNRE incentive application. The EAG would assess the project's technical and financial viability through a site visit and assessing the project using the prepared guidelines.
- The assessment report would be sent to both MNRE and/or PSC and to the partner bank or FI. Based on this report and any further information needed from the project developer the EAG would recommend the project for funding. This recommendation may then include:

    a) Approval for a % MNRE incentive and a subsequent 'certification of the project' to be sent to the financing bank to provide that bank with assurances that the project will receive an incentive following commissioning

    b) Approval for the % niche technology innovation incentive based on the innovativeness of the technology involved; this incentive is expected to be available for the 2-4 demonstration projects only

    The scale-up phase will be facilitated through the combined efforts of capacity building, reduction of (perceived) risk and the establishment of a Partial Risk Guarantee Fund:

    c) Approval for the use of the Partial Risk Guarantee (PRG) to protect a % of the standard loan product

    d) Approval for the use of the interest repayment holiday or grant.

The remaining finance would come from equity (from the project developer) and a standard loan from the bank based on their own due diligence and terms and conditions. The size of the loan for the demonstration project and leveraged finance in general will be greater due to the PRG in place.

The development of this fund will form part of the project and it is expected that it will support further waste to energy projectsn within the project timeframe. Although it is expected that a further 7-10 projects will be developed with support from Component 3, these have not been included within the deliverables of the project since the projects, and their co-finance, have not yet been identified.

3.1.2.2 Exploring potential sources of funds for scale-up and sustainability

Key to the operation of the financing mechanism described above is the identification of funding to provide the partial risk guarantee (PRG). Depending on the level of GEF-UNIDO funds used, as grants for the demonstration projects there may be some funds available to provide some of the Risk Guarantee Fund. Even if this is the case it is necessary to identify future funding sources to sustain the Risk Guarantee Fund; for as long as it is needed for the FIs to increase the size of their loans.

Options for sustainable funding will be investigated with respect to the use of CSR revenues from related industrial organizations. In addition the options will be explored with respect to how bio-methanation projects, where on-site energy is displaced, could be defined as energy efficiency projects, which allows them to access more funds (see section A.7 for possible funds). Similarly recommendations will be made on how bio-methanation could be designated a priority lending sector allowing RBI to provide borrowing at a rate 2% lower than normal due to confidence in sector.

3.1.3 Framework for Service Support Networks in different sectors/clusters set up

3.1.3.1 Framework for service support networks

A service network will result in a one-stop solution for any pre or post installation operation and maintenance service required with biogas plants. Service centres will be established and will comprise of fabricator, local service provider and technology provider operating in any particular cluster. Service centres will be developed in consultation with State nodal agencies. Service centres will be a nodal point for any services required during the

project implementation phase. These service centres will report to the Project Monitoring Unit (PMU). Training to various people within the service support network will comprise part of Component 4.

3.1.4 Quality standards, performance guidelines, and a standardization framework for innovative biogas projects in SMEs in place

3.1.4.1 Needs assessment and roadmap for quality infrastructure for bio-methanation plants in SMEs (both for technology and for the outputs from technology)

A needs assessment will be carried out for the quality infrastructure for bio-methanation technology related standards. This will look into the needs for quality control of specific components as well as for the installation. The work will include reviewing international standards and assessing their applicability for the Indian situation and making recommendations for their introduction/adaptation in India, where relevant.

At the same time standards on outputs, or products, will be assessed. Standards on wastewater, composition of bio-methane for Bio-CNG, PESO standards for Bio-CNG needs will be reviewed in consultation with respective agencies, research institutions and MNRE to see if it requires any further modifications. If Bio-CNG has to be considered as an alternative transport fuel, standards have to conform to PESO. Consultation will be done with PESO and oil companies like GAIL to enquire about the possible interventions required for Biogas to be applied to automobiles and natural gas network respectively.

A first Indian Standard IS 16087: 2013 entitled 'Biogas (Biomethane) – Specifications' has been released by BIS. This standard covers biogas (biomethane) applications in stationary engines, automotive and thermal applications and supply through piped network. The use and application of this standard (e.g. through support in conformity assessments, staff certification on installation and maintenance, as well as potential refinement of the standard) will be supported through the project.

Long-term sustainability of global environmental benefits and institutional continuity through national ownership for Project Component 3 – Scale up

Key to the sustainability of the initiative is the availability of finance for SMEs for future organic waste to energy projects. Therefore this component focuses on the establishment of a financing facility for such projects and identifying potential beneficiaries as well as designing business models which make it easier for industrial units to take projects forward (eg. centralised co-digestion projects). The financing facility will include a partial risk guarantee which will continue beyond the end of the project to enable further SME based projects.

The organisations for long-term national ownership for the scale up component will be financing partners such as SIDBI and IREDA, the industry associations such as CII, and MNRE.

COMPONENT 4: Capacity Building

Capacity Building of the major stakeholders including participating industry, banks/FIs, technology developers and suppliers, government agencies, local and environmental CSOs along with the indigenous people is essential to creating interest and a market for bio-methanation technologies. Capacity building of implementing agencies is of particular importance so that the goals of the GEF5 assistance are realized by the end of the programme and ensure the mainstreaming of industrial waste to energy projects after the project.

Each of these activities has been designed with long-term sustainability in mind. For this to be practicable the capacity building needs to be owned by national institutions which will be responsible for taking it forward beyond the project. The training will include train-the-trainers sessions ensuring that staff in the key sector associations and chambers of commerce, FIs, at service support centres and at MNRE are in a position to pass on their knowledge beyond the end of the project. In particular the associations will help ensure replication through their members and can play a role in identifying possible clusters of units that could work together. This will include work in helping with the market surveys and in encouraging unit owners to become replication projects through the demonstration of the benefits.

Output	Activities
4.1.1 Enhanced awareness and knowledge in key players in target 30 – 50 SMEs, 20 – 30 banks/FIs, technical institutions, manufacturers and other service providers in each of the selected states.	4.1.1.1 OWTE training programmes for FIs 4.1.1.2 OWTE training programmes for target SME sectors 4.1.1.3 Project facilitation service for target clusters

4.1.2 Knowledge products developed that are targeted at anaerobic digestion in industrial sector, including those to facilitate technology transfer.	4.1.2.1 Development of knowledge products for OWTE
4.1.3 Capacity building mechanism for O&M, technical and service roles is established at state level to develop and retain skilled workforce for innovative biogas applications	4.1.3.1 Capacity building for SME industry staff and service providers

4.1.1 Enhanced awareness and knowledge in key players in target 30 – 50 SMEs, 20 – 30 banks/FIs, technical institutions, manufacturers and other service providers in each of the selected states.

4.1.1.1: Training programmes for FIs

Despite the technologies for using organic waste for renewable energy applications in industry being available, banks and financial institutions at state/national levels are however, selective in financing such projects. Projects for generating energy from organic residues (including e.g. rice husks and wastewater from many industries) are not yet preferred and are considered too risky by the banking sector; the interest of the banking sector can be created once the risk perception is properly addressed. Therefore, in addition to the development of the due diligence guidelines in Project Component 2, a number of training programmes will be developed targeted at the FIs at state level. The programmes will include an overview of the technologies, its benefits and how to assess the risks. The programme will include on-line material as well as workshops and site demonstrations. Bank staff will be identified for their ability to pass the training on to others. The aim will be to reach 20 - 30 bank staff in each of the nine targeted states.

4.1.1.2 OWTE training programmes for target SME sectors

Training programmes will be designed to target the SME sectors and specifically the SMEs listed in the 'Master Database'. The manuals developed in Project Component 2 will provide some of the input to the programme but in addition further training material will be developed. This training will be targeted both at the end users as well as at other trainers in Technical Institutes and at the Service Support Centres. Training will involve exercises for the participants to help them to assess viability and to help them to identify markets for their products. Workshops and site visits will be held in each of the states with a target of reaching 30 - 50 SMEs in each state. Apart from technical level (engineers, energy managers etc) also a tailored training programme for senior management (CEOs, Managing Directors) will be developed and conducted to increase the awareness at the decision-making level.

4.1.1.3 Project facilitation service for target clusters

One of the key ways to help get projects off the ground is to ensure that the various stakeholders exchange information with each other. Therefore this project facilitation service aims to target clusters and to organize workshops for local industry owners, FIs, technology and service providers. This will be further facilitated by national experts. Industry association and federations which are well aware of the clusters will also be involved during facilitation activity. This project facilitation service will be carried out to encourage projects to become part of the scale up of the project. Each of the organizations will attend such events with their own objectives and the key to the success of the events will be to 'match-make' suitable businesses with the appropriate technology provider and interested FIs. Once a cluster has an example then this can be used to encourage other cluster members to invest in a similar project.

4.1.2 Knowledge products developed that are targeted at anaerobic digestion in industrial sector, including those to facilitate technology transfer.

4.1.2.1 Development of knowledge products

There are a number of products already available in India on bio-methanation (e.g. Fixed Dome Biogas Plant: A Design, Construction and Operation Manual; Spherical Biogas Plants: A Manual for Extension Workers; and Spherical Biogas Plants: A Manual for Plant Owners – all available from TERI). However there are no products or literature targeted at anaerobic digestion specifically for industrial sectors. Material will be developed targeted at industries highlighting the technologies, the FIs that are investing in the sector, and provides checklists. A simple on-line tool will be designed that allows industries to simply assess the viability of such a project at their site and access will be provided to the manuals developed under Project Component 2.

4.1.3 Capacity building mechanism for O&M, technical and service roles is established at state level to develop and retain skilled workforce for innovative biogas applications.

4.1.3.1 Capacity building for SME industry staff and service providers

The operation and maintenance of bio-methanation plants is very important to their on-going sustainability. Therefore a specific training programme will be designed for industry O&M staff and technology and service providers. Training will be provided at a state level. These programmes would involve specialized workshops that not only provide hands on training for smooth operation to the industry staff but also ensures regular technical up-gradation based on technology advancements to the service providers as well. Training will be provided at a state level, targeting 20 industry staff from each of the 9 states and also targeting the service support centres and 10 OEMs at a National level.

Long-term sustainability of global environmental benefits and institutional continuity through national ownership for Project Component 4 – Capacity building and awareness raising

The creation of a group of industrial experts highly skilled and fully equipped in the development and implementation of industrial biogas projects, provision of and other services, is expected to play a most important role in generating and implementing new biogas / organic waste to energy projects during and after the completion of the GEF project implementation. During the GEF project implementation period not only will stakeholders be trained directly but trainers (component 4.2) will be trained to ensure that the training continues beyond the timeframe of the project. It is anticipated that the training modules are incorporated into new or existing courses run by the Technical Institutes and universities. Trained industrial biogas energy experts will continue offering and providing training as result of increased demand, kicking-off the development of provider start-ups and the growth of a national market. In addition the capacity of academic and research institutions will be enhanced in innovative biogas technologies providing the basis for future Indian R&D in this area. Training of representatives from the CSOs would also be done such that awareness and benefits of such activities are promoted in the region thereby acceleration adoption more such initiatives in the area. The project is expected to generate the level of awareness needed to boost the interest in and demand for SME based organic waste to energy projects. It will see the involvement and active participation of private sector organizations, such as the Chambers of Commerce and Industry and other industry/sector associations, which can rely on well-established national networks and platforms. The awareness and capacity built through these “Awareness raising meetings” will stimulate the development and implementation of new waste to energy projects and generate additional GHG emission savings. This component will build further on the demonstration projects from Project Component 2.

The organisations for long-term national ownership for the capacity building component will be industry associations such as CII, industry owners, and financing partners such as SIDBI and IREDA.

Global Environment Benefits

The investments as part of the technology demonstration are initially estimated to generate 228,000 tCO_2eq (direct GEBs) emission reductions over a 20 year lifecycle duration of the systems. After the completion of this project, investments are expected to be increased due to the long term outcomes of the project activities; the policy component will strengthen the policy and institutional framework to enhance penetration and scaling up of the use of organic waste for energy by SMEs; awareness raising and capacity building activities will contribute to significant indirect CO_2 emissions reduction. As a conservative estimate a replication factor of 4 can be used, which will result in deployment of further bio-methanation projects and the cumulative amount of emission reductions achieved would be 912,000 tCO_2eq over the project and post-project duration (bottom-up methodology). Using the GEF top-down methodology, indirect emission reductions attributable to the project are estimated at 462,000 tCO_2eq. The range of indirect CO_2 emission reductions is therefore 462,000 – 912,000 tCO_2eq. More information on how the emissions reductions were estimated is provided in Annex G.

Institutional continuity and replicability, and sustainability of global environmental benefits

The strategy for long-term national ownership to ensure sustainability and replication in other sectors has been described in the individual components. The focus of the activities is to develop national capacities, particularly within MNRE, the industry associations and banks since these organisations are in the best position to replicate the activities and build the market. Financing partners such as IREDA and SIDBI will extend their outreach into biogas technologies, MNRE will implement tailored policy, the industry associations will engage with their members to raise awareness and ensure that they are aware of the benefits, and the banks will be in a better position to lend to such projects. The outputs to be generated by the GEF UNIDO Project will contribute to creating an enabling environment for a national market for SME based organic waste to energy projects. All planned outputs are consistent with and instrumental to achievements of the objectives of India's key energy policies and legislation.

Therefore, the combined efforts of the four project components are designed in such a way to ensure the sustainability of global environmental benefits beyond the life of the project.

A.6 Risks, including climate change, potential social and environmental risks that might prevent the project objectives from being achieved, and measures that address these risks:

The results of risk assessment carried out during the PPG identified the following major project risks and risk mitigation measures:

Risk Factors	Description of risk	Risk Level	Mitigation measures
Political risk	Lack of government commitment to support the project.	M	The project objectives and activities are in line with national policies and objectives. The project will actively involve representatives from concerned ministries to ensure their full support throughout the project and beyond
Implementation risk	Lack of interest from industries to take up WTE projects	M	Development of detailed activity plans in close cooperation with in-country project partners, stakeholders and developers. A thorough stakeholder consultation process conducted during the project preparation phase identified industries happy to take up WTE
	Lack of interest from technology providers	M	Technology advisors expressed their interest in the project during the PPG Throughout the project, there will be regular and continued contact with manufacturers which should lead to their interest and participation. The project design also motivates and creates interest of manufacturers.
	Unsuccessful demonstration at selected sites Lack of capacity to operate and maintain biogas	L	Suitable sites will be selected through careful analysis of target sectors and plants to ensure success of demonstration projects including: - Identification of proven technologies - Quality audit of equipment - Implementation guidance by experts - Training to the operating personnel in the industry
Technical risks	WTE technologies do not succeed;	L	There is limited technical risk since technologies are widely used in many other countries. Detailed assessment of suitable sites for technologies will carried out and training from technology importers will be provided.
Project Sustainability	Lack of collaboration by key agencies	M	A central co-ordination committee will be established to facilitate project implementation. Members will include representatives of MoA, MoF, NDRC and MoE.
	Failure to achieve project outcomes and objectives after successful delivery of outputs.	M	By making market players fully aware of the economic potential of biogas technologies and by equipping them with the capacity and tools to realize and reap the benefits of such potential, the project will generate a self-reinforcing market. In addition, the financial mechanisms that will be put in place will create a positive context that is expected to ensure the attainment of the project outcomes and their sustainability.
	Lack of technical capacity	L	Strengthening and expansion of technical capability through training centre established in component 3. Training activities will be closely monitored and supported under M&E plan. Linkage to experts and specialized institutions for training and support will be established and coordinated.
	Changes in the availability of the waste from industry	M	Market and demand analysis. Continuous policy dialogue with the Government on the improvement of the sector development during the project implementation.
Financial Risks	Industries' lack of resources to repay loans	L	Stringent selection of borrowers through assessment and due diligence of each borrower's historic and future financial management capacity.
	Lack of co-finance	L	Demonstration projects only selected on evidence of co-finance of the project
	Lack of interest among banks and FIs for large scale uptake.	H	Banking sector was closely involved during the PPG phase and has shown their support of the project and technologies. Letters of commitment to invest have been provided by three banks. Proper dissemination of the results will be organised to raise awareness among banking sector
Environmental and social risk	In case any possible social and environmental safeguards issues occurred.	M	Carry out Environmental Impact Assessments as part of preparation of the technology interventions, including sanitary management of organic waste, ways to address potential odour problems caused by the biochemical process to covert waste to energy, etc.; Annual environment and safeguards M&E reports will be provided, which will follow up with necessary actions
Climate change risk	The technology or renewable resource is affected by climate change	L	Changing patterns in temperature and rainfall may affect the availability of the renewable resource; due to the different sectors in different parts of the country, and the target of applying co-digestion, the risk is deemed low; Biogas technology is very little impacted by climate change

A.7. Coordination with other relevant GEF financed initiatives

As part of the completed UNDP/GEF project on "Development of High Rate Bio-methanation Processes as a means of Reducing Greenhouse Gas Emissions", a National Master Plan (NMP) for waste-to-energy was finalized in 2002 which has been used by MNRE in their policy formulation regarding waste management and methane gas recovery. Whereas the focus of that project has been primarily on large-scale industries, the proposed project will aim to introduce available technologies to the SME sector as well as to build on and update the work undertaken as part of that project.

Potential synergies have been investigated with the World Bank's initiatives, most notably the financing mechanisms currently available or under development for SMEs. World Bank and Global Environmental Facility are currently implementing a project on "Financing Energy Efficiency at MSMEs", through SIDBI and BEE (Bureau of Energy Efficiency) for enhanced energy efficiency in identified Indian MSME clusters. A Project Management Unit at SIDBI currently focuses on 5 identified target clusters for assessing the potential of Energy Efficiency improvements. Financing is then provided to those projects for reaping the efficiency and GHG mitigation gains. Potential synergies are possible to encompass this initiative for OWTE under this World Bank – GEF project in its subsequent phases of implementation. CII supported by DFID has already established a financing mechanism in the area of Energy Efficiency for Indian SMEs in consultation with BEE & few banks/FIs and is now working with a large number of SMEs to validate the model by establishing a few pilots. This may result in some larger international finance coming in through Bilateral/ Multilateral agencies to support this initiative and replicate it on a large scale. This project on innovative biogas projects may be able to access such funds, once established. Banks and financial institutions like SIDBI, IREDA and Axis are involved in financing RE projects and coordination with these programs will be ensured so that proper leveraging of funds available under the proposed program is possible. The projects developed under the proposed program may also take benefits under national schemes like Renewable Energy Certificates (REC).

UNIDO has its Regional Office in Delhi and will be able to draw upon the experience gained from its wider portfolio of relevant and mainly GEF funded projects on bio-energy, including in Ukraine (low-carbon technologies in bakery industry, biogas from organic farm waste to provide heat and electricity for on-farm needs), gasification in wood-processing sector, Uruguay (biogas and other low carbon waste utilization technologies), the Dominican Republic (biomass for electricity generation) and Chile (biogas for agro-industries). Furthermore, UNIDO has carried out projects in Nigeria (rice husks for electricity), Thailand (bamboo waste from chopstick industry and rice husks for energy), Sri Lanka (bamboo waste processing into pellets). UNIDO's energy-related GEF funded projects in India have been mentioned in Section A.3.

B. ADDITIONAL INFORMATION NOT ADDRESSED AT PIF STAGE:

B.1 Describe how the stakeholders will be engaged in project implementation.

Primary target beneficiaries of the project are energy policy-making and implementing institutions, primarily MNRE, IREDA and SIDBI as well as industrial unit owners (end beneficiaries), biogas manufacturers, designers, installers, training institutes, energy professionals, service providers and the financial sector. The projects are expected to be co-financed from specific assistance programs of MNRE through financing partners such as SIDBI and IREDA. The involvement of entities like SIDBI and IREDA are appropriate for ensuring continuity after completion of the GEF project is over; they have extensive experience with financial instruments and providing credit to a wide variety of industries and companies. Lines of credit may be possible with other Indian FIs from other multilateral financial institutions with a focus on RE technologies, including organic waste for energy applications in industry. In addition, to increase market awareness the national and local industrial associations will be responsible for facilitating the awareness programs, to help industries opt for demonstration projects and post project scale up. Engaging CSOs will be critical for the long term sustainability of the projects and its integration into Indian industrial sector. Collaboration of the CSOs with the industry and its association would increase the awareness of such initatives in the area and also provide a platform for awareness and training in the region beyond the duration of the project.

The outcomes of the planned project activities and potential recommendations for bridging the gaps have been discussed with all the potential stakeholders during the PPG stage. More details on the consultation workshops and validation workshop are provided in ANNEX 2 and ANNEX 3.

Anticipated Project Management and Implementation

Fig.3 shows a diagram of the planned project implementation and execution arrangement.

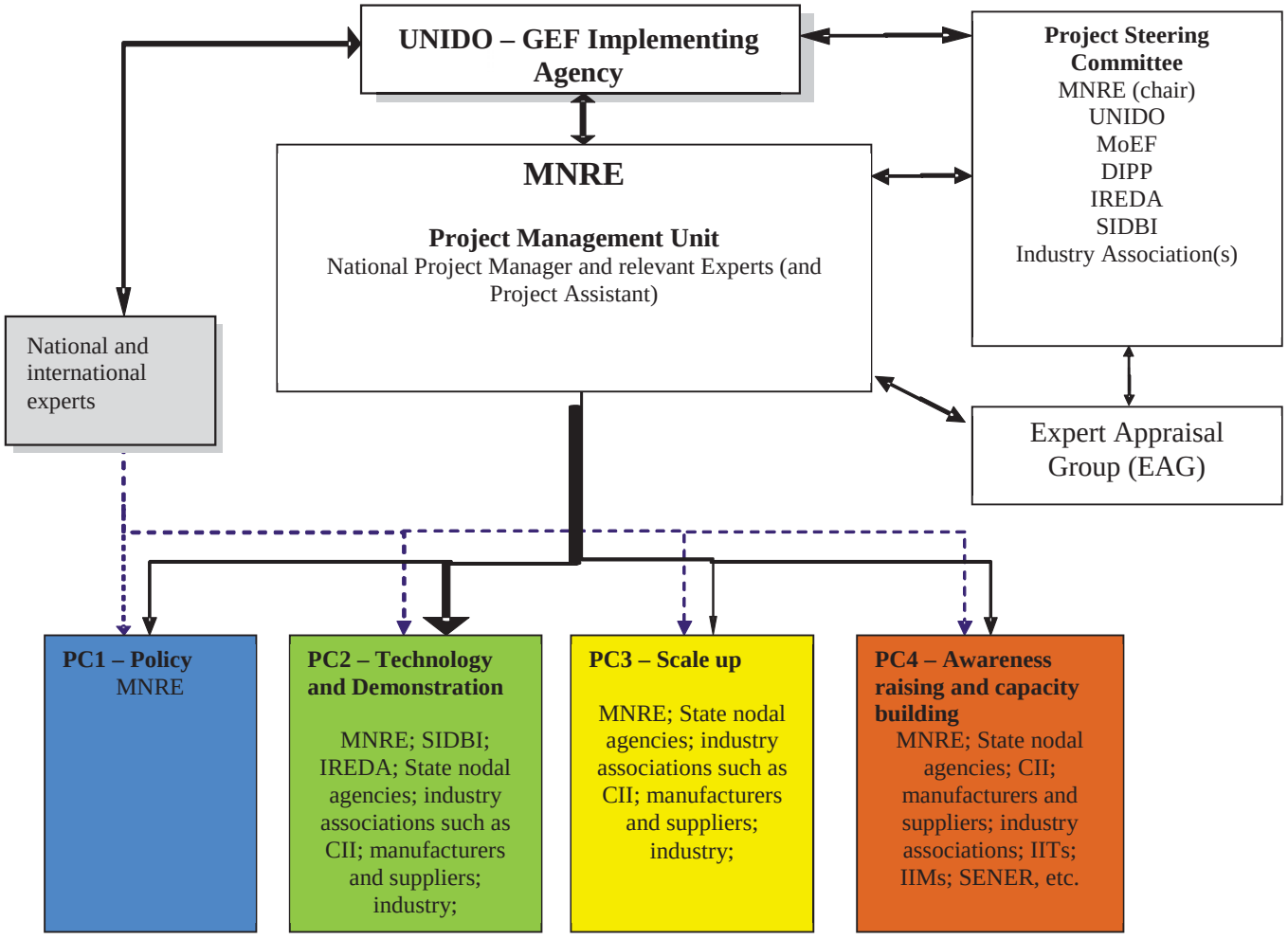


Figure 5: Diagram of planned project implementation structure

- *UNIDO:* as the GEF Implementing Agency holds the ultimate responsibility for the implementation of the project, the delivery of the planned outputs and the achievement of the expected outcomes; UNIDO will be responsible for supervision and monitoring of the project, and reporting on the project performance to the GEF;
- *MNRE:* hosts the PMU and will have a mentoring role; a focal point to the project on behalf of MNRE will be appointed; MNRE will ensure that the activities on organic waste to energy are properly coordinated with the other activities which MNRE is undertaking or promoting, including the "Energy from urban, industrial and agricultural waste program". MNRE will ensure co-finance on eligible demonstration projects from its subsidy programme and will be responsible for cooperation with financing institutions like IREDA and SIDBI regarding a credit line for the scale up component.
- *Project Management Unit (PMU):* will be responsible for the day-to-day planning and execution of project activities as in the agreed project work plan. The PMU will be headed by the National Project Manager (NPM), and (indicatively) a technical, financial and capacity building expert, and a project assistant; The PMU will coordinate all project activities and will report to UNIDO and MNRE.
- *Project Steering Committee:* will be established for periodically reviewing and monitoring project implementation progress, provide strategic advice, facilitate co-ordination between project partners, provide transparency and guidance, and ensure ownership and sustainability of the project results. The Terms of Reference and final composition of the Steering Committee will be defined during the project implementation start-up phase and is expected to be chaired by MNRE and is expected to include representation from MNRE, DIPP, IREDA, Ministry of Environment and Forests (MoEF) and an industry association/member.
- *Expert Appraisal Group (EAG):* will be formed to support the Project Management Unit (PMU), with oversight from MNRE. The EAG will assess prospective demonstration project, prepare and facilitate sound decision

making by the PSC Based on a recommendation of the EAG MNRE (or the PMU on behalf of MNRE) could then provide a certificate of authenticity which could be provided to the FIs. For projects in clusters this will also help providing finance where there may be multiple owners. The EAG can also provide independent advice on the project or its components, and will take the form of an operational "working group" and will consist of (operational level) of the PSC members and additional experts on a needs basis; the involvement of the PSC members will also support the building of the capacity towards long-term ownership and sustainability of the activities.

- *Indian Renewable Energy Development Agency (IREDA):*UNIDO-GEF funds for the technology demonstration and scale-up components may flow through IREDA; IREDA being a Public Limited Government Company established in 1987, under the administrative control of the Ministry of New and Renewable Energy (MNRE), and acts as a Non-Banking Financial Institution to promote, develop and extend financial assistance for renewable energy and energy efficiency /conservation projects. In addition, IREDA provides soft loans for RE investments and has the capacity to design and implement appropriate non-grant instruments, such as a bank guarantees.
- *Small Industries Development Bank of India (SIDBI):*UNIDO-GEF funds for the technology demonstration and scale-up components may flow through SIDBI, being the principal financial institution for the promotion, financing and development of industry in the small scale sector and to co-ordinate the functions of the institutions engaged in the promotion and financing or developing industry in the small scale sector and for matters connected therewith or incidental thereto.

At the beginning of project implementation a detailed work plan for the first year of implementation will be developed by the PMU in collaboration with UNIDO and MNRE, based on the overall work plan for the entire duration of the project. The yearly work plan will clearly define roles and responsibilities for the execution of project activities, including monitoring and evaluation; it will set milestones for deliverables and outputs. The overall and annual work plans will be used as management and monitoring tool by PMU and UNIDO and the overall work plan will be reviewed and updated as appropriate on a biannual basis.

The mentioned stakeholders per component are indicative.

The respective execution tasks to be carried out by organisations and experts will be made part of contractual arrangements with UNIDO and in line with UNIDO's rules and regulations.

B.2 Describe the socioeconomic benefits to be delivered by the Project at the national and local levels, including consideration of gender dimensions, and how these will support the achievement of global environment benefits (GEF Trust Fund/NPIF) or adaptation benefits (LDCF/SCCF):

To ensure that men and women can equally benefit from development projects and that gender inequalities in activities and outcomes are reduced or eliminated, gender differences need to be considered during the entire project cycle – from design and implementation to monitoring and evaluation. By systematically mainstreaming gender into their interventions, UNIDO's Energy and Climate Change Branch (ECC) aims to ensure equal opportunities for both women and men, thus furthering UNIDO's inclusive and sustainable industrial development agenda and contributing to the achievement of the Millennium Development Goals (MDGs), and the Post-2015 development framework, as well as the Sustainable Energy for All (SE4ALL) objectives. In order to "demystify" gender mainstreaming and provide practical guidance on how to systematically address existing or potential gender inequalities specific to UNIDO's energy and climate change interventions, a tailored guide has been developed aimed at helping the staff of UNIDO`s ECC Branch to apply a gender perspective to their work and, more specifically, to mainstream gender throughout the project cycle. It is anticipated that a gender expert will be involved to monitor the gender-specific dimension of the project and provide guidance to maximize the impact.

Even though the project as a whole is not particularly gender sensitive, the gender aspect is expected to be relevant especially for the training and capacity building activities. Since women represent a significant part of the work force in many of the target SMEs, support in innovation and increased competitiveness through reduced cost of energy will promote favorable social and economic conditions through (sustained or increased) employment generation, economic wellbeing and gender mainstreaming. Similarly, the project is not targeted at indigenous populations, but where relevant indigenous populations would be expected to be included in the training and capacity building activities.

The project will trigger social and economic benefits at the local and national level by increasing employment opportunities, helping to develop the local economy and strengthening local capacity by increasing technical knowledge and capabilities. The bio-methanation projects will replace fossil fuels and as such will hedge the risks

against fluctuation in prices. The technology does not require any input fuel, thus significantly reducing its cost of operation.

The results from the PPG phase suggest promising cost effectiveness especially if the benefits of latest innovation are introduced (e.g. through increased biogas yield at the upstream level, and diversified marketable end-products at the downstream level). While these figures will need to be verified on a case-by-case basis, it is clear that the introduction of innovative and cost-effective technologies will save energy costs, strengthen the competitiveness of the individual enterprises and put the local economy on the path to low-carbon and sustainable industrial development. These projects will generate new ventures for entrepreneurs in consulting, designing, project implementation, manufacturing, operation and maintenance; hence will improve the social status through creating employment opportunities.

In addition the Project is expected to produce a number of other environmental benefits besides the reduction of GHG emissions: non-point source pollution abatement, water and air pollution reductions and public health improvement.

Non-point source pollution: The quality of surface water in India is generally low. In recent years, non-point source loadings, particularly wastes from livestock and food processing operations, have grown to become a major source of water pollution for India's water environment. By targeting these SME operations, the Project will greatly reduce pollution and improve the quality of the water environment. Additionally anaerobic digestion is estimated to reduce chemical oxygen demand by 87% to 90% and biochemical oxygen demand by 88%.

Air pollution*:* Studies have shown that livestock feeding operations are a source of air pollutants, including NH_3, H_2S, particulate matter PM10 and PM2.5, odour and volatile organic compounds (VOCs). These contaminants cause respiratory, cardiovascular and immune illnesses, and spread infectious diseases. The biogas plants will significantly reduce the generation of these air pollutants, thus reducing the risk to public health. Meanwhile the biogas and electricity produced under the Project will replace the use of coal or other fire-biomass which is a major source of air pollution for Indian cities and households. The health benefits of the emission reductions are difficult to quantify as they depend on population density and distribution and a variety of other factors, but the health and social economic benefits are believed to be significant.

Public health: In addition to the public health benefits derived from the reduced water and air pollution, the anaerobic digestion process is known to reduce disease-causing pathogens and virus by 90.6% to 99.9%, the removal rate by anaerobic digestion for coliforms by up to 99.9% and ascarid eggs by up to 93.3%. The anaerobic digestion technology will greatly reduce the risk of water-borne and infectious diseases for animals and local residents. If an additional hygiene process step is operated, i.e. pasteurisation, all pathogens will be removed.

Eco-farming expansion: The slurry generated from the biogas plants contains nitrogen, phosphorus, potassium and humus, which has been proven to be a valuable replacement of chemical fertilizers to provide nutrients to crops and improve soil fertility and contributes by carbon sequestration to GHG emission mitigation (CH_4 and N_2O emission reduced and carbon stored in the soil). On-farm management will further reduce emissions, in particular GHG from manure and fertilizer handling. The use of organic fertilizer rather than chemical fertilizers can also reduce the amount of nitrogen, phosphorus and potassium entering water courses and reduce the degradation of soil texture and permeability.

B.3. Explain how cost-effectiveness is reflected in the project design:

Bio-methanation, or anaerobic digestion, is a mature technology that has been adopted widely for the treatment of waste with higher concentration of organic materials from livestock farms and the agro processing industries. It is considered a cost-effective way of treating these wastes, and produces a useful by-product, biogas, which can be used for heat processes, cooking and electricity production. This biogas displaces fossil fuels used for these purposes, leading to a reduction in CO_2 emissions.

The project takes a comprehensive approach to address many of the barriers that are preventing SMEs uptake of organic waste to energy technologies, in particular those related to awareness and capacity as well as a supportive regulatory framework. The strategy for the project to achieve good cost-effectiveness is based on a number of principles: 1) build on and maximize leverage of national public and private resources; 2) training-the-trainers approach for industry-wide awareness raising of and capacity building in renewable energy; 3) select pilot projects primarily on the basis of their replication potential (and therefore direct and indirect avoided GHG emissions); and 4) searching and maximizing synergies with institutions for investment. The aim is to improve the cost-effectiveness of biogas plants by supporting the Government in improving technical standards, business models for centralised biogas, and a performance monitoring system to enhance the efficiency of biogas plants.

Given its focus on addressing policy and technical capacity barriers, this project will generate the largest share of GHG emission savings after the project implementation period, when the new guidelines would be in place, capacity built and the training programmes established that will deploy their full impact in terms of new SME based organic waste to energy projects.

This project will result in:

- Direct emission reductions of 228,000 tCO_2eq through its demonstration activities
- Target investment levels of 11.9 million USD by the end of the project in 2020 (leveraging at least million 10.2 million USD for a 6:1 leverage ratio)
- Direct energy generation from demonstration projects totalling 3,700 kW
- Post-project indirect emission reductions of 462,000-912,000 tCO_2eq due to increased awareness and capacity to develop and finance SME based waste to energy projects

Calculating the cost per tonne of direct reduction of emissions for GEF, the cost per tonne of abatement would then be 14.62 USD/tonne CO_2e (assuming grid electricity is offset). If the GEF investment cost is used then the cost per tonne of abatement would reduce to 7.46 USD/tonne CO_2e. Adding the post-project indirect reduction of emissions, the cost per tonne of abatement would reduce to as low as 3.7-7.2 USD/tonne CO_2eq.

C. DESCRIBE THE BUDGETED M &E PLAN:

Formal monitoring and evaluation (M&E) of the project will follow the principles, criteria and minimum requirements set out in the GEF Monitoring and Evaluation policy in its current version and the respective guidelines and procedures issued by the GEF Evaluation Office and/or the GEF Secretariat. At the same time, M&E will comply with the rules and regulations governing the M&E of UNIDO technical cooperation projects, in particular the UNIDO Evaluation Policy and the Guidelines for Technical Cooperation, both in their respective current versions.

The overall objective of the monitoring and evaluation process is to ensure successful and quality implementation of the project by:

i) Tracking and reviewing project activities execution and actual accomplishments;
ii) Leading the project processes so that the implementation team can take early corrective action if performance deviates significantly from original plans;
iii) Adjust and update project strategy and implementation plan to reflect possible changes on the ground, results achieved and corrective actions taken; and
iv) Ensure linkages and harmonisation of project activities with that of other related projects at national, regional and global levels.

A detailed monitoring plan for tracking and reporting on project time-bound milestones and accomplishments will be prepared by UNIDO in collaboration with the Project Management Unit (PMU) and project partners at the beginning of project implementation and then periodically updated.

By making reference to the impact and performance indicators defined in the Project Results Framework, the monitoring plan will track, report on and review project activities and accomplishments in relation to:

a. Renewable energy heat/power delivered and GHGs emission reductions directly generated by the UNIDO GEF project. These will include the type and the number of projects developed and implemented.
b. Renewable energy heat/power generation and GHGs emission reductions in-directly generated by the UNIDO GEF project. These will include type and the number of projects developed and implemented due to the increased capacity and conducive environment for the renewable energy projects.
c. Renewable energy investment generated by the UNIDO GEF project, directly and indirectly
d. Development of policy, legislative and regulatory frameworks aimed to promote and support the SME bio-methanation market
e. Level of awareness and technical capacity for the use of organic waste for energy within relevant institutions, in the market and within enterprises.
f. Overall socio-economic impacts of the project to include increase in productive capacities, access to modern energy services, gender balance etc

The National Project Manager will be responsible for day-to-day and local management of project activities execution, performance and track progress towards milestones. However, monitoring and evaluation of the demonstration projects with respect to energy generation, technical performance, commercial viability and GHGs

emission reduction, and related information, will be integral part of the evaluation component of Project Component 2.

The UNIDO project manager will be responsible for oversight and tracking overall project milestones and progress towards the attainment of the set project outputs. The UNIDO project manager will be responsible for narrative reporting to the GEF. The UNIDO project manager will be responsible for the preparation of Annual Project Implementation Reviews (PIR) and mid-term evaluations as established in the M&E Plan.

One mid-term review will be carried out and a final external evaluation at least one month before the completion of the project. UNIDO will make arrangements for the independent terminal evaluation of the project. The UNIDO project manager will inform UNIDO Evaluation Group at least 6 months before project completion about the expected timing for the Terminal Evaluation (TE). UNIDO Evaluation Group will then manage the TE in close consultation with the project manager.

The following table provides the tentative budget for the two evaluations, which has been included in Project Component 5.

UNIDO as the Implementing Agency will involve the GEF Operational Focal Point and project stakeholders in order to ensure the use of the evaluation results for further planning and implementation.

Project's Indicative Monitoring and Evaluation Work plan

Type of M&E activity	Responsible Parties	Budget USD*	Time frame
Inception Workshop (IW) and inception report	UNIDO Project Manager (PM); Project Management Unit (PMU)	0**	Within first two months of project start up
M&E design and tools to collect and record data (performance indicators) including survey to confirm baseline for industry, manufacturers, policy makers etc.	UNIDO Project Manager (PM); Project Management Unit (PMU) and M&E specialists as required	5,000	Within first two months of project start up and mid of project
Regular monitoring and analysis of performance indicators (technical, social, policy, environmental)	UNIDO Project Manager (PM); Project Management Unit (PMU) and M&E specialists as required	0**	Regularly to feed into project management and Annual Project Review
Annual Progress Reports (APRs) and Project Implementation Reviews (PIRs)	Project Management Unit (PMU) to prepare prior to the annual project review PM UNIDO to validate and finalize to submit to GEF	0**	Annually
Annual Project Review to assess project progress and performance	Project Management Unit (PMU), PM UNIDO HQ and Project Steering Committee to review the project performance and make corrective decision	0**	Annually prior to the finalization of APR/PIR and to the definition of annual work plans
Steering Committee (SC) Meeting	Project Management Unit (PMU), PM UNIDO HQ and Project Steering Committee	0**	Annually coincide with the Annual Project Review and whenever urgent and important decisions need approval of SC
Project Executive Committee	PMU, PM UNIDO HQ	0	Every six months
Mid-term Evaluation including survey to measure progress against baseline for industry, manufacturers and policy makers	PMU, external consultants, UNIDO PM, UNIDO Evaluation Unit (ECA) in advising on TOR and selection of evaluators, Steering Committee and M&E specialists as required	20,000	Mid project
Final survey to measure progress against baseline for industry, manufacturers and policy makers	UNIDO Project Manager (PM); Project Management Unit (PMU) and M&E specialists as required	5,000	
Terminal Project Evaluation	UNIDO Evaluation Unit (ECA), Project Management Unit (PMU), PM UNIDO HQ and Project Steering Committee, independent external evaluators	30,000	Evaluation at least one month before the end of the project; report at the end of project implementation
Lessons learned	PMU, external consultants, UNIDO PM	0**	By the end of project implementation; annual as part of PIR
Visits to field sites	PM	0	Annually
	UNIDO HQ Representative from the Steering Committee	0	
TOTAL indicative cost ** Excludes project team staff time and UNIDO staff* *** The costs are covered under Project Management Costs*		60,000	

According to the Monitoring and Evaluation policy of the GEF and UNIDO, follow-up studies like Country Portfolio Evaluations and Thematic Evaluations can be initiated and conducted. All project partners and contractors

are obliged to (i) make available studies, reports and other documentation related to the project and (ii) facilitate interviews with staff involved in the project activities.

Legal Context:

The Government of the Republic of India agrees to apply to the present project, mutatis mutandis, the provisions of the Revised Standard Technical Assistance Agreement concluded between the United Nations and the Specialized Agencies and the Government on 31 August 1956 and as amended on 3 October 1963.

PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)

A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT(S) ON BEHALF OF THE GOVERNMENT(S):): (Please attach the Operational Focal Point endorsement letter(s) with this form. For SGP, use this OFP endorsement letter).

NAME	POSITION	MINISTRY	DATE *(MM/dd/yyyy)*
Mr. Hem Pande	GEF Operational Focal Point	Ministry of Environment and Forestry	04/03/2012

B. GEF AGENCY(IES) CERTIFICATION

This request has been prepared in accordance with GEF/LDCF/SCCF/NPIF policies and procedures and meets the GEF/LDCF/SCCF/NPIF criteria for CEO endorsement/approval of project.

Agency Coordinator, Agency Name	Signature	Date *(Month, day, year)*	Project Contact Person	Telephone	Email Address
Mr. Philippe R. Scholtès, Managing Director, Programme Development and Technical Cooperation Division (PTC), UNIDO GEF Focal Point		02/09/2015	Mark Draeck, Industrial Development Officer, Energy & Climate Change Branch	+43 1 260265317	m.draeck@unido.org 

ANNEX A: PROJECT RESULTS FRAMEWORK (either copy and paste here the framework from the Agency document, or provide reference to the page in the project document where the framework could be found).

Project Strategy		Objectively verifiable indicators				
		Indicator (quantified and time-bound)	**Baseline**	**Target**	**Source of verification**	**Risks and Assumptions**
Objective of the project	**The proposed project will focus on using organic waste streams for industrial renewable energy (RE) applications in SMEs, in support of the energy policy priorities, with the overall aim for promoting application of innovative and adaptive technology in the SMEs to reduce their dependency on fossil fuels.**	1. CO_2 emission reduced (tonnes of CO_2eq) 2. Energy generated from biogas technologies (in MWh) 3. No. of projects in SMEs using innovative technology	1. Direct CO_2eq emission reductions 2. Indirect CO_2eq emission reductions	Cumulative reduction of GHG by about 228,000 tCO_2 over the period 2015-2035 16,310 MWh energy generated annually from biogas through projects installed over the period 2015-2035	GEF project tracking tool Project documents	The GoI remains committed to the development of RE Implementation of project activities will foster investment in innovative biogas technologies Adequate resources mobilized
Project Component 1 – Strengthening the policy and institutional framework						
OUTCOME 1.1	Enhanced use of organic waste streams for industrial RE applications in target SME sectors through a strategic roadmap.	Extent to which National Master Plan (NMP) and roadmap are proposed and adopted	NMP not updated since 2002	New NMP to 2027 published	MNRE	Institutional and policy barriers can be overcome through analysis and tailored proposals Sustained GoI support
Output 1.1.1	An updated and tailored roadmap for increased use of waste-to-energy practices in the target SME sectors	Revised NMP for organic waste to energy	NMP not updated since 2002	New NMP to 2027 published	Project reports MNRE	Sustained GoI support Effective collaboration with industry regarding proposed changes
		Specific strategic action plan/road map for organic waste to energy for SMEs	No clear strategies for SMEs	Clear action plan for organic waste to energy for SMEs	MNRE	

		Certificate of authenticity from government for support programmes	No certificate issued prior to subsidy allocation	Certificate of authenticity for support programmes prepared	MNRE website	
Project Component 2 – Demonstration of the most relevant financially feasible technologies in selected sectors						
OUTCOME 2.1	Demonstrated technical and financial viability of projects in the range of 0.25 – 2 MW (or equivalent thermal energy)	No. of projects with innovative biogas technology MW installed Volume of investment mobilised Tonnes of CO_2eq avoided	No innovative projects 0 MW No co-finance No avoided emissions	2-4 innovative projects 3.7 MW installed 18 MUSD 228,000 tCO_2eq avoided	GEF project tracking tool Financing partner data Independent evaluation reports Project reports Project website	Fossil fuel prices remain high in the medium and long-term Beneficiary industries have co-finance to implement projects and there is the technical capacity to install the project.
Output 2.1.1	Techno-financial and strategic assessment of most suitable business models	Number of assessments of business and technology models available	No assessments of appropriate models carried out	2-3 models assessed appropriate for the four priority sectors	Project documents	Cooperation between users and suppliers to develop standard conditions Cooperation between FIs and technical experts to develop models
Output 2.1.2	A 'Consolidation Matrix' on appropriate financial models and schemes suitable for SME financing for innovative technology financing in SMEs	Matrix on appropriate financial models	No matrix available to assist in selecting appropriate financial model	Matrix developed	Financing partner data Project documents	
		Due diligence guidelines for organic waste to energy projects	No due diligence guidelines developed	Due diligence guidelines for the different technologies developed		
		Establishment of a Technical Advice Committee to advise on technical merits of projects	No Technical Advice Committee in existence	Technical Advice Committee established made up of 5 experts		
Output 2.1.3	Detailed technology packages with specifications for identified technologies	Number of technology packages developed for the priority sectors	No technology packages or guidelines developed for SMEs in priority sectors	4 technology packages and guidelines (one per sector)	Copies of the technology packages and guidelines Copies of the guides	

	for target sectors (food processing, poultry, cattle and sugar-press mud) and applications (thermal, power, bio-CNG) and applications (e.g. thermal, power, bio-CNG)	Guides on developing markets for by-products	No guides for market development of by-products	Guides developed for market development for bio-CNG and organic fertiliser	Copies of standardised reporting	
		Standardised financial and technical parameters for reporting in DPRs	No standardised parameters for feasibilities and DPRs	Standardised financial and technical parameters for reporting in DPRs		
Output 2.1.4	2-4 innovative organic waste to energy projects installed and operating in selected SME sectors	Number of organic waste to energy projects implemented with support from GEF Number of innovative technologies Number of co-digestion systems	No innovative systems installed No systems designed as co-digestion	2-4 additional projects implemented with direct support from GEF. 2-4 innovative technologies included 1-2 co-digestion systems installed	GEF project tracking tool Project implementers' records. Independent evaluation reports Project reports Copies of case studies	Co-finance is available for each project and there is the technical capacity to install the project.
		Installed capacity of new organic waste to energy projects (MW)	0 installed	Installed capacity of more than 3.7 MW		
		Performance monitoring, evaluation reports and case studies on each GEF supported project	No dissemination material on organic waste to energy for SMEs	2-4case studies		
Project Component 3 – Scale up of technologies in organic waste to energy applications in industry						
OUTCOME 3.1	Sustainable replication model for effective scaling up of different technologies across target industries	Number of waste to energy projects installed (in MWeq) in industrial sector from 2015 onwards.	156.33 MW (By September 2014, 136.33 MW capacity of waste to energy projects have been installed and 20 MW capacity is under installation.)	The project will activate the utilisation of the estimated potential of approx. 1700MWeq capacity of energy generation from industrial organic waste from 2015 onwards.	MNRE	The GoI remains committed to the development of RE. Favourable policy intervention from the government during the duration of the project. Continued interest from industry sector. Continued uptake of waste to energy project

						in sectors other than the four targeted industrial sectors of this project. Interest from FIs in being involved in bio-methanation market
Output 3.1.1	Development of database and tools to identify and help SMEs to invest in innovative biogas projects	A master database of potential SMEs/ Industries for bio-methanation technology adoption Standardised long term feedstock supply agreement	No national database of potential for SMEs and biogas Informal/non-standardised feedstock supply agreements	Master database developed for 4 priority sectors Standardised long term feedstock supply agreement developed	Project reports Standardised long term feedstock supply agreement	Sufficient interest from industry and MNRE in developing database and agreements
Output 3.1.2	Specific financing mechanism established to reduce risk for investing in innovative biogas projects and sources of funds secured to ensure a healthy project pipeline	Financing facility established Quantity (USD) of funding identified	No financing facility available for organic waste for energy for SMEs No dedicated funding for organic waste to energy	A financing facility established 10 MUSD identified as partial risk guarantee	Project documents. Financing records	Interest from FIs in being involved in bio-methanation market A number of financing institutions interested in funding bio-methanation projects
Output 3.1.3	Framework for Service Support Networks in different sectors/clusters set up	No. of service support networks	No service support networks dedicated to organic waste streams	More than 10 service support networks established	Project records	Continued interest from SME sectors and clusters
Output 3.1.4	Quality standards, performance guidelines, and a standardization framework for innovative biogas projects in SMEs in place	Needs assessment and roadmap for quality infrastructure for bio-methanation plants in SMEs (both for technology and for the outputs from technology)	No assessment or roadmap for the quality infrastructure for bio-methanation	Needs assessment and roadmap for quality infrastructure for technology components Needs assessment and roadmap for quality infrastructure for biogas products	Project documents MNRE	Continued support from government entities (e.g. standardisation bodies) in charge of quality infrastructure
Project Component 4 – Capacity building of public and private sector stakeholders						
OUTCOME 4.1	Enhanced capacity of key players in target industries, promotion	1. No of trained personnel				

	of knowledge and information sharing and dissemination of best practices	2. No. of training sessions provided 3. Advice given to stakeholders				
Output 4.1.1	Enhanced awareness and knowledge in key players in target 30 – 50 SMEs, 20 – 30 banks/FIs, technical institutions, manufacturers and other service providers in each of the selected states.	No. of training sessions targeted at financial institutes	None	Nine training sessions	Participant logs and evaluation forms Copies of training material Copies of manuals	Targeted stakeholders show willingness for training. Growth in industry leading to growth in training demand Training programme successfully implemented
		No. of trained bank staff	Zero	450		
		No. of training sessions targeted at SME sectors 20% of female participation in training sessions	0 0	9		
		No. of trained SMEs	0	450		
		Established facilitation service for target clusters	No facilitation service in existence	> 9 facilitation events		
Output 4.1.2	Knowledge products developed that are targeted at anaerobic digestion in industrial sector, including those to facilitate technology transfer.	Knowledge platform establishment	None	Knowledge platform established	Participant logs and evaluation forms Knowledge platform and user statistics Discussion archive and membership list	Stakeholders will engage with knowledge platform
		Number of users of platform	None	200		
		Organic waste stream web portal established Number of users of website per year	None 0	1 1000		
Output 4.1.3	Capacity building mechanism for O&M, technical and service roles is established at state level to develop and retain skilled workforce for innovative biogas applications	No. of training sessions targeted at O&M	None	Nine	Participant logs and evaluation forms Annual reports of MNRE	Growth in industry leading to growth in training demand Sufficient topics are identified by industry and academia
		No. trained O&M personnel	0	200		

ANNEX B: RESPONSES TO PROJECT REVIEWS (from GEF Secretariat and GEF Agencies, and Responses to Comments from Council at work program inclusion and the Convention Secretariat and STAP at PIF).

Germany comments at PIF stage

	Germany comment	GEF Agency response
1	The project follows interesting approaches like the cluster approach for joining different sources of organic material. In the identification of potential sites, sites that consume the total biogas or service (e.g. thermal and electric energy) should be favoured:	The pre-feasibility studies carried out as part of the PPG assessed the financial feasibility for different uses of the biogas (onsite thermal use, onsite or/and exported electricity, the sale of bio-CNG or a mixture). The viability of the different options depended on the exact characteristics of the site and there were examples where each of the options was the most economically attractive. Between 2 and 4 projects will be developed and it is expected that half of them will be co-digestion or cluster projects. The demonstration projects will be selected during the project and the final specifics will be determined by the characteristics of the companies and the return on investment required. In most cases it is expected that there will be some on-site consumption of the biogas (as heat or electricity).
2	The project aims at installing seven to ten demonstrations plants of up to 2 MWth of waste-to-energy plants in SMEs mentioning that larger plants of mostly 6 – 8 MWth have been incentivized in India through the CDM. In this context, we request the project to clarify the need for further demonstration plants, as differences in technology mainly manifest in plant sizes below 1 MWth, but not among plants of 2 MWth and 6 MWth. In this context, we also seek clarifications if the smaller plants are not yet available in India.	During the PPG, the need for technology transfer of international best practice became apparent and since these technologies are more expensive than the indigenous technologies it is now proposed to support 2-4 highly replicable demonstration projects (rather than the originally envisaged 7-10 projects). The scale of these projects will still be between 0.25-2 MW. Although there is experience with biogas in India, it is predominately limited to large scale industries (or domestic biogas) and outside of the projects which have received international or government support the projects have used low cost technology and have consequentially low performance. There is still a need for further demonstration projects which focus on SMEs since SMEs need to see examples in companies of similar conditions (even if the technology used is the same). Four target sectors (sugar pressmud, fruit and vegetable processing, cattle and poultry) have been selected where, despite large potential, the sectors remain largely unexploited for energy conversion and there is therefore need for demonstrations. In addition the focus of the demonstration projects will be on co-digestion projects and inclusion of international technologies; demonstrating new models and novel technologies in India. There is limited co-digestion in India and few, if any, centralized plants. Further information is provided in Section 2.1.4.1c) : Selection of eligible projects.

3	Component 2, para 3 talks about "anaerobic and aerobic digestion". However, there are no energy services from aerobic plants. Aerobic plants are thus assumedly not in the focus of the project.	The project is only focusing on anaerobic technologies. Mention of aerobic digestion has been removed from the document.
4	In order to evaluate on the potential for scale-up an analysis of potential regarding the availability of biomass and its costs would be welcomed as well as a specification of the mentioned "smart subsidy system" to be designed in the project.	During the PPG an assessment of the biogas potential was carried out for the four prioritized industrial sectors (food processing, cattle farming, poultry and sugar) which has been selected for their large unrealized potential. Table 2 provides details of the energy potential from the available waste. The costs and financial feasibility was assessed for 12 sites across the four sectors providing indications for the sectors. The results of the studies are included in Annex 4 of the technical annexes. A 'Flexi-fund arrangement' has been proposed as the financial model under this project. This will include a mix of a partial risk guarantee (for a bank loan) and grant funding. Details and specifications of the financial model have been provided in Section 2.
5	Section B.2.: Please indicate whether services other than energy provision by SMEs are also covered, especially the generation of chemicals.	Services other than energy provision can be provided through inclusion of downstream technologies. The inclusion of such technologies can improve the financial viability of the project. Depending on the selected sites the project may include downstream technologies which allow provision of other services as sulphur production and carbon-dioxide capture. More information is provided in Section A.4.2, A.4.5 and in the technical annexes. The GEF funds would only be utilized for technologies specific to bio-gas production and enrichment. The viability of downstream technologies would be investigated on a demonstration-project basis and its funding would need to be determined alternatively through either bank loan or owner's equity.
6	As the quality of co-substrates may differ by region and thus different technology may be necessary, the knowledge of international (scientific) institutions as well as the experience of similar projects in the region shall be considered in the further project development.	The knowledge and experience of international organizations is a key part of the project (although the actual institutions/experts will be selected during the project). The demonstration part of the project will focus on co-digestion projects and the introduction of international innovations. In line with MNRE's requirements the target technologies are deliberately not being specified at this point to allow the selection of technology to be as flexible and innovative as possible. The 2-4 demonstration projects will be selected during the project and the final specifics will be determined by the characteristics of the waste available. It is envisaged that in addition to the use of international technologies that there is significant technical assistance provided by international experts in the design of the projects. In addition activity 4.1.2 allows for activities to facilitate international technology transfer.

7	Regarding the emission reduction calculation, clarification is sought on whether it is considered that the project emissions (e.g. due to physical leakage of methane from digesters) might eventually exceed baseline emissions in biogas plants.	The actual project emissions will depend on the technologies selected for each project and include leakage as well as (minor) electricity consumption in the production of biogas. The default figures for leakage from biogas would be used from the appropriate CDM methodology. In the most conservative case this assumes that there is 10% leakage of the CH_4 produced but for more modern technologies (as envisaged for this project) it is 2.8% or 5%. The leakage, while significant, is less than the overall annual emission savings. At this level methane leakage reduces net annual GHG emission savings by about 16%.The calculations provided have assumed methane leakage of 2.8% and auxiliary electricity consumption of 12%. See Annex G.

GEF Review sheet

	GEF comment	**GEF Agency response**
1	Detailed descriptions of the baseline project and incremental reasoning	A detailed description of the baseline project is included in Section A4 including the existing biogas initiatives and policy, the energy and waste situation, the status of bio-methanation technology and the barriers to its uptake. Incremental reasoning for the project is described at the beginning of A5
2	Concrete plan of the demonstration component, in particular waste collection system and homogeneity of waste	The activities to be included under Component 2 on demonstration have been provided in detail in the document. This includes the selection process for the demonstration projects. The project will focus on co-digestion and cluster systems where waste collection and quality will be key factors in the project. The final waste collection system design and the characterization of the waste will be carried out as part of the detailed design. Additional technical assistance has been included for this component to provide the extra help to take into account these project aspects.
3	A sound and appropriate description of GHG emissions reduction and cost effectiveness.	Annex G provides a description of the GHG emission reduction following the GEF top down and bottom up methodologies. The cost effectiveness of the project is provided in Section B.3

STAP comments at PIF stage

	STAP comment	**GEF Agency response**
1	Accumulating wastes from several neighboring companies and developing a small-scale district heating system could be warranted, given the benefits of economies of scale. Although alluded to, this option appears not to have been thought through in detail not the cost of heat distribution evaluated. Matching heat demand with reliable	The accumulation of waste from a number of different companies is one of the key components of the demonstration projects. Between 2 and 4 projects will be developed and it is expected that half of them will be co-digestion or cluster projects. If the companies are close enough and the heat demand sufficient then a small scale district heating network might be considered. However

	organic waste supplies, both daily and seasonally, also needs consideration along with storage options if necessary	the project specifics will be determined by the characteristics of the companies. Options for electricity, heat and bio-CNG will be investigated as appropriate. A snapshot overview on the "Status of international biogas technologies for industrial RE applications"is given in section A4.1, with more detailed information provided in ANNEX 1. Section A4.3 "Identification of priority clusters for use of organic waste streams for RE applications in Indian SME sectors" explains the rationale behind the selection of target sectors, with section 4.4 providing further details on the baseline and baseline trajectory. A4.5 Target technologies The demonstration part of the project will focus on co-digestion projects and the introduction of international innovations. In line with MNRE's requirements the target technologies are deliberately not being specified at this point to allow the selection of technology to be as flexible and innovative as possible. As set out earlier there are a number of international advancements in the overall bio-methanation process that either improve the performance of the technology (through pre-treatment technologies, biogas production technologies and co-digestion, i.e. upstream technologies) or improve the economics through the upgrading/value addition of the outputs or products (downstream technologies). As part of the PPG an assessment of these technologies was undertaken and is included in ANNEX 1. Co-digestion indeed presents specific challenges, as described in section "A4.6 Challenges and barriers to the use of organic waste streams". The ways to address those challenges are then described ing section "A5.1 Proposed additional GEF activities (including detailed design)", specifically on Component 2 "Technology demonstration"
2	The estimated 1.5 Mt CO2-eq avoided equates to around $10 /t CO2-eq but offset against this is the avoided costs of waste treatment and disposal by landfill or other methods. It would be desirable if project components assess the cost-effectiveness of this proposal	There should be additional cost benefits from the avoided waste disposal. However in most cases there is no avoided cost of waste treatment since the waste is 'dumped' or disposed of for free due to weak enforcement of the waste regulations. Therefore this has not been taken into account at this time. On the other hand, it is exactly the innovation at both upstream (i.e. before biogas production) and downstream (i.e. after biogas production) level which are expected to increase the financial viability of such investments, and which will increase cost-effectiveness. As mentioned in section A.4.5., possible pre-treatment technologies that increase the biogas yield include extrusion, grit removal, size reduction, pasteurization and nitrogen extraction. Biogas technologies not common in India which could be

		introduced include those using co-digestion, dry fermentation and plug flow digesters. Downstream technologies include those that increase the methane purity of the biogas and the production of hydrogen as an additional by-product. As for cost per tonne of CO_2 please refer to section B.3; depending on assumptions cost can be as low as 3.7-7.2 USD/tonne CO_2eq.
3	No timelines are given for the 5 year period, including for assessing whether plants are still functioning according to design specifications some years after completion. Robust M&E system for this project is strongly recommended.	Robust M&E is proposed for this project both as a specific project component and monitoring of the individual demonstration projects is envisaged. This will include an assessment of whether the projects are functioning to their design specifications. At project inception the requirements for the monitoring will be set out. A detailed timeline for the project is provided in Annex H "Work Plan".

GEF Secretariat Comments at PPG Phase

	GEF comment	**GEF Agency response**
1	Question 2: Has the operational focal point endorsed the project?	The comments from MOEF have been addressed and the endorsement is expected this month.
2	Question 11 In the baseline, please demonstrate or justify that small anaerobic digesters (less than 1 MWth) are not yet available or not widely used in Indian industries. This information should be put in the baseline section rather than in Annex 1. Please write the baseline taking into account the comments of the German Council member.	Although there is experience with biogas in India, it is predominately limited to large-scale industries (or domestic biogas) with less than 34% of the 118 WTE projects below the 1 MWth size. Outside of the projects, which have received international, or government support the projects have used low cost technology and have consequentially low performance. There is still a need for further demonstration projects, which focus on SMEs since SMEs need to see examples in companies of similar conditions (even if the technology used is the same). Four target sectors (sugar press-mud, fruit and vegetable processing, cattle and poultry) have been selected where, despite large potential, the sectors remain largely unexploited for energy conversion and there is therefore need for demonstrations. Small anaerobic digesters are not widely used in the Indian industries due to the challenges associated with economies of scale. Economic incentives for application of waste-to-energy technologies are present when either large percentage of electricity can be replaced or application of downstream technologies produces a range of bi-products such as bio-CNG, sulphur and many others which present further financial benefits. Captive electricity consumption does not present attractive economics and installation of the cost-intensive downstream processing technology for a small-scale installation further weakens that. The above information has been added in Section A.4.4.1
3	Question 14: Please put target numbers in	The information has been added in the Outputs listed in Table B:

	Table B on pages 1 and 2. These should include: (1) the number of feasible technologies and the total capacity of the demonstration projects in various industries (Component 2); (2) total targeted installation capacity in MW in the INV sub-component (Component 2); (3) the expected number of duplications of different technologies across the targeted industries (Component 3); and (4) the number of stakeholders targeted for capacity building (Component 4).	Project Framework.
4	Question 15: In ANNEX G: Estimation of Energy Savings and GHG Emission Reductions, please document in detail the methodology, data, and assumptions that are used for GHG emission reduction calculations. Please take into account methane leakage into account. Please also see and address the comments of the German Council.	The requested details have been provided in Annex G. The comments by the German Council have been addressed in Annex B.
	Question 17: Please address the roles of CSOs and indigenous people, if there are, in this project.	The roles of CSOs and indigenous people have been identified in Component 2 and Component 4 and Sections B.1.
	Question 25: The government of India has a policy to financially support waste to energy technologies at a rate of range of Rs. 2 million to Rs. 20 million per MW, or between US$ 0.032/W and US$0.32/W. The agency used US$0.32/W in the calculation of the co-financing amount from the government. Please request the government to issue a letter with an accurate amount of co-financing for the project. 2. The co-financing letter from SIDBI for the $8.4 million is missing. The agency submitted the co-financing letter from the MNRE two times. There must have been some mistake in co-financing letter submission. Please find and re-submit the letter from SIDBI.	The co-financing expected from the government provided in the MNRE letter dated 9th October 2014 is accurate and relates to both cash and in-kind finance. The cash co-finance relates to incentives provided under the current government support programme (Energy from Urban, Industrial and Agricultural Wastes/Residues during 12th Plan period) plus contributions towards the project management and training. The central finance assistance (CFA) available to support waste to energy technologies under this programme ranges from INRs. 2 million to INRs. 20 million per MW depending on the category of project as shown in the table below. In addition there is an upper cap of CFA of 20% of the capital cost. All the proposed demonstration projects meet the eligibility criteria of the programme. There is a focus on the use of the biogas, which will be used for power generation and/or bio-CNG. As a result the likely projects fall into two of the potential categories, namely 2. and 4 (please see the table below) with available grants of 0.4 million USD/MW or 0.2 million MSD/MW (based on an exchange rate of 1 USD=50 INR). In line with MNRE's wishes this GEF-UNIDO project aims to demonstrate fewer more innovative and state-of-the-art biogas projects from industrial and agricultural waste in India. Bringing new technologies to India is capital intensive and therefore MNRE have assumed the higher capital subsidy in the calculations. In addition it has been assumed to cap the capital

<table>
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<td>contribution at 15%. It is clearly understood that the final amount of CFA will be decided by MNRE on submission of an application for grant subsidy from the project owner.

The in-kind co-finance is also significant and relates to staff secondments to the project and provision of a project management office.

<u>Capital subsides for energy from waste projects</u>

<table>
<tr><th>Wastes/Processes/Technologies</th><th>Capital Subsidy (USD)
(1USD = 50 INR)</th></tr>
<tr><td>1.Power generation from Municipal Solid Waste</td><td>USD 0.4 million/MW (Max. USD 2 million/project)</td></tr>
<tr><td>2. Power generation from biogas at Sewage Treatment Plant (STP) or through biomethanation of Urban and Agricultural Waste/residues including cattle dung or production of bio-CNG</td><td>USD 0.4 million/MW or bio-CNG from 12000 m3 biogas/day (Max. USD 1 million /project)</td></tr>
<tr><td>3. Biogas generation from Urban, Industrial and Agricultural Wastes/residues</td><td>USD 0.1 million/ MWeq. (12000 m3 biogas /day with maximum of USD 1 million/ project)</td></tr>
<tr><td>4. Power Generation from Biogas (engine / gas turbine route) and production of bio-CNG for filling into gas cylinders.</td><td>USD 0.2 million /MW
Or bio-CNG from 12000 m3 biogas (Max. USD 1 million/project)</td></tr>
<tr><td>5. Power Generation from Biogas, Solid Industrial, Agricultural Waste/residues excluding bagasse through Boiler + Steam Turbine Configuration</td><td>USD 0.04 million /MW (Max USD 0.2 million/project)</td></tr>
</table>

The SIDBI letter is provided.</td>
</tr>
<tr>
<td></td>
<td>Question 27: The Tracking Tool for this project is not in the PMIS. Please submit it.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Question 33: Please address the following:1. Bullet c) in Item 31, namely "c) A sound and appropriate description of GHG emissions reduction and cost-effectiveness."

2. The comments of German Council members (there is no information on this on page 50). While doing so, please revise the CEO ER document and highlight the revised paragraphs that address the German comments.

3. The comments in Boxes: 11, 14, 15, 17, 25, and 27.</td>
<td></td>
</tr>
</table>

Comments by MoEF (Additional Secretary - Shri Susheel Kumar)		GEF Agency Response
1	What is our estimate of production of organic waste from SMEs and how many megawatts of energy generation is possible? Does UNIDO or CPCB has an estimate? Currently it is getting mixed with MSW and / or Hazardous Waste. So, to me it appears that our focus should be on decentralized waste to energy project technologies based on bio-waste. Many such projects are already under implementation. What is new here?	There exists a potential for generation of 4000 MW of power from urban and industrial wastes in the country. Another estimate suggests that based on the industrial waste that would be generated in the year 2017, the potential for power generation that year would be 1997 MW. The sectors included here are Distillery, Paper, Sugar (pressmud), Maize Starch, Dairy, Sugar (liquid), Poultry Farms, Slaughter House, Tapioca Starch and Tannery. In 2013 the waste to energy generation in the country was 115.57MW, which was increased to 136.33 MW by September 2014. These include installations based on both urban and industrial waste. Also, a total of 12 projects with an aggregate capacity of 20 MW based on urban and industrial waste is under installation in India. These projects are based on cattle dung, starchy industry waste and poultry litter. Therefore there is huge scope of technology innovation and scale up in the country. The above mentioned is now incorporated in Section A.4.4.1: Status of biogas technologies in India. Although bio-methanation plants are now more prevalent in India many of the projects are either very small (domestic scale) or installed at large scale industries. Outside of the projects, which have received international or government support, the projects have used low cost technology and often have had suboptimal performance. This is due to a lack of experience in planning and operation of the bio-methanation plants – all too often the experiences from the small-scale digesters is used, even when not relevant. The proposed project will focus on industrial organic waste streams for conversion to usable forms of energy for application in SME units and/or clusters of units, with the primary focus being conversion to (process) heat on site or for heat purposes for local SMEs (e.g. via bio-CNG or other downstream value addition), yet wherever feasible and appropriate power will also be added. There has been little uptake by SMEs since they are too large for the small scale programmes and lack the capacity to make use of the urban, industrial and agricultural waste programme. In addition it is acknowledged that this programme – despite its importance – provides an insufficient signal for sectors to invest in innovative technologies. Support is focused at “standard” technologies and power generation. As described earlier, internationally, there are developments in dry fermentation, in upstream pre-treatment and downstream treatments as well as a growing demand for co-digestion projects; all of which can improve the performance of the biogas projects. Under the Indian baseline project there is limited innovation, limited use of dry fermentation, of pre-treatment or downstream technologies such as CO2 extraction, elemental sulphur recovery or processed bio-manure extraction. The focus of the proposed project will therefore be to trigger and assist SMEs to absorb promising innovative technologies which

		can increase biogas yields, enable downstream diversification and have a replication effect across agro-industrial sectors. The technology focus for the proposed project will be on bio-methanation. The demonstration part of the project will focus on co-digestion projects and the introduction of international innovations. Suitable financial and institutional mechanisms for mainstreaming the uptake of such interventions in SMEs will be piloted. The project will provide policy, technical and financial inputs required to support and effectively leverage national efforts in facilitating the increased up-take of bio-methanation by SME industries, using their organic waste.
Comments by MoEF (GEF Consultant - Dr. Nayanika Singh)		**GEF Agency Response**
2	The banks mentioned on page: 1 of FSP is not the same in Table: C of the FSP.	As discussed during the telephonic conversation, the executing partner is MNRE; this has been confirmed in the revised version of the CEO Endorsement document.
3	The project objective mentions 'trigger technology innovation in SMEs' but there is no proposed strategy/ activity to achieve the same in the FSP.	The title for the objective has been modified.
4	The first project component focuses on strengthening policy / regulation recommendations for increased use of bio-methanation – which policy/ regulations we are talking about. Please specify.	The output of component 1 has been further made specific.
5	Component: 3 – may be shown as the scale up phase through on ground implementation.	The component 3 title has been reworded and the term scale up has been added.
6	The last para of section A.1 needs to be detailed out to bring out the gaps in the MNRE's incentive measures to build the case for GEF project.	This has been included in the A 1.1 section
7	The linkage with UNDP/ GEF project on Bio-methanation needs to be developed. Also, the report of GEF Evaluation office on this project may be seen (attached) to build upon.	This has been included in the A 1.1 section
8	Section A.4.5.1 – is the technology suggested feasible to Indian scenario. Are we proposing to promote certain technologies or the approach is towards performance based.	Statement providing the clarity for basis of selection has been provided.
9	Capacity building component is too general with not a clear defined strategy to operationalize or achieve the objective.	The outputs for the component 4 have been revised.
Comments by MOEF (Climate Change Division – Dr. S. Satapathy)		**GEF Agency Response**
10	This Division in its PIP stage reviewed the above project. Comments provided have been incorporated. The present document has been examined in the light of National	

	Action Plan on Climate Change (NAPCC) with specific reference to renewable energy generation. The project has 4 components namely, strengthening the policy and institutional framework, demonstration of financially feasible technology, application of technology and capacity building.	
11	The M/o New & Renewable Energy as Nodal Ministry will provide grants to bio-methanation project. This should be consistent with the requirements envisaged in State Action Plan on Climate Change (SAPCC).	The mentioned grants scheme is an existing grant scheme, not a newly proposed scheme. It is therefore assumed the consistency with the SAPCC has been ensured as per the relevant government approval procedures. In case the grant scheme needs revision, the impact of such changes will be addressed during project implementation.
12	The demonstration of financially feasible technologies in selected sectors needs to be calibrated taking into account the cost-effectiveness and adequate safeguard to protect environment and climate system. On successful demonstration of the technology, the technical know-how and transformation of the technology to State Government should be facilitated by the Executive Agency.	As mentioned in Section 2.1.4.1, the criteria for the selection of the technology among others would be the level of innovation and cost benefit analysis. The level of innovation would be based on the level of integration, level of technology and the suitable business models. The pilots will be selected on a number of criteria including their GHG emission reductions and their replicability. Where applicable one of the key areas to be assessed will be alternative business models, for example cluster approaches, co-digestion, ESCOs or BOO, and the lessons learned will feed into the development of clear replication business models for the use of organic waste for energy for The long term national ownership of such projects, building on its existing experience, would be MNRE, as well as other key stakeholders such as the industry owners and industry associations. This will indeed be facilitated by UNIDO, as part of ensuring the long-term sustainability of the project's impact. In section 2.1.4.4, state government has been added as the organizations considered for national ownership.
13	As the target group as beneficiary is small and medium enterprises, appropriate training provision to maintain the sustainability could be considered while transferring the technology.	Component 4 of the project aims at capacity building of the stakeholders. Training programmes will be designed to target the SME sectors and specifically the SMEs listed in the 'Master Database'. Training will also be held at the state level, targeting 20 industry staff from each of the 9 states and also targeting the service support centres and 10 OEMs at a National level. Output 4.1.1 aims at enhanced Awareness and knowledge in key players in 30 - 50 SMEs, 30 – 50 banks/financial institutions, technical institutions, manufacturers and other service providers in each of the selected states. Output 4.1.2 aims at Knowledge products developed that are targeted at anaerobic digestion in industrial sector, including those to facilitate technology transfer. Output 4.1.3 aims at capacity building mechanism for O&M, technical and service roles is established at state level to develop and retain skilled workforce for innovative biogas applications. Service centres will be developed in consultation with State nodal

		agencies A service network will result in a one-stop solution for any pre or post installation operation and maintenance service required with biogas plants. (From Section 3.1.3.1)
14	A Risk Guarantee Fund has been proposed to incentivize SME for adopting the technology. State Nodal Agencies needs to be closely associated for enforcement of the provisions envisaged in the document.	For the longer term sustainability of the market an innovative fund arrangement has been designed to finance OWTE projects. This is expected to include an incentive element, a 'Risk Guarantee Fund', an interest holiday, the MNRE Grant and a Standard Bank Loan Product. State Nodal Agencies will indeed be closely associated.
15	During the implementation of this project, this division may be in the loop for monitoring and evaluation and transformation of technologies to State Governments.	The project steering committee (PSC) includes representation from MOEF. PSC is responsible for periodic reviewing and monitoring of project implementation progress, providing strategic advice, facilitating co-ordination between project partners, providing transparency and guidance, and ensuring ownership and sustainability of the project results. (Section B.1) The climate change division would thus be periodically kept informed about the project's progress. The transfer of the technologies to state government has been address in comment 11.

ANNEX C: STATUS OF IMPLEMENTATION OF PROJECT PREPARATION ACTIVITIES AND THE USE OF FUNDS[13]

A. PROVIDE DETAILED FUNDING AMOUNT OF THE PPG ACTIVITIES FINANCING STATUS IN THE TABLE BELOW:

PPG Grant Approved at PIF: $80,000			
Project Preparation Activities Implemented	***GEF/LDCF/SCCF/NPIF Amount ($)***		
	Budgeted Amount	***Amount Spent to date***	***Amount Committed***
National subcontractor (TERI and CII) for baseline project, sector prioritization, stakeholder consultation, development of financing model and preparation of CEO Endorsement document	80,000	80,000	0
Total	**80,000**	**80,000**	0

ANNEX D: CALENDAR OF EXPECTED REFLOWS (if non-grant instrument is used)

Provide a calendar of expected reflows to the GEF/LDCF/SCCF/NPIF Trust Fund or to your Agency (and/or revolving fund that will be set up)

There are not expected to be any reflows from this project.

ANNEX E: TRACKING TOOL FOR CLIMATE CHANGE MITIGATION PROJECTS

Separate file with file name "Annex E _GEF CC Mitigation Tracking Tool.xls"

[13] If at CEO Endorsement, the PPG activities have not been completed and there is a balance of unspent fund, Agencies can continue undertake the activities up to one year of project start. No later than one year from start of project implementation, Agencies should report this table to the GEF Secretariat on the completion of PPG activities and the amount spent for the activities.

ANNEX F1: BUDGET SHEET (GEF FUNDING)

COMPONENTS		GEF DISBURSEMENT				
	GEF FINANCING	YR1	YR2	YR3	YR4	YR5
COMPONENT 1: STRENGTHENING OF POLICY AND INSTITUTIONAL FRAMEWORK						
OUTCOME 1.1 AN UPDATED AND TAILORED ROADMAP FOR INCREASED USE OF WASTE-TO-ENERGY PRACTICES IN THE TARGET SME SECTORS	200,000	70,000	65,000	65,000		
SUBTOTAL	**200,000**	**70,000**	**65,000**	**65,000**		
COMPONENT 2: DEMONSTRATION OF THE MOST RELEVANT TECHNOLOGIES IN SELECTED SECTORS						
OUTCOME 2.1 DEMONSTRATED TECHNICAL AND FINANCIAL VIABILITY OF PROJECTS IN THE 0.25 – 2 MW CAPACITY (OR EQUIVALENT THERMAL ENERGY) RANGE	2,249,000	749,000	750,000	750,000		
SUBTOTAL	**2,249,000**	**749,000**	**750,000**	**750,000**		
COMPONENT 3: SCALE UP OF TECHNOLOGIES IN ORGANIC WASTE TO ENERGY APPLICATIONS IN INDUSTRY						
OUTCOME 3.1 SUSTAINABLE REPLICATION MODEL FOR EFFECTIVE SCALING UP OF DIFFERENT TECHNOLOGIES ACROSS TARGET INDUSTRIES	316,000		61,000	85,000	85,000	85,000
SUBTOTAL	**316,000**		**61,000**	**85,000**	**85,000**	**85,000**
COMPONENT 4: CAPACITY BUILDING OF PUBLIC AND PRIVATE SECTOR STAKEHOLDERS						
OUTCOME 4.1. ENHANCEMENT OF CAPACITY OF KEY PLAYERS IN TARGET INDUSTRIES; *OUTCOME 4.2. PROMOTION OF TECHNOLOGY TRANSFER, INFORMATION SHARING AND DISSEMINATION OF BEST PRACTICES*	350,000	25,000	25,000	100,000	100,000	100,000
SUBTOTAL	**350,000**	**25,000**	**25,000**	**100,000**	**100,000**	**100,000**
M&E						
OUTCOME 5.1 PROJECT'S PROGRESS TOWARDS GOALS CONFIRMED AND/OR NECESSARY ADJUSTMENTS MADE	60,000			20,000		40,000
SUBTOTAL	**60,000**			**20,000**		**40,000**
PROJECT MANAGEMENT						
PROJECT MANAGEMENT	158,000	32,000	32,000	32,000	32,000	30,000
TOTAL	***3,333,000***	**876,000**	**933,000**	**1,052,000**	**217,000**	**255,000**

ANNEX F2: BUDGET SHEET (COFINANCING)

PROPOSED CO-FINANCING BUDGET*				
	CO-FINANCING BUDGET COMPONENT 1			
COMPONENT 1: STRENGTHENING OF POLICY AND INSTITUTIONAL FRAMEWORK	**GOI**	**BANKS**	**UNIDO**	**OUTCOME TOTAL**
OUTCOME 1.1 AN UPDATED AND TAILORED ROADMAP FOR INCREASED USE OF WASTE-TO-ENERGY PRACTICES IN THE TARGET SME SECTORS	480,000	520,000		**1,000,000**
	CO-FINANCING BUDGET COMPONENT 2			
COMPONENT 2: DEMONSTRATION OF THE MOST RELEVANT TECHNOLOGIES IN SELECTED SECTORS	**GOI**	**BANKS**	**UNIDO**	**OUTCOME TOTAL**
OUTCOME 2.1 DEMONSTRATED TECHNICAL AND FINANCIAL VIABILITY OF PROJECTS IN THE 0.25 – 2 MW CAPACITY (OR EQUIVALENT THERMAL ENERGY) RANGE	2,745,000	10,200,000		**12,945,000**
	CO-FINANCING BUDGET COMPONENT 3			
COMPONENT 3: SCALE UP OF TECHNOLOGIES IN ORGANIC WASTE TO ENERGY APPLICATIONS IN INDUSTRY	**GOI**	**BANKS**	**UNIDO**	**OUTCOME TOTAL**
OUTCOME 3.1 SUSTAINABLE REPLICATION MODEL FOR EFFECTIVE SCALING UP OF DIFFERENT TECHNOLOGIES ACROSS TARGET INDUSTRIES	499,000	1,081,000		**1,580,000**
	CO-FINANCING BUDGET COMPONENT 4			
COMPONENT 4: CAPACITY BUILDING OF PUBLIC AND PRIVATE SECTOR STAKEHOLDERS	**GOI**	**BANKS**	**UNIDO**	**OUTCOME TOTAL**
OUTCOME 4.1. ENHANCEMENT OF CAPACITY OF KEY PLAYERS IN TARGET INDUSTRIES; *OUTCOME 4.2. PROMOTION OF TECHNOLOGY TRANSFER, INFORMATION SHARING AND DISSEMINATION OF BEST PRACTICES*	763,000	987,000		**1,750,000**
	CO-FINANCING BUDGET M&E			
M&E	**GOI**	**BANKS**	**UNIDO**	**OUTCOME TOTAL**
OUTCOME 5.1 PROJECT'S PROGRESS TOWARDS GOALS CONFIRMED AND/OR NECESSARY ADJUSTMENTS MADE			150,000	**150,000**
	CO-FINANCING BUDGET PROJECT MANAGEMENT			
PROJECT MANAGEMENT	**GOI**	**BANKS**	**UNIDO**	**OUTCOME TOTAL**
PROJECT MANAGEMENT	790,000			**790,000**
TOTAL:	*5,277,000*	*12,788,000*	*150,000*	***18,215,000***
** COFINANCING MAY VARY PER COMPONENT AND PER SOURCE DURING PROJECT IMPLEMENTATION*				

ANNEX G: ESTIMATE OF ENERGY SAVINGS AND GHG EMISSION REDUCTIONS

Direct emission reductions

Direct emission reductions within this project result from the investment in 2-4 demonstration projects. These projects will be installed and commissioned during the project's 5 year implementation phase resulting in direct greenhouse gas emission reductions. For each of these projects an economic lifetime of 20 years is assumed. For the indicative 4 demonstration projects this results in total direct emission reductions of 228,000 tonnes of CO_2 equivalent (tCO_2eq) over the lifetime of the investments, assuming that the biogas is used in power generation. In the non-GEF base case these energy needs would be satisfied by electricity provided by the grid with its associated emission factor. Biogas production per tonne of waste has been calculated using Indian benchmarks. To be conservative some leakage of methane has been assumed, at 2.8% in line with CDM methodology for modern technologies, and auxiliary electricity consumption has been assumed at 12% in line with CERC (Central Electricity Regulatory Commission of India). The grid emission factors vary by state and for the four indicative projects vary between 0.83 and 0.85 tCO_2/MWh. The following table summarises the assumptions and emission reductions for the demonstration projects.

Demonstration project	Waste (tpd)	Size (kW/ MW/or equivalent)	Use of biogas	CH_4 leakage (tonnes/ yr)	GHG emission due to leakage (tCO_2eq /yr)	Electricity offset/exported (MWh)	GHG offset (tCO_2 eq/yr)	Net annual GHG savings (tCO_2eq)	GHG over lifetime (tCO_2eq)
Sugar press mud	185	1.4 MW	Bio-CNG/Power	54	1132	8178	6788	5656	113,111
Food processing plus other	200	2 MW	Power	44	928	6698	5693	4766	95,311
Poultry	8.58	50 kW	Power/Bio-CNG	2	36	262	217	181	3620
Cattle	48	250 kW	Power/Bio-CNG	8	162	1173	973	811	16,215
Total								**11,413**	**228,257**

As a conservative approach any projects supported under Component 3 of the project have not been included in the calculations.

Direct post-project emission reductions

Although the project will facilitate the financing of new organic waste to energy projects beyond the implementation phase, this is not expected to use GEF funding which would be used during the project implementation phase only. Therefore as a conservative assumption, no direct post-project greenhouse gas emission reductions are claimed.

Indirect emissions reductions

The project is expected to catalyse significant further investment in organic waste to energy technologies due to its policy, technical and capacity building activities that are designed to address the current barriers to investment. These are likely in the four priority sectors but there is also likely to be an impact on other industrial sectors with organic waste. This investment will result in indirect emissions reductions. Using the GEF bottom-up methodology, indirect emission reductions attributable to the project are expected to be 912,000 tCO_2eq. This figure assumes a replication factor of 4 (GEF uses 3 for a market transformation initiative and 4 where a credit guarantee is introduced).

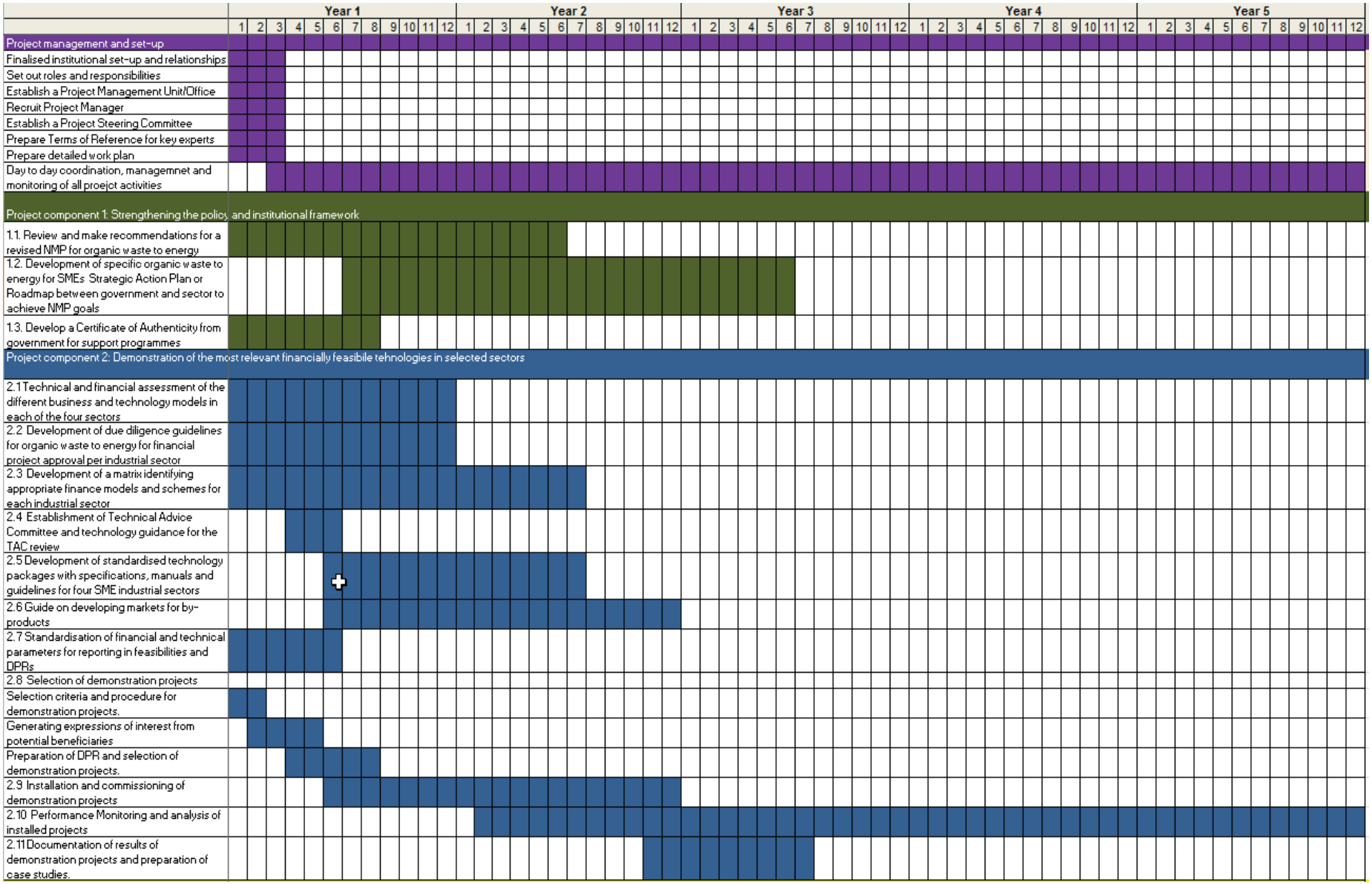
Using the GEF top-down methodology, indirect emission reductions attributable to the project are estimated at 462,000 tonnes of CO_2eq. This figure assumes that total technological and economic potential for GHG emission reductions in

this area over the post-project 10 years is 770,000 tCO_2eq, with a project causality factor of 60%, which takes into account the influence of the related existing MNRE initiatives[14].

The range of indirect CO_2 emission reductions is 462,000 – 912,000 tCO_2eq.

[14] It is expected that post – project at least 40 additional projects would be installed in India, equivalent to 37 MWe. Current projections are to continue as now; in the target sectors only 12 projects have been installed – equal to about one a year. The emission reductions due to these installations would equal approximately 110,000 tCO_2eq per year. Assuming greater interest in the immediate years than in the 10 year post project period 7 years of operation is assumed equal to 770,000 tCO_2eq.

ANNEX H: WORK PLAN



Project component 3: Increased use of technologies in organic waste to energy applications in industry	
3.1 A master database of potential SMEs/ Industries for Bio-Methanation Technology adoption	
3.2 Development of standardized long term feedstock supply agreements	
3.3 Establishment of a financing facility to include the use of a partial risk guarantee	
3.4 Exploring potential sources of funds	
3.5 Framework for Service support networks	
3.6 Review and development of MNRE standards, quality control and a certification framework	
Project component 4: Capacity building of private and public stakeholders	
4.1 OWTE training programmes for FIs	
4.2 OWTE training programmes for target SME sectors	
4.3 Project facilitation service for target clusters	
4.4 Development of knowledge products for OWTE for SMEs	
4.4 Development of knowledge products for OWTE for FIs	
4.5 Capacity building for SME industry staff and service providers on O&M	
Website and other dissemination	

OVERVIEW OF TECHNICAL ANNEXES

ANNEX 1: ADDITIONAL BASELINE INFORMATION

BIOMETHANATION TECHNOLOGY

POLICY

WASTE-TO-ENERGY SCENARIO IN SELECTED INDUSTRIAL SECTORS

BARRIERS TO UPDATE OF BIOGAS TECHNOLOGY BY SMES

SUMMARY OF ENERGY AUDITS / PRE-FEASIBILITY PROJECTS

ANNEX 2

PROCEEDINGS OF STAKEHOLDER CONSULTATION WORKSHOPS in PUNE (January 2014), DELHI (February 2014), CHANDIGARH (February 2014), BELGAUM (March 2014)

ANNEX 3

PROCEEDINGS OF VALIDATION WORKSHOP, 29 May 2014, Delhi

ANNEX 4

ENERGY AUDITS FOR 12 SITES