Programme Implementation Document

Tanzania Domestic Biogas Programme

Final version
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0.1 Summary

0.1.1 Development of the programme

Following the "Biogas for a Better Live, and African Initiative", Biogas stakeholders in Tanzania, supported by SNV, established a task force. The aim of this task force was to prepare for the start of a national domestic biogas programme. As an early result of their efforts, supported by the Initiative, Thomas Schmidt of GTZ studied the feasibility of a domestic biogas programme for Tanzania mid-2007 [1]. Around the same time, two students of the University of Utrecht, the Netherlands [2], studied feasibility and possible impact of such a programme for the northern areas of the country.

The results of both studies justified the further preparation of a national domestic biogas programme. Building on the results of the aforementioned studies, SNV and CAMARTEC fielded a programme formulation mission in July – August 2008. The mission resulted in the *final draft* Programme Implementation Document, providing details on scope, activities, institutional set-up and related budget. Comments and suggestions of the programme's Interim Executive Committee subsequently resulted in this final version.

During the second half of 2008, however, it became clear that funding for the Initiative was lacking behind expectations and was unlikely to succeed in meeting its objective of supporting domestic biogas programmes in entire Africa. Both organizationally as well as financially DGIS, the main supporter of the Initiative, deemed the proposal too large to carry on its own, and together with Hivos and SNV a more modest domestic biogas proposal for Africa was formulated.

As a result of the cooperation, December 2008 saw the birth of the Africa Biogas Partnership Programme (ABPP). In the partnership, DGIS provides funds to the amount of nearly € 30 million to support national biogas programmes in six African countries: Ethiopia, Kenya, Tanzania and Uganda in East-Africa and Burkina Faso and Senegal in West-Africa. Hivos was selected as the fund manager for this programme whereas SNV committed (from its own core funding) to provide capacity building and knowledge brokering services to the programme.

Subsequently, during the first half of 2009, CAMARTEC, the host organisation of the TDBP, and Hivos are finalizing the agreement regulating ABPP funding for the TDBP. Signing of the agreement is expected to happen before the 30th of June 2009.

To bridge the gap between the formulation of this PID and the availability of ABPP funding, SNV agreed to make available € 200,000 as a start-up fund. As a result, the preparations and initial activities of the programme could start per the first of October 2008.

0.1.2 Introduction

With a GDP (PPP) of US$ 1300 per capita and 37% of the population living below the poverty line, Tanzania belongs to the poorest countries worldwide. This is, among others, reflected in the low share of commercial energy use; 94% of the country's energy requirement is met by biomass, primarily wood fuel and over 80% of the total energy consumption is used in rural areas. The high consumption of wood fuel contributes to deforestation and soil degradation. Nearly 80% of the national energy consumption is applied for domestic energy (cooking and lighting). Poor households spend a considerable higher share (up to 35%) of their income on domestic energy.

0.1.3 Biogas in Tanzania

Domestic biogas was introduced by SIDO in 1975. A number of other NGOs joined in the promotion of the technology. However, involvement CAMARTEC, later in cooperation with GTZ accelerated awareness and dissemination, particularly in the northern regions of the country. Out of the total production, some 1900 installations are expected to be in operation. Through its involvement, CAMARTEC established itself as a reputable knowledge centre on biogas in Tanzania as well as internationally.

After withdrawal of GTZ from the domestic biogas programme, government support for the parastatal CAMARTEC gradually reduced. NGO's –in particular MIGESADO and, to a lesser extent, FIDE- filled the gap to some extent and although CAMARTEC remains well reputed, it has lost its leading role in biogas dissemination in Tanzania.

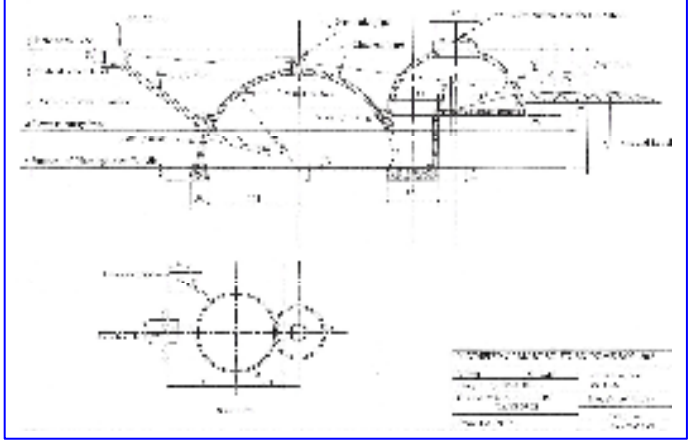
The reputation of CAMARTEC is closely linked to the robust design of their fixed dome biogas model and its derivates. Also MIGESADO supports the fixed dome design, but of Indian origin. The more traditional floating drum design has been piloted in Tanzania only during the early years; high costs of construction and maintenance have made this model obsolete. Experiments with "plastic bag" biogas plants, attractive for their very low investment costs, have not resulted in acceptance of this technology, mainly because of their low reliability and limited lifetime.

As part of the formulation mission, SNV commissioned in cooperation with the Tanzania Biogas Task Force[1] an *assessment of the currently used technologies*. The assessment mission reported that even with little training to masons and minimum supervision, the general quality of construction and workmanship has been good, resulting in the majority of the users being satisfied with the performance of their biogas plants. In contrast with the good workmanship shown in the civil structure, however, the efficiency of biogas appliances and the quality of fitting works left ample room for improvement. The report further mentions that households require more training in the optimizing the benefits their installations, in particular regarding the proper application of bio-slurry.

Standing out in the technical assessment report are the high investment costs of most of the installations. For biogas installations to be affordable for a larger share of the (rural) population there is need to assess cost reduction methodologies without compromising the quality. The high investment costs can be attributed to a large extent to biogas plants being over-sized. The actual feeding, as compared with the designed feeding rate, ranged from 15 to 90%. The resulting low plant efficiency, based on plant-sizing, ranged from 12 to 50%, clearly indicating that farmers –on average- could have done easily with installations smaller then half their actual size.

The technical assessment mission resulted in development of the "Modified CAMARTEC Design", combining strong points of the original CAMARTEC plant with those of the MIGESADO model.

Modified camartec

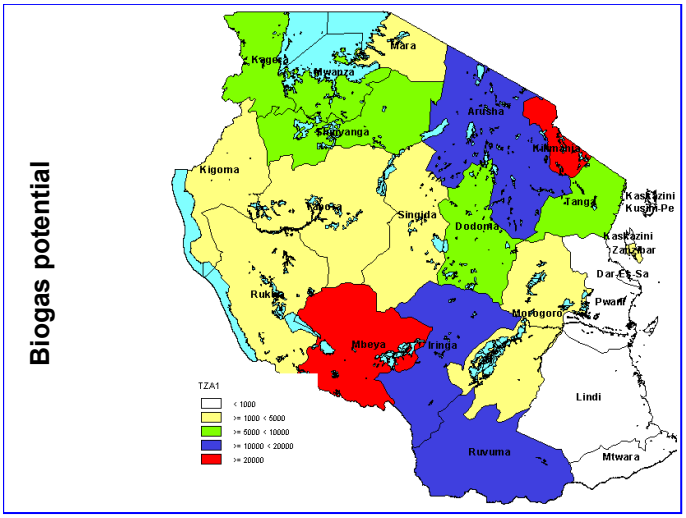


Addressing proper sizing of biogas installations, the programme proposes a plant size range of 4, 6, 9 and 13 m^3 total plant volume.

Tanzania's (international) reputation as a pioneer of domestic biogas contrasts with its hampering large-scale dissemination. The feasibility report identifies as *main barriers*: the high investment costs; the limited availability of appropriate credit facilities; the centralistic, (N)GO lead dissemination approach; the limited availability of the technology, and; corresponding limited awareness of costs and benefits of the technology; the declining financial support of the Government of Tanzania; the limited coordination between sector-actors, and; the limited availability of process water.

[1] The Task Force was established to carry forward the momentum raised during the launching meeting of the Biogas for a Better Life, an African Initiative in May 2006.

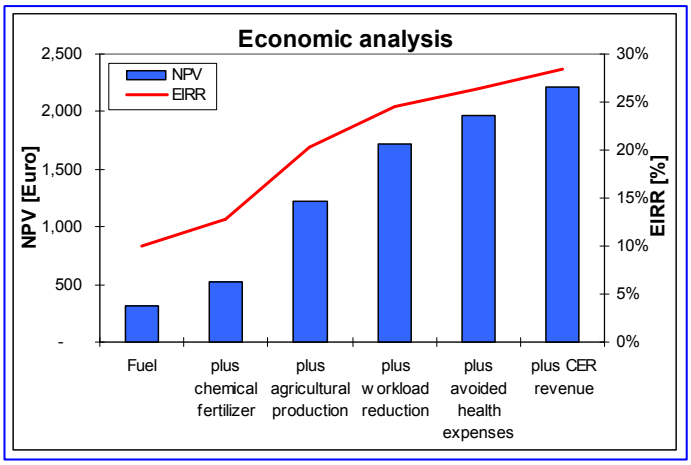
The *technical potential for domestic biogas*, based and the available substrate (manure) is estimated at 165,000 installations in a 10-year time frame.



Critical in this estimate is that process water –necessary to operate the installation- is in many places at a premium, and technical solutions (direct feeding from the stable floor, small installations, water harvesting) can only partly address this issue. For a starting programme, the availability of skilled human resources will be another important hampering factor; a significant training effort will be necessary.

Ambient temperature and the availability of construction materials seem favourable for a biogas programme.

The *economic attractiveness* depends –apart from investment and support cost- on the extent to which a household is able to materialize the full range of benefits of the installation and the commercial value of substituted fuels. The simple payback period of a biogas installation, for example, varies between 2.5 and 9.5 years, depending on whether purchased charcoal or firewood, largely collected for free, is substituted.



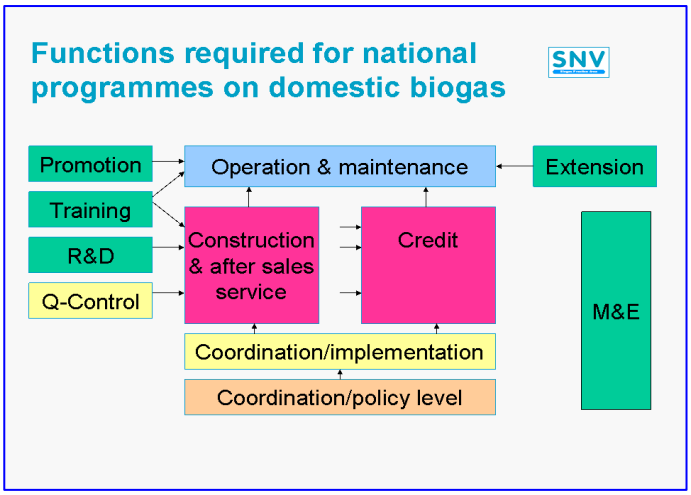
The Economic Internal Rate of Return, based on replacement of charcoal, varies between 10% and 28%, depending on the extent to which benefits are realized. An important conclusion is that the investment for domestic biogas installations can hardly be justified by fuel savings only.

The experience of previous programmes indicates that *social acceptance* for installation of a biogas plant is large. However, when installations are connected with a toilet, households express reluctance in handling the bio-slurry. The programme should take due note of this, and support toilet connection only on the explicit request of the family, as otherwise the benefits of toilet connection will easily by nullified by loosing out on the fertilizing value of bio-slurry. Another issue to be taken account is the initial "mismatch" between beneficiary and decision maker; although women reap most of the benefits of the installation, they often are not in the position to take the investment decision on their own.

Domestic biogas contributes to *sustainable development* and reaching the *UN Millennium Development Goals*. Domestic biogas installations provide benefits in the fields of (rural) energy supply, agriculture, health, sanitation, gender and environment. The programme joins-in well with the development intentions of the Government of Tanzania. Notably, a national biogas programme will support realization of Government policies in the fields of energy, poverty reduction, livestock development, rural development and SME development.

0.1.4 Goal, purpose and expected results

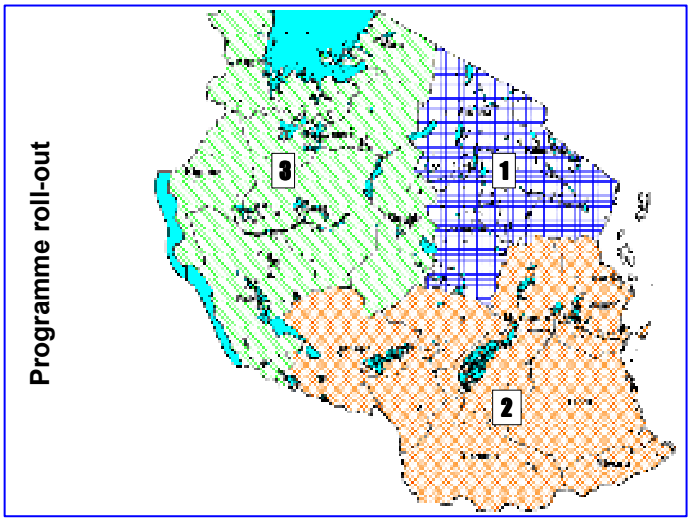
The focus of the programme shall be the development of the biogas sector as a whole. Sector development implies the close cooperation of all relevant stakeholders (Government, Non-Government and private sector) in the sector at all levels (micro and macro) whereby those stakeholders are sufficiently equipped to fulfil the necessary functions.



The proposed goal of the programme is *to improve the livelihoods and quality of life of rural farmers in Tanzania through exploiting the market and non-market benefits of domestic biogas*. By the end of the first phase (5 years) of the programme:

- 12,000 new biogas plants will be built nationwide;
- Over 95% of the constructed biogas plants are operated properly;
- 80% of the biogas households will have facilities that enable proper bio-slurry use, and;
- 100% of the biogas plants will have a second inlet pipe to allow future toilet connection;

The purpose of the programme is *to develop a commercially viable domestic biogas sector*. To that extent, the programme will:



- follow the technical potential for domestic biogas. Operations will start Tanzania's North-eastern regions and subsequently annually expand to the South and South-east and the West and North-west regions of the country.
- will stimulate construction in clusters of at least 20 installations per village to allow emerging Biogas Construction Enterprises to efficiently provide their services,.
- develop biogas credit component enabling plant owners access to credit for biogas construction whereby 60% of biogas owners utilise the credit facility by the end of the first phase of the programme.
- identify regional vocational training institutes (VETAs) to provide short-term biogas courses at construction and supervision level. The vocational training institutes will act as "knowledge brokers" in their catchment areas.
- partner with local NGOs for Biogas Awareness and Promotion as well as extension on biog-slurry / organic farming
- partner closely with SIDO to provide business development support to the emerging Biogas Construction Enterprises (BCEs).

The *expected results* of the proposed 12,000 installations include an installed capacity of 31 MW, producing energy to the tune of over 110,000 MWh. Provisionally, the installations will reduce GHG emissions with 60 kt and avoid deforestation of nearly 8,000 ha of forests. Through the bio-slurry, 65 kt of organic matter will be made available as organic fertilizer. The generated biogas will have substituted nearly 100 kt biomass.

The programme will reach 72,000 beneficiaries, reducing the workload, mainly for women and children, with 2003 person-years. The latter group, women and children, will also mainly benefit from the elimination of indoor air pollution. Some 2,400 households are forecast to connect a toilet to their biogas installation, further improving the sanitary situation of the households. Productive slurry use will increase agricultural yields significantly and may reduce farm expenses on chemical fertilizer expenses.

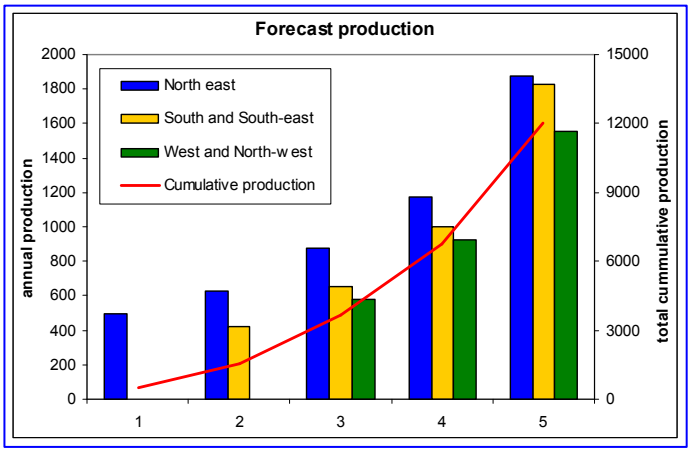
The programme foresees a significant effort in training, investing 16,800 training days in user training and over 5,000 training days in professional training. The programme will generate (rural) direct employment to the tune of 840 person years.

Tanzania Domestic Biogas Programme *expected results (provisional)*		
Biogas plant construction	**12.000**	[plants]
Energy		
Energy production	**110.222**	[MWh]
Power installed	**30.799**	[kW]
Environment		
GHG emission reduction	**60.101**	[t CO_2eq]
Deforestation reduction	**7.954**	[ha of forest]
Soil nutrificaton	**64.909**	[t(DM) bio-slurry]
Fuel substitution		
Biomass	**98.952**	[t biomass]
Fossil fuel	**817**	[t]
Socio-economic		
Persons reached	**72.000**	[persons]
Workload reduction (women & children)	**2.003**	[pers years]
Exposure to indoor air pollution reduced	**60.000**	[women & children]
Toilets attached	**2.400**	[toilets]
Productive slurry use	**9.600**	[households]
Employment generation (direct)	**840**	[person years]
Training		
User training	**16.800**	[person days]
Professional training	**5.142**	[person days]

0.1.5 Output targets

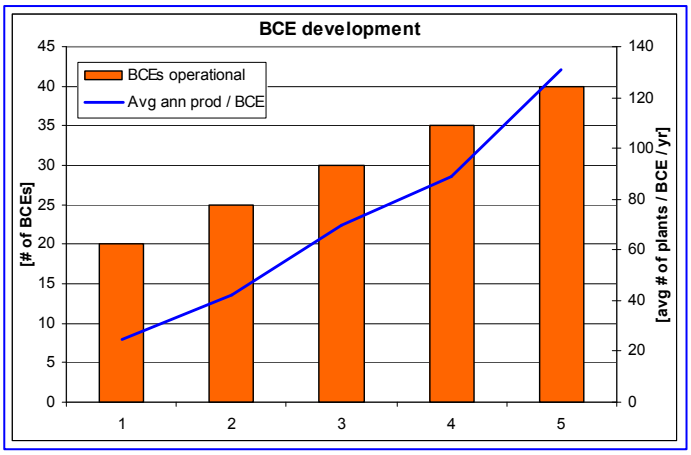
In view of the shear size of the country, starting-up in all regions at the same time would be costly and inefficient. Therefore, in the first year the programme will commence in 5 regions in the North-east of Tanzania. In two consecutive years the programme will expand to 8 regions in the South / South-east and West / North-west respectively. Hence, the programme will –potentially- cover 21 regions of mainland Tanzania in the 3rd year.

As the programme will follow a commercial approach towards biogas dissemination, the planning does not prescribe production quota per region. The forecast, however, provides an impression of how the market may develop. Following this forecast, production is expected to arrive at 500 installations in the first year, reaching an annual production of 5,250 installations in the 5th year of the programme.



Construction and After Sales Service will be provided by the private sector, in the shape of *Biogas Construction Enterprises* (BCEs). BCEs typically are locally based micro enterprises, and their production may vary from less than 50 to over 1000 installations per year. For households to have access to biogas services, it is crucial that BCEs are based in the rural area.

In the first year, the programme will support the establishment of 20 BCEs to construct the first 500 biogas installations in the North-east. Subsequently, the programme will move to other regions and support establishment and growth of the BCEs. At the end of the first phase, about 40 BCEs should be in operation. Over this period, the average production will increase from 25 to 131 plants per BCE per year.



Parallel to the development of BCEs, the establishment of local *Biogas Appliance Manufacturers* will be supported. By the end of the 1st phase, 5 to 10 local Biogas Appliance Manufacturers will be producing biogas stoves and lamps for the programme, whereby Biogas Appliance Manufacturers shall be able to cover all operational districts of the programme.

Quality control plays a crucial task in the programme's quality management objective. For the targeted 12,000 installations over 27,000 plant visits are foreseen; 24,450 by BCEs and 2,667 by the national TBP-office.

Quality control

			Plant visits					
			1	2	3	4	5	Total
BCE	Plant completion	PC	500	1050	2100	3100	5250	**12000**
BCE	Annual maintenance	PM	0	500	1550	3650	6750	**12450**
	Total BCE plant visits		**500**	**1550**	**3650**	**6750**	**12000**	**24450**
TBP	Quality Control on completed plants	QC-Comp	50	105	210	310	525	**1200**
TBP	Quality Control on plants under construction	QC-UC	30	63	126	186	315	**720**
TBP	Quality Control on ASS	QC-ASS	0	30	93	219	405	**747**
	Total TBP plant visits		**80**	**198**	**429**	**715**	**1245**	**2667**
	Total plant vists		**580**	**1748**	**4079**	**7465**	**13245**	**27117**

The programme proposes a comprehensive *training* component. Over the first phase, the programme plans to provide over 1,800 training courses and workshops, reaching more then 50,000 persons. The programme's training component includes technical training, programme workshops, user training and training of trainers.

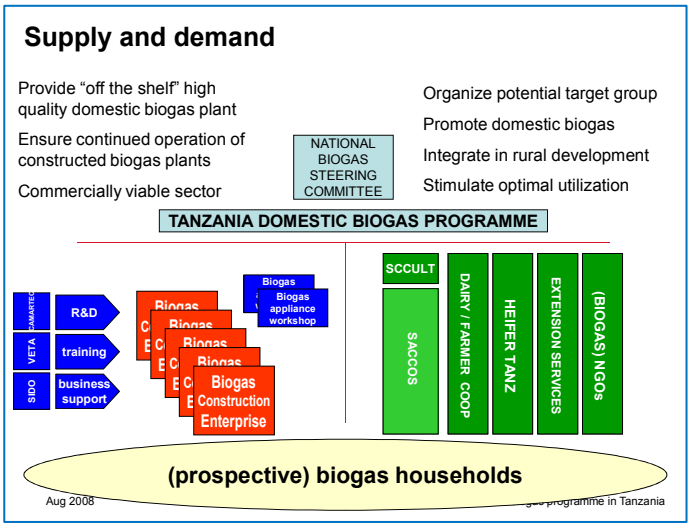
Training programme

			batch size	Training courses						Persons reached
				1	2	3	4	5	Total	
Technical training	Biogas Mason	BMT	20	2	2	4	4	8	**20**	**394**
Technical training	Biogas Mason Refresher	BMT-R	24	0	1	3	8	14	**26**	**623**
Technical training	Biogas Supervisor	BST	10	0	1	1	1	2	**4**	**41**
Technical training	Biogas Supervisor Refresher	BST-R	12	0	0	1	2	3	**5**	**65**
	Total technical training			**2**	**4**	**9**	**14**	**27**	**55**	**1123**
Programme	Biogas Programme Workshop	BPW	12	1	1	2	3	4	**11**	**127**
Programme	Village Extension Service Providers	VEW	20	1	3	5	8	13	**30**	**595**
Programme	Loan Officer Training	LOT	12	1	1	2	3	4	**11**	**127**
	Total programme training			**3**	**4**	**9**	**13**	**22**	**51**	**849**
User training	Biogas Awareness & Promotion	BAW	40	25	53	105	155	263	**600**	**24000**
User training	Biogas Operation & Maintenance	BOM	30	17	35	70	103	175	**400**	**12000**
User training	Bio-slurry Application	BSA	20	20	42	84	124	400	**670**	**13400**
	Total user training			**62**	**130**	**259**	**382**	**838**	**1670**	**49400**
ToT technical training	ToT Biogas mason trainers	TBM	8	1	1	1	1	1	**5**	**40**
ToT technical training	ToT refresher Biogas mason trainers	TBM-R	16	0	1	2	2	3	**8**	**128**
ToT technical training	ToT Biogas supervisor trainers	TBS	6	0	1	0	0	1	**2**	**12**
ToT technical training	ToT refresher Biogas supervisor trainers	TBS-R	12	0	0	1	1	1	**3**	**36**
	Total ToT technical training			**1**	**3**	**4**	**4**	**6**	**18**	**216**
ToT user training	ToT Awareness & promotion	TAP	12	1	1	1	1	1	**5**	**60**
ToT user training	ToT Awareness & promotion refresher	TAP-R	24	0	1	1	1	1	**4**	**96**
ToT user training	ToT Operation & maintenance	TOM	12	1	1	1	1	1	**5**	**60**
ToT user training	ToT Operation & maintenance refresher	TOM-R	24	0	1	1	1	1	**4**	**96**
ToT user training	ToT Bioslurry application	TBA	12	1	1	1	1	1	**5**	**60**
ToT user training	ToT Bioslurry application refresher	TBA-R	24	0	1	1	1	1	**4**	**96**
	Total ToT user training			**3**	**6**	**6**	**6**	**6**	**27**	**468**
	Total training			**71**	**147**	**286**	**419**	**898**	**1821**	**52056**

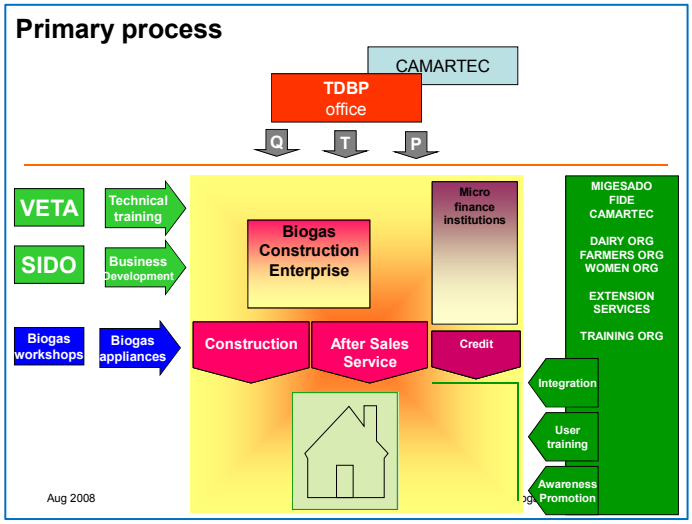
0.1.6 Institutional aspects

Central in a commercially viable approach is the household and its demands in view of agriculture, health and sanitation, environment and energy services. *Characteristics of a prospective biogas household* thus would include:

- farming households, having 2 (zero-grazed) to 10 cattle or 8 to 40 pigs (or a combination thereof);
- real demand for alternative domestic energy sources, whereby it is helpful when the household already (partially) uses commercial energy;
- opportunities for meaningful application / marketing of bio-slurry;
- organized in dairy collection, micro-credit, women or rural development groups.



In concept, the domestic biogas sector can be segmented in a *demand and supply side* whereby the main responsibility of the sector's supply side is to establish a commercially viable biogas sector that provides "off the shelf" high quality biogas installations and ensures the continued operation of all biogas plants installed under the programme and whereby the demand side of the sector will be involved in organizing the potential target group to increase public awareness of the technology, provide credit to prospective biogas households, stimulate optimum use of the installations, and to integrate the technology in rural development.



The core of the *primary process* is in the commercial interaction between the (prospective) biogas household and the Biogas Construction Enterprise, in which both parties aim to maximize their returns. The first party by demanding the best possible service level at the lowest possible costs, the latter aiming for high profit and future market penetration.

In this process, the importance of the quality of domestic biogas cannot be overstated. Particularly in a rural setting, a household that is satisfied with the benefits of a biogas plant is by far the most powerful promotional tool for the technology. Clearly, however, this works in two ways; an unsatisfied owner will cast a bad reputation on the technology, with a disastrous effect on market development. An enabling environment for the primary process to blossom would have the following salient features:

- Potential customers are well informed on costs and benefits, but also limitations, of the technology.
- Biogas service providers are rooted in the local society, to ensure that initial as well as follow-up services are easily available.
- BCEs operate on a level playing field; standardized technology is marketed together with transparent quality standards and quality control and enforcement.

In such an environment, BCEs have a vested interest in providing high quality services at competitive rates as a means to safeguard and expand their market. Hence, the main responsibility of the Tanzania Domestic Biogas Programme is to create and maintain the required conditions.

The *Tanzania Biogas Programme Office* (TBP-Office), with the NBSC as its Governing Board, has coordinating, regulating and facilitating functions.

CAMARTEC will be the host organization for the TBP-Office, whereby the TBP-Office will be established in the premises of CAMARTEC in Arusha. The precise organizational arrangements required for CAMARTEC to successfully host the TDBP will be detailed during a comprehensive organizational assessment planned for the 3rd quarter of 2008. Key in the arrangement, however, will be the creation of an organization with a fair degree of autonomy and business orientation, able to react pro-actively to developments in the sector. At the end of the first phase, the TBP-Office will employ 19 staff. The TDBP-Office will be governed by the National Biogas Steering Committee.

TBP-Office staffing *[# of persons]*

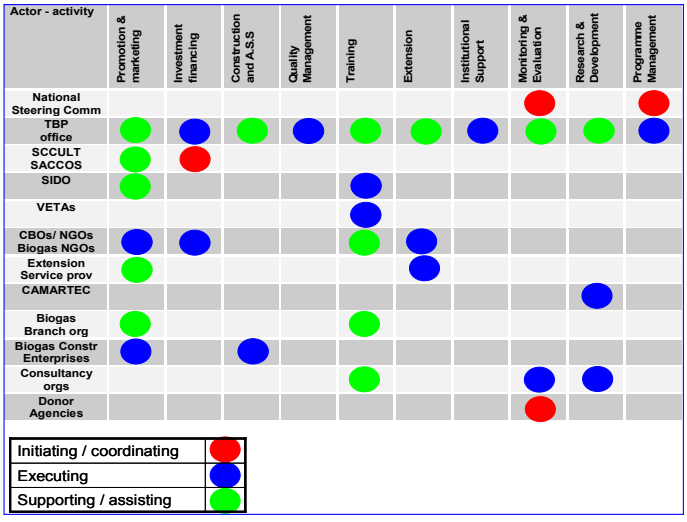
		Total
Programme Coordianator	PC	1
Chief Finance and Administration	CFA	1
Chief Biogas Technician	SBT	1
Finance officer	FO	1
Officer Promotion and PR	PPRO	1
Training Officer	TRO	1
Extension officer	EXO	1
ICT Officer	ICTO	1
Exec secretary	ES	1
Senior Biogas Technician	SBT	3
Biogas Technician	BT	3
Data processer	DP	2
Support staff	SS	2
Total staff		**19**

The programme is funded up to June the 30th of 2009 by SNV's special core funding. For the period starting July the 1st 2009 and ending December the 31st 2012, the programme seeks funding form the ABPP. To that effect, CAMARTEC will enter into an agreement with Hivos, the Fund Manager of the ABPP.

SNV-the Netherlands Development Organization will make experts available to provide technical assistance to the programme as a whole (apex, supply- and demand-side). The experts will assist with the programmatic, technical and administrative aspects of the programme.

The programme will propose to the Rural Energy Agency to contribute to the subsidy component of the programme through their Rural Energy Fund (REF). In addition, the programme will seek funding from other donors and will secure funding for continuation after 2012.

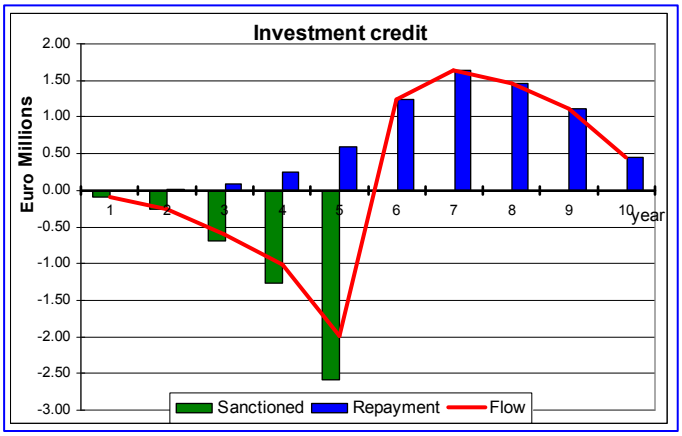
The programme will cooperate closely with other organizations. Main actors are presented on the actor – activity matrix.



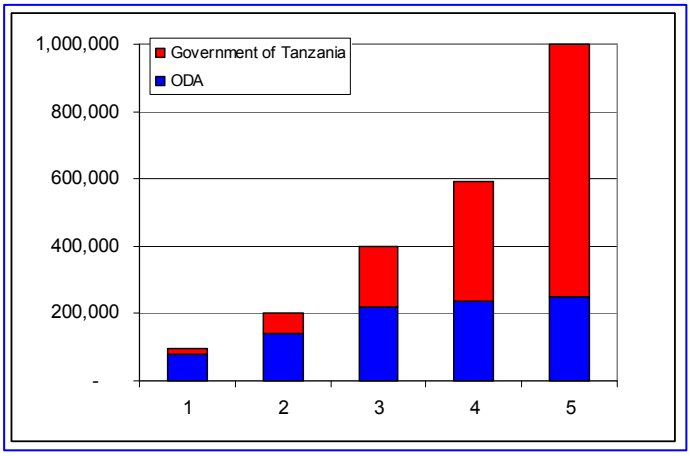
0.1.7 Activities and inputs

Average plant investment costs of the new "modified CAMARTEC design" are estimated at € 793. The *total investment cost* for the programme -compounded by household investment, credit financing costs and investment subsidy- amounts to € 12,351,827.

The availability of an appropriate (matching loan repayments with traditional energy expenditure) biogas credit scheme will be crucial for the programme. Based on such a scenario, assuming that the *credit requirement* will gradually increase with the penetration of the programme, a total sanctioned credit amount of about € 5 million will be required. The programme will seek credit fund assistance.

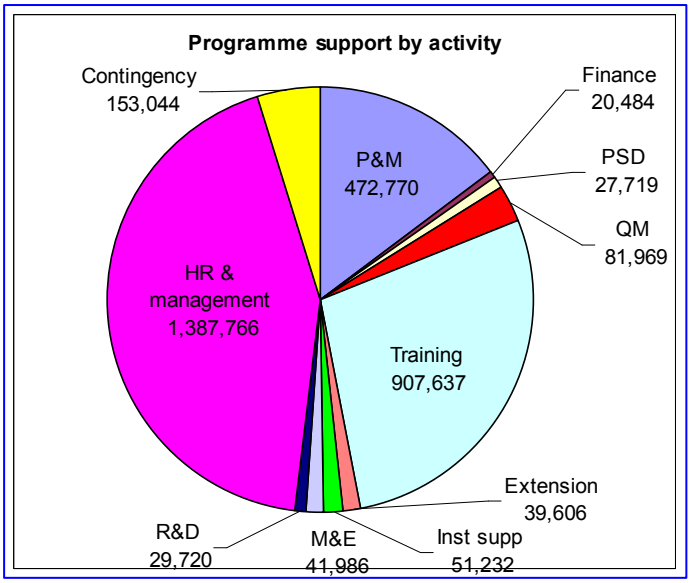


The programme proposes a flat rate *investment subsidy* at two levels: TZS 300,000 as regular investment subsidy and TZS 500,000 for poorer (HEIFER assisted-) households. The subsidy component of the programme has a dual purpose; buying-down the investment costs for the household, and; creating leverage on the quality of the installations. The total subsidy requirement for the 1st phase of the programme amounts to nearly € 2.3 million.



To support the sustainability of the programme, the Government of Tanzania, through the Rural Energy Fund, will be requested to consider taking a share of the subsidy expenses, ranging from a 15% share in the 1st programme year to 75% in the 5th. In this fashion, the Government will contribute € 1,357,851 (TZS 2,496 million), 59%, to the programme's subsidy component.

Programme support activities include promotion and marketing; finance and subsidy administration; private sector development; quality management; training, extension; institutional support; monitoring and evaluation; research and development, and; HR and management. The budget for support activities arrives at € 3.2 million, as detailed in the paragraph below.



The *total budget* for the first phase of the programme, corrected for inflation on Euro basis, arrives at € 16,737,357 (TZS 30,771 million). Details on main cost centres are provided in the table below.

Summary project budget by activity *(corrected for inflation)* *[Euro]*

		Summary project budget					
		1	2	3	4	5	total
	Forecast production	*500*	*1050*	*2100*	*3100*	*5250*	***12000***
	Total investment *(incl subsidy and financing)*	432.883	963.438	2.041.449	3.191.622	5.722.435	**12.351.827**
1	Promotion & marketing	25.040	46.858	90.134	116.215	194.523	**472.770**
2	Finance	3.595	5.139	3.840	6.012	1.899	**20.484**
3	Private sector development	-	2.241	7.161	8.469	9.848	**27.719**
4	Quality management	8.406	5.778	14.948	21.710	31.127	**81.969**
5	Training	50.509	70.005	146.494	190.034	450.828	**907.869**
6	Extension	600	10.568	7.448	13.899	7.091	**39.606**
7	Institutional support	9.250	10.558	9.813	11.200	10.411	**51.232**
8	Monitioring & Evaluation	3.264	3.361	11.950	8.483	14.928	**41.986**
9	Research and development	7.863	1.703	9.300	5.740	5.115	**29.720**
10	HR and management	252.071	221.353	272.711	308.589	333.041	**1.387.766**
	Contingencies *(activities only)*	18.030	18.878	28.690	34.518	52.941	**153.056**
	International technical assistance	197.500	201.450	205.479	209.589	213.780	**1.027.798**
	Camartec service fee	49.800	24.948	23.814	21.949	23.046	**143.557**
	Total project	**1.058.809**	**1.586.277**	**2.873.229**	**4.148.029**	**7.071.014**	**16.737.357**
	million TZS	*1.947*	*2.916*	*5.282*	*7.626*	*13.000*	***30.771***

Application of funds: Investment takes the lion share, 74%, of the programme costs, technical assistance the remaining 26%.

Per installation, fund application so results in € 1,029 and € 365 for investment and technical assistance respectively.

Source of funds: Participating households, through the investment costs of their installations, will contribute 60% to the programme budget. The Government of Tanzania will be requested to contribute to the programme's subsidy component, through the Rural Energy Fund,. The total contribution of the GoT, thus will amount to 8% of the programme budget. In total, 32% of the required programme funds will be sought from Official Development Aid.

The proposed contribution of the GoT is not yet committed and ODA , through the ABPP, remains to be contracted. Assuming these contributions will materialize, the budget still shows a gap of € 704,384, which may be filled by other donors and/or carbon revenue.

Application of funds		*[Euro]*	*[%]*
	Investment		
1a	Household investment	8.111.411	*66%*
1b	Credit financing costs	1.955.914	*16%*
1c	Investment subsidy	2.284.502	*18%*
	Total investment	**12.351.827**	*74%*
	Techncial assistance		
2a	Support activities	3.214.176	*73%*
2b	International technical assistance	1.027.798	*23%*
2c	Camartec service fee	143.557	*3%*
	Total project support	**4.385.531**	*26%*
	Total application	**16.737.357**	

Source of funds		*[Euro]*	*[%]*
a	**Households**		
a1	Household investment	8.111.411	*81%*
a2	Credit financing costs	1.955.914	*19%*
	Total participating farmers	**10.067.325**	*60%*
b	**Government of Tanzania**	*(not yet committed)*	
b1	REF (subs comp)	1.357.851	*100%*
	Total Gvt of Tanzania	**1.357.851**	*8%*
c	**Official Development Aid**	*(not yet committed)*	
c1	ABPP (subs comp + act comp)	3.580.000	*67%*
c2	SNV (ITA comp)	1.027.798	*19%*
c3	Other (act comp)	704.384	*13%*
	Total ODA	**5.312.182**	*32%*
	Total source	**16.737.357**	

0.2 Acknowledgements.

It was a pleasure to conduct this mission on the formulation of a national biogas programme in Tanzania. We received full cooperation during the interviews, field visits and workshop and were amply provided with valuable information and opinions. We like to extend our gratitude to all respondents and informants for their constructive contributions and hope the outcome of this mission will serve its purpose.

August 2008,

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Developing the draft Programme Implementation Document to this final version, the Interim Executive Committee of the TDBP and Hivos provided valuable input. We're indebted for their efforts.

March 2009,

Peter Bos,
Felix ter Heegde
Arusha, Tanzania

0.3 Table of content.

0.4 List of Annexes.

0.5 Exchange rates used.

1 Euro	= TZS 1,838
1 US Dollar	= TZS 1,200

0.6 List of acronyms and abbreviations.

ABC	Arusha Biogas Contractors
ABPP	Africa Biogas Partnership Programme
BBA	Biogas Branch Association
BCE	Biogas Construction Enterprise
BES	Biogas Extension Service
BET	Board of Ecternal Trade
BFTW	Brot fuer die Welt (Bread for the World)
BoQ	Bill of Quantities
CAMARTEC	Centre for Agricultural Mechanization and Rural Technology
CDM	Clean Development Mechanism
CO_2	Carbon dioxide
DGIS	Directorate General for International Cooperation (-the Netherlands)
EIRR	Economic Internal Rate of Return
ELCT	Evangelical Lutheran Church in Tanzania
FIDE	Friends in Development Trust Fund
FIRR	Financial Internal Rate of Return
GDP (PPP)	Gross Domestic Product (Purchasing Power Parity)
GEF	Global Environment Facility
GoT	Government of Tanzania
GTZ	Organization for Technical Cooperation (-Germany)
Hh	Household
Hivos	Himanist Institute for Co-operation with Developing Countries
HR	Human Resources
IMF	International Monetary Fund
ITA	International Technical Assistance
IPI	Institute of Production Innovation (Technology Transfer Centre)
kWh, MWh	Kilowatt hour, Megawatt hour
LPG	Liquefied Petroleum Gas
M&E	Monitoring and Evaluation
MEM	Ministry of Energy and Minerals
MIGESADO	
NBSC (-EC)	National Biogas Steering Committee (-Executive Committee)
NEDF	National Entrepreneurship Development Fund
NGO	Non-Governmental Organisation
NIGP	National Income Generating Programme
NMB	National Microfinance Bank
ODA	Official Development Assistance
QC, QM	Quality Control, Quality Management
R&D	Research and Development
REA	Rural Energy Agency
REF	Rural Energy Fund
SACCOS	Saving and Credit Cooperative Society
SELF	Small Entrepreneurs Loan Facility
SHS	Solar Home Systems
SIDA	Swedisch International Development Agency
SIDO	Small Industries Development Organisation
SME	Small and Medium Enterprises
SNV	Netherlands Development Organisation
SUDERETA	Sustainable Development and Renewable Energies Tanzania
SURUDE	Foundation for Sustainable Rural Development
SWOC	Strong, Weak, Opportunity, Challenge
t, kt	Tons, kilo tons
TBP-Office	Tanzania Biogas Programme Office
TDBP	Tanzania Domestic Biogas Programme
TEMDO	Tanzania Engineering and Manufacturing Design Organization
TIRDO	Tanzania Industrial Research Development Organization
ToT	Training of Trainers
TZS	Tanzania Shilling
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention for Climate Change
VETA	Vocational Education and Training Authority
W, kW, MW	Watt, kilo Watt, Mega Watt
WDF	Women Development Fund
YDF	Youth Development Fund

1 Introduction and background.

Shortly after achieving independence from Britain in the early 1960s, Tanganyika and Zanzibar merged to form the nation of Tanzania in 1964. One-party rule came to an end in 1995 with the first democratic elections held in the country since the 1970s, whereby Zanzibar's kept a semi-autonomous status regarding internal affairs

1.1 Country background.

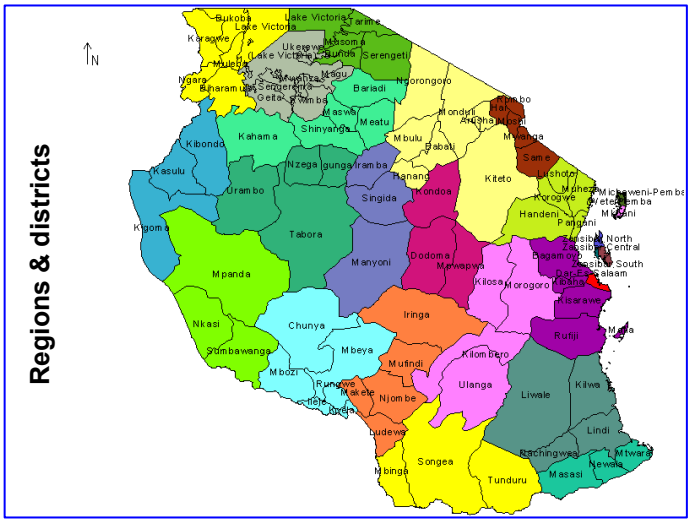
Divided over 26 regions, the country covers an area of 886,037 km². The country's capital is Dodoma, in the centre of the dry highlands, although Dar Es Salaam harbours most of the Ministries and embassies.

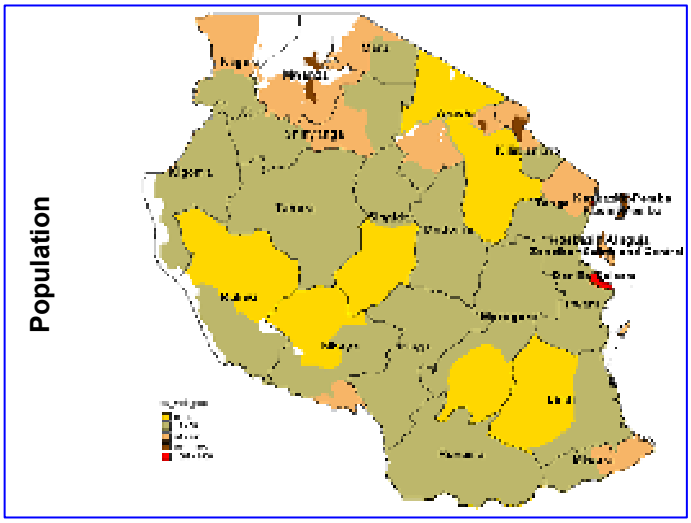
Population: Tanzania is home to a population of 40.2 million people whereby the population is growing at a rate of 2 % per annum (est. 2008) [7]. Mainland Tanzania is for 95% populated by Bantu, consisting out of over 130 tribes.

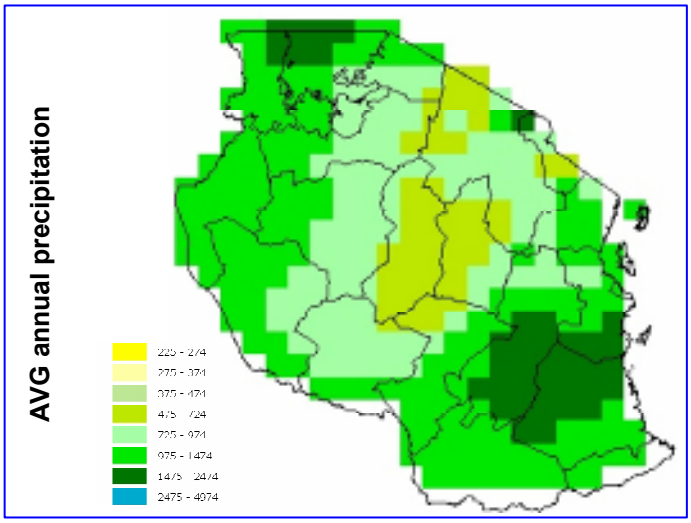
Christianity, Islam and Indigenous beliefs are roughly equally divided over the mainland population, Zanzibar, however, is mainly Muslim. The main languages are Kiswahili and English, about 70% of the population over 15 years can read and write at least one of these languages or Arabic.

Climate: Situated just below the equator, Tanzania has a tropical on the coast, semi-temperate inland. In the eastern rift zones and on the south-eastern slopes of the volcanoes precipitation of 1,500 to 2,000 mm occurs due to orographic rain with more than 10 wet months. Along the coast, the monsoon brings moderate rainfall (500 to 1,000 mm) with 5 to 6 wet months. The highland in the interior is relatively dry with 3 to 4 wet months and annual precipitation of below 500 mm.

Economy: Tanzania is one of the poorest countries in the world. The economy depends heavily on agriculture, which accounts for more than 40% of GDP, provides 85% of exports, and employs 80% of the work force. Topography and climatic conditions, however, limit cultivated crops to only 4% of the land area. Industry traditionally featured the processing of agricultural products and light consumer goods. The World Bank, the IMF, and bilateral donors have provided funds to rehabilitate Tanzania's out-of-date economic infrastructure and to alleviate poverty. Long-term growth through 2005 featured a pickup in industrial production and a substantial increase in output of minerals led by gold. Recent banking reforms have helped increase private-sector growth and investment. Continued donor assistance and solid macroeconomic policies supported real GDP growth of nearly 7% in 2007 [7].







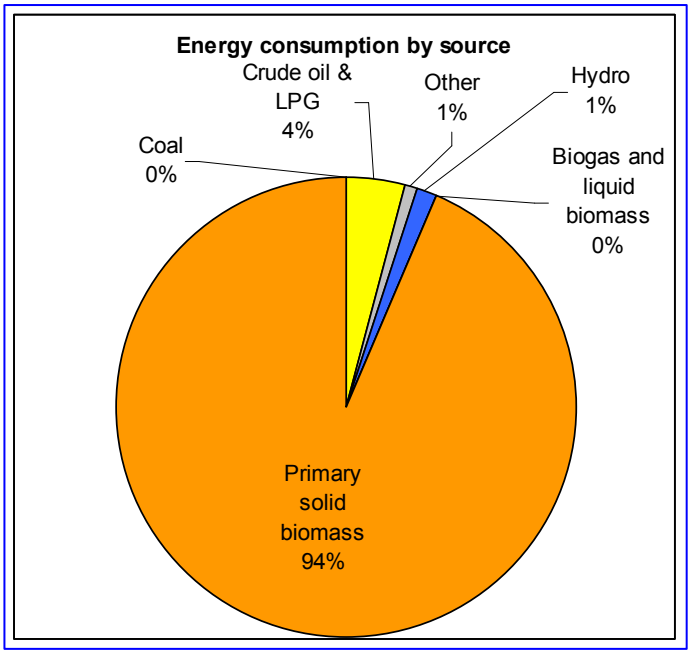
With a GDP (PPP) of US$ 1300 per capita, 36% of the population is living below basic needs poverty line [7] and 18.7% of the population is living below the food poverty line. The unemployment rate is 12.9%. The rural situation may be significantly worse for most of these indicators [1].

The average household size in mainland Tanzania in 2000 was 4.9 and in rural areas 5.1members. 23% of the population live in urban areas, 77% in rural areas. The monthly mean expenditure of a rural household in 2000/01 was TZS 52,649. The average monthly per capita income in rural areas was TZS 14,134 resulting in a mean rural household income of TZS 72,084. Differences between expenditures and income result from the fact that owned produced agricultural commodities do not count as expenditure, but was included in the income survey. The richest quintile of rural society had 5.9 times more expenditures than the poorest quintile. Mean share for food expenditure of rural HHs was 64% [3].

The countries currency is the Tanzanian Shilling (TZS). The exchange rate of the TZS was TZS 1,000 = € 0.5439 in august 2008.

1.2 Energy situation.

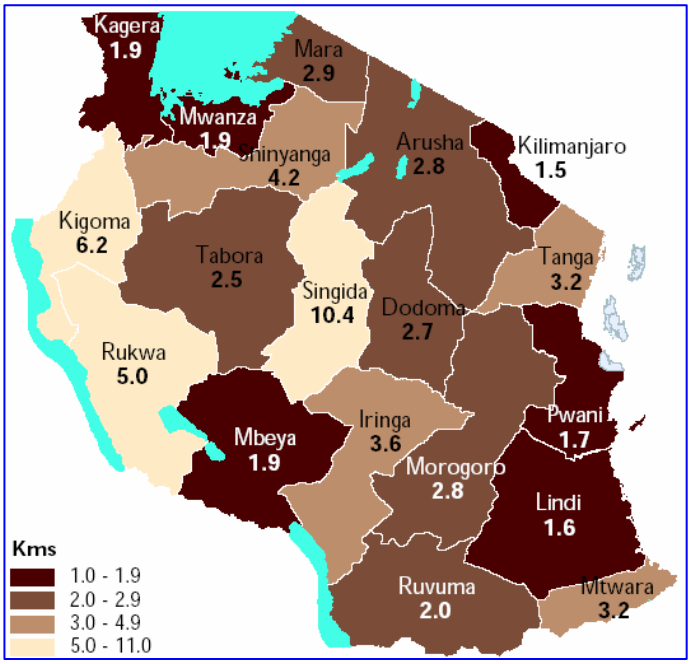
In 1999, around 94% of Tanzania's energy needs were met by biomass, particularly wood fuel. Fossil fuel and hydropower account for 4% to primary energy supply, the remaining energy is provided by coal, biogas and liquid biomass and other sources. Tanzanian prime energy consumption is depicted in the pie chart.



The low use of commercial energy sources indicates that many economic activities are carried out using traditional, low-energy technologies. This is particularly the case in rural areas, where transport difficulties and inefficient agricultural methods are prevailing.

The estimated annual per capita firewood consumption adds up to 1 m³ per year [1], which results in 7 kg per rural HH per day. The collection and use of fuel wood are linked to heavy and often low-productive, time-consuming work and carried out predominantly by children and women. A nationwide survey resulted in regional mean distances for firewood collection (see map). However, current sources give evidence that these distances increased in recent years.

The use of other energy sources such as solar, biogas and liquefied petroleum gas (LPG) is limited despite various promotional efforts. The installed electricity generation is a mix of hydropower, natural gas and fuel oil making the collective capacity in 2005 around 950 MW. Nationwide electrification is about 10% (urban 39% and rural 2%). The electricity consumption per capita in 2002 was 84 kWh. Electricity supply is unreliable and prone to frequent blackouts.



1.3 Domestic energy.

Domestic energy accounts to 78.8 % of total nation-wide energy consumption. More than 80% of the total energy is consumed in rural areas. The rural end user primarily requires energy for fundamental, basic needs, and rarely for development purpose.

In rural areas, in 2000/01 by far the most used energy source for lighting was kerosene with a share of 90.4%. Firewood accounts to 7.1%. Electricity is of minor importance. For cooking, firewood is the predominant source of energy (93.4%). Charcoal is more used by households having higher incomes. In 2000/01 the share of biogas in rural cooking fuel was 0.1%. Other sources report the use and collection of cow dung (around Lake Victoria) for cooking purposes. Cow dung has not been commercialised yet. Results from the 2005 Arusha survey give evidence that about 70% of the population consider their situation in regard to energy as inadequate. The lack of electricity and the high expenditures for kerosene have been major concerns. Consequently, in order to reduce poverty, the World Bank recommends strongly providing reliable, affordable and efficient energy and alternative rural energy schemes for Tanzania.

In the Arusha region, the monthly average expenditure for energy in 2005, including kerosene, charcoal and batteries etc., was TZS 33,000. Poor households spend TZS15,000, middle income households TZS 27,000 and rich households spend TZS 55,000 on energy each month. However, more than half of the households suspected that they may not be able to pay for a future renewable energy installation in their houses (57%). Separated by household-type 77% of poor households, 57% of medium-income households and 25% of the rich households doubt they will be able to pay for such kind of systems. In Mwanza (2007), poor households spend approximately TZS 12,171 on energy, medium-income households TZS 15,011 and better-off households TZS 63,159. This means on average 19,683 TZS per month.

2 Biogas in Tanzania

2.1 History of domestic biogas

The history of biogas dissemination in Tanzania dates back to 1975. Over period for 1997 to 2007, some 2900 biogas installations have been reported, out of which 120 of the floating drum design and 430 plastic bag plants and the remaining of fixed-dome design. Out of these, some 1900 are expected to still be in operation [1].

Biogas was initiated by SIDO who constructed 120 floating-drum installations between 1975 and 1984. In the Arusha region the Arusha Appropriate Technology Project constructed traditional Chinese fixed-dome plants and "floating-seven-drum digesters", their own development consisting of a gas holder made of seven oil drums connected together. The objective of this project was to build biogas plants at the lowest investment costs possible.

In 1982 the newly founded parastatal organisation CAMARTEC furthered the dissemination of this technology in the Arusha area. About one year later, cooperation between Tanzania and Federal Republic of Germany led to the introduction of the Biogas Extension Service (BES). CAMARTEC and GTZ were in charge of implementing this project in Tanzania.

During the initial years the BES disseminated biogas plants mainly in the so-called "Coffee and Banana Belt" area, the region around Arusha where particularly positive conditions promised a high dissemination density for biogas plants. As a result of the withdrawal of German support to the BES, the dissemination strategy and project structure underwent decisive changes around 1990. In the course of this transfer phase from 1990 to 1992, and with a further extension from 1992 to 1994, the project received financial support within the framework of the Special Energy Programme (SEP). The programme resulted in the construction of some 1000 "CAMARTEC" installations so far.

The ELCT has been active in dissemination since 2003 as a fairly large player. In addition, MIGESADO has been operating from Dodoma region in the dry centre of the country, promoting biogas.

Currently, MIGESADO is by far the largest domestic biogas plant disseminator in the country operating in Dodoma and surrounding regions.

The Sustainable Energy Programme in Karatu, Arusha, with Danish support, has been testing biogas plants using cheaper plastic technologies. Experiences with these relatively cheap digesters have not been good as mainly lifetime was limited and gas pressure too low for operating lamps.

The ELCT biogas dissemination concept.
The concept for dissemination followed by the ELCT differs significantly from the CAMARTEC approach. In ten dioceses of the church, biogas experts coordinate advice, promotion and technical training of biogas craftsmen.

The target group is made up of farmers with at least two heads of cattle. Depending on the socio-economic condition of the household, farmers receive up to 50% of the investment costs as a credit.

To keep the investment costs low, households are assisting in the construction of plants. The ELCT supports the Chinese fixed-dome design whereby biogas appliances were imported from India and China to further reduce the investment.

CAMARTEC's commercially oriented, strictly standardised dissemination programme was considered by ELCT as not appropriate for Tanzania, serving foremost richer farmers [1], [2].

Tanzania has a modest commercial biogas sector, aiming at the construction of larger, institutional, installations (hospitals, schools, prisons etc).

2.2 Applied technology

The existing types of biogas digesters can be divided in five design groups:

Floating drum installations

In early days of biogas dissemination in Tanzania, SIDO introduced the floating drum design. The limited lifetime of the metal drum and relatively high costs, however, make the design inappropriate for Tanzania.

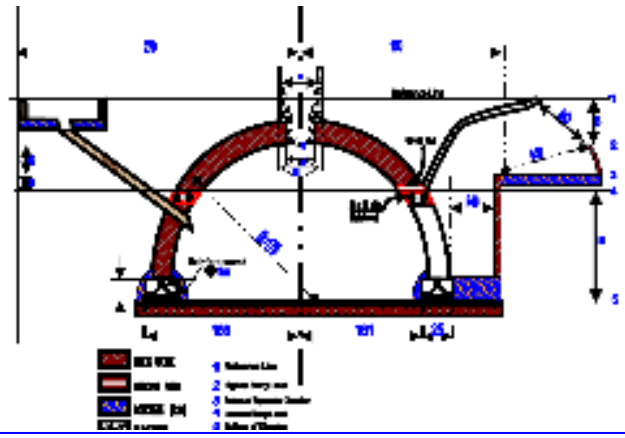
CAMARTEC

A fixed dome biogas plant based on Chinese design and modified by CAMARTEC. The CAMARTEC plant has been built over 1000 times in Tanzania and experiences show long lifetimes at high costs.

This type has not only been adopted by Tanzanian private sector, also other African countries installed this design successfully.

Technically, this design demonstrated to be suitable for Africa, but high investment costs have hampered wide-spread dissemination and gas-tightness of the manhole cover at the top of the dome have been a concern for this design all over the world.

CAMARTEC

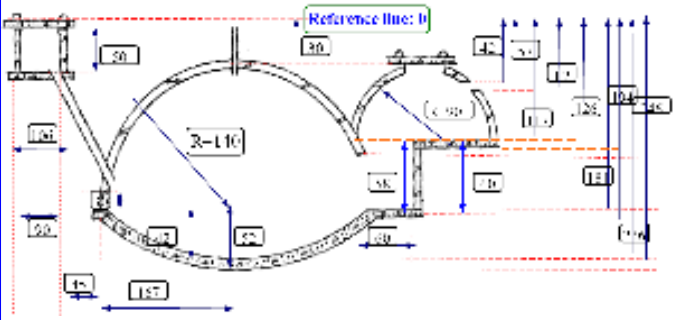


MIGESADO

Fixed dome design based on the Indian Deen Bandhu model, by MIGESADO. This type has been built over 850 times over the past 9 years in central Tanzania. Experiences show also long lifetimes.

Investment costs are still relatively high, but significantly lower than the CAMARTEC plants.

MIGESADO

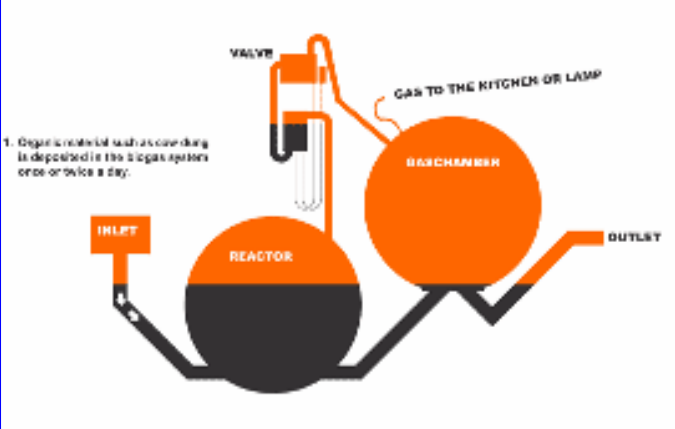


Tubular plastic bag plants

Of the tubular plastic digesters, mainly promoted by SURUDE and KAKUTE Ltd., some 300 to 500 units have been built in Tanzania. Prices per digester are about $US 150. The low investment is off-set by the limited average lifetime of only a couple of years and low gas-pressure. SURUDE, which built about 200 plants of this kind, does not consider this technology as sustainable any more and stopped dissemination.

Superflex

Very few digesters installations following the Superflex design have been reported in Tanzania (mainly on Zanzibar). This design also uses plastic as main material with modified plastic water tanks accommodating biogas digestion and gas storage. The design has not found wide-spread dissemination in Tanzania so far.



ARTI-TZ
ARTI-Tanzania is a Tanzanian registered non-profit making organization. ARTI derives its technologies from the internationally recognized ARTI-India. ART-TZ's "Compact Biogas System" takes waste flour, vegetable residue etc as input material and converts it to biogas. The model mainly accommodates energy generation from kitchen waste, and is complementary to domestic biogas installations for livestock smallholders.

2.3 Assessment of domestic biogas plants in Tanzania

In the framework of the formulation of a Programme Implementation Document for a National Domestic Biogas Programme for Tanzania, SNV assisted the Tanzania Biogas Stakeholder Group fielding a mission for a technical assessment of domestic biogas installations as constructed in the country. Details on the missions findings were presented in the report [5], hereunder follows a brief summary

The mission's field investigations revealed that even with little training to masons and minimum supervision, the quality of construction and workmanship, in general, has been good, resulting in the majority of the users being satisfied with the performance of their biogas plants. Comparing actual gas production with the theoretical gas production following the amount of substrate fed to the plant daily confirms the good quality of workmanship. In contrast with the good workmanship shown in the civil structure, however, the efficiency of biogas appliances and the quality of fitting works left ample room for improvement.

High plant investment costs prohibit large scale dissemination; there is need to assess cost reduction methodologies without compromising the quality. The high investment costs can be attributed to a large extent to biogas plants being over-sized. The actual feeding, as compared with the designed feeding rate, ranged from 15 to 90%. The resulting low plant efficiency, based on plant-sizing, ranged from 12 to 50%, clearly indicating that farmers –on average- could have done easily with installations smaller then half their actual size.

For households to optimize the benefits from their investment, operation and maintenance training should receive more emphasis. Although users are generally aware of the fertilizing value of the bio-slurry; slurry-pits can improve bio-slurry handling and application.

2.4 Barriers for large-scale dissemination.

Domestic biogas was introduced in Tanzania in the mid seventies of the previous century. As one of the few countries on the continent, the technology was further developed, reaching its pinnacle of reputation and dissemination some 15 year later. Although early development actually mimics that of countries in Asia, subsequent market penetration trailed behind other early adopters. The question standing out, hence, is the sharp contradiction between Tanzania's (international) reputation as a pioneer in domestic biogas and its hampering large-scale dissemination.

Major barriers would include:

Investment costs. In the 1980s, CAMARTEC and GTZ did excellent work in development of a biogas plant suitable for Tanzania. In their eagerness to develop the perfect installation, though, focus shifted from building an affordable installation to designing a "bomb-proof" but expensive biogas plant. As a result, the target group for domestic biogas diverted to rich farmers and institutions, again increasing costs with digester size, and limiting the market potential dramatically. Typical CAMARTEC plants would measure at least 16m^3, and their investment of TZS 2.1 million is far above what even a not-so-poor farming household can afford. More recently, MIGESADO and FIDE "returned to basics", promoting smaller and simpler installations while maintaining quality; although installations are still relatively expensive, the new effort of both organizations proof a considerable market potential for domestic biogas.

Biogas credit. Even with simpler plants at lower costs, households face the investment "up-front". To accommodate such an investment, most households will require proper support of a dedicated credit facility. Although Tanzania has some micro-finance infrastructure, biogas loans do not fit in the current services of most saving and credit organizations.

Dissemination approach. CAMARTEC for years followed a centralistic approach towards domestic biogas. Production facilities are mainly centred around Arusha, and with their traditional focus on large, expensive installations the parastatal limited its market to the few rich farmers and institutions. Commercial biogas enterprises - spun-off from CAMARTEC- largely followed the same approach and most of them need regular construction work to stay in business. Construction in other parts of the country, furthermore, would rapidly result in excessive transport costs. ELTC, and to a lesser extent MIGESADO and FIDE, applied a more decentralised dissemination approach, resulting in commendable production [2]. However, none of the initiatives seems to have actively promoted dissemination by the private sector in a decentralized, rural manner. Part of the reason for this may be found in Tanzania's socialistic past in which central, government-directed institutions were intended to provide services.

Limited availability of the technology. Following from the high investment costs and the centralized approach, the technology is only available in pockets in the country, both regarding necessary construction skills and required dedicated biogas appliances. As biogas specific training has reduced sharply since the early nineties, the required knowledge and skill is limited mainly to the few remaining CAMARTEC alumni and technical staff of MIGESADO. Similarly, replacement appliances and, in general, after sales service, is often unavailable.

Limited awareness of domestic biogas. Although not documented, in the absence of national or regional promotion campaigns, the awareness of the benefits and costs of domestic biogas can expected to be limited to the same pockets where MIGESADO, CAMARTEC, ELCT and some smaller initiatives have constructed biogas installations.

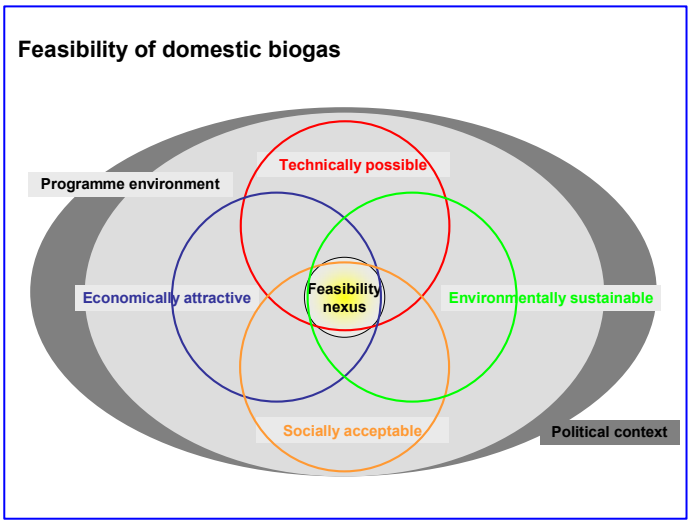
Declining financial support by the Government of Tanzania. After the withdrawal of German development support to CAMARTEC, the latter organization was faced with gradually declining budgets for biogas dissemination. Other biogas organizations too became mainly dependent on foreign financial support to continue their biogas efforts. As a result, construction of fixed dome biogas plant construction reached its maximum in 1990 with just over 150 installations annually, and hovers at about half of that ever since. Experience in other countries (Nepal, India, China) clearly shows that strong policy and financial support from the host government is a key success factor for national biogas programmes.

Limited coordination between sector-actors. Prior to the Feasibility Study by GTZ last year, CAMARTEC and MIGESADO had not exchanged technical details of their products, and structural technical cooperation only happened on the occasion of the SNV technical assessment mission one year later. Similarly, participants of the Tanzania Biogas Task Force remarked that this was the fist time that they sat together discussing the future of the sector. Tanzania's small domestic biogas sector for years has been marked by fragmentation, unable to coordinate promotional efforts or making a strong plea for assistance towards the government or donors.

Limited availability of process water. Tanzania is a dry country; many parts are characterized by long periods of drought between rainy seasons. As the operation of biogas installations requires a reliable source of significant amounts of process water, dryer areas may not qualify easily for the technology.

2.5 Potential for domestic biogas.

For a national domestic biogas programme, the notion "feasibility" is multi-facetted. This document applies a framework incorporating technical, economic, social and environmental elements within a programmatic environment and political context. The nexus of these factors indicates the feasibility of a large-scale biogas programme.



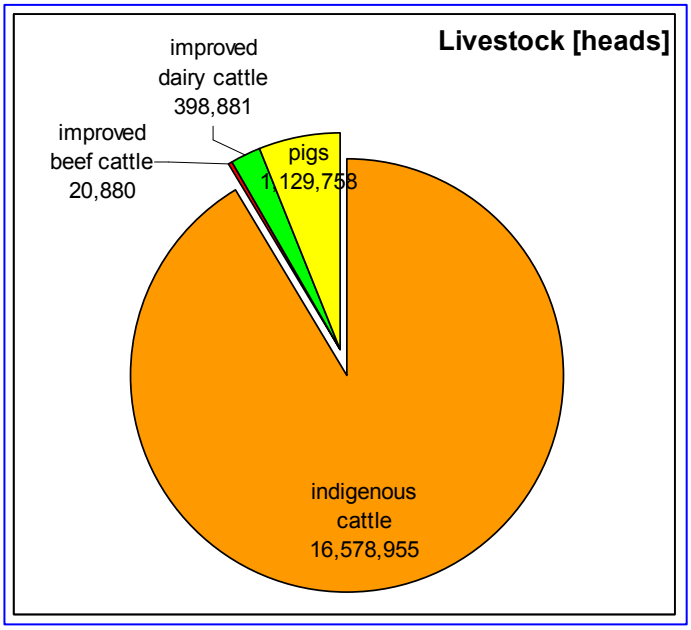
The feasibility of domestic biogas in Tanzania is studied in a detailed manner in the Feasibility Study [1]. For the PID, hence, it will suffice to briefly attend to the technical possibilities (2.2.1) economic attractiveness (2.2.2), social acceptability (2.2.3) and the environmental sustainability (2.2.4). Subsequently the programme environment and the political context will be discussed.

2.5.1 Technical potential

The technical potential for rural and pheri-urban domestic biogas is determined by the availability of sufficient substrate (animal dung) and process water, the ambient temperature, the availability of construction materials, enough land (space) for plant installation, freedom from natural disasters like floods and earth quakes and availability of human resources for plant construction.

Livestock holding: With nearly 17 million heads of cattle kept by over 1.3 million households, Tanzania is home to the third largest cattle population on the African continent. In addition nearly 350,000 farmers keep over 1.1 million pigs [4]. Livestock in Tanzania is mainly kept by small-holders. A table with detailed information per region is provided as annex 1.

Although the rough numbers on cattle and pig holding suggest ample availability of biogas feeding material, this suggestion may proof inaccurate; the lion share of the cattle population is of indigenous breed, and a large share of these will be kept as free-ranging herds, possibly penned or stabled for the night only. Improved breeds, for beef and dairy production, however, can be expected to be kept under zero-grazing conditions. Although semi-intensive holding modalities certainly qualify for biogas, the latter category will relatively contribute more to the technical potential for domestic biogas.



The agricultural census does not provide details on the country's pig keeping modalities, but it seems fair to assume the larger share being kept stabled.

A complicating factor is that the census does not provide information on the extent to which a combination of animals is kept by a single household; inevitably, a share of the households may appear two, or even three times in the dataset.

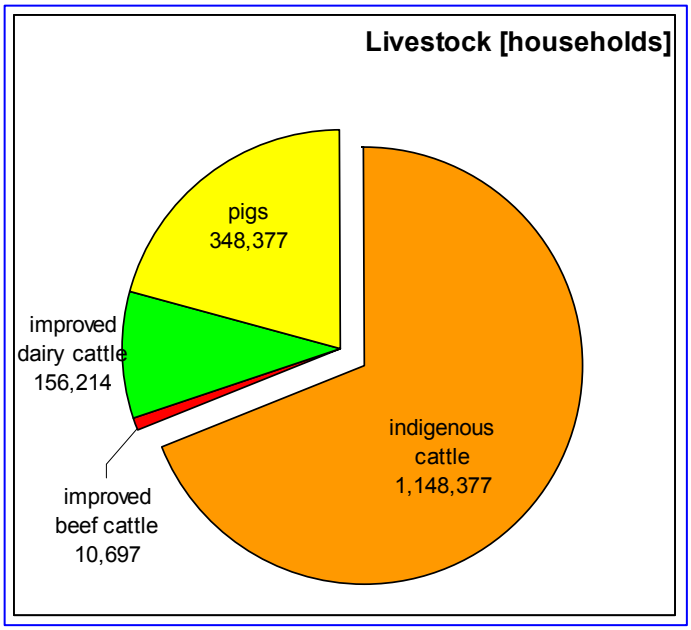
As a first approximation to the technical potential for domestic biogas (based on the availability of substrate), the density of a specific livestock category in a region is taken and linked to the number of households keeping that category of livestock in a "if – then" statement. For this statement, the actual production of MIGESADO in the Dodoma region over the past 10 years is taken as an "anchor point". Details on the calculation, and its results per region, are provided in annex 6. The approximation suggests a 10-year potential of 165,000 installations for the country, with Kilimanjaro, Mbeya, Iringa and Ruvuma with a 34,000, 25,000, 19,000 and 13,000 installations respectively as the most potential districts.

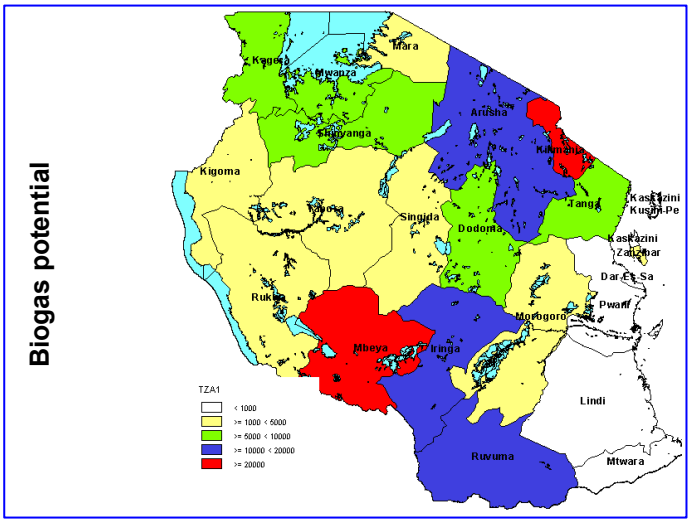
Although the mapping should provide a good insight in regional location of market potential for domestic biogas, working with regional data introduces inaccuracies[2]:

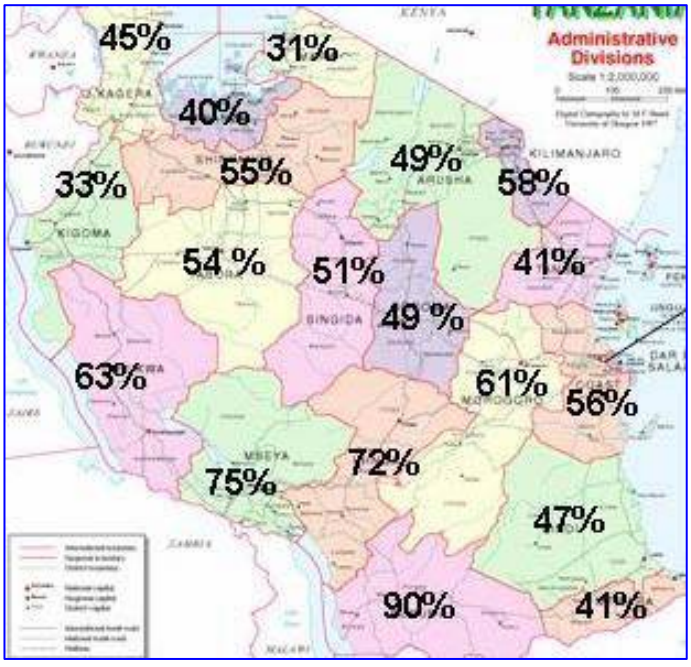
- The high potential of some regions may not be valid for the entire region; livestock smallholders may well be concentrated only in some of the districts.
- Likewise, the low potential of some other regions may be deceiving, smaller pockets of (semi-) intensive livestock keeping may prove viable for commercial exploitation.
- The low potential of the Southern coastal zones as well as Dar Es Salaam puzzles experts; observations indicate a large number of livestock smallholdings.

Process water: Domestic biogas installations use a fair amount of water as both the hydraulic and the micro-biological process require a feeding with a 1 : 1 mixture ratio of dung and water (not necessarily of "drinking water" quality, though). Even at minimal feeding of the smallest installation, the water requirement is already 25 litres a day and larger installation can consume up to over 100 litres of process water daily. To ensure biogas plants do not add to the burden of household chores, therefore, as a rule of thumb, the water source should be within 20 minutes walking distance – about 1 km- of the installation.

The share of households living within 1 km of drinking water varies from 31% in the Northern region of Mara to 90% in the Southern region of Ruvuma [1, pg 5], whereby even in more water-rich areas, water may be at a premium during the long dry spells in the Tanzanian climate. The map provides an overview.







[2] As data is available at district as well, using more geographically detailed data will provide more accurate information

Clearly then, water is a critical element in the potential of domestic biogas in (large parts of) Tanzania. CAMARTEC and MIGESADO, sharing over three decades of domestic biogas dissemination experience in various parts of the country, have -to some extent- come to terms with the "water issue" in two ways:

- Proper design and lay-out of the stable will not only facilitate easy collection of the manure, but will also capture nearly all of the urine produced by the animals. The collected urine will substitute part the water requirement. Equally important, adding urine to the biogas plant will increase the bio-slurry's nitrogen content, and so further improve the fertilizing value.
- MIGESADO (and to al lesser extent CAMARTEC and FIDE), operating mainly in the Dodoma region, integrates water harvesting systems in its biogas schemes when deemed necessary. In this way the NGO has been successfully disseminated biogas for the past decade in one of the dryer regions of the country. Although water harvesting systems add considerably to the costs of the entire investment, it should be noted that the harvested water will have a wider application then process agent for the biogas installation alone.

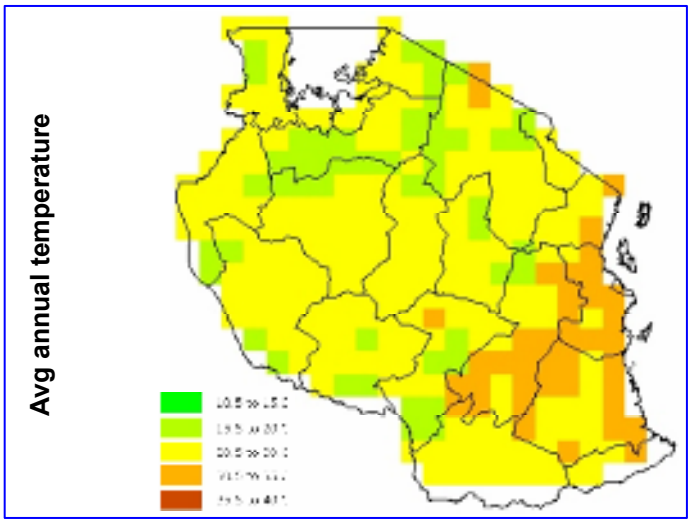
In addition it should be noted that biogas installations in Tanzania generally are over-sized and under-fed [5, pg 7]. MIGESADO has come to realize that over sizing leads to excess consumption of water, resulting in a net increase of the workload of the household (women in particular). The NGO has played a pioneer role in down-sizing plant volumes, matching digester size closely with the available substrate as well as the energy requirement of the household. As a consequence, digester sizes reduced from 16m^3 at the early start to 8m^3 currently

The above measures mitigate water shortages, further options could include:

- Connecting the toilet to the biogas plant, as toilets are often operated with an oversize of water.
- Collection of grey "non-washing" water, e.g. used for cleaning vegetables or animals.

Both options, however, have to go together with careful information and extension to the household, as toilet connections may hamper the application of slurry as fertilizer, and feeding of grey water with detergents will hamper the micro-biological process of the digester.

Temperature: Tanzania is located just south of the equator, and large parts of the country enjoy (from a micro-biological point of view) correspondingly high average temperatures. There are, however, substantial variations, both diurnal as well as by region (from 3^{o}C in Mbeya to 35^{o}C in Kilimanjaro). Therefore, although in general temperatures are conducive for simple biogas installations, households are well advised maintaining a decent top cover over their installations to avoid too steep temperature gradients in the digester.



Construction materials: The availability of bricks, cement, and aggregate in rural areas appears to be good. Plumbing materials, however, are available in larger cities and (some) regional capitals only. The (un-)availability of dedicated domestic biogas appliances in many areas is critical [4], [5].

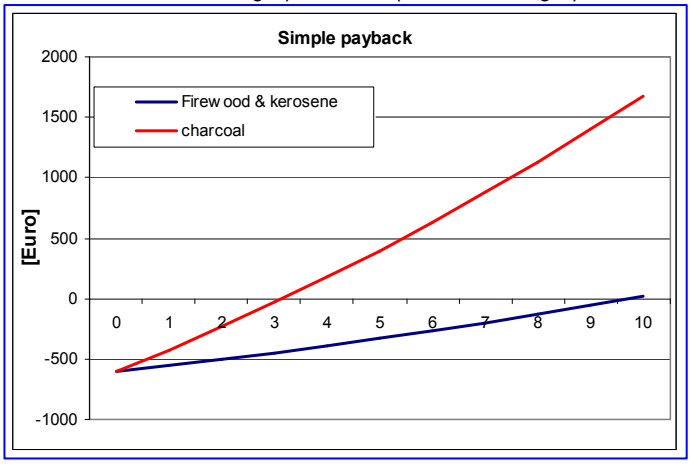
Construction space: Most Tanzanian farmyards are laid-out spaciously, providing ample space for the proper location of a biogas installation.

Human resources: With the slow decline of the earlier CAMARTEC / GTZ domestic biogas programme [4, pg 24], a large part of the skilled artisans is no longer available. Any programme aiming for large-scale introduction of the technology will have to invest heavily in training of technical, extension and promotion staff.

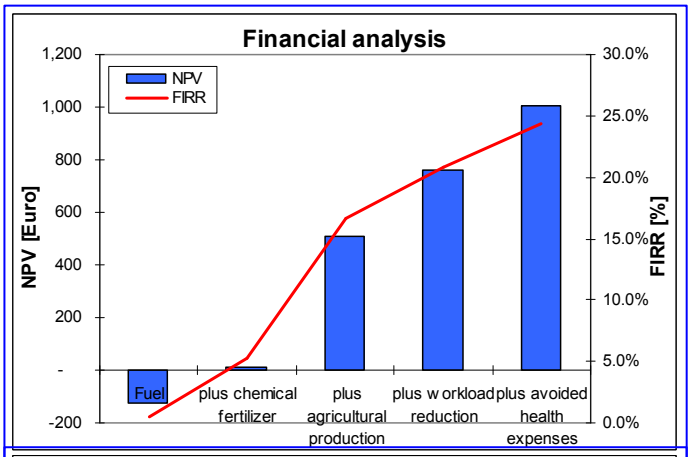
2.5.2 Economic and financial attractiveness

Economic potential: The Feasibility Study [1, pg. 32 and appendix 4] addresses in detail the economic performance of a domestic biogas installation in the Tanzanian (rural) context. Actual fuel savings depend heavily on the type of fuel that is replaced by biogas (charcoal, firewood or kerosene) and the extent to which these fuels are purchased or collected for free (that is, households putting in labour only). Potential annual domestic energy savings, then, range between zero (all firewood collected), € 50 (firewood and kerosene bought) to € 190 (charcoal bought).

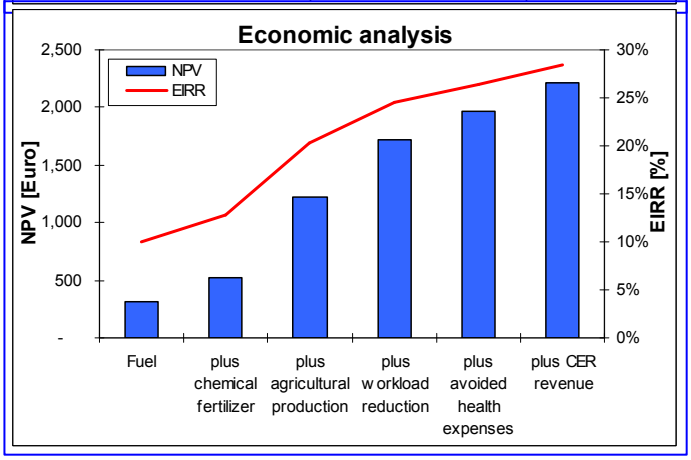
Assuming biogas will replace bought firewood and kerosene would result in a biogas replacement value of € 0.06 / m^3. Replacing charcoal, however, will increase the biogas replacement value to € 0.22 / m^3. The simple pay back period (based on the average investment of € 793 and investment subsidy of € 190) will thus range between 9.5 years and 3 years for situations of replacing bought firewood and kerosene and charcoal respectively.
With measured domestic energy expenses between € 120 and € 240 per annum (2006 pricing) [1, pg 7], the actual simple pay-back period will roughly be between 2.5 and 5 years. Clearly, the economic attractiveness highly depends on the biogas replacement value.



The financial internal rate of return (FIRR), based on the conservative assumption that only bought firewood and kerosene will be replaced by biogas, subsequently will vary between 0.5% (fuel substitution only) to 24% (including all benefits.



The economic internal rate of return, based on replacement of charcoal and including the programme support costs, ranges from 10% for fuel substitution only to 28% when all benefits are included. An important conclusion is that for many households the investment for domestic biogas installations can hardly be justified by fuel savings only.



Financial potential: Despite the reasonable economic potential, the extent to which a household can actually accommodate the upfront investment will depend on the availability of a suitable biogas credit scheme. The proposed arrangement (see chapter 6.1.3) attempts to match loan repayments with actual domestic energy expenses. Assuming such an arrangement will materialize and households are able to realize more than fuel substitution benefits alone, biogas installations should be an attractive investment for most rural households.

2.5.3 Social acceptability

Except for the Massai, previous GTZ projects did not report any reluctance in regard to biogas caused by social or traditional issues [26]. The conclusion from the stakeholder meetings was that in general, the major issue against biogas are the high investment costs.

From the household survey in Mwanza (2007), a small share of the households indicated "fear" for biogas installations, like for example cows dying from the use of that technology. These responses mainly indicate the limited available information rather then a general resistance versus biogas. The programme should address this awareness deficiency by proper "social marketing" campaigns.

The male domestic decision prerogative: Another issue altogether is the mismatch between beneficiaries of the technology and the main decision maker in the household, typical for domestic appliances. Traditionally, the male head of the household decides on larger investments, whereas the main beneficiaries are the women and children. For domestic biogas, the fact that the installation can power biogas lamps will be a mitigating factor, as light will benefit the entire household. Nevertheless, the consequence for the programme will be that promotion should make a targeted attempt to reach women.

Toilet connection: Finally, the acceptance of connecting a toilet to the biogas installations should be discussed here. From a rational point of view, toilet connection –provided the use of detergents to clean the toilet is avoided- brings a household mainly advantages:

- the sanitary situation improves significantly;
- biogas generation and the amount of available organic fertilizer both increase slightly, and;
- important for dryer areas- the amount of process water in the installation is larger.

In general, however, users are (very) reluctant to connect a toilet to their installation, mainly because they regard handling bio-slurry from toilet-connected plants as hazardous or unclean.

Research indicates that health risk of handling slurry from toilet-connected installations is minimal [x], but it cannot be ruled out entirely. More importantly, though, the perception of the household and/or its environment can cause households to avoid proper application of the bio-slurry or even the gas. Although a survey in Mwanza indicated otherwise (only 4 out of 100 respondents saw problems in connecting a toilet to their installation, MIGESADO reported experiences that would confirm the general reluctance.

Large biogas programmes in other countries show that this tendency reduces with growing awareness of the benefits of the technology (Nepal, Vietnam); clearly proper information plays an important role here.

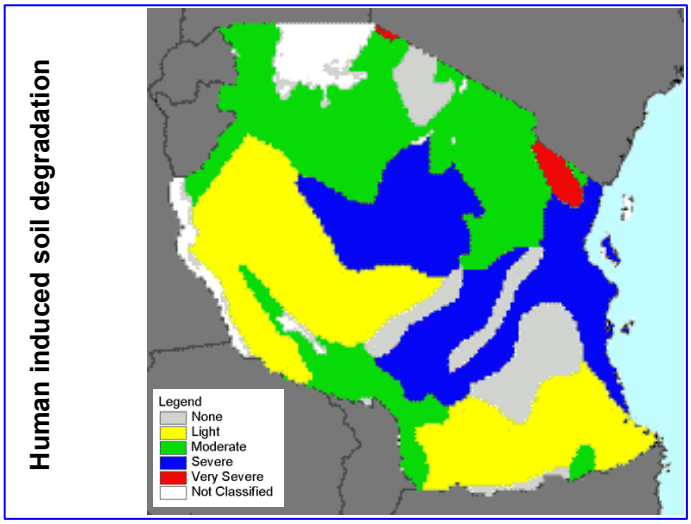
The bottom line remains that compulsory connection is likely to have an adverse effect; households should be free to choose for a toilet connection. At the same time, installations should be prepared for easy toilet connection after construction, by including a second inlet pipe in the design.

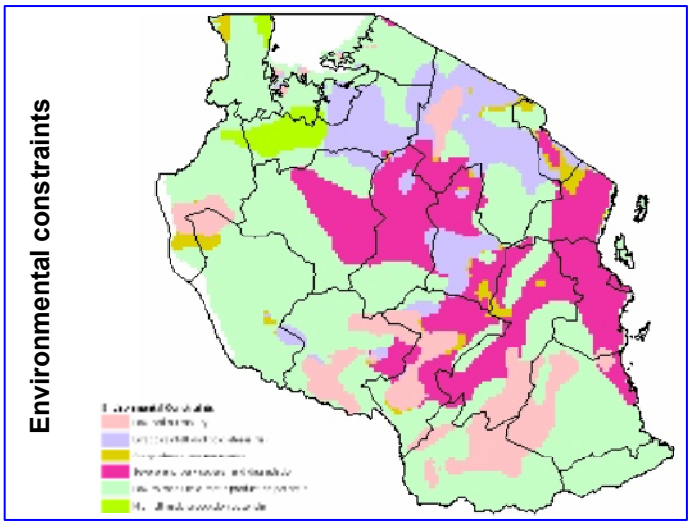
2.5.4 Environmental sustainability

Biogas installations generally have a benign effect on the environment: the substitution of fuel wood checks deforestation, the bio-slurry increases agricultural yields and reduces dependency on chemical fertilizer and zero-grazing –stimulated with biogas installations- reduce the pressure on scarce ranging lands. Nevertheless, the following environmental risks should be taken into account while designing a large-scale programme.

Methane escape: Methane (CH4) has a GWP twenty times higher than CO_2. As long as the installation is used properly, this would not be a problem as burning biogas converts methane into carbon dioxide and water. However, under certain conditions that combine high feeding rates with low consumption or limited gas storage, the biogas will escape directly through the compensation tank into the environment. The installation of biogas lamps, together with properly instructing households to finish (most of) the biogas in the evening, will go a long way in mitigating this risk. In addition, installation of a pressure meter will provide the household with the information on how much biogas is still available at the end of a day.

Ground water pollution: Although it should not happen, biogas installations may seep slurry to their environment. Also slurry pits, which are often not lined, may cause this effect. Generally harmless, seepage may pollute close-by water pits. Therefore, construction instructions shall include a minimal distance between the installation and water sources.





2.5.5 Programme environment and political context

The National Energy Policy's overall objective is to provide an input in the development processes by establishing efficient energy production, procurement, transportation, distribution and end-user systems in an environmentally sound manner and with due regard to gender issues.

Specific objectives include:

- To exploit the abundant hydro resources;
- To develop natural gas and coal resources;
- To step-up petroleum exploration activities;
- To reduce deforestation through efficient woody biomass to energy conversion technologies & techniques
- To promote the *development and utilization of renewable energy sources*;
- To promote energy conservation and efficiency;
- To develop human resources for facilitation of energy technology development;

Recently, the Government established the Rural Energy Agency under the Ministry of Energy and Minerals. It is the objective of REA to stimulate access to energy in rural areas, to which extent a Rural Energy Fund was established.

This fund, sponsored by a levy in the electricity charges and donors, will (co-) fund rural energy technology dissemination programmes.

The National Strategy for Growth and Reduction of Poverty mentions that by 2010:
- institutional arrangements for rural energy development are established and strengthened, and;
- at least 10% of the population is using alternative power to wood fuels for cooking.

The Government's National Livestock Policy [6, cpt 3.8.3] is more explicit on biogas, stimulating *the use of manure as a renewable source for energy and organic fertilizer*. The Government hence states that:
- efforts will be undertaken to *promote management of manure and (bio-) slurry*;
- it will strengthen *technical support services on manure and biogas production and utilization*, and;
- it will collaborate with other stakeholders to *promote investments in the production of biogas equipment*.

The Rural Development Strategy (2001)[3] considers *biogas an alternative to firewood to foster rural development*. "Emphasis needs be put to promoting technologies like solar power, windmills, *biogas*, and power from spillways currently used for irrigation and drinking water services in rural areas". Among others, the following actions are included in the strategy:
- Promote the use of complementary sources of energy.
- Establish appropriate fiscal and financial incentives for renewable energy development to complement a Rural Energy Fund whose objectives include renewable energy programme and projects.
- Support R & D in renewable energy technologies.
- Promote application of alternative energy sources other than fuel-wood and charcoal, in order to reduce deforestation, land degradation, indoor health hazards and time spent by rural women in search of firewood as well as minimising climatic change threats.
- Promote entrepreneurship and private initiatives in the production and marketing of products and services for rural renewable energy.
- Support research and development on rural energy"

A strategy for the **SME Development Policy** has been formulated in the form of priority programmes and projects that cover up to 5 years. Policy makers expect that through the participatory and consultative process built into this policy statement, lessons learnt during the first 5 years of implementation will enable stakeholders to continuously update the portfolio of priority programmes and projects to be adopted in the future periods to steer towards the overall objective of the SME Development Policy: "*a Tanzanian SME sector that contributes increasingly to equitable economic growth, income and employment generation.*

Apart from SIDO, various institutions have been established to support enterprise development in Tanzania. These institutions cater for the whole enterprise sector including SMEs. They include:
- the Tanzania Industrial Research Development Organisation (TIRDO) which supports local raw materials utilization;
- the Centre for Agricultural Mechanization Rural Technology (CAMARTEC) which is involved in promotion of appropriate technology for rural development currently a lead organization in the implementation of the national biogas programme;
- the Tanzania Engineering and Manufacturing Design Organisation (TEMDO) responsible for machine design;
- the Tanzania Bureau of Standards (TBS) mandated to promote standards;
- the Board of External Trade (BET) which is instrumental in promotion of exports mainly through trade fairs, and;
- the Institute of Production Innovation (IPI) now known as Technology Transfer Centre which is active in prototype development and promoting their commercialization.

[3] Abstract from [5]

A number of initiatives have been designed by the Government to set up funding mechanisms and schemes to address poverty and employment related problems through promoting SMEs. Such funds include:

- the National Entrepreneurship Development Fund (NEDF);
- the Youth Development Fund (YDF) which is managed by the Ministry of Labour;
- the Youth Development and Sports and the Women Development Fund (WDF) that is managed by the Ministry of Community Development and Women Affairs and Children.

Apart from these, there are other related programmes that were established through Government/donor joint efforts including the Small Entrepreneurs Loan Facility (SELF), National Income Generating Programme (NIGP), Presidential Trust Fund and Community Development Trust Fund. Another initiative towards this direction has been the establishment of the National Micro-finance Bank (NMB), meant to cater specifically for micro enterprises.

In recent years, the country has witnessed the mushrooming of Non-Government Organizations that are doing a commendable job in promoting SMEs. Most of the NGOs are involved in credit delivery, business training, providing general consultancy, supporting market linkages and addressing gender and environmental issues. However, most of the institutions supporting SMEs are rather weak, fragmented, concentrated in urban areas and uncoordinated. This calls for the need to strengthen the institutions supporting small and medium enterprises. Therefore the SME Development Policy intends to support and strengthen these institutions.

The Vocational Education and Training Act of 1994 provides the framework for the vocational training system in Tanzania. This Act led to the formation of Vocational Education Training Authority which has over 630 centres in the country offering training in more than 66 different trades. In 1999, the University of Dar-es-Salaam established the Entrepreneurship Development Centre within the Faculty of Commerce and Management. The Centre provides consultancy and training in SME related issues. Furthermore the College of Business Education offers business training including entrepreneurship development.

2.6 Benefits of biogas

Domestic biogas contributes to sustainable development and reaching the UN Millennium Development Goals[4]. The benefits of biogas in energy supply, agriculture, health, sanitation, gender and environment are well documented. Various aspects of biogas production have multiple benefits:

Animal dung (and night soil where culturally acceptable) is collected regularly and fed into the biogas plant, this:

- reduces pollution: leading to a cleaner farm environment;
- reduces human and animal disease: by improving sanitary conditions related to bad sanitation and polluted surface water for the household, and;
- reduces greenhouse gas emissions: depending on the traditional manure handling, the improved manure management system can significantly reduce GHG emissions.

The generated gas substitutes conventional fuels. In doing so, biogas:

- reduces indoor air pollution: the incomplete combustion of conventional biomass fuels is minimized, resulting in a reduction of eye and respiratory illnesses particularly of those most heavily exposed to smoke namely women and children;
- reduces workload: especially in regards to fetching firewood, maintaining the fire and cleaning cooking pots. The use of biogas can reduce workload by 2 to 3 hours per day, particularly the workload of women and children;
- reduces fuel expenses: traditional domestic fuels are increasingly becoming part of the formal economy. Biogas significantly decreases consumption of these traditional fuels;
- increases benefits of better lighting and hot water through the use of appliances such as gas lamps and

[4] Please refer to annex 2 and 3 for an overview of the contribution of biogas on sustainable development and reaching the UN Millennium Development Goals respectively.

water heaters;
- reduces greenhouse gas emissions emitted by the conventional energy sources and traditional manure management modality[5];
- reduces deforestation: by reducing the demand for firewood;
- provides income generation opportunities: by providing an energy source for different economic activities (incubators, kilns, lanterns etc) as a new or more efficient resource.
- allows for the time saved, from not having to collect firewood and faster cooking, to be used in on- and off-farm income generating activities.

The residue of the process - bio-slurry-, is a potent organic fertilizer. When used in this way it can:
- provide a superior organic fertilizer: in terms of available nutrients and soil texture, increasing agricultural yields by 10-40%.
- provide a catalyser for composting other agricultural waste: Applying this practice increases the amount and quality of organic fertilizer;
- improve handling safety: of residue due to the fact that the process of digestion followed by composting makes handling of the residue much safer from a hygienic point of view;
- reduce chemical fertilizer costs of farmers: by reducing the amount of synthetic fertilizer used;
- reduce greenhouse gas emissions through avoiding the application of synthetic fertiliser
- enables farmers to participate in animal husbandry in areas in which discharge regulations would otherwise have been prohibitive: anaerobic digestion reduces odour and environmental load resulting from livestock holding.

As shown in the tangibility table below, biogas benefits, although not all equally tangible, do not only profit the investor, but have an impact on the community at meso and macro levels as well.

	MICRO	MESO	MACRO
INFORMAL	• Reduced indoor smoke-induced illnesses. • Reduced poor-sanitation induced illnesses. • Reduced drudgery from fuelwood collection. • Reduced pressure for illegal forest encroachment. • Reduction drudgery from weeding fields. • Reduced workload for food-preparation. • Reduced soil degradation. • Improved opportunity for education.	• Reduced risk of erosion and landslides in mountainous areas. • Improved forest quality and quantity. • Reduced pollution of surface water. • Reduced pollution of the environment as a result of uncontrolled dumping of animal waste.	• Reduction of illness-induced production losses. • Improved biodiversity. • Increased non-marketable (NT)FP availability. • Increased efficient productivity. • Reduced mortality. • Improved human resource base. • Reduced risks as result of global warming.
FORMAL	• Increased efficient productivity. • Reduced direct medical costs. • Reduced expenses on conventional energy sources. • Reduced chemical fertilizer expenditures. • Increased opportunity for (small scale) animal husbandry. • Increased opportunity for (small-scale) organic agriculture. • Improved agricultural yields. • Increased family income.	• Increased employment and income generating opportunities. • Opportunity to develop markets for (organic) agricultural produce.	• Reduced (forex) cost on medication. • Reduced health system expenses. • Reduced (forex) costs on chemical fertilizer. • Reduced (forex) costs on fossil fuels. • Increased availability marketable (NT)FP. • Increased agricultural production. • Increased tax revenues. • Generating CDM revenues.

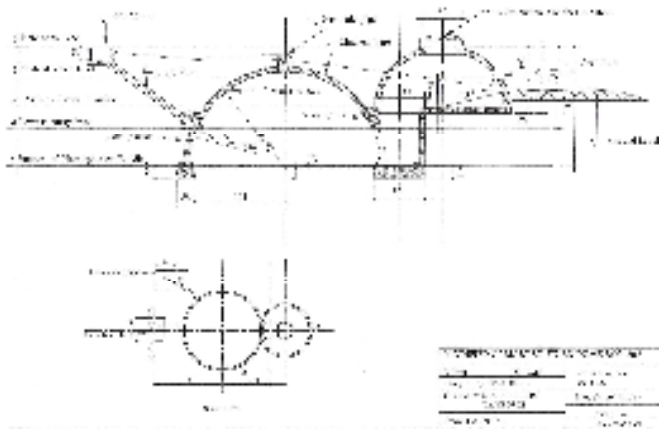
[5] Please refer to annex 4 for an explanation on biogas installations and greenhouse gas reduction.

2.7 Proposed plant design

In the framework of the formulation of a Programme Implementation Document for a National Biogas Programme for Tanzania, SNV assisted the Tanzania Biogas Task Force fielding a mission for a technical assessment of domestic biogas installations as constructed in the country. The main objective of the mission was to assist in the formulation of PID by:

- Selecting best suitable design/model of biogas plants for wide-scale dissemination of the technology in Tanzania;
- Formulating basic framework for a quality management mechanism in general and quality control in particular within the Biogas Programme, and;
- Preparing general accreditation/certification modality for the participation of private sector constructors and manufacturers in the biogas programme.

Modified camartec



2.7.1 Selection results

In a workshop with all major biogas constructors present, three main designs –CAMARTEC, MIGESADO and modified GGC- were discussed against an agreed set of criteria. Following also earlier suggestions of the feasibility study [1], the workshop concluded to adopt features of the first two designs to arrive at a "modified CAMARTEC" design, to be standardized under the proposed national programme.

2.7.2 Plant size range

Tanzania has a history of building large domestic digesters. As a consequence, many installations feature a very low efficiency in relation with their volumetric potential [5]. Oversized biogas plants not only add unnecessary costs to the installation, but also increase to workload for the (women of the) household [MIGESADO]. Both for financial and social reasons then, a national biogas programme should strive towards properly sized biogas installations. This holds even truer when a programme promotes the technology with an investment subsidy, as the over-installed capacity can easily consume the subsidy amount.

To arrive at a rational plant sizing range, it is assumed that the minimum amount of biogas that can economically be produced by a domestic plant is about 1,000 ltr per day. Technically, biogas plants can be constructed for even smaller gas production, but economies of scale of current technologies would make such installations relatively expensive. A daily gas production of 1,000 ltr would equal 3 to 4 single stove hours; up to 6 lamp hours; or a combination thereof. Clearly this minimum production may not satisfy the full energy demand of a family, but will replace a significant part of the traditional fuel consumption.

The maximum biogas amount that can reasonably be consumed in a domestic setting would be about 5,000 ltr per day, equalling over 10 double stove hours per day; over 30 lamp hours; or a combination thereof. An installation producing this amount of energy is only justified if there is evidence of a significant energy need including semi-productive use in the form dairy production or commercial food production.

Following the above, the rational plant size range can be calculated, using design parameters for a warm climate as tabled. The calculated resulting plant sizes would than have a total volume of 3.900, 5.850, 8.775 and 13.163 m^3 For practical application, then, a range of daily gas production from 1,000 to 5,000 ltr per day can be covered by four different plant sizes of 4, 6, 9 and 13 m^3 total volume.

Design parameters		
Dung / water ratio	[d/w -vol]	1.00
Specific gas production	[m^3/kg]	0.040
Minimum daily gas production	[m^3/day]	1.00
Maximum retention time	[days]	**60**
Minimum retention time	[days]	**40**
Gas storage volume	[% of max dgp]	**60%**

The proposed smallest biogas installation of 4 m^3 will be able to produce 1,000 ltr of gas per day on the minimal feeding of 25 kg of cattle dung per day (together with 25 ltr. of water). The same plant will be able to digest up to 38 kg of manure, producing 1.5 m^3 of gas per day. This installation will be appropriate for households having 2 to 3 zero-grazed cattle (depending to some extent on breed and size[6]) and will satisfy the lion-share of the domestic energy demand of a smaller family. The Feasibility Study estimates the average domestic energy demand at 1.4 m^3 per day, based on traditional fuel consumption [1, pg 27]

The following size of 6 m^3 is able to digest between 38 and 56 kg per day; the manure production of 3 to 5 heads of cattle, and will produce between 1.5 and 2.25 m^3 of biogas per day. The author estimates the biogas demand for an average Tanzanian household on 2.55 m^3 per day. The 9 m^3 installation would be appropriate for larger households having 4 to 7 heads of zero grazed cattle. With a maximum daily gas production of well over 3 m^3 per day, the household would have some 10 single stove hours per day; 20 lamp hours per day, or a combination thereof. The largest proposed size for the domestic biogas programme measures 13 m^3. As argued above, this size can only be justified in a domestic setting with a considerable demand for (semi-) commercial energy needs.

Plant size range warm climate					
Plant volume	[dm^3]	**3900**	**5850**	**8775**	**13163**
Gas storage volume	[dm^3]	900	1350	2025	3038
Digester volume	[dm^3]	3000	4500	6750	10125
Min feeding	[kg/day]	25	38	56	84
Max feeding	[kg/day]	38	56	84	127
Min daily gas production (min dgp)	[m^3/day]	1.00	1.50	2.25	3.38
Max daily gas production (max dgp)	[m^3/day]	1.50	2.25	3.38	5.06

Proper sized biogas installations, then, take into account both the available amount of feeding and the demand for biogas. Therefore, the proper plant size can only be established through careful measurement of the amount of available dung (rather then counting the number of animals) and estimating the energy demand of the family.

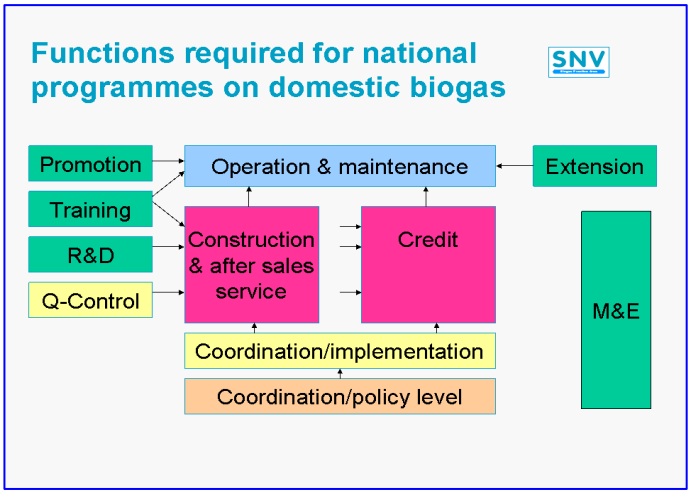
Although there is a clear tendency of embarking upon the construction of smaller biogas installations –spearheaded by MIGESADO- there is still some reluctance amongst some actors in the biogas sector regarding the acceptance of the smallest plant sizes. Partly, this might be explained by tradition, but the following argument merits consideration.

Most biogas plants in Tanzania are directly connected to the stable floor. This excellent practice not only maximizes the amount of manure and urine fed to the installation, but also reduces the workload connected to plant feeding to an absolute minimum. As a consequence, however, the feeding will have larger amounts of bedding material and sand, which will settle as debris at the bottom of the installation. As a result, the digester volume will gradually reduce and regular cleaning of the installation will be necessary. The proper location of the lower part of the inlet pipe, however, will limit the amount of debris, and give a clear indication on when a plant might be in need of cleaning. And a well functioning after sales service system should be able to take timely action. The bottom line is that, however large the plant is constructed, this will not reduce the amount of debris collected, and sooner or later the installation will have to be cleaned out anyway.

[6] Manure production ranges from under 10 kg per day for smaller indigenous cattle to over 20 kg per day for mature dairy cattle or large oxen of improved breed on an appropriate diet.

3 Objectives

The focus of the programme shall be the development of the biogas sector as a whole. Sector development implies the close cooperation of all relevant stakeholders (Government, Non-Government and private sector) in the sector at all levels (micro and macro) whereby those stakeholders are sufficiently equipped to fulfil the necessary functions. The chart indicates the main functions in a large-scale domestic biogas programme and its relations.



3.1 Salient features.

The Tanzania Biogas Programme as proposed hereunder intends to lay out a robust foundation for the establishment of a commercially viable domestic biogas sector. Salient features of the programme include:

Scope: The proposal uses a time horizon of 10 years to establish a commercially viable biogas sector. Within this planning horizon, a first phase of 5 years is proposed, aiming to construct 12,000 domestic biogas installations.

Sectoral approach: The programme will strongly promote an approach in which Government, non-government and private sector organizations, in a complementary fashion assume those programme functions that intrinsically fit to the character of their organization. To that extent the sector is disentangled in a supply and demand side in which the supply side ensures "off-the-shelf- availability" of the technology and the demand side organizes the beneficiaries, provides microfinance, promotes the technology and integrates it into rural development activities.

Programme facilitation: A National Biogas Steering Committee, with representatives of all major stakeholders, will provide the conducive policy environment for the programme.

Programme support and coordination: The Tanzania Biogas Programme Office (TBP-Office),hosted by CAMARTEC, will act as an autonomous entity, responsible for coordination and management of the support activities.

Private sector: Introducing the private sector, as biogas construction (micro-) enterprises, in the primary process of the programme (construction, after sales service, primary user training).

Credit: In view of the significant construction costs, households are expected to need credit assistance for their investment. The programme will broker credit conditions suitable for financing a long term investment that is not directly income generating. The programme will seek cooperation with regular (micro-) credit institutions.

Quality management: Service quality will be condition *sine-qua-non* for user confidence and, subsequently, for promotion of the technology. Precise control of the quality of construction, after sales and extension services will not only safeguard the investment of the farmer and enable the farmer to maximize the benefits of the investment. It will also level the playing field for aspiring biogas companies to operate on the emerging market. The quality management system will be compatible with quality assurance certification and CDM registration.

Training: Both at supply and demand side of the sector large-scale dissemination experience on domestic biogas is very limited. The programme will invest significantly in training. On the supply side of the market -to ensure that dissemination skills are as much as possible available locally- and on the demand side -to ensure households understand the operation and maintenance of their plants sufficiently and apply bio-slurry to their best advantage.

Programme financing: The programme will explore the opportunities of carbon-financing to improve its financial and programmatic sustainability.

3.2 Programme goal and purpose.

The proposed goal of the programme is **to improve the livelihood of rural farmers in Tanzania through exploiting the market and non-market benefits of domestic biogas**. By the end of the first phase of the programme:

- 12,000 new biogas plants will have been built nationwide;
- Over 95% of the constructed biogas plants will be operated properly;
- 80% of the biogas households will have facilities that enable proper bio-slurry use, and;
- 100% of the biogas plants will have a second inlet pipe to allow future toilet connection[7];

The purpose of the programme is **to develop a commercially viable domestic biogas sector**. Therefore:

- Programme implementation will follow the technical potential for domestic biogas. Operations will start Tanzania's North-eastern regions and subsequently annually expand to the South and South-east and the West and North-west regions of the country.
- To allow emerging Biogas Construction Enterprises to efficiently provide their services, the programme will stimulate construction in clusters of at least 20 installations per village.
- All plant owners will have access to credit for biogas construction and 60% of biogas owners utilise the credit facility by the end of the first phase of the programme[8].
- Regional vocational training institutes will be identified to provide short-term biogas courses at construction and supervision level. The vocational training institutes will act as "knowledge brokers" in their catchment areas.
- The programme will partner closely with SIDO to provide business development support to the emerging BCEs.

3.3 Specific objectives

The specific objectives for each of the programme components are as follows:

	Component	Specific objective
1	Promotion	To stimulate demand, informing beneficiaries and stakeholders on costs and benefits of domestic biogas.
2	Financing	
	Investment subsidy	To lower the financial threshold of an investment in a domestic biogas installation and to create a mechanism for quality management.
	Credit	To provide accessible and affordable loans for biogas investment
	Carbon revenue	To utilize carbon revenue resulting from the GHG emission reduction of biogas plants constructed under the programme to establish a financially-sustainable national domestic biogas sector.
3	Construction and After Sales Service	To facilitate the construction of 30,000 domestic biogas-plants and ensure their continued operation.
4	Quality Management	To maximise the effectiveness of the investment made by the biogas owners and to maintain consumer confidence in domestic biogas technology. To create a level playing field for participating Biogas Construction Enterprises To safeguard the carbon-revenue of the programme
5	Training	To provide the skills to Biogas Construction enterprises to run market biogas services To provide skills to biogas users to operate their plants effectively.
6	Extension	To provide the information enabling biogas users to effectively exploit all the benefits of biogas.
7	Institutional Support	To maximise the ability of sector stakeholders to provide the services and support required by the biogas sector to facilitate access and development of quality biogas products.
8	Monitoring and Evaluation	To identify project progress and impact on stakeholders/other aspects in order to facilitate knowledge transfer.
9	Research and Development	To increase knowledge about domestic biogas issues to maximise effectiveness, quality and service delivery of the biogas programme.
10	Programme management	To support, coordinate and supervise the activities driving the development of a commercially viable biogas sector.

[7] Surveys indicate that actual toilet connection may face cultural reluctance. Despite the sanitary gains of toilet-connected biogas plants, a policy for compulsory connection is likely to have adverse effects. With the second inlet pipe, households can attach their toilet at a later stage at low costs.

[8] It is assumed that for the first programme-year 30% of the households will apply for a biogas loan. Over the first phase, as the programme is gradually reaching poorer households, the share of households applying for credit will increase to 70%.

3.4 Expected results

Over the first phase of the programme 12,000 installations shall be installed. Assuming an annual failure rate of 2%, by the end of the first phase 11,754 installations will be operational. The gross energy production of these installations will be equivalent to over 110,000 MWh. Combined, the installed net power of these installations will amount to nearly 31 MW.

Provisionally, a biogas plant under Tanzanian conditions will reduce GHG emissions with at least 2.5 tons of CO_2 equivalent per year; the programme expects to reduce over 60,000 tons of CO_2eq. The programme will contribute to reduction of the deforestation equivalent to nearly 8,000 ha of forest. Soil fertility will have improved as nearly 65,000 tons (dry matter) of organic material will have become available as organic fertilizer (including 4,000 t N, 0.4 t P and 1.6 t K).

A biogas installation will on average substitute 4.12 tons of biomass per household per year (0.45 t agricultural residue, 0.36 t dung cake and 3.2 t fuelwood). Programme wide, nearly 100,000 tons biomass will have been substituted. In addition, the biogas will have substituted nearly 817 tons of fossil fuel (kerosene and LPG).

Tanzania Domestic Biogas Programme	*expected results (provisional)*	
Biogas plant construction	**12.000**	[plants]
Energy		
Energy production	**110.222**	[MWh]
Power installed	**30.799**	[kW]
Environment		
GHG emission reduction	**60.101**	[t CO_2eq]
Deforestation reduction	**7.954**	[ha of forest]
Soil nutrificaton	**64.909**	[t(DM) bio-slurry]
Fuel substitution		
Biomass	**98.952**	[t biomass]
Fossil fuel	**817**	[t]
Socio-economic		
Persons reached	**72.000**	[persons]
Workload reduction (women & children)	**2.003**	[pers years]
Exposure to indoor air pollution reduced	**60.000**	[women & children]
Toilets attached	**2.400**	[toilets]
Productive slurry use	**9.600**	[households]
Employment generation (direct)	**840**	[person years]
Training		
User training	**16.800**	[person days]
Professional training	**5.142**	[person days]

Assuming an average biogas-household size of 6 persons, by the end of the first phase 72,000 persons will reap the benefits of the technology. As a result of the workload reduction induced by a biogas plant, assumed conservatively at 2 hour per day per household, the total workload reduction will have amounted to just over 2,000 person-years. For 60,000 women and children, the indoor air pollution resulting from the combustion of biomass will be virtually eliminated. Some 2,400 households will benefit improved sanitary conditions resulting from a toilet connection to their biogas installation and 9,600 farming households will experience an increased agricultural production as a result of applying bio-slurry as fertilizer to their fields. The participating households will have received 16,800 person-days of training in operation, maintenance and proper bio-slurry use.

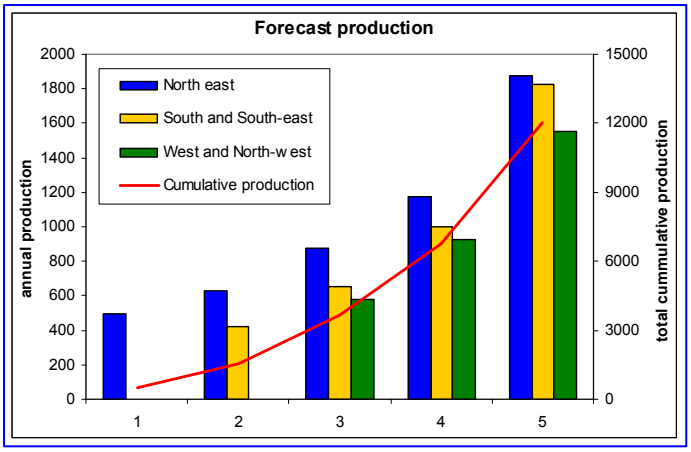
The programme will have generated direct employment (construction, manufacturing and after sales service) to the tune of 840 person-years, mostly in rural areas. The programme will have provided over 5,100 person days of professional training (construction, supervision, business support and extension) to Biogas Construction Enterprises. In addition, the programme will provide awareness and promotion training to demand-side organizations (NGOs, credit institutions, farmer / dairy associations etc).

A detailed overview of the expected results of the programme is provided in annex 5.

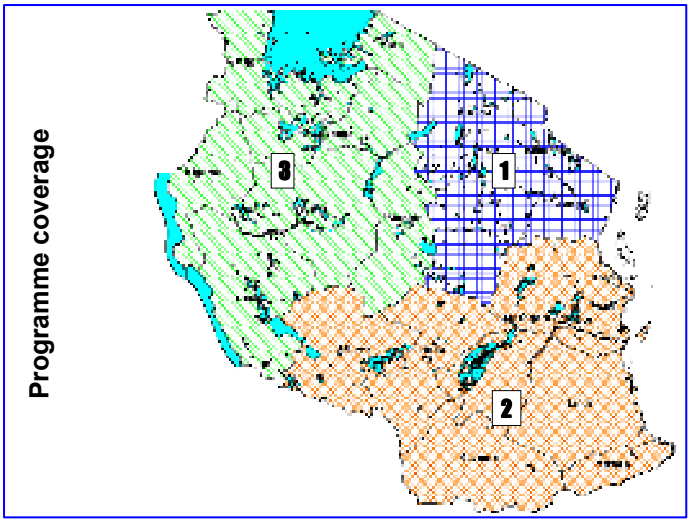
4 Output targets

4.1 Production

Out of the estimated potential of 165,000 installations (see chapter 2.5.1) the programme proposes to take 100,000 installations as its 10-year target. As a ten year period will prove too long for precise planning, the programme is divided in two phases, whereby the programme aims to support the construction of 12,000 biogas installations during its 1st phase of 5 years.

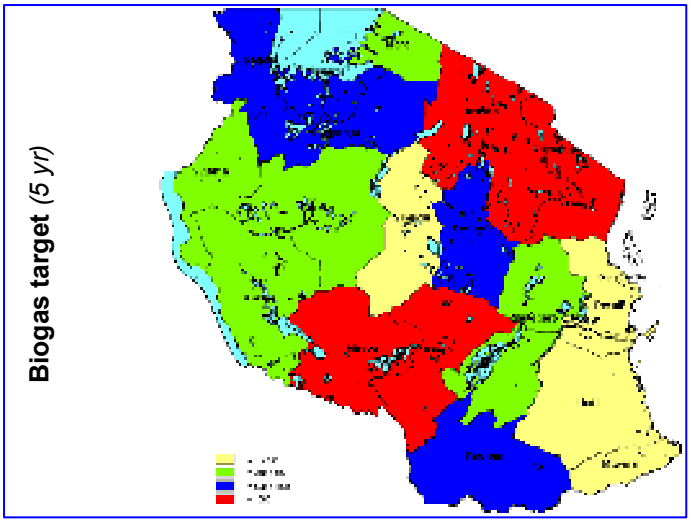


In view of the shear size of the country, starting-up in all regions at the same time would be costly and inefficient. Therefore, in the first year the programme will commence in 5 regions in the North-east of Tanzania. In two consecutive years the programme will expand to 8 regions in the South / South-east and West / North-west respectively. Hence, the programme will –potentially- cover 21 regions of mainland Tanzania in the 3rd year.

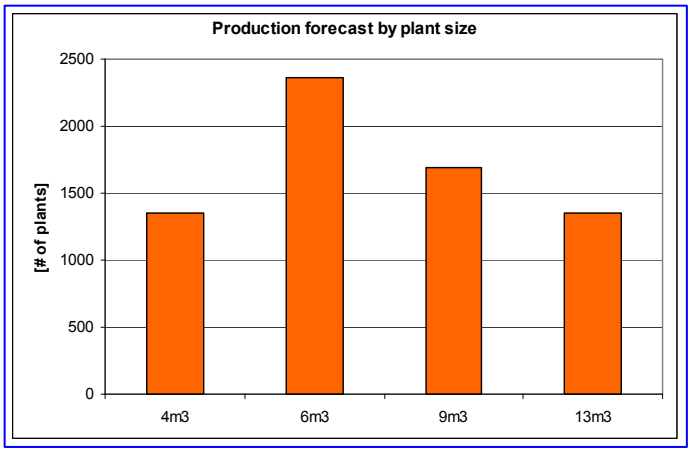


As the programme aims to follow a commercial approach towards biogas dissemination, it will not prescribe production quota per region. However, in order to obtain an impression of how the market may develop, a regional mapping has been made, based on the potential of that region.

Following this mapping, production is forecast to arrive at 500 installations in the first year, reaching an annual production of 5,250 installations in the 5th year of the programme. Annex 6 provides details on the forecast production per year and per region.



Domestic biogas installations typically range in size (proposed 4 to 13m^3 plant volume), whereby the actual size for a particular household depends on the amount of available substrate (for Tanzania cattle dung and, to a lesser extent, pig manure) and the required (daily) biogas production.



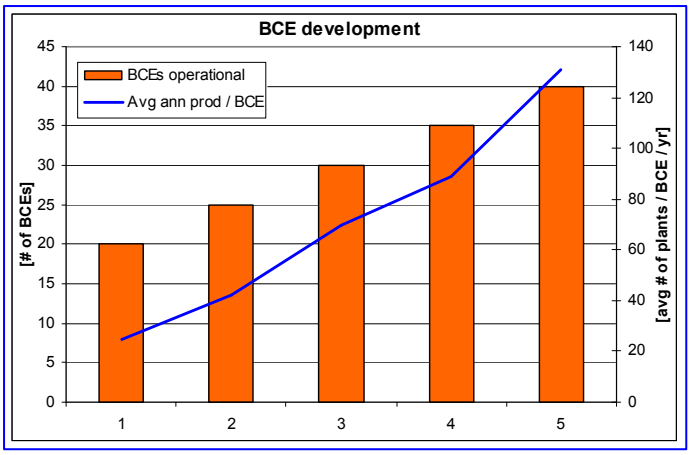
Surveys for Tanzania indicate that the amount of available dung is lesser a limiting parameter than the required gas production [5]. Lacking comprehensive baseline data on household energy requirements, smaller household surveys suggest this required production to be 1.5 to 2.5 m^3 biogas per day. To generate such amount of biogas, a plant-sizing mix is assumed with an average plant volume of 7.5 m^3.

4.2 Biogas service providers

Direct primary biogas services include marketing, construction and after sales services by the Biogas Construction Enterprises and the manufacturing of appliances (stoves, lamps, gas taps, dome pipes and mixers) by biogas workshops.

4.2.1 Biogas Construction Enterprises

Biogas Construction Enterprises (BCEs) typically are locally based micro enterprises consisting of a manager, a few supervisors, biogas (master) masons and construction assistants. BCEs can range in size from 4 persons up to perhaps 50-70, and their production may vary from less than 50 to over 1000 installations per year. For households to have access to biogas services, it is crucial that BCEs are based in the rural area; expansion of the enterprise is possible, even stimulated, but for enterprises to stay in reach of their customers, they will have to establish satellite offices when their area of operation grows.



In the first year, the programme will support the establishment of 20 BCEs to construct the first 500 biogas installations in the North-east. Subsequently, the programme will move to other regions and support establishment and growth of the BCEs. At the end of the first phase, about 40 BCEs should be in operation. Over this period, the average production will increase from 25 to 131 plants per BCE per year.

4.2.2 Biogas appliance manufacturers

Based on the typical average biogas installation of 7.5 m^3 plant volume, a single installation would require the following biogas-specific appliances: 1 large and 1 small stove; 1 or 2 biogas lamps, 2 gas taps, and 1 dome pipe. Mixing devices have not been introduced in Tanzania yet, as most installations use direct feeding from the stable floor.

CAMARTEC so far has played a large role in supplying these appliances. However, with the anticipated growth of the programme, CAMARTEC can not be expected to fulfil this function. As all these appliances can be fabricated in rural metal workshops with equipment that is generally available, as demonstrated by MIGESADO, CAMARTEC will instead have to assume its responsibility in transferring manufacturing knowledge and skills to local, small workshops.

Judging from experience in other countries, by the end of the first phase, 5 to 10 local biogas appliance manufacturers will be producing for the programme.

4.3 Quality management

Quality control plays a crucial role in the programme's quality management objective. Quality control will take place at local BCE and national TDBP level as follows:

Biogas Construction Enterprises: Biogas Supervisors, employed by the BCEs, will visit each newly completed installation to check the quality of construction against agreed standards (100% check). Biogas Masons or Supervisors will subsequently visit plants that have been in operation at least 1 year for two subsequent years annually for the contractual maintenance visit (100% cumulative check).

Tanzania Domestic Biogas Programme: Biogas Technicians, employed by the national TBP-office, will visit randomly selected biogas plants to check the quality of the services as provided by the BCEs against agreed service standards. Biogas Technicians will visit plants under construction (6% check), plants recently completed (10% check), and plants under the contractual maintenance scheme (6% cumulative check).

For the targeted 12,000 installations over 27,000 plant visits are foreseen; 24,450 by BCEs and 2,667 by the national TBP-office.

Quality control

			Plant visits					
			1	2	3	4	5	Total
BCE	Plant completion	PC	500	1050	2100	3100	5250	**12000**
BCE	Annual maintenance	PM	0	500	1550	3650	6750	**12450**
	Total BCE plant visits		**500**	**1550**	**3650**	**6750**	**12000**	**24450**
TBP	Quality Control on completed plants	QC-Comp	50	105	210	310	525	**1200**
TBP	Quality Control on plants under construction	QC-UC	30	63	126	186	315	**720**
TBP	Quality Control on ASS	QC-ASS	0	30	93	219	405	**747**
	Total TBP plant visits		**80**	**198**	**429**	**715**	**1245**	**2667**
	Total plant vists		**580**	**1748**	**4079**	**7465**	**13245**	**27117**

4.4 Training requirement

The programme proposes a comprehensive training component. Over the first phase, the programme plans to provide over 1,800 training courses and workshops, reaching more then 50,000 persons.

Technical training: The quality of the primary services (construction, after-sales service and manufacturing) will be key to the success of the programme. To ensure a high level of service quality, the programme will make a significant investment in training of biogas masons and supervisors. Only trained and certified masons and supervisors will be allowed to work under the programme. The programme aims to provide 55 technical training courses, certifying 1,123 biogas masons and supervisors.

Programme workshops: To explain benefits and operation modalities of the programme to (potential) programme partners, the programme will offer biogas programme workshops to affiliated demand-side organizations (diary / farmer associations, micro-credit organizations and SACCOS, NGOs, Community Organizations, Village

Extension Service Providers). The programme plans to provide 51 biogas programme workshops, reaching 849 representatives of affiliated demand-side organizations.

User training: Next to the importance of the quality of the primary services will be the quality of product promotion (offering a realistic picture on costs and benefits of domestic biogas), operation and maintenance of the installation and bio-slurry application by the users. The programme plans to provide 1,670 user training courses, reaching 49,400 household members.

Training of Trainers: Although initially the programme may be directly involved in technical training, the objective is to transfer this responsibility to the participating VETAs on short notice. SIDO and participating BCEs will take care of promotion and user training respectively. To assure adequate and proper training is provided, the programme will invest in Training of Trainer courses for both technical as well as user training. In total 18 ToT courses for technical training and 27 ToT courses for user training are foreseen, aiming to reach 216 technical trainers and 468 user trainers.

Training programme			**batch size**	**Training courses**						**Persons reached**
				1	**2**	**3**	**4**	**5**	**Total**	
Technical training	Biogas Mason	BMT	20	2	2	4	4	8	**20**	**394**
	Biogas Mason Refresher	BMT-R	24	0	1	3	8	14	**26**	**623**
	Biogas Supervisor	BST	10	0	1	1	1	2	**4**	**41**
	Biogas Supervisor Refresher	BST-R	12	0	0	1	2	3	**5**	**65**
	Total technical training			**2**	**4**	**9**	**14**	**27**	**55**	**1123**
Programme	Biogas Programme Workshop	BPW	12	1	1	2	3	4	**11**	**127**
	Village Extension Service Providers	VEW	20	1	3	5	8	13	**30**	**595**
	Loan Officer Training	LOT	12	1	1	2	3	4	**11**	**127**
	Total programme training			**3**	**4**	**9**	**13**	**22**	**51**	**849**
User training	Biogas Awareness & Promotion	BAW	40	25	53	105	155	263	**600**	**24000**
	Biogas Operation & Maintenance	BOM	30	17	35	70	103	175	**400**	**12000**
	Bio-slurry Application	BSA	20	20	42	84	124	400	**670**	**13400**
	Total user training			**62**	**130**	**259**	**382**	**838**	**1670**	**49400**
ToT technical training	ToT Biogas mason trainers	TBM	8	1	1	1	1	1	**5**	**40**
	ToT refresher Biogas mason trainers	TBM-R	16	0	1	2	2	3	**8**	**128**
	ToT Biogas supervisor trainers	TBS	6	0	1	0	0	1	**2**	**12**
	ToT refresher Biogas supervisor trainers	TBS-R	12	0	0	1	1	1	**3**	**36**
	Total ToT technical training			**1**	**3**	**4**	**4**	**6**	**18**	**216**
ToT user training	ToT Awareness & promotion	TAP	12	1	1	1	1	1	**5**	**60**
	ToT Awareness & promotion refresher	TAP-R	24	0	1	1	1	1	**4**	**96**
	ToT Operation & maintenance	TOM	12	1	1	1	1	1	**5**	**60**
	ToT Operation & maintenance refresher	TOM-R	24	0	1	1	1	1	**4**	**96**
	ToT Bioslurry application	TBA	12	1	1	1	1	1	**5**	**60**
	ToT Bioslurry application refresher	TBA-R	24	0	1	1	1	1	**4**	**96**
	Total ToT user training			**3**	**6**	**6**	**6**	**6**	**27**	**468**
	Total training			**71**	**147**	**286**	**419**	**898**	**1821**	**52056**

5 Institutional aspects.

5.1 Description of the target group

Central in a commercially viable approach is the household and its demands in view of agriculture, health and sanitation, environment and energy services. Characteristics of a prospective biogas household thus would include:

- farming households, having 2 (zero-grazed) to 10 cattle[9] or 8 to 40 pigs (or a combination thereof);
- real demand for alternative domestic energy sources, whereby it is helpful when the household already (partially) uses commercial energy[10];
- opportunities for meaningful application / marketing of bio-slurry;
- organized in dairy collection, cattle / pig rearing, micro-credit, women or rural development groups.

The prime characteristic, households having at least 2 heads of cattle or 8 pigs, indicates that the technology will not directly reach the very poor households. At best, domestic biogas will indirectly improve the livelihood of the very poor by improving access to non-commercial domestic fuel, general improvement of the community's sanitary situation and generation of employment (construction and after sales services).

To improve the access to domestic biogas for poor households, the TDBP will link with the Tanzania Heifer programme. A higher subsidy together with micro-credit will make the technology available for a wider section of the society.

5.2 Description of the sector

In concept, the (future) domestic biogas sector can be segmented in:

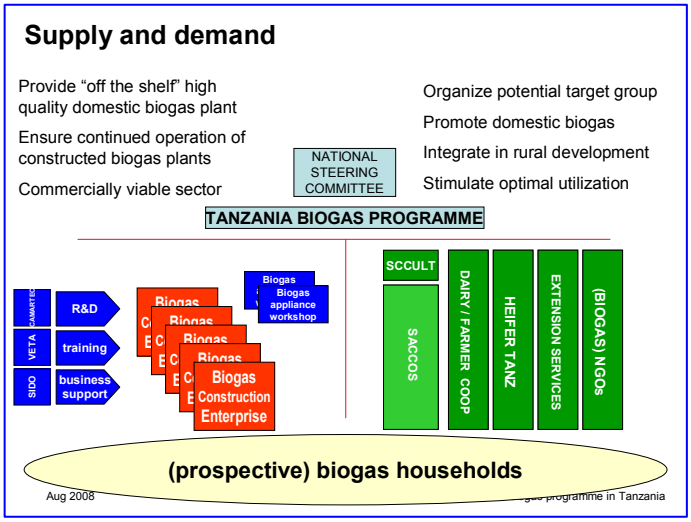
- organizations creating and organizing the demand for biogas services, the demand side, and;
- organizations providing the biogas services to the target group, the supply side.

The main responsibility of the sector's **supply side** is to establish a commercially viable biogas sector that:

- provides "off the shelf" high quality biogas installations, and;
- ensures the continued operation of all biogas plants installed under the programme.

The **demand side** of the sector will be involved in organizing the potential target group to:

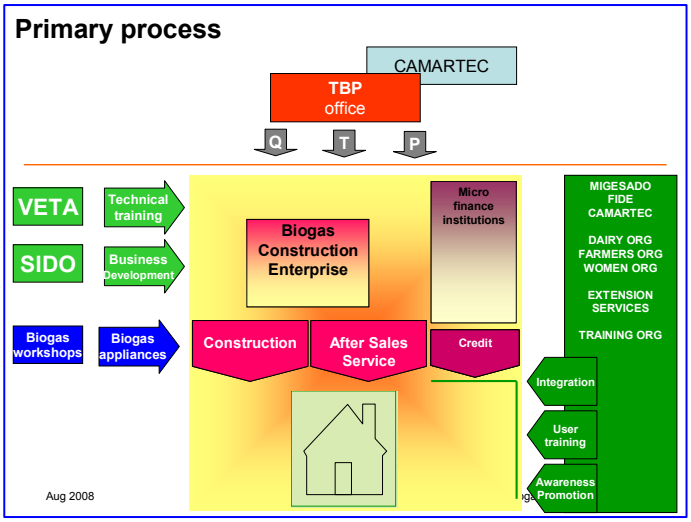
- increase public awareness of the technology;
- provide credit to prospective biogas households;
- stimulate optimum use of the installations, and;
- integrate the technology in rural development.



[9] Semi-intensive cattle holding would require roughly double these numbers of heads
[10] Commercial domestic energy: LPG, kerosene, but also purchased fuel wood or charcoal.

5.3 Description of the primary process

The core of the primary process is in the commercial transaction between the (prospective) biogas household and the Biogas Construction Enterprise, in which both parties aim to maximize their returns. The first party by demanding the best possible service level at the lowest possible costs, the latter aiming for high profit and future market penetration.



In this process, the importance of the quality of domestic biogas cannot be overstated. Particularly in a rural setting, a household that is satisfied with the benefits of a biogas plant is by far the most powerful promotional tool for the technology. Clearly, however, this works in two ways; an unsatisfied owner will cast a bad reputation on the technology, with a disastrous effect on market development. Hence, the margin for error, especially in the early days of a programme, is very small.

An enabling environment for the above described primary process to blossom would have the following salient features:

- Potential customers are well informed on costs and benefits, but also limitations, of the technology.
- Biogas service providers are rooted in the local society, to ensure that initial as well as follow-up services are easily available.
- BCEs operate on a level playing field; standardized technology is marketed together with transparent quality standards and quality control and enforcement.

In such an environment, BCEs have a vested interest in providing high quality services at competitive rates as a means to safeguard and expand their market. Hence, the main responsibility of the Tanzania Domestic Biogas Programme is to create and maintain the required conditions.

5.4 Apex actors in the sector

5.4.1 The National Biogas Steering Committee

The National Biogas Steering Committee (NBSC) will facilitate the establishment of a commercially viable domestic biogas sector in Tanzania. To that extent, the NBSC will:

- Ensure that the TDBP is implemented in line with the Government's policies on rural energy, rural development, livestock and agricultural development, employment creation and poverty reduction.
- Oversee the TDBP, ensuring the implementation is according to the Programme Implementation Document and subsequent Annual Plans, and meets generally accepted standards for project management and administration.
- Assist the TDBP in developing domestic biogas as a mainstream domestic energy source in Tanzania.
- Review performance of TDBP including its being hosed by CAMARTEC with a view of establishing it as an independent legal entity.

The NBSC will consist of maximum 10 members[11]. Members will represent the Government and relevant line ministries, civil society, programme donors and the private sector.
Responsibilities of the NBSC include:

- Endorsement of the programme's strategy;
- Facilitation of a conducive programme environment;

[11] For details please refer to Annex 11, final draft Terms of Reference for the NBCS.

- Establishing high-level linkages between relevant policies and organizations and the programme;
- Programme monitoring.

To enable effective programme monitoring, the NBSC's responsibilities include more in detail:
- Provisional approval of the annual activity plan & budget and the mid-term activity & budget review;
- Approval of the annual report
- Approval of the management reply on the programme's audit reports.
- Approval of the management reply on the programme's evaluation reports

Final approval of annual activity plan & budget and mid-term activity & budget review will be the prerogative of the programme donor, whereby the donor will commit funds accordingly. The final approval will be according to the CAMARTEC – Hivos agreement.

An approved annual activity plan & budget will create the mandate for the TDBP to implement activities and corresponding expenditures. Approved annual reports, together with the management reply on audit reports, will form the justification of the programme to its partners. The NBSC will meet three times per annum:
- in March to discuss and approve the programme's annual plan;
- in September to discuss and approve the programme's annual report, audit report and audit-management reply, and;
- in October to discuss and approve the programme's mid-term activity and budget review.

To assist the NBSC, it will have and Executive Committee. The NBSC Executive Committee (NBSC-EC) consists of:
- the Chair Person of the NBSC — NBSC-EC Chair
- Two NBSC members, selected by the NBSC
- the TDBP Programme Coordinator, — NBSC-EC Secretary

The NBSC-EC will meet as needed, but at most four times a year, and will prepare consolidated annual plans and reports and the management reply to the annual audit report. To that extent, the Executive Committee will:
- commission annual programme audits;
- commission programme evaluations;
- formulate monitoring and reporting requirements for sector partners, and;

Initially, an Executive Committee *ad-interim* (the IEC) will assist the NBSC with the further preparation of the TDBP.

5.4.2 The Tanzania Biogas Programme Office

The Tanzania Biogas Programme Office (TBP-Office), with the NBSC as its Governing Board, has coordinating, regulating and facilitating functions.

CAMARTEC will be the host organization for the TBP-Office, whereby the TBP-Office will be established in the premises of CAMARTEC in Arusha. The precise organizational arrangements required for CAMARTEC to successfully host the TDBP will be detailed during a comprehensive organizational assessment planned for the 3rd quarter of 2008. Key in the arrangement, however, will be the creation of an organization with a fair degree of autonomy and business orientation, able to react pro-actively to developments in the sector.

The main tasks of the TBP-Office include:
- Coordination of the activities of the programme partners;
- Standardization of biogas plant- and appliance design, construction, after sales service and quality control routines;
- Development, implementation and coordination of a biogas promotion campaign;
- Technical (ToT) training and subsequent certification of biogas masons and supervisors;

- Quality management and subsequent accreditation of BCEs;
- Management of subsidy and -possibly- carbon revenue streams.

The TBP-Office will:

- formulate a detailed annual activity plan and budget (submitted to the NBSC in the first week of February);
- formulate a mid-term activity and budget review (submitted to the NBSC in the first week of September), and;
- submit its annual report to the NBSC mid of August.

At the end of the first phase, the TBP-Office will employ 19 staff

PBDE staffing *[# of persons]*

		Total
Programme Director	PD	1
Finance and Administration Officer	FAO	1
Finance officer	FO	1
Officer Promotion and PR	P&PRO	1
Training Officer	TO	1
Extension officer	EO	1
ICT Officer	ICTO	1
Senior Biogas Technician	SBT	1
Exec secretary	ES	1
Biogas Technician	BT	6
Data processer	DP	2
Support staff	SS	2
Total staff		**19**

5.4.3 International Technical Assistance

SNV-the Netherlands Development Organization will make international experts available to provide technical assistance to the programme as a whole (apex, supply- and demand-side) to a total of 1250 Direct Advisory Days. In addition, SNV may choose to make available additional HCN biogas experts for assistance. The experts will assist with the programmatic, technical and administrative aspects of the programme. Scope and character of SNV assistance will be detailed in the CAMARTEC – SNV Memorandum of Understanding and subsequent Assignment Agreements

1	Technical assistance	unit	Planned activities					
			1	2	3	4	5	total
1.01	Senior Technical Advisor (International)	pers day	100	100	100	100	100	**500**
1.02	Medior Technical Advisor (International)	pers day	150	150	150	150	150	**750**
1.03	Junior Technical Advisor (International)	pers day						**0**
	Total ITA		**250**	**250**	**250**	**250**	**250**	**1250**

5.4.4 Rural Energy Agency (REA)

REA is an autonomous body under the Rural Energy Act No. 8 of 2005 to promote improved access to modern energy services in rural areas of mainland Tanzania. To that extent, REA provides subsidies and grants to developers of rural energy projects though its Rural Energy Fund (REF).

The programme will propose to the REA to contribute to the subsidy component of the programme through its REF to the tune of € 1,375,851 (see table).

Gov of Tanzania contribution to subsidy component *(through REA / REF)* *[Euro]*

	1	2	3	4	5	Total
REF share of subsidy expenses	15%	30%	45%	60%	75%	59%
Contribution	14,278	59,968	179,905	354,098	749,602	**1,357,851**
					TZS x 1000	*2,496,375*

In addition, programme donors may choose to channel their ODA contributions through the REF.

5.5 Implementation partners

5.5.1 Biogas Construction Enterprises

Although Tanzania has a reputable history in domestic biogas –and to some extent in the commercial dissemination there off, the current capacity in the sector will proof too small for the programme to reach its numerical targets. With MIGESADO, ELCT and FIDE having a small rural workforce capable of constructing biogas installations in rural areas,

and CAMARTEC and most of the commercial companies drawing on the small pool of artisans trained under the BES programme in the early 90s the installation capacity would be between 200 and 400 installations annually.

The programme targets to have 40 BCEs established by the end of the first phase. The following pathways can be explored to reach this target:

- *Selecting individual masons*[12]*:* Most villages will have masons employed in housing and rural infrastructure. During the village promotion workshops, these masons can be selected and, assuming the masons are interested, been offered training in domestic biogas construction. However, where masons working in civil and community infrastructure are working for a daily wage, the difference here will be that masons are expected to start operating independently, as an entrepreneur. This will be an important difference to be clarified during selection, and possibly these (very micro-) enterprises need extra initial support.
- *Advertisement*[13]*:* The programme can formulate criteria for BCEs, and reach (potentially) interested parties by advertisement. Selection, based on the set criteria, will be the responsibility of the programme. This modality will likely attract more entrepreneurial persons / organizations and –possibly- existing enterprises that would like to extend their scope of activities.
- *Inclusion:* Interested NGOs[14] may choose to include providing biogas construction and after sales in their services. Especially where these NGOs are already disseminating domestic biogas, the programme should aim to embrace this opportunity. It should be noted, though, that the TDBP aims to have private enterprises responsible for rendering biogas services to rural households. Therefore, possibly after a transition period, NGO's will be requested to privatise their construction units.
- *Tendering*[15]*:* The programme can divide the programme area in tender-lots (based on e.g. technical potential) and develop tender criteria. These tender lots can be tendered to interested parties. Selection will take place on tender criteria and the bid. This modality tends to attract commercial, large organizations, not necessarily with their roots in the locality, and eliminates competition at local level.

The last modality, tendering, may not be appropriate for a domestic biogas sector, as the goal is to have biogas services, over a longer period of time, accessible to households. The programme will therefore likely use a mix of the first three modalities; selection of masons, advertisement and inclusion.

A special note is due with regard to the high unemployment rate under rural youth in Tanzania. In cooperation with the VETA's the programme will make a targeted effort to interest young men and women to become employed in the domestic biogas sector. As this group of people, however, may be short on both technical as well as entrepreneurial skills, they will need coaching of experienced constructors. Youth, therefore, may only properly qualify to establish their own BCE, after a carefully guided apprentice period. The Government pays special attention to employment of youth in its SME policy

5.5.2 Biogas Branch Association

The programme will stimulate the establishment of a Biogas Branch Association (BBA). This association will provide a platform for their member-BCEs regarding promotion and marketing and market regulation. Biogas Branch Organizations can represent the interests of BCEs regarding policy development, regulatory and legal issues at provincial or national level.

[12] This modality is used in Vietnam's national biogas programme; over 200 BCEs were working under the programme after 4 years of operation. BCEs are typically small and are working in a limited area.
[13] This modality has been applied in the biogas programme in Nepal. The programme started in 1992, and currently over 60 BCEs are working under the programme. The BCE size in Nepal shows a "Pareto division" roughly 80% of the construction is done by 20% of the BCEs.
[14] In Nepal UNDP-supported NGOs included biogas construction and after-sales services in their services. For that purpose, however, these services were established as separate private enterprises, to avoid BCE competition at unequal footings.
[15] Tendering of programme areas as tender-lots is applied by the SHS programme under ASER, Senegal.

5.5.3 Other programme partners

Camartec
CAMARTEC has been intimately involved in the earlier biogas dissemination programme and subsequent (national and international) training and promotion. Over the past 2 decades, CAMARTEC has established itself as a centre for biogas with an excellent reputation. It's not surprising, then, that the biogas taskforce recommended CAMARTEC as the host organization for the programme. It has to be noted, though, that both programme and cooperation modalities differ strongly with the earlier programme. Under the proposed programme, CAMARTEC will be expected to "own the programme" in all its aspects. This will require rethinking its current organizational set-up. To assist CAMARTEC in this, SNV-TZ will lead a participatory organizational assessment in the last quarter of 2008.

Biogas NGOs
Quite a number of NGOs have been, or still are, involved in domestic biogas dissemination. Examples include FIDE, MIGESADO or ELCT. The NGO's not only showed great interest in participation in the programme, but will prove a crucial extension of the reach of the programme through their rural networks and experience. Living up to its multi-stakeholder approach, the programme will include these NGOs in the sector. Activities will include promotion / awareness and extension services. Where these NGOs are currently involved in construction, a practical solution will be developed whereby the construction capacity of the NGO is maintained, or even increased, without compromising the private-sector approach of the programme.

Biogas Companies
Tanzania has a small number of existing biogas companies (ABC, AEC, HORA etc), as a spin-off of the earlier CAMARTEC biogas programme. The existing biogas companies now embark mainly on the construction of larger, institutional biogas installations. However, these companies harbour a wealth of technical and marketing experience, which will prove an asset to the programme. Therefore, existing companies will be encouraged to join the programme, constructing domestic biogas installations.

Heifer International
HEIFER INTERNATIONAL in Tanzania holds the view that dairying at smallholder level has many benefits. The income from selling milk cushions the farmers cash flow, improves the nutritional status at house-hold level, creates employment and in some societies dairy business empowers women. Cows recycle crop residue, cow dung is used to generate biogas, and the slurry from biogas plant is a very good fertilizer. In addition and dairy cattle provides a social safety net (insurance) and is perceived in many societies as an indicator of status.

The above socio-economic importance of the dairy cattle have led HEIFER INTERNATIONAL in Tanzania to become the lead organization in mobilizing funding for acquisition of dairy cattle and building the capacity of the farmers who receive the dairy heifers. HEIFER INTERNATIONAL's aim is to improve the living conditions of the disadvantaged groups through an in kind heifer revolving scheme.

HEIFER INTERNATIONAL's strategy is to identify an implementing agent whose aims converge with heifers. A working arrangement is established whereby HEIFER INTERNATIONAL supplies the dairy heifers to the implementing agent to distribute the same to its target population. Monitoring and evaluation is participatory. Some of the implementing agents of this scheme are the ELCT, TEC, ACT, AIC and some local community based organizations etc. In this way the scheme has easily grown horizontally and vertically in Tanzania.

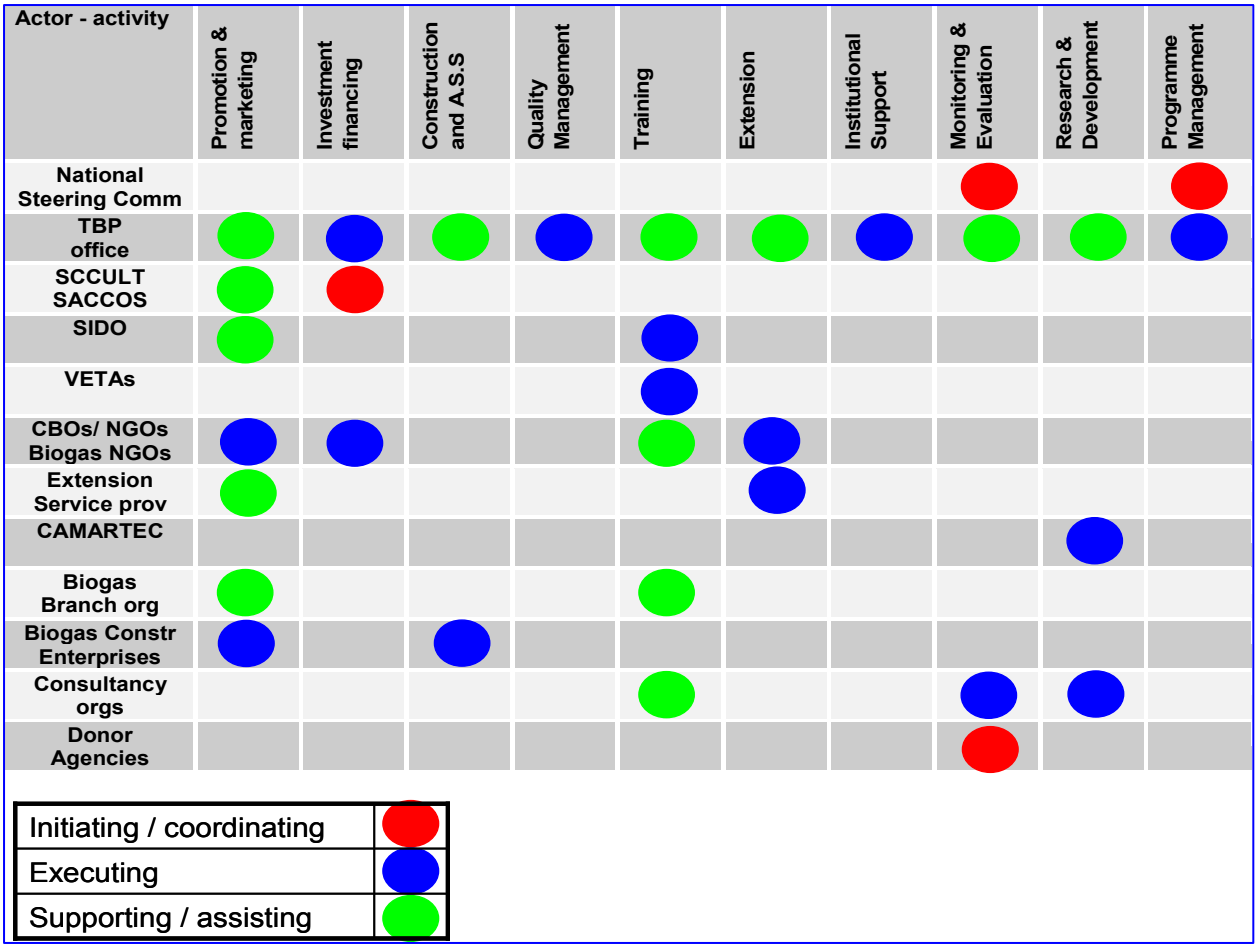
SIDO
SIDO was established in October 1973 as a parastatal organisation under now Ministry of Trade, Industry and Marketing. Its objective was to develop the small industry sector in Tanzania. It was expected to fulfil a very wide range of functions, from policy formulation to direct support to industries, to hands-on involvement in the establishment of SMEs in both rural and urban areas. SIDO will play a major role in the private sector support of the programme, ranging from identification of potential BCEs to providing business training and coaching.

Saving and Credit Cooperatives Union League of Tanzania (SCCULT)
SCCULT LIMITED (1992) is National Association of SACCOS in mainland Tanzania. It was registered on 19th October 1992, with its head office in Dar Es Salam. SCCULT is governed by an elected nine member Management Board. Currently SCCULT has over 1000 members (SACCOS – affiliates). Services to its members include liquidity balancing, risk management and capacity building. In addition, SCCULT manages soft loans and development funds. In the programme, SCCULT will play a pivotal role in making biogas credit funds available to SACCOS.

Saving and Credit organizations (SACCOs)
Tanzania currently knows some 3500 SACCOS. Although individual SACCOS range widely in outreach, financial and managerial capabilities, they will be the "vehicle of choice" to assist households with a biogas-loan.

Vocational Training Centres
Both the Ministry of Education and the Ministry of Livestock Development & Fisheries run a network of vocational training centres. The programme will, right from the start, cooperate with established training centres to incorporate technical biogas training in their curricula.

5.6 Actor – activity matrix



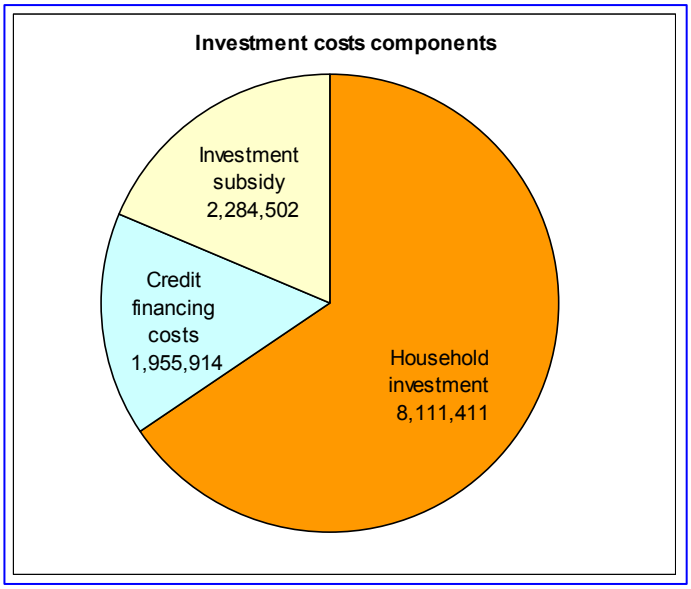
6 Activities and inputs

A detailed activity schedule and budget is provided in annex 8.

6.1 Investment

The total investment cost -compounded by household investment, credit financing costs and investment subsidy- amounts to € 12,551,827.

Household investment costs (€ 8.11 million) combine cash payments by the households and repayments on the principal loan amounts. Credit financing costs (€ 1.96 million) include interest and transaction costs. Both household investment and credit financing costs are born by the participating household. The investment subsidy amount (€ 2.28 million) is born by the programme.



Investment costs / plant						*[Euro]*
	1	**2**	**3**	**4**	**5**	**AVG**
AVG plant cost	**793.23**	817.03	841.54	866.79	892.79	866.33
Subsidy	**190.38**	190.38	190.38	190.38	190.38	190.38
Farmer investment	**602.86**	**626.65**	**651.16**	**676.41**	**702.41**	**675.95**
TZS	*1,108,338*	*1,152,088*	*1,197,150*	*1,243,565*	*1,291,372*	*1,242,719*

6.1.1 Detailed plant construction costs

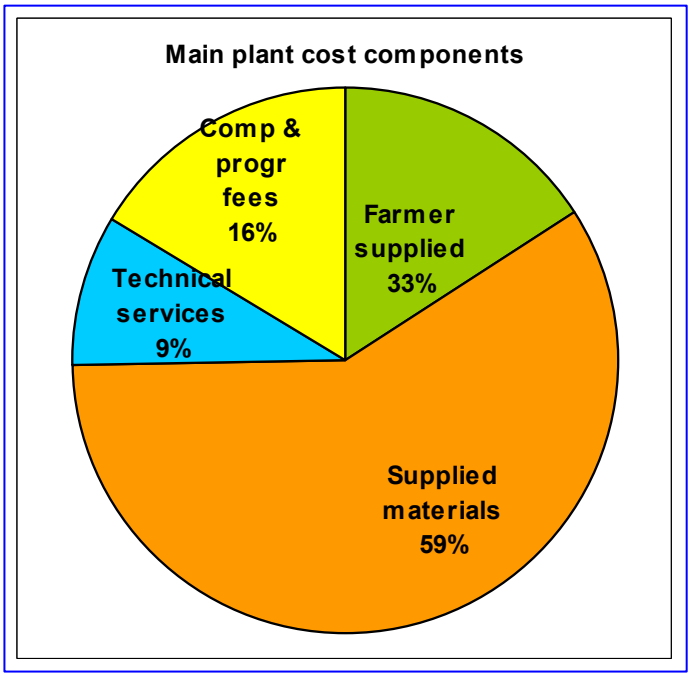
Based on the expected average daily biogas requirement, it is assumed that 20%, 40%, 25% and 15% of the installations have the sizes 4 m^3, 6 m^3, 9 m^3 and 13 m^3 respectively. The average plant size would thus arrive at 7.25 m^3 with a corresponding average (theoretical) investment cost of TZS 1.46 million (€ 793).

Investment costs						*[Euro]*
		4m³	**6m³**	**9m³**	**13m³**	
Investment costs	[Euro]	627	714	885	1,073	
Size share	[%]	20%	40%	25%	15%	
Average size	[m³]	**7.25**				
Average costs	[Euro]	**793**				
	[TZS]	*1,458,338*				

The estimated investment costs are based on preliminary pricing and construction in burned bricks. Construction costs can be divided in the main components farmer-supplied material and labour, 33%; Supplied materials, 59%; Technical services, 9%, and; Company and programme fees, 16%.

Construction with stabilized soil / cement blocks (20 b/b), as practiced by MIGESADO, would result in a cost reduction of about 10%. Details of the Bill of Quantities for the installation are provided in annex 7.

Based on the average plant costs, assuming a 3% inflation rate (Euro) the average investment will arrive at nearly € 866 per installation. The proposed subsidy component (see cpt 6.1.4 for details) of € 190 per installation will reduce average investment costs for the farmer to € 676 (TZS 1.2 million).



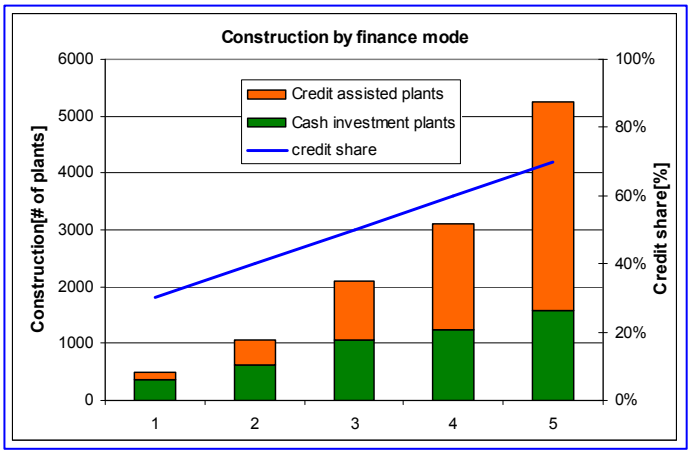
6.1.2 Programme investment costs

The total investment costs for the 12,000 installations constructed during the programme's first phase will amount to € 10,395,913 (TZS 19,113 million). Out of this amount, farmers will contribute € 8,111,411 and the subsidy component of the programme will bear € 2,284,502.

Direct investment	*(inflation correction in farmer investment)*					*[Euro]*
	1	**2**	**3**	**4**	**5**	**total**
Annual production biogas plants	*500*	*1050*	*2100*	*3100*	*5250*	*12000*
Farmer investment	301,428	657,987	1,367,446	2,096,874	3,687,676	**8,111,411**
Investment subsidy	95,188	199,894	399,788	590,163	999,470	**2,284,502**
Total direct investment	**396,616**	**857,880**	**1,767,234**	**2,687,037**	**4,687,146**	**10,395,913**
TZS x 1000	*729,169*	*1,577,192*	*3,249,016*	*4,940,051*	*8,617,201*	*19,112,628*

6.1.3 Investment credit requirement

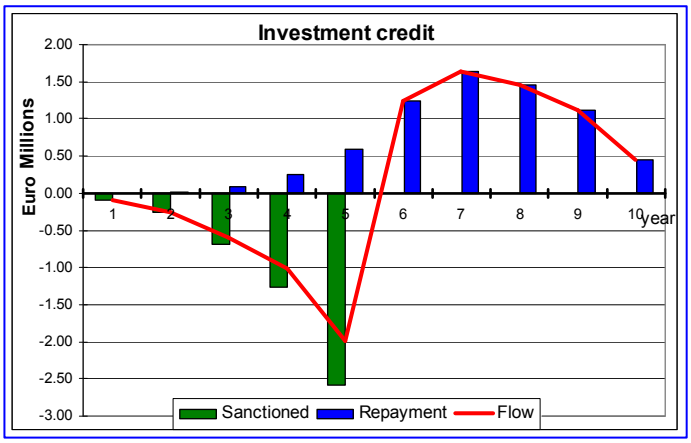
Initially, households reached by the programme will be relatively well-off, as these households will be in a better position to risk their investment on a new technology. Gradually, as the technology inspires confidence with its users, poorer households will show interest in domestic biogas. As a result of the dissemination modality then, the credit requirement of the programme will increase with its rate of penetration. It is assumed that during the first year of the programme 30% of the households will require credit assistance for their investment, increasing gradually to 70% of the households in the 5th programme year.



As biogas is not income generating but rather reduces expenditures on domestic fuels, credit conditions suitable for quick-returning investments typically do not fit the installation's saving performance. Surveys indicate that households would on average spend between TZS 20,000 to TZS 40,000 per month (based on 2006 pricing) on domestic fuel. Ideally then, credit conditions should be such that repayment of the principal plus interest should not exceed the traditional expenditure on domestic fuels. Credit conditions that match this situation fairly would look like:

- Maturity: 4 years
- Grace period: none
- Interest rate: 15% on outstanding debt.
- Repayment: monthly, interest + principal, at PMT

A household taking a loan for the investment costs minus the investment subsidy would under the above proposed conditions repay TZS 36,273 per month; in tune with the expected traditional fuel savings of the installation.



Based on this scenario, at the end of the first phase of the programme the total sanctioned amount of credit that will amount to TZS 8,966 million (€ 4.9 million). The total repayment at the end of year 10 will amount to TZS 12,561 million (€ 5.8 million). The maximum required credit fund will amount to TZS 3,672 million (€ 2 million) in year 5 of the programme.

An interview with SCCULT revealed that dedicated funds to this amount will not be available. The programme will seek credit fund assistance -in the shape of soft loans to SCCULT- to improve the liquidity of the micro-finance sector in Tanzania. SCCULT, in its turn, will make loans available to its member SACCOS in a package also including biogas promotion and loan administration training

6.1.4 Investment subsidy

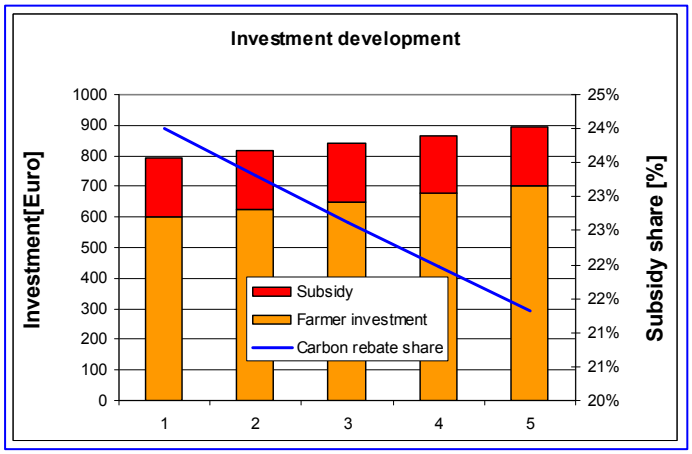
The subsidy component of the programme has a triple justification:

- Firstly, the subsidy will buy-down the investment costs for the farmer. In this way, biogas plants will become easier available to rural households, and the subsidy will have an important promotional effect;
- Secondly, the investment subsidy will compensate for the difference between the financial and the economic return on investment of a biogas installation, and;
- Thirdly, subsidy payment is arranged in such a way that it provides the programme leverage over the service quality (both construction and after sales) as provided by the BCEs. The arrangement, explained in more detail below, pays the subsidy to the constructing BCE rather than the household. As long as the services provided by the BCE meet the programme's standards, the subsidy will be fully reimbursed to the BCE. At the moment that the programme's quality control reveals that quality does not meet the programme's standards, however, penalties will be imposed as a deducted from the subsidy amount[16].

The programme will provide a subsidy to households that have a biogas plant constructed by BCEs certified by the programme. Subsidy will be provided for biogas plants following the design of the programme in the sizes 4, 6, 9 and 13 m^3.

[16] Likewise, in case service delivery is over and above what is expected by the programme, subsidies can be increase with a stimulating bonus.

The subsidy will be "flat rate", independent from the size or actual investment cost of the installation. The flat-rate approach not only simplifies the administrative procedure, but also aims to favour poorer households with lesser livestock, more than richer households.



During the programme, the subsidy amount will *not* be corrected for inflation. As a result, the subsidy share in the total investment will gradually decrease as inflation will increase investment costs. Based on a 3% annual inflation rate (Euro-based), the subsidy share will reduce from 28% in the first programme year to 25% in the 5th.

To obtain a better focus on poorer households, the programme will have two subsidy levels:

- a regular level, at TZS 300,000 per installation, and;
- a high level, at TZS 500,000 per installation, aiming at poorer households.

The high level subsidy will be reserved for households that have been supported by the HEIFER chain in Tanzania. Typically, households benefiting from the HEIFER INTERNATIONAL support are poorer, smallholder farming households starting-up dairy farming. Once their dairy herd extends to two cows or more, a biogas installation will be able to further improve their livelihood. Administrative procedures will (have to) be made in cooperation with HEIFER INTERNATIONAL and their partners in Tanzania.

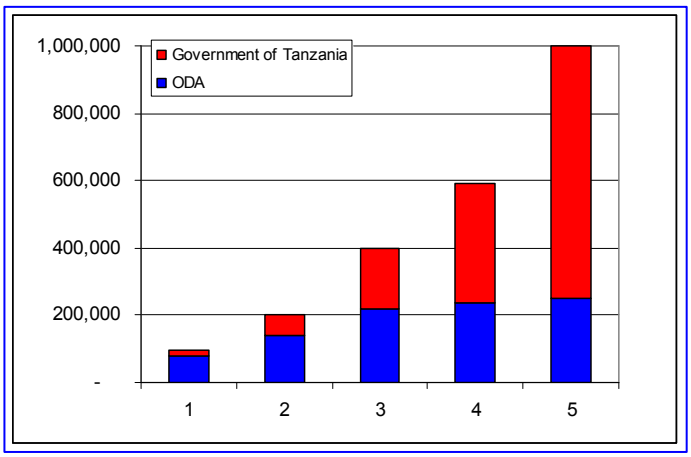
Assuming that 25% of programme's biogas households belong to the "HEIFER-group", the average subsidy amount for the first phase amounts to TZR 350,000 per installation

Investment subsidy		**rates**	
	TZS	Euro	**share**
Regular	300,000	163.18	75%
High	500,000	271.96	25%
Avg investment subsidy	**350,000**	**190.38**	100%

For the first phase, total subsidy expenses for the programme will arrive at € 2,284,502 (TZS 4,200 million).

Subsidy fund requirement						*[Euro]*
	1	**2**	**3**	**4**	**5**	**Total**
# of plants	*500*	*1050*	*2100*	*3100*	*5250*	**12000**
Investment subsidy requirement	**95,188**	**199,894**	**399,788**	**590,163**	**999,470**	**2,284,502**
					TZS x 1000	*4,200,000*

One critical success factor of the programme will be to guarantee the sustainability of the subsidy component. Unpredictability of the subsidy amount, both up and down-wards, will make farmers waiting for the "best deal", postponing –or even cancelling- their investment decision. To that extent, also in view of the 10-year horizon of the entire programme, it will be very important for the Government of Tanzania to contribute to the subsidy component.



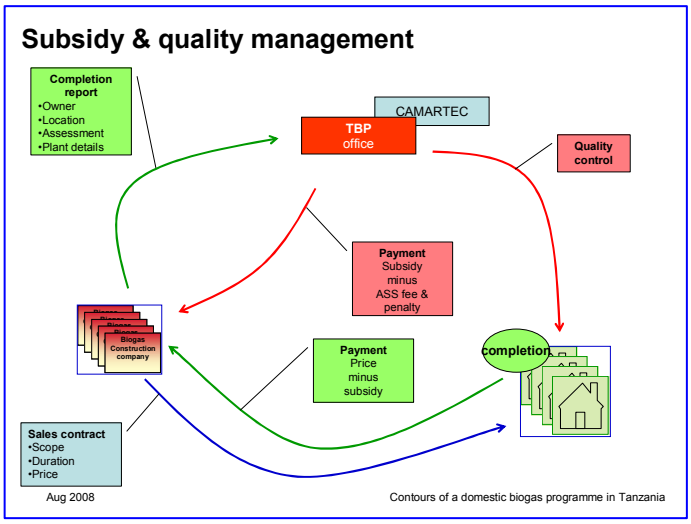
The GoT's Rural Energy Agency, therefore, will be requested to avail its Rural Energy Fund to bear part of

the subsidy expenses. The programme will request the Government to consider taking a gradual increasing share of the subsidy expenses, ranging from a 15% share in the 1st programme year to 75% in the 5th. In this fashion, the Government will contribute € 1,357,851 (TZS 2,496 million), 59%, to the programme's subsidy component.

Gov of Tanzania contribution to subsidy component						*[Euro]*
	1	**2**	**3**	**4**	**5**	**Total**
Share of ann subsidy expenses	15%	30%	45%	60%	75%	59%
Contribution	14,278	59,968	179,905	354,098	749,602	**1,357,851**
					TZS x 1000	*2,496,375*

The administrative process regarding payment of investment, subsidy, penalties and fees includes the following steps:

Sales agreement: A prospective biogas household will approach a BCE for the construction of a biogas installation. The sales agreement, detailing scope, timing and price of the work, will be the formal basis for the BCE to commence its activities. Upon completion of the installation, the household will pay the for the services extended as per the sales contract, *deducting the programme's subsidy from the agreed amount*.



Completion report: The Biogas Supervisor, on behalf of the constructing BCE, will inspect the installation and confirm the proper construction and functioning of the plant in the Plant Completion Report. The BCE will submit this report to TBP-Office.

Subsidy payment: Based on the received Plant Completion Reports, on a monthly basis, the TBP-Office will transfer the subsidy ***minus penalties and annual maintenance fees*** to the BCE's biogas current account.

Channelling Annual Maintenance fees: BCEs will provide their installations with a 3-year guarantee. The guarantee includes 2 annual maintenance visits, at which a qualified Biogas Mason or Biogas Supervisor of the BCE visits the installation and checks for proper functioning and operation. Households will pay an Annual Maintenance fee. The Annual Maintenance fee (AM-fee) to the amount of TZS 2,500 will be withheld from the investment rebate and transferred to the *joint savings account* of the TBP-Office and the respective BCE. Annually, the BCE will visit all its plants under guarantee. Following the visit, a Maintenance Report will be submitted to the TBP-Office. Based on the submitted Maintenance Reports, the TBP-Office will release the maintenance fee in equal amounts over the two years following the year of construction. Interest over the account will be made available to the BCEs annually.

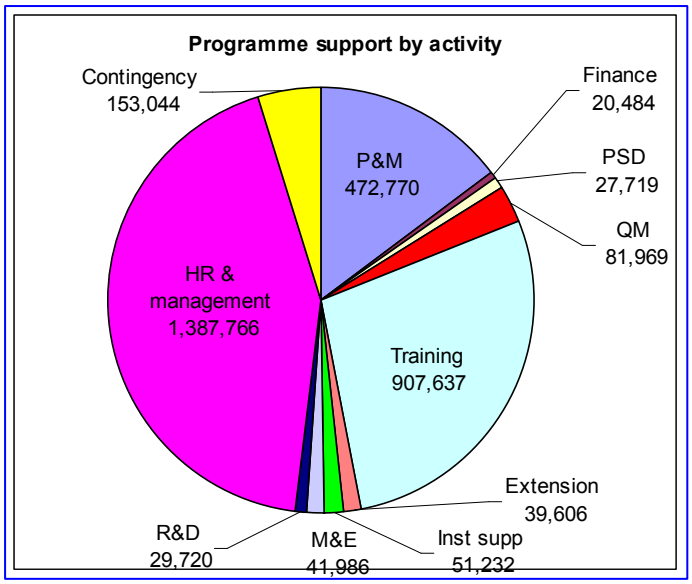
Quality penalties and bonuses: Based on the standards for construction and after sales service, the programme will set penalties for sub-quality performance of BCEs. Penalties will be charged in the last quarter of the construction season, and will be deducted from the outstanding subsidy amount.

Bonuses will be provided to BCEs providing outstanding service quality (high production, high and consistent quality of construction and after sales service, correct plant sizing and location, excellent user instruction, sound business administration, etc). Bonuses will be made available in the last quarter of the construction season.

By channelling the subsidy to the BCE rather than the household, the programme's penalty / bonus system becomes an effective instrument for quality management.

6.2 Activity schedule and budget

Activity schedule and budget, as provided hereunder are intended as a framework for more detailed programme planning. Activities, their sequence and the resulting budget will be detailed in annual plans by the programme management.



The total activity costs, corrected for inflation but excluding the investment costs born by the households and excluding the expenses for international technical assistance, for the first phase of the programme amount to € 3,213,932. Human Resources / general management costs take the lion share of the budget; activity-wise, Training and Promotion & Marketing are the main activities with corresponding budget shares.

Hereunder, summary budget cost centre and a brief description of the involved activities are presented. The detailed Activity Schedule & Budget is provided in Annex 8.

6.2.1 Promotion and marketing

Introduction of the new technology will start-off in each new region with an exploration of the market. Biogas Market PRAs will map not only the potential demand, but also identify programme partners at regional and district level. To that extent, programme staff will team-up with local partners will implement PRA-style assessments. Following these PRAs, biogas awareness & promotion workshops will address potential customers, programme partners and constructors at village level with the aim to create demand for biogas in batches of 15 to 25 installations.

To support the promotional activities, the programme will prepare promotional material and train staff of local partners (scheduled under training). The total budget for promotion, not corrected for inflation, amounts to € 434,667 (TZS 799 million) as per the table below.

6.2.2 Finance

During the first phase of the programme, the programme office will receive 12,000 subsidy requests. Both for accountability and monitoring reasons, proper administration of the requests and processing of the payments is important. Adequate financial software, partly custom made, will used to assist in this task.

Financial audits will be commissioned annually, implemented by a reputed, independent auditor. In addition the programme plans for a management audit in its second and fourth year; after all doing things right is one thing, doing the right things quite another. The total budget for finance, not corrected for inflation, amounts to € 19,392 (TZS 36 million)

6.2.3 Private sector support

An active and efficient private sector will be the backbone of the programme. The programme will support new and existing Biogas Construction Enterprises to grow. Support may range from basic bookkeeping skills to developing their own business and marketing plans.

A Biogas Sector Survey in the second year will establish the BCE baseline. Based on the findings of the survey, the programme will organize annual biogas business seminars and measure the support need of participating BCEs. Subsequently, BCEs will be offered individual support arrangements. For the private sector support activities, the programme will cooperate closely with SIDO as the latter organization has a good reputation on rural business

development and support. The total budget for private sector support, not corrected for inflation, amounts to € 25,426 (TZS 47 million)

6.2.4 Quality management

As explained in chapter 4.4, quality management is crucial in safeguarding the households' investment as well as levelling the playing field for competing Biogas Construction Enterprises. Physical control will be implemented both by the BCE, as prime responsible actor, as well as the TBP-Office Hereunder a brief explanation on the activities at hand and the corresponding budgets[17].

Quality control by the BCEs

Plant Completion visit: All newly constructed biogas plants will be visited by a Certified Biogas Supervisors of the BCE upon completion, allowing sufficient time for the plant to have generated its first biogas. During the Plant Completion visit the Biogas Supervisor will confirm, through a "Plant Completion form" according the PC-protocol, that the installation is properly constructed according to the agreed standards, that the installation is fully functional. The Biogas Supervisor will note the GPS coordinates of the installation on the Plant Completion form. At the same time, the Biogas Supervisor will instruct the household how to operate and maintain the plant and explain the guarantee arrangements valid under the programme. The BCE will submit the Plant Completion Form, countersigned by the household, to the TBP-Office as a legal document confirming existence and proper functioning of the installation and proper instruction of the owner. The TBP-Office will enter the information in the biogas data base.

BCEs will perform a 100% check on plant completion: hence 12,000 installations will be visited.

Plant Maintenance visit: Annually, a certified Biogas Mason or Biogas Supervisor will visit all the installations constructed by the BCE that are in operation for at least one year, for 2 subsequent years (Installations under the programme come with a 3 year construction and after sales guarantee). According to the PM-protocol, during the annual Plant Maintenance visit, the company representative will check the installation, carry out small maintenance works, instruct the user where necessary to improve operation and maintenance and confirm, through the "Plant Maintenance form" that the installation is properly working (possibly listing outstanding maintenance works). The BCE will submit the Plant Maintenance form to the TBP-Office as a legal document confirming proper operation if the installation. The TBP-Office will enter the information in the biogas data base.

BCEs will perform a cumulative 100% check on plant maintenance; hence in total 12,450 plants will be visited during the 1st phase of the programme.

Quality control by the TBP-Office

The Tanzania Biogas Programme Office is responsible to assure the quality of the provided services provided by the BCEs at programme level. Programme level-quality management will create a level playing field for participating BCEs and will safeguard the carbon revenue for the programme. Therefore, on a random-sample basis, Biogas Technicians employed by the TBP-Office will perform quality control visits on installations under construction, installations recently completed and installation under the guarantee scheme. In total, 7 TBP technical staff will visit a total of 2,667 biogas plants during the five years of phase 1.

Quality control on installations under-construction: Biogas Technician teams (2 persons) will visit commissioned installations for control of the quality of construction. Control, together with a representative of the constructing BCE, will take place on-site against the agreed construction standards and according to the QC-UC protocol. The QC-UC form, countersigned by the BCE representative, will be submitted to the TBP-Office, where the information will be entered in the biogas data base.

[17] Staff costs are combined in budget category 10, HR & Management.

Biogas Technician teams will perform a 6% check on the plants while under construction; hence 720 installations will be visited.

Quality control on completed installations: Biogas Technician teams will visit recently completed installations for control of the quality of construction and user-instruction. Control, together with a representative of the constructing BCE, will take place on-site against the agreed construction standards and according to the QC-Comp protocol. The QC-Comp form, countersigned by the BCE representative, will be submitted to the TBP-Office, where the information will be entered in the biogas data base.

Biogas Technician teams will perform a 6% check on completed biogas plants; hence 1200 installations will be visited.

Quality control on installations under guarantee: Biogas Technician teams will visit installations under guarantee for control on operation and quality of the after sales services as provided by the BCE. Control, together with a representative of the constructing BCE, will take place on-site against the agreed after sales service standards and according to the QC-ASS protocol. The QC-ASS form, countersigned by the BCE representative, will be submitted to the TBP-Office, where the information will be entered in the biogas data base.

Biogas Technician teams will perform a 6% cumulative check on biogas plants under guarantee; hence 747 installations will be visited.

The data on construction and after sales service quality resulting from plant visits by both BCE and TBP-Office staff will be entered by the TBP-Office in a data base. The processed data will subsequently provide information on:

- Performance of individual biogas masons
- Performance of BCEs including the penalties and bonuses
- Overall performance of the sector

In this fashion, biogas plants constructed under the first phase of the programme will receive 27,117 quality control visits; the lion share by BCE Biogas Supervisors.

Quality control								
			Plant visits					
			1	**2**	**3**	**4**	**5**	**Total**
BCE	Plant completion	PC	500	1050	2100	3100	5250	**12000**
BCE	Annual maintenance	PM	0	500	1550	3650	6750	**12450**
	Total BCE plant visits		**500**	**1550**	**3650**	**6750**	**12000**	**24450**
TBP	Quality Control on completed plants	QC-Comp	50	105	210	310	525	**1200**
TBP	Quality Control on plants under construction	QC-UC	30	63	126	186	315	**720**
TBP	Quality Control on ASS	QC-ASS	0	30	93	219	405	**747**
	Total TBP plant visits		**80**	**198**	**429**	**715**	**1245**	**2667**
	Total plant vists		**580**	**1748**	**4079**	**7465**	**13245**	**27117**

Based on this information, BCEs will annually receive a quality rating (5 steps, A to E). Companies with a high grading (A and B) will be able to use this in the marketing of their services, and will receive privileges from the programme (work advance, unlimited construction quota, etc). Companies with an average or low grading (C and D) will in the following year receive assistance of the programmed to improve their performance. E-grade companies will be allowed one year to get their act together; a second E-grading will result in exclusion from the programme.

The total budget for quality management, not corrected for inflation, amounts to € 75,629 (TZS 130 million).

6.2.5 Training

Training will be the programme's main activity, and includes technical training, training for programme partners, user training and training of trainer activities. Although the programme may initially implement training it self, the aim will be to out-source all training activities to existing vocational training centres.

Technical training

Technical training will be provided by selected existing vocational training institutes (VETAs. By the end of the programme, some 4 to 6 vocational training institutes will offer short term technical biogas training courses. The programme will provide support and technical backstopping to the selected vocational training institutes. Professional support will be made available for curriculum development, development of training material and Training of Trainers (ToT).

Biogas Mason Training: During the first phase, the programme will train and certify 394 biogas masons. The training will have a theoretical and a practical component, the course durations will be 12 days. Women and men with at least grade 6 pass and reasonable experience in masonry work in the construction sector will be admitted to the training course.

Based on the assumption that a certified mason will construct 20 installations per year and allowing 50% training over-capacity, the programme will run 20 training courses of batches of 20 trainees for initial Biogas Mason Training.

Biogas Mason Refresher training: In addition the programme will offer refresher training to certified biogas masons to keep them up-dated with the developments in the programme. Mason refresher courses, organized annually after the first year, will take 2 days and have a theoretical and a practical component. In total the programme plans for 26 Biogas Mason Refresher courses in batches of 24 trainees, reaching approximately 623 certified biogas masons.

Biogas Supervisor Training: Over the same period, the programme will train and certify biogas supervisors. Based on the assumption that 1 supervisor will manage 8 masons, the programme plans for 41 biogas supervisors. Supervisor training will only start in the second programme yearThe course duration will be 3 days. Women and men with a biogas mason certificate and at least 1 year experience in the biogas sector will be admitted to this training course.

Based on batches of 10 trainees and allowing a training over-capacity of 25%, the programme will run about 4 training courses for initial biogas supervisor training.

Biogas Supervisor Refresher Training: In addition the programme will offer refresher training to biogas supervisors to keep them up-dated with the developments in the programme. Supervisor refresher courses, organized annually after the second year, will take 1 day. In total the programme plans for 5 Biogas Supervisor Refresher courses, reaching approximately 65 biogas supervisors

Training to programme partners

For the programme's sectoral, multi-actor approach, it is crucial that (potential) programme partners at the demand side are well informed on domestic biogas, its costs and benefits and the objectives and modalities of the programme.

Biogas Programme Workshop: The programme will provide biogas programme workshops to interested Dairy / farmer associations, NGOs and Community Organizations. Workshops, planned in batches of 12 persons, will take 1 day. In total, the programme plans to provide 11 BPWs.

Village Extension Service Providers: For service and efficiency reasons, the programme will stimulate construction in batches of at least 20 installations per location. In this modality, Village Extension Workers can play

an important role providing advice on operation and maintenance of biogas plants and the application of bio-slurry. Moreover, the Village Extension Worker can liaise with the BCE or the programme in case more expert assistance is required. VEW training, in batches of 20 persons, will take 1 day. In total, the programme plans to provide 30 VEW training courses.

Loan Officers: Loan officers sanctioning loans for biogas installations should have a good knowledge of biogas and the programme modalities. In addition, loan officers play an important role in the awareness and promotion of the technology. LOT training, in batches of 12, will take 1 day. In total the programme plans to provide 11 Loan Officer training courses.

(female) User training

The programme will provide training to biogas households thrice. As women are the prime beneficiaries of a biogas installation, and, in practice, they will operate the plant, the programme's user training, in particular the second and third course[18], is focussed on women. In total, the programme will run 1,670 training courses for (female) users. User training includes:

Biogas awareness & promotion workshops: The workshops aim on the one hand to inform prospective biogas users on costs and benefits of a biogas installation and bio-slurry and, on the other, to make users aware of the construction process, what they should expect from the programme in general and the BCE in particular. The programme will reach 24,000 persons with biogas awareness & promotion workshops / pre-construction training (600 training courses in batches of 40 participants).

BAP training will be provided by (preferably female-) biogas promoters recruited by BCEs and demand-side organizations like NGOs and farmer / dairy development organizations.

Biogas Operation & Maintenance training: The third training, between 6 months and 1 year after the plant has been commissioned, will provide users more in-depth information on the operation and maintenance of their installation and proper use of bio-slurry. Having operated the installation for a reasonable period of time by now, during this training course, users are invited discuss their experiences with the trainer and other users. The programme will reach 12,000 persons with post-construction training (400 training courses in batches of 30 participants).

BOM training will be provided by (preferably female-) staff of participating Rural Support Programmes *1*

Bio-slurry application: Proper preparation and application of bio-slurry can easily double the benefits of a biogas installation. The programme will provide practical training to households that have participated in the post-construction training in how to prepare and apply bio-slurry, specific to the local situation. Assuming that 20% of the households do not have their own fields and households receive bio-slurry training twice, the programme will reach 13,400 persons with bio-slurry application training (670 training courses in batches of 20 participants).

BSA training will be provided by (preferably female-) staff of participating demand side organizations

Operation and maintenance instruction: In addition to the formal training mentioned above, upon completion of the installation, the supervisor of the constructing BCE will provide on-site instruction to the household on operation and maintenance of the installation. Thus 12,000 users will be reached individually with operation & maintenance instruction.

[18] For user training courses, the programme pre-scribes that at least 80% of the course participants is female.

Training of trainers

The programme shall assure that trainers for technical and user-oriented training courses are equipped to deliver adequate training. To that extent, the programme will provide both initial and refresher training for trainers for: Biogas Masons Training; Biogas Supervisor Training; Biogas awareness & promotion training; Operation & maintenance training, and; Bio-slurry application training. During the first phase, the programme will provide 18 ToT training courses.

ToT training courses will be provided by staff of the biogas programme, supported by experts for specific topics. In total the nprogramme will execute 1,821 training courses, reaching over 52,000 persons.

Training programme			batch size	Training courses						Persons reached
				1	2	3	4	5	Total	
Technical training	Biogas Mason	BMT	20	2	2	4	4	8	**20**	**394**
	Biogas Mason Refresher	BMT-R	24	0	1	3	8	14	**26**	**623**
	Biogas Supervisor	BST	10	0	1	1	1	2	**4**	**41**
	Biogas Supervisor Refresher	BST-R	12	0	0	1	2	3	**5**	**65**
	Total technical training			**2**	**4**	**9**	**14**	**27**	**55**	**1123**
Programme	Biogas Programme Workshop	BPW	12	1	1	2	3	4	**11**	**127**
	Village Extension Service Providers	VEW	20	1	3	5	8	13	**30**	**595**
	Loan Officer Training	LOT	12	1	1	2	3	4	**11**	**127**
	Total programme training			**3**	**4**	**9**	**13**	**22**	**51**	**849**
User training	Biogas Awareness & Promotion	BAW	40	25	53	105	155	263	**600**	**24000**
	Biogas Operation & Maintenance	BOM	30	17	35	70	103	175	**400**	**12000**
	Bio-slurry Application	BSA	20	20	42	84	124	400	**670**	**13400**
	Total user training			**62**	**130**	**259**	**382**	**838**	**1670**	**49400**
ToT technical training	ToT Biogas mason trainers	TBM	8	1	1	1	1	1	**5**	**40**
	ToT refresher Biogas mason trainers	TBM-R	16	0	1	2	2	3	**8**	**128**
	ToT Biogas supervisor trainers	TBS	6	0	1	0	0	1	**2**	**12**
	ToT refresher Biogas supervisor trainers	TBS-R	12	0	0	1	1	1	**3**	**36**
	Total ToT technical training			**1**	**3**	**4**	**4**	**6**	**18**	**216**
ToT user training	ToT Awareness & promotion	TAP	12	1	1	1	1	1	**5**	**60**
	ToT Awareness & promotion refresher	TAP-R	24	0	1	1	1	1	**4**	**96**
	ToT Operation & maintenance	TOM	12	1	1	1	1	1	**5**	**60**
	ToT Operation & maintenance refresher	TOM-R	24	0	1	1	1	1	**4**	**96**
	ToT Bioslurry application	TBA	12	1	1	1	1	1	**5**	**60**
	ToT Bioslurry application refresher	TBA-R	24	0	1	1	1	1	**4**	**96**
	Total ToT user training			**3**	**6**	**6**	**6**	**6**	**27**	**468**
	Total training			**71**	**147**	**286**	**419**	**898**	**1821**	**52056**

The total budget for training, not corrected for inflation, amounts to € 830,807 (TZS 1,527 million).

6.2.6 Extension

The obvious benefit of a domestic biogas installation, domestic energy supply, is in monetary terms easily equalled by the value of bio-slurry. It is well documented that, provided properly processed and applied, bio-slurry will increase agricultural yields and reduce the effort the farmer has to put in weeding his fields. Extension, therefore, will focus on demonstration and adaptation of proven bio-slurry processing and application methodologies.

Initiated and coordinated by the TBP-Office, the programme will establish 480 bio-slurry demonstration plots at provincial level. To support extension of proper bio-slurry use, extension material will be developed and made available to the households. In addition, at national level, the TBP-Office will commission studies on bio-slurry and fertilizer, sanitation, dairy farming and organic farming.

The total budget for extension, not corrected for inflation, amounts to € 36,900 (TZS 68 million).

6.2.7 Institutional support

The programme is set-up as a multi-stakeholder, multi-actor sectoral approach. Establishing and maintaining stakeholder networks will be crucial to the success of the programme.

In addition to establishing a National Steering Committee, The TBP-Office will initiate and support BCE associations, village extension networks and NGO networks at provincial level.

The total budget for institutional support, not corrected for inflation, amounts to € 48,250 (TZS 89 million).

6.2.8 Monitoring and evaluation

M&E will resort directly under the NBSC. The allocated budget includes commissioning of domestic energy baseline studies, biogas user surveys, and an environmental impact study. In addition, the NBSC will commission an external mid term and final evaluation for the programme's first phase.

The total budget for monitoring and evaluation, not corrected for inflation, amounts to € 38,818 (TZS 71 million).

6.2.9 Research and development

CAMARTEC will be requested to coordinate / implement the programme's R&D activities. Research and development is planned for the further development and piloting of the new "Modified CAMARTEC Design", biogas stoves and lamps.

The programme will provide financial support to students choosing to do their final thesis on technical, economic or social aspects of domestic biogas. In addition, the budget foresees to support research in this field.

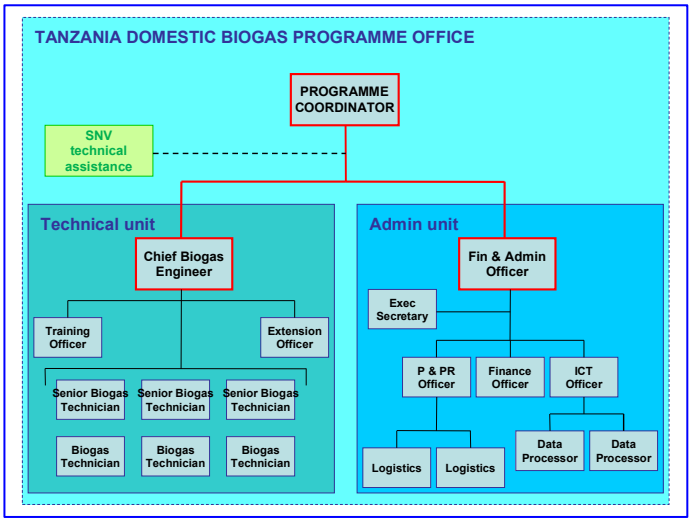
The total budget for research and development, not corrected for inflation, amounts to € 28,079 (TZS 52 million).

6.2.10 Human resources, operations and management

Under this heading, all staffing, accommodation and general operation costs have been grouped.

The TBP-Office, by the end of the first phase, will employ 19 staff, divided over a technical and an administrative unit.

The total budget for HR, operations and management, not corrected for inflation, amounts to € 1,302,339 (TZS 2,304 million).



6.3 International Technical Assistance

SNV, with its experience worldwide on development and implementation of sectoral large-scale domestic biogas programmes, will provide technical assistance to the programme. To that extent, SNV will allocate two biogas experts to the programme.

The total budget for international technical assistance, covered by SNV's core budget, not corrected for inflation, amounts to € 987,500.

6.4 CAMARTEC programme service

Camartec will render administrative, logistic and –during starting up- technical services to the programme. Based on actual activities and costs, the total budget, not corrected for inflation, amounts to € 137,040.

6.5 Summary programme activity costs

The total budget for the first phase of the programme, corrected for inflation on Euro basis, arrives at € 16,737,357 (TZS 30,771 million). A summary overview on main cost centres is provided below.

Summary project budget by cost centre *(corrected for inflation)* *[Euro]*

		Summary project budget					
		1	**2**	**3**	**4**	**5**	**total**
1a	Household investment	301.428	657.987	1.367.446	2.096.874	3.687.676	**8.111.411**
1b	Credit financing costs	36.267	105.557	274.215	504.585	1.035.289	**1.955.914**
1c	Investment subsidy	95.188	199.894	399.788	590.163	999.470	**2.284.502**
2a	Programme support activities	378.626	396.441	602.487	724.869	1.111.753	**3.214.176**
2b	International TA	197.500	201.450	205.479	209.589	213.780	**1.027.798**
2c	Camartec service fee	49.800	24.948	23.814	21.949	23.046	**143.557**
	Total project	**1.058.809**	**1.586.277**	**2.873.229**	**4.148.029**	**7.071.014**	**16.737.357**
	million TZS	*1.947*	*2.916*	*5.282*	*7.626*	*13.000*	***30.771***

6.4.1 Application of funds

Investment takes the lion share, 74%, of the programme costs, technical assistance is budgeted for the remaining part of the costs. Per installation, fund application so results in € 1,029 and € 365 for investment and technical assistance respectively.

6.4.2 Source of funds

Participating households, through the investment costs of their installations, will contribute 60% to the programme budget. The Government of Tanzania will be requested to contribute to the programme's subsidy component, through the Rural Energy Fund. The total contribution of the GoT, thus will amount to 8% of the programme budget. In total, 32% of the required programme funds will be sought from Official Development Aid.

The proposed contribution of the GoT is not yet committed and the ODA contribution, through the ABPP, awaits contracting. Assuming these contributions will materialize, the budget still shows a gap of € 704,384, which may be filled by other donor contributions or carbon revenue.

Application of funds		[Euro]	[%]
	Investment		
1a	Household investment	8.111.411	*66%*
1b	Credit financing costs	1.955.914	*16%*
1c	Investment subsidy	2.284.502	*18%*
	Total investment	**12.351.827**	*74%*
	Techncial assistance		
2a	Support activities	3.214.176	*73%*
2b	International technical assistance	1.027.798	*23%*
2c	Camartec service fee	143.557	*3%*
	Total project support	**4.385.531**	*26%*
	Total application	**16.737.357**	
Source of funds		[Euro]	[%]
a	**Households**		
a1	Household investment	8.111.411	*81%*
a2	Credit financing costs	1.955.914	*19%*
	Total participating farmers	**10.067.325**	*60%*
b	**Government of Tanzania**	*(not yet committed)*	
b1	REF (subs comp)	1.357.851	*100%*
	Total Gvt of Tanzania	**1.357.851**	*8%*
c	**Official Development Aid**	*(not yet committed)*	
c1	ABPP (subs comp + act comp)	3.580.000	*67%*
c2	SNV (ITA comp)	1.027.798	*19%*
c3	Other (act comp)	704.384	*13%*
	Total ODA	**5.312.182**	*32%*
	Total source	**16.737.357**	

7 SWOC analysis

Domestic biogas programmes in Africa have an ambiguous track record. In that respect is Tanzania an exception. Introduced in 1975, and strengthened by the CAMARTEC programme and its spin-off, the technology continued to play a role in domestic energy supply. Over three decades after its initial introduction, conditions for large scale dissemination seem to have improved considerably. Strong points and opportunities for the proposed programme, then, include:

Strong: Tanzania is home to the third largest livestock population on the continent, and a large share of the livestock is kept in smallholdings. Over the past years, commercial and environmental concerns induced an increasing share of the livestock is kept in stables. The demand for alternative domestic energy, as a result of deforestation and land degradation, has increased significantly. Main potential stakeholders are well aware of the benefits of a larger biogas programme, and show great support.

Opportunities: Tanzania's dairy-industry is quickly expanding, increasing the potential target group. SCCULT and SACCOS form a reasonably dense micro-credit infra-structure through which biogas loans and awareness campaigns can be channelled. A respectable number of NGOs is either active, or has been active until quite recently, in the field of domestic biogas. Their experience and network will be formidable pillars under the programme.

Despite Tanzania's efforts in the field of domestic biogas, however, the technology has not developed as a mainstream rural energy source. The centralistic dissemination approach may be an important factor in this failure. Other weak point and threats would include:

Weak: With an average investment of nearly € 800, expenditure is close to the average annual income per capita. In addition, existing rural credit facilities don't match biogas loans; households face an up front investment that often exceeds their liquidity. Despite the history of biogas in Tanzania, rural awareness of the benefits of biogas is not wide-spread, and a large share of the human resources has evaporated since the CAMARTEC programme. Programme costs are considerable, and require significant Government and ODA contribution. These contributions, however, are not yet committed.

Challenges: Although from an economic point of view, investment in biogas proves justified, the expendable income of rural households is very low in comparison with the necessary investment. It is hard to predict whether, even with an appropriate credit facility, households are willing to take this investment risk. The programme foresees partial financing of subsidy and support costs by carbon revenue. Although a lot of work in this field has been done, the concept remains to be proven for Tanzania.

SWOC analysis

Strong	Weak
•Significant livestock population with an increasing share of the livestock kept in smallholdings •Significant demand for alternative domestic fuels •Interest and support of main stakeholders •Strong reputation on domestic biogas programmes	•High investment costs •Existing rural credit facility does not match biogas loans •Funding for programme not yet committed •Limited popular awareness on biogas benefits •Limited (rural) availability of skilled human resources
Opportunity	**Challenge**
•Strong stimulation and development of dairy industry •Infrastructure (sccult & saccos) for biogas credit •High potential for NGOs to cooperate in the programme	•Low expendable income rural households •Uncertainty regarding actual value of carbon revenue

8 References

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Annexes to the Programme Implementation Report on a national programme for domestic biogas in Tanzania.

Agricultural households and cattleholding

Region	Agricultural hh nocattle-hh	Agricultural hh rearing cattle cattle-hh	Total agricultural hh agric_hh	Density cattle rearing households cattle_hh/agric_hh	Share of agric hh rearing cattle / total cattle_hh/tot_hh
Dodoma	260,682	63,037	**323,719**	19%	5.0%
Arusha	46,930	107,928	**154,858**	70%	8.5%
Kilimanjaro	87,688	128,484	**216,172**	59%	10.1%
Tanga	209,436	55,762	**265,198**	21%	4.4%
Morogoro	250,709	10,037	**260,746**	4%	0.8%
Pwani	135,961	5,568	**141,529**	4%	0.4%
Dar es Salaam	18,322	2,072	**20,394**	10%	0.2%
Lindi	152,335	838	**153,173**	1%	0.1%
Mtwara	225,747	3,567	**229,314**	2%	0.3%
Ruvuma	174,338	16,837	**191,175**	9%	1.3%
Iringa	224,888	53,829	**278,717**	19%	4.2%
Mbeya	253,733	119,111	**372,844**	32%	9.4%
Singida	107,410	72,505	**179,915**	40%	5.7%
Tabora	169,992	65,925	**235,917**	28%	5.2%
Rukwa	128,710	43,551	**172,261**	25%	3.4%
Kigoma	174,055	21,711	**195,766**	11%	1.7%
Shinyanga	229,641	148,216	**377,857**	39%	11.6%
Kagera	304,198	49,079	**353,277**	14%	3.9%
Mwanza	222,023	118,062	**340,085**	35%	9.3%
Mara	124,773	63,430	**188,203**	34%	5.0%
Manyara	64,448	89,747	**154,195**	58%	7.1%
Zanzibar	63,234	33,288	**96,522**	34%	2.6%
Total	**3,629,253**	**1,272,584**	**4,901,837**	**26%**	**100%**

Agricultural households and indigenous cattleholding				
Region	**# of hh with indigenous cattle** indig_hh	**# of indigenous cattle** indig_cattle	**Indigenous cattle holding size** indig_cattle/hh	**Density indigenous cattle rearing hh** indig_hh/agric_hh
Dodoma	62,255	1,025,388	16.5	19%
Arusha	88,000	1,532,103	17.4	57%
Kilimanjaro	69,554	351,191	5.0	32%
Tanga	46,947	350,210	7.5	18%
Morogoro	8,826	455,985	51.7	3%
Pwani	4,864	110,360	22.7	3%
Dar es Salaam	532	4,660	8.8	3%
Lindi	391	2,019	5.2	0.3%
Mtwara	3,474	16,383	4.7	2%
Ruvuma	12,909	105,884	8.2	7%
Iringa	49,481	401,773	8.1	18%
Mbeya	104,647	898,050	8.6	28%
Singida	72,363	1,255,118	17.3	40%
Tabora	65,854	1,566,169	23.8	28%
Rukwa	43,345	503,345	11.6	25%
Kigoma	21,627	421,613	19.5	11%
Shinyanga	147,784	2,591,532	17.5	39%
Kagera	43,483	869,424	20.0	12%
Mwanza	117,613	1,710,309	14.5	35%
Mara	62,730	1,090,007	17.4	33%
Manyara	88,807	1,163,051	13.1	58%
Zanzibar	32,891	154,381	4.7	34%
Total	**1,148,377**	**16,578,955**	**14.4**	**23%**

Agricultural households and improved beef cattleholding					
Region	# of hh with improved beef cattle beef_hh	# of improved beef cattle beef_cattle	improved beef cattle holding size beef_cattle/hh	Density improved beef cattle rearing hh beef_hh/agric_hh	
Dodoma	433	1,856	4.3	0.1%	
Arusha	1,764	2,853	1.6	1.1%	
Kilimanjaro	3,457	5,454	1.6	1.6%	
Tanga	195	298	1.5	0.1%	
Morogoro	13	26	2.0	0.0%	
Pwani	331	1,140	3.4	0.2%	
Dar es Salaam	107	302	2.8	0.5%	
Lindi	32	64	2.0	0.0%	
Mtwara	0	0		0.0%	
Ruvuma	181	181	1.0	0.1%	
Iringa	475	1,659	3.5	0.2%	
Mbeya	1,813	2,045	1.1	0.5%	
Singida	412	925	2.2	0.2%	
Tabora	274	671	2.4	0.1%	
Rukwa	69	274	4.0	0.0%	
Kigoma	0	0		0.0%	
Shinyanga	353	1,375	3.9	0.1%	
Kagera	0	0		0.0%	
Mwanza	0	0		0.0%	
Mara	132	264	2.0	0.1%	
Manyara	496	1,139	2.3	0.3%	
Zanzibar	160	354	2.2	0.2%	
Total	**10,697**	**20,880**	**2.0**	0.2%	

Agricultural households and dairy cattleholding

Region	# of hh with improved dairy cattle dairy_hh	# of improved dairy cattle dairy_cattle	improved dairy cattle holding size dairy_cattle/hh	Density improved dairy cattle rearing hh dairy_hh/agric_hh
Dodoma	1,589	4,645	2.9	0.5%
Arusha	21,959	57,744	2.6	14.2%
Kilimanjaro	62,252	137,910	2.2	28.8%
Tanga	11,383	27,683	2.4	4.3%
Morogoro	1,447	5,052	3.5	0.6%
Pwani	1,588	10,809	6.8	1.1%
Dar es Salaam	1,765	8,233	4.7	8.7%
Lindi	482	998	2.1	0.3%
Mtwara	124	775	6.3	0.1%
Ruvuma	5,401	15,111	2.8	2.8%
Iringa	6,086	17,522	2.9	2.2%
Mbeya	19,280	40,982	2.1	5.2%
Singida	372	1,115	3.0	0.2%
Tabora	262	1,851	7.1	0.1%
Rukwa	878	1,107	1.3	0.5%
Kigoma	448	748	1.7	0.2%
Shinyanga	2,664	11,198	4.2	0.7%
Kagera	7,204	17,050	2.4	2.0%
Mwanza	2,254	7,882	3.5	0.7%
Mara	2,555	8,797	3.4	1.4%
Manyara	4,108	13,761	3.3	2.7%
Zanzibar	2,113	7,908	3.7	2.2%
Total	**156,214**	**398,881**	**2.6**	**3.2%**

Agricultural households and pigholding

Region	Agricultural hh rearing pigs pig_hh	# of pigs pigs	Pig holding size pigs/hh	Density pig rearing hh pig_hh/agric_hh
Dodoma	14,859	43,835	2.95	4.6%
Arusha	3,154	7,958	2.52	2.0%
Kilimanjaro	32,981	155,070	4.70	15.3%
Tanga	2,601	6,281	2.41	1.0%
Morogoro	18,008	44,986	2.50	6.9%
Pwani	353	3,673	10.41	0.2%
Dar es Salaam	703	12,993	18.48	3.4%
Lindi	1,494	4,956	3.32	1.0%
Mtwara	3,355	6,293	1.88	1.5%
Ruvuma	54,852	134,951	2.46	28.7%
Iringa	67,979	180,904	2.66	24.4%
Mbeya	79,606	229,465	2.88	21.4%
Singida	2,554	6,375	2.50	1.4%
Tabora	2,719	6,286	2.31	1.2%
Rukwa	12,101	58,754	4.86	7.0%
Kigoma	5,221	23,698	4.54	2.7%
Shinyanga	678	3,266	4.82	0.2%
Kagera	27,685	145,761	5.26	7.8%
Mwanza	525	610	1.16	0.2%
Mara	402	2,409	5.99	0.2%
Manyara	16,493	50,699	3.07	10.7%
Zanzibar	54	535	9.91	0.1%
Total	**348,377**	**1,129,758**	**3.24**	**7.1%**

Biogas and Sustainable Development

Sustainable development covers three aspects of society - economic, social and environmental. Biogas contributes to these three aspects of sustainable development in the following ways:

Domestic biogas digesters contribute to economic development because:
- The expenses for domestic energy are significantly reduced.
- The labour required to maintain traditional energy systems (such as firewood collection) can be used in more directly economically productive ways.
- Substitution of petroleum products will reduce the countries foreign exchange demand.
- Application of bio-slurry increases the yield and reduces the need` -and expenses- for synthetic fertilizer.
- A vibrant biogas sector creates significant employment and related economic activities, particularly in rural areas.
- Reduced disease (human and animal) can improve productivity.

Biogas and the World Summit on Sustainable Development

As a follow-up to the Rio Summit of 1992, the World Summit on Sustainable Development was held in Johannesburg in 2002. Energy was highlighted as a key topic for discussion as it was felt that there had not been enough focus on it at the previous summit. As with the previous Plan of Implementation, waste management, pollution control and social sustainability were highlighted.

The Plan of Implementation states that about two billion people, or one third of the world's population, presently lack access to electricity or modern energy services and rely on burning firewood or biomass to meet their cooking and heating needs. Meeting the energy needs of these people with modern energy services was a major issue at the Summit, and governments committed themselves to "improving access to reliable, affordable, economically viable, socially acceptable and environmentally sound energy services and resources."

Domestic biogas digesters contribute to social development because:
- The reduction in domestic workload, particularly for women and children, increases opportunities for education and other social activities.
- Respiratory illnesses resulting from indoor air pollution and gastro-enteric diseases as a result of poor sanitary conditions reduce significantly.
- In rural areas, biogas digesters often initiate innovation (education, sanitation, agriculture).
- Increase awareness of alternative farming and animal husbandry practices and environmental impacts of behaviour.

Domestic biogas digesters contribute to environmental development as follows:
- Substituting conventional fuels and synthetic fertilizer, and changing traditional manure management systems, biogas installations reduce the emission of greenhouse gasses significantly.
- Bio-slurry improves soil texture, thus reducing degradation, and reduces the need for further land encroachment.
- Reduction of firewood use contributes to checking deforestation and reduces forest encroachment.
- Improved manure management practices reduce ground and surface water pollution and odour and improve aesthetics.

Bruntland & biogas

The generally accepted definition of Sustainable development, published in the Bruntland Report in 1987:

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Domestic biogas is compatible with the Bruntland definition by:
- meeting household energy and income generation needs;
- reducing greenhouse gas emissions
- reduces reliance on fire wood therefore pressure on forest resources
- reduces ground and surface water pollution
- reduces reliance on non-renewable energy sources and raises the profile of renewable energy technology
- providing a long term solution to pollution and energy needs
- reducing reliance on chemical fertizer and improving soil condition and fertility through proper application of bio-slurry

Biogas & the United Nations Millennium Development Goals.
Domestic biogas programmes contribute to reaching the UN-MDGs in the following ways:

MDG 1 Eradicate extreme poverty and hunger.
Target 1: To halve extreme poverty
In general, households who install biogas are not amongst the poorest of the poor due to the fact that for a biogas plant to function a household must have a minimum number of animals that is often more than a very poor family has. However, the biogas dissemination process and the resulting reduced claim on common ecosystem services do affect the livelihood conditions of (very) poor non-biogas households as well. For example:

- Construction and installation of biogas creates employment for landless rural people
- Biogas saving on the use of traditional cooking fuels increases the availability of these fuels for (very) poor members of the community
- Pollution control and waste management benefit all members of the community

MDG 3 Promote gender equality and empower women.
Target 4: Eliminate gender disparity in education
It is predominantly women and girls who spend the most time and effort providing traditional energy services and using a domestic energy supply. Biogas directly benefits this group in the following ways:

- Biogas can provide light that helps women and girls to extend the amount of time in the day that they can study and gain access to education and information or engage in economic activities.
- Domestic biogas reduces the workload of women by reducing the need to collect firewood, tend fires and clean the soot from cooking utensils. This can save on average 2-3 hours per household per day
- The reduced smoke from replacing traditional fire wood stoves with biogas can improve the health of women (and children) who are most exposed to the dangers of wood smoke.
- The provision of biogas can provide an additional or more cost effective home based energy source that can enable women to participate in home based enterprises to generate additional income or at least generate income in a way that suits their life and obligations.

MDG 4 Reduce child mortality.
Target 5: Reduce by two-thirds the under-five mortality rate
Half of the world's population cooks with traditional (mostly biomass based) energy fuels. Indoor air pollution from burning of these fuels kills over 1.6 million people each year, out of which indoor smoke claims nearly one million children's (<5) lives per year. Diseases that result from a lack of basic sanitation, and the consequential water contamination, cause an even greater death toll, particularly under small children (<5 mortality caused by diarrhoea is approximately 1.5 million persons per year).

- Biogas stoves substitute conventional cook stoves and energy sources, virtually eliminating indoor smoke pollution and, hence, the related health risks that particularly affect children who are often heavily exposed to indoor smoke.
- Biogas significantly improves the sanitary condition of the farm yard and its immediate surrounding, lowering the exposure of household members to harmful infections especially children who spend extended periods in the farm yard.
- Proper application of bio-slurry will improve agricultural production (e.g. vegetable gardening), thus contributing to food security for the community.

MDG 6: Combat HIV/AIDS, malaria and other diseases.
Target 8: Halt / reverse the incidence of malaria and other major diseases
Indoor air pollution and poor sanitary conditions annually cause millions of premature deaths.

- Biogas virtually eliminates health risks (e.g. respiratory diseases, eye ailments, burning accidents) associated with indoor air pollution.
- Biogas improves on-yard manure and night-soil management, thus improving sanitary conditions and protecting freshwater sources, lowering the exposure to harmful infections generally related with polluted water and poor sanitation.

MDG 7 Ensure environmental sustainability
Domestic biogas can help to achieve sustainable use of natural resources, as well as reducing (GHG) emissions, which protects the local and global environment. Application of bio-slurry increases soil structure and fertility, and reduces the need for application of chemical fertilizer.

Biogas and the Millennium Ecosystem Assessment

As part of the implementation of the MDGs, the Millennium Ecosystem Assessment was released in March 2005. This assessment examined the relationship between ecosystems and achieving the MDGs. It not only found that not sustainable ecosystem management and development are imperative for reaching the MDGs, but moreover that ecological limits to worldwide growth will affect both developed and developing countries.

In addition to providing predictions and evidence the assessment provided a series of proposed responses and interventions. Biogas programmes have elements that are relevant to each of these responses and interventions.

Target 9: Integrate the principles of sustainable development into country policies and program and reverse the loss of environmental resources.

- Large scale domestic biogas programmes positively influences national policies on sustainable development (e.g. agriculture, forestation, poverty reduction)
- Biogas programmes usually comply with and support government policies and programmes that have positive environmental impacts including pollution control, green house gas emission reduction and forestation

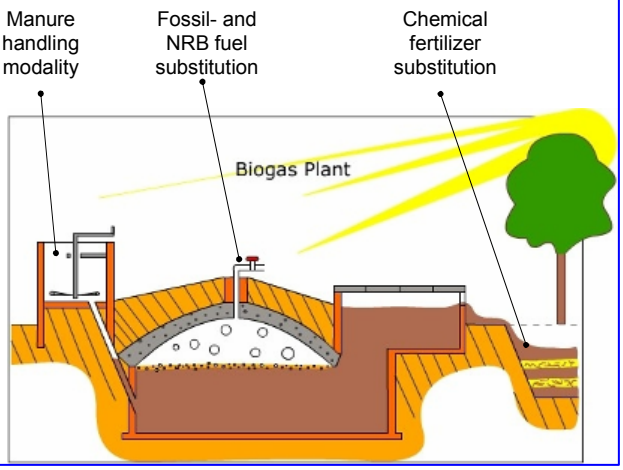
Target 10: Halve the proportion of people without sustainable access to safe drinking water and basic sanitation.

- Biogas reduces fresh water pollution as a result of improved management of dung.
- Connection of the household toilet to the biogas plant significantly improves the sanitary conditions in the farmyard therefore reducing the risk of water contamination.

Domestic biogas and Greenhouse Gas reduction

Domestic biogas plants are installations used for fermentation of –mainly- animal manure with the objective to generate biogas and bio-slurry that can be used by individual households for cooking or lighting and agricultural production respectively.

Biogas & GHG reduction



Domestic biogas installations –potentially- reduce greenhouse gas (GHG) emissions in three ways: by changing the manure management modality; by substituting fossil fuels and non-renewable biomass for cooking (and to a smaller extent for lighting) with biogas, and; by substituting chemical fertilizer with bio-slurry.

Manure management: The traditional manure management modality may include storage or discharge of animal dung under (semi-)anaerobic conditions, e.g. by deep pit storage or discharge of raw manure in sewage channels or lagoons. The anaerobic condition will cause the manure to (partly) ferment, in which case methane (CH_4), a potent greenhouse gas, is emitted in the environment.

In a domestic biogas installation, the manure is immediately discharged in the installation. In the plant the fermentation of the manure takes place under controlled conditions, whereby the generated methane gas is captured and used for cooking. Technically, this process is referred to as "methane capture and destruction", whereby the potent CH_4 is converted in carbon-dioxide (CO_2) and water. Although CO_2 is a greenhouse gas, it is far less potent than CH_4 and, more importantly, can be considered "renewable" as the CO_2 is absorbed by the very growth of vegetation from which it originates.

Substitution of fossil fuel and non-renewable biomass: The domestic fuel mix of rural households in developing countries typically includes significant amounts of fossil fuel (kerosene, coal, LPG) and biomass (fuelwood, charcoal, dung cakes). The combustion of these traditional energy sources creates carbon-dioxide emissions (and to a lesser extent CH_4 and Nitrous-oxide (N_2O), emissions).

Fossil fuels, by definition, are non-renewable sources of energy. Hence, the full amount of GHG emission resulting from combustion of these energy sources results in a net increase of GHG in the atmosphere. For biomass, however, the situation is less straight-forward. As far as the burned biomass is obtained from renewable sources (agricultural waste, dung-cakes) the produced carbon-dioxide is assumed to be absorbed by the vegetation from which they originate. Therefore, carbon-dioxide emissions from renewable biomass do not contribute to the net GHG concentration in the atmosphere. Biomass obtained from non-renewable sources (referred to as "Non Renewable Biomass, NRB), however, do contribute to global warming. NRB includes e.g. fuelwood and charcoal whose harvest results in a reduction of forested area and therefore in a reduction of the carbon sink function of this area.

To the extent that biogas replaces fossil fuels or non-renewable biomass, this substitution then results in a reduction of greenhouse gas emissions.

Chemical fertilizer substitution: Many developing countries face a net outflow of soil nutrients and farmers apply chemical fertilizer to maintain the fertility of their soil. Although chemical fertilizer use in developing countries often is erratic and scattered, typically fair amounts of chemical fertilizer is applied. Production as well as application of chemical fertilizer has a GHG aspect, mainly as a result of the high energy requirement (often sourced from fossil fuels) for chemical fertilizer production and the Nitrous oxide (N_2O) emissions.

The "by-product" of a biogas installation is "bio-slurry". Bio-slurry is the digested dung that is discharged from the installation after the fermentation process. The fermentation process does not reduce the nutrient value (NPK-value) of the feeding material. In fact, when applied correctly, the fertilizing value of bio-slurry even surpasses that of raw manure. Therefore, bio-slurry is a good organic fertilizer that can replace or reduce the application of chemical fertilizer.

To the extent to which bio-slurry is actually replacing chemical fertilizer, GHG emissions are reduced. From an accountability point of view, however, this component of GHG emission reduction by domestic biogas installations may proof very cumbersome to substantiate.

GHG emission reduction potential of domestic biogas installations: The actual reduction of greenhouse gas emissions by domestic biogas installations depends on the local situation, the size of the installation and the way the installation is operated, whereas the "claimable" GHG emission reduction depends on the used methodology. However, results based on –tentative- calculations with data sets of biogas programmes in which SNV is involved and claimed reductions by other domestic biogas projects would indicate GHG emission reductions in a range of 1.7 to 5.9 tons CO_2eq per installation per year. It has to be noted that the currently approved CDM – biogas projects are working under methodologies that have since been withdrawn.

Reducing global GHG emissions: In 1992, the United Nations Framework Convention on Climate Change (UNFCCC) was established to combat global warming. Subsequently, in 1997, the Kyoto Protocol (KP) was adopted to commit developed countries (annex 1 parties) to reduce their greenhouse gas emissions. This binding protocol eventually came into force in February 2006, following the ratification of Russia. The KP requires annex 1 countries to reduce their GHG emission to ~ 95% of their pre 1990-levels over the period from 2008 to 2012. The required GHG reduction, also know as the assigned amount units (AAUs), is measured in tons of Carbon-dioxide equivalent.

As global warming is a world-wide phenomenon; the geographical location of greenhouse gas emission reductions is irrelevant. Hence, the KP defined three "flexibility mechanisms" to achieve its emission targets economically:

- The Emission Trading (ET) allows for annex 1 parties (industrialized countries) to acquire (buy, trade) emission reduction units from other annex 1 parties.
- Joint Implementation (JI) allows annex 1 parties to implement GHG emission reducing projects in other annex 1 parties and count the resulting emission reduction for meeting their own KP target.
- The Clean Development Mechanism (CDM) allows annex 1 parties to implement GHG emission reducing projects in non-annex 1 parties (developing countries) in return for Certified Emission Reductions (CERs) whereby host parties are assisted in achieving sustainable development (through "technology transfer") and the ultimate goal of the Convention is supported.

By capping global GHG emissions and allowing trade in GHG reduction units, the UNFCCC, with its Kyoto Protocol, introduced a commercial, compliance-based market for greenhouse gas reduction. In the spirit of this compliance market, but also to circumvent the complicated and lengthy formal procedures, non-UNFCCC initiatives were launched as well. These initiatives are normally referred to as the "Voluntary Market". Voluntary projects are outside the Kyoto system; their emission reductions cannot be traded in official emission trading systems. Most offset projects to date are developed in the voluntary market and do not follow a particular standard. Small projects will find the voluntary offset market increasingly attractive because projects are often cheaper to develop and implement than under the CDM. They are attractive to companies who use offset as part of their corporate social responsibility strategy but which up to now are not legally obliged to lower their emissions. To distinguish between UNFCCC and voluntary emission reductions, emission reductions traded at the voluntary market are referred to as Verified Emission Reductions (VERs), similarly equalling one ton of carbon dioxide equivalent.

Tanzania Biogas Programme									Expected results
Activity	**Rate**	**Unit**	**1**	**2**	**3**	**4**		**Total**	
Biogas plant construction	*annual*	[# of plants/yr]	500	1050	2100	3100	5250	**12000**	[plants]
	corrected cumulative	[# of plants]	500	1540	3609	6637	11754		
Energy									
Energy production (gross)	4.6	[MWh/plant/yr]	2292	7061	16548	30430	53891	**110,222**	[MWh]
Power installed (nett)	1.28	[kW_{th}/plant]	641	1973	4624	8503	15059	**30,799**	[kW]
Environment									
GHG emission mitigation	2.5	[tons CO_2 eq/plant/yr]	1250	3850	9023	16593	29386	**60,101**	[t CO_2eq]
Deforestation reduction	0.3	[ha of forest/plant/yr]	165	510	1194	2196	3889	**7,954**	[ha of forest]
Soil nutrificaton	2.7	[t (DM) bio-slurry/plant/yr]	1350	4158	9745	17920	31737	**64,909**	[t(DM) bio-slurry]
Nitrogen (N)	*6.1%*	*[% N in bioslurry (DM)]*	*82*	*254*	*594*	*1093*	*1936*	***3,959***	*[t N]*
Phosporus (P)	*0.6%*	*[% P in bioslurry (DM)]*	*8*	*25*	*58*	*108*	*190*	***389***	*[t P]*
Potassium (K)	*2.5%*	*[% K in bioslurry (DM)]*	*34*	*104*	*244*	*448*	*793*	***1,623***	*[t K]*
Fuel substitution									
Biomass									
Agricultural residue	0.45	[tons agric res/plant/yr]	223	686	1607	2956	5235	**10,706**	[t agric residue]
Dung cake	0.36	[tons dungcake/plant/yr]	181	558	1307	2403	4255	**8,703**	[t dung cake]
Fuelwood	1.68	[tons fuelw ood/plant/yr]	842	2592	6076	11173	19787	**40,469**	[t fuelw ood]
Charcoal	0.54	[tons charcoal/plant/yr]	271	834	1955	3596	6368	**13,025**	[t charcoal]
Total biomass	4.12	[tons biomass/plant/yr]	**2058**	**6339**	**14856**	**27318**	**48381**	**98,952**	[t biomass]
Fossil fuel									
Kerosene	0.02	[tons/plant/yr]	12	37	88	161	285	**584**	[t kerosene]
LPG	0.01	[tons/plant/yr]	5	15	35	64	114	**234**	[t LPG]
Total fossil fuel			**17**	**52**	**123**	**226**	**400**	**817**	[t fossil fuel]
Socio-economic									
Persons reached (female)	3	[pers/biogas hh]	1500	3150	6300	9300	15750	**36,000**	[w omen]
Persons reached (male)	3	[pers/biogas hh]	1500	3150	6300	9300	15750	**36,000**	[men]
Workload reduction (women & children)	0.0833	[pers-year/plant/yr]	42	128	301	553	980	**2,003**	[pers years]
Exposure to indoor air pollution reduced	5	[pers/biogas hh]	2500	5250	10500	15500	26250	**60,000**	[w omen & children]
Toilets attached	20%	[connection rate]	100	210	420	620	1050	**2,400**	[toilets]
Productive slurry use	80%	[inclusion rate]	400	840	1680	2480	4200	**9,600**	[households]
Employment generation (direct)	0.07	[pers-year/plant]	35	74	147	217	368	**840**	[person years]
Training									
User training									
Pre construction training (female)	0.2	[pers-day/plant]	100	210	420	620	1050	**2,400**	[person days]
Pre construction training (male)	0.3	[pers-day/plant]	150	315	630	930	1575	**3,600**	[person days]
Post construction training (female)	0.4	[pers-day/plant]	200	420	840	1240	2100	**4,800**	[person days]
Post construction training (male)	0.1	[pers-day/plant]	50	105	210	310	525	**1,200**	[person days]
Bio-slurry extension (female)	0.2	[pers-day/plant]	100	210	420	620	1050	**2,400**	[person days]
Bio-slurry extension (male)	0.2	[pers-day/plant]	100	210	420	620	1050	**2,400**	[person days]
Total User Training	1.4	[pers-day/plant]	**700**	**1470**	**2940**	**4340**	**7350**	**16,800**	[person days]
Professional training									
Biogas Construction Enterprise support	0.08	[pers-day/plant]	41	87	173	256	433	**990**	[person days]
Biogas technology	0.10	[pers-day/plant]	49	103	207	305	517	**1,182**	[person days]
Biogas construction	0.22	[pers-day/plant]	108	226	452	667	1129	**2,580**	[person days]
Biogas extension	0.03	[pers-day/plant]	16	34	68	101	171	**390**	[person days]
Total professional training	0.43	[pers-day/plant]	**214**	**450**	**900**	**1328**	**2250**	**5,142**	[person days]

	Indigenous cattle	Beef cattle	Dairy cattle	Pigs
IF	20%	0.6%	10.0%	10.0%
	40%	1.2%	20.0%	20.0%
	60%	1.8%	30.0%	30.0%
THEN	10%	10%	20%	10%
	5%	15%	30%	15%
	1%	20%	40%	20%

Overall 10-yr production target **100,000**

Region	Indigenous cattle plants_indig	Beef cattle plants_beef	Dairy cattle plants_dairy	Pigs plants_pigs	Total plants_tot	Total mainland Tanzania		Share/region	10-yr production target	10-yr production target rounded plants_target
Arusha	880	265	6,588	315	**8,048**	8,048		5%	4,936	5000
Dar es Salaam	53	11	353	70	**487**	487		0%	299	500
Dodoma	6,226	43	318	1,486	**8,073**	8,073		5%	4,951	5000
Iringa	4,948	48	1,217	13,596	**19,809**	19,809		12%	12,149	12000
Kagera	4,348	0	1,441	2,769	**8,558**	8,558		5%	5,248	5000
Kigoma	2,163	0	90	522	**2,774**	2,774		2%	1,702	2000
Kilimanjaro	3,478	691	24,901	4,947	**34,017**	34,017		21%	20,863	20000
Lindi	39	3	96	149	**288**	288		0%	177	500
Manyara	888	50	822	2,474	**4,233**	4,233		3%	2,596	2500
Mara	3,137	13	511	40	**3,701**	3,701		2%	2,270	2500
Mbeya	5,232	181	3,856	15,921	**25,191**	25,191		15%	15,450	15000
Morogoro	883	1	289	1,801	**2,974**	2,974		2%	1,824	2000
Mtwara	347	0	25	336	**708**	708		0%	434	500
Mwanza	5,881	0	451	53	**6,384**	6,384		4%	3,915	4000
Pwani	486	33	318	35	**872**	872		1%	535	500
Rukwa	2,167	7	176	1,210	**3,560**	3,560		2%	2,183	2500
Ruvuma	1,291	18	1,080	10,970	**13,360**	13,360		8%	8,194	8000
Shinyanga	7,389	35	533	68	**8,025**	8,025		5%	4,922	5000
Singida	724	41	74	255	**1,095**	1,095		1%	671	1000
Tabora	3,293	27	52	272	**3,644**	3,644		2%	2,235	2000
Tanga	4,695	20	2,277	260	**7,251**	7,251		4%	4,447	4500
Zanzibar	1,645	16	423	5	**2,089**					
Total	**60,192**	**1,504**	**45,889**	**57,555**	**165,139**	**163,051**		**100%**	**100,000**	**100,000**

Investment costs Modified CAMARTEC *for construction in bricks* *[PKR]*

		unit	4 m³ digester qty	4 m³ digester costs	4 m³ digester total	6 m³ digester qty	6 m³ digester costs	6 m³ digester total	9 m³ digester qty	9 m³ digester costs	9 m³ digester total	13 m³ digester qty	13 m³ digester costs	13 m³ digester total
1	**Contribution farmer in kind**													
1.1	Unskilled labour	[person days]	10	85.000		12	102.000		14	119.000		16	136.000	
1.2	Sand	[m³]	2,5	62.500		3,0	75.000		4,0	100.000		5,0	125.000	
1.3	Gravel	[m³]	0,8	16.000		1,0	20.000		1,5	30.000		2,0	40.000	
1.4	Stones	[m³]	0,5	12.000		0,5	12.000		0,5	12.000		0,5	12.000	
1	**Total farmer contribiution**				**175.500**			**209.000**			**261.000**			**313.000**
2	**Supplied materials**													
2.1	Cement	[bags]	12	192.000		14	224.000		18	288.000		25	400.000	
2.2	Bricks	[piece]	590	188.800		770	246.400		1.010	323.200		1.350	432.000	
2.3	Lime	[bags]	2	15.000		2	15.000		3	22.500		4	30.000	
2.4	Cement waterproofing	[kg]	3	5.400		4	7.200		5	9.000		6	10.800	
2.6	Fitting material & sundry	[set price]	[ls]	200.000		[ls]	200.000		[ls]	200.000		[ls]	200.000	
2.7	Appliances	[set price]	[ls]	70.000		[ls]	70.000		[ls]	120.000		[ls]	120.000	
2	**Total materials**				**671.200**			**762.600**			**962.700**			**1.192.800**
3	**Technical services**													
3.1	Skilled labour	[person days]	2	40.000		2	40.000		2	40.000		2	40.000	
3.2	Semi skilled labour	[person days]	4	60.000		5	75.000		6	90.000		7	105.000	
3.3	Annual maintenance fee	[fee per visit]	2	10.000		2	10.000		2	10.000		2	10.000	
3	**Total services**				**110.000**			**125.000**			**140.000**			**155.000**
4	**Company fee**													
4.1	Overhead	[person days]	2	40.000		2	40.000		2	40.000		2	40.000	
4.2	Risk coverage	[share of 2]	5%	33.560		5%	38.130		5%	48.135		5%	59.640	
4.3	Company profit	[share of 2+3]	15%	117.180		15%	133.140		15%	165.405		15%	202.170	
4	**Total company fee**				**190.740**			**211.270**			**253.540**			**301.810**
5	**Programme fee**													
5.1	Participation fee	[once]		5.000			5.000			10.000			10.000	
5	Total programme fee				**5.000**			**5.000**			**10.000**			**10.000**
	Total investment				**1.152.440**			**1.312.870**			**1.627.240**			**1.972.610**
	Total investment [Euro]				*627*			*714*			*885*			*1.073*

Investment costs Modified CAMARTEC *for construction stabilized blocks (20 b/b)* *[PKR]*

		unit	4 m³ digester qty	4 m³ digester costs	4 m³ digester total	6 m³ digester qty	6 m³ digester costs	6 m³ digester total	9 m³ digester qty	9 m³ digester costs	9 m³ digester total	13 m³ digester qty	13 m³ digester costs	13 m³ digester total
1	**Contribution farmer in kind**													
1.1	Unskilled labour	[person days]	10	85.000		12	102.000		14	119.000		16	136.000	
1.2	Sand	[m³]	2,5	62.500		3,0	75.000		4,0	100.000		5,0	125.000	
1.3	Gravel	[m³]	0,8	16.000		1,0	20.000		1,5	30.000		2,0	40.000	
1.4	Stones	[m³]	0,5	12.000		0,5	12.000		0,5	12.000		0,5	12.000	
1	**Total farmer contribiution**				**175.500**			**209.000**			**261.000**			**313.000**
2	**Supplied materials**													
2.1	Cement	[bags]	10	160.000		12	192.000		16	256.000		23	368.000	
2.2	Blocks	[piece]	120	144.000		160	192.000		210	252.000		280	336.000	
2.3	Lime	[bags]	2	15.000		2	15.000		3	22.500		4	30.000	
2.4	Cement waterproofing	[kg]	3	5.400		4	7.200		5	9.000		6	10.800	
2.6	Fitting material & sundry	[set price]	[ls]	200.000		[ls]	200.000		[ls]	200.000		[ls]	200.000	
2.7	Appliances	[set price]	[ls]	70.000		[ls]	70.000		[ls]	120.000		[ls]	120.000	
2	**Total materials**				**594.400**			**676.200**			**859.500**			**1.064.800**
3	**Technical services**													
3.1	Skilled labour	[person days]	2	40.000		2	40.000		2	40.000		2	40.000	
3.2	Semi skilled labour	[person days]	3	45.000		4	60.000		5	75.000		6	90.000	
3.3	Annual maintenance fee	[fee per visit]	2	10.000		2	10.000		2	10.000		2	10.000	
3	**Total services**				**95.000**			**110.000**			**125.000**			**140.000**
4	**Company fee**													
4.1	Overhead	[person days]	2	40.000		2	40.000		2	40.000		2	40.000	
4.2	Risk coverage	[share of 2]	5%	29.720		5%	33.810		5%	42.975		5%	53.240	
4.3	Company profit	[share of 2+3]	15%	103.410		15%	117.930		15%	147.675		15%	180.720	
4	**Total company fee**				**173.130**			**191.740**			**230.650**			**273.960**
5	**Programme fee**													
5.1	Participation fee	[once]		5.000			5.000			10.000			10.000	
5	Total programme fee				**5.000**			**5.000**			**10.000**			**10.000**
	Total investment				**1.043.030**			**1.191.940**			**1.486.150**			**1.801.760**
	Total investment [Euro]				*567*			*648*			*808*			*980*

1	Promotion & marketing	unit	Planned activities						rate	Budget					
			1	2	3	4	5	total		1	2	3	4	5	total
1.01	Development prom material	ls/year	1		1			**2**	3.000,00	3.000	-	3.000	-	-	**6.000**
1.02	Repro & distrib prom mat	ls/plant	500	1050	2100	3100	5250	**12000**	2,50	1.250	2.625	5.250	7.750	13.125	**30.000**
1.03	Promotion activities	ls/region	5	13	21	21	21	**81**	500,00	2.500	6.500	10.500	10.500	10.500	**40.500**
1.04	Biogas awareness & promotion wsp	# of wsp	25	53	105	155	263	**600**	568,41	14.210	29.841	59.683	88.103	149.207	**341.043**
1.11	Biogas Market PRA	PRA/new reg	5	8	8	0	0	**21**	815,89	4.079	6.527	6.527	-	-	**17.134**
	Total promotion									**25.040**	**45.493**	**84.960**	**106.353**	**172.832**	**434.677**
									TZS x 1000	*46.035*	*83.639*	*156.196*	*195.527*	*317.746*	*799.143*

2	Finance	unit	Planned activities						rate	Budget					
			1	2	3	4	5	total		1	2	3	4	5	total
2.01	Subsidy transfer & administration	# of transfers	500	1050	2100	3100	5250	**12000**	0,25	125	263	525	775	1.313	**3.000**
2.11	Annual financial audit	audit	1	1	1	1	1	**5**	2.719,65	2.720	2.720	2.720	2.720		**10.879**
2.12	Management audit	audit		1		1		**2**	1.631,79	-	1.632	-	1.632		**3.264**
2.21	Financial software / updates	ls								750	375	375	375	375	**2.250**
	Total finance									**3.595**	**4.989**	**3.620**	**5.501**	**1.688**	**19.392**
									TZS x 1000	*6.609*	*9.172*	*6.655*	*10.114*	*3.102*	*35.652*

3	Private sector support	unit	Planned activities						rate	Budget					
			1	2	3	4	5	total		1	2	3	4	5	total
3.01	Biogas Sector Survey	survey		1				**1**	2.175,72	-	2.176	-	-	-	**2.176**
3.02	Biogas business dev seminar	# of seminar			1	1	1	**3**	750,00	-	-	750	750	750	**2.250**
3.03	BCE assessment & coaching	# of BCE			30	35	40	**105**	200,00	-	-	6.000	7.000	8.000	**21.000**
	Total private sector support									**-**	**2.176**	**6.750**	**7.750**	**8.750**	**25.426**
									TZS x 1000	*-*	*4.000*	*12.410*	*14.248*	*16.087*	*46.745*

4	Quality management	unit	Planned activities						rate	Budget					
			1	2	3	4	5	total		1	2	3	4	5	total
	Plant completion visits	*100% prod*	*500*	*1050*	*2100*	*3100*	*5250*	***12000***	*by BCE*						
	Plant annual maintenance vists	*100% cumm*		*500*	*1550*	*3650*	*6750*	***12450***	*by BCE*						
4.01	BCE plant report processing	# of reports	500	1550	3650	6750	12000	**24450**	0,25	125	388	913	1.688	3.000	**6.113**
4.11	QC completed visits	10%	50	105	210	310	525	**1200**	21,37	1.068	2.243	4.487	6.623	11.217	**25.639**
4.12	QC under construction visits	6%	30	63	126	186	315	**720**	17,09	513	1.077	2.154	3.179	5.384	**12.307**
4.13	QC after sales service visits	6%		30	93	219	405	**747**	14,24	-	427	1.325	3.119	5.769	**10.640**
4.14	QC administration / processing	# of reports	80	198	429	715	1245	**2667**	0,25	20	50	107	179	311	**667**
	QC teams:		*1*	*1*	*2*	*3*	*3*								
4.21	Honda XL 125	motorcycle	2	0	2	2	0	**6**	1.359,82	2.720	-	2.720	2.720	-	**8.159**
4.22	QM technical equipment	set	2	0	2	2	0	**6**	50,00	100	-	100	100	-	**300**
4.23	QM IT-equipment	set	2	0	2	2	0	**6**	350,00	700	-	700	700	-	**2.100**
4.24	GPS equipment technicians	set	2	0	2	2	0	**6**	80,00	160	-	160	160	-	**480**
4.25	GPS equipment supervisors	set	0	7	7	6	13	**33**	80,00	-	525	525	500	1.075	**2.625**
4.31	GIS software & maintenance	ls/year								500	150	150	150	150	**1.100**
4.32	QM database software & maint	ls/year								2.500	750	750	750	750	**5.500**
	Total quality management									**8.406**	**5.610**	**14.090**	**19.868**	**27.656**	**75.629**
									TZS x 1000	*15.454*	*10.313*	*25.903*	*36.527*	*50.845*	*139.042*

5	Training	unit	Planned activities						rate	Budget					
			1	2	3	4	5	total		1	2	3	4	5	total
5.10	*Certified masons*	*# of persons*	*25*	*53*	*105*	*155*	*263*								
	New mason requirement	*# of persons*	*25*	*28*	*53*	*50*	*108*	***263***							
5.11	Biogas mason trg courses	# of trg crs	2	2	4	4	8	**20**	10.163,86	19.057	20.963	40.020	38.114	81.946	**200.101**
5.12	Biogas mason refresher training	# of trg crs		1	3	8	14	**26**	2.191,22	-	2.283	7.076	16.662	30.814	**56.835**
5.13	Development mason manual	lump sum	1		1			**2**	750,00	750	-	750	-	-	**1.500**
5.14	Print & distrib mason manual	# of docs	38	41	79	75	161	**394**	2,50	94	103	197	188	403	**984**
5.15	ToT Biogas mason trainers	# of trg crs	1	1	1	1	1	**5**	1.732,14	1.732	1.732	1.732	1.732	1.732	**8.661**
5.16	ToT refresher Biogas mason trainers	# of trg crs		1	2	2	3	**8**	1.214,59	-	1.215	2.429	2.429	3.644	**9.717**
5.20	*Certified supervisors*	# of persons		*7*	*13*	*19*	*33*								
	New supervisor requirement	# of persons		*7*	*7*	*6*	*13*	***33***							
5.21	Biogas supervisor trg (12 pers)	# of trg crs		1	1	1	2	**4**	1.875,20	-	1.538	1.538	1.465	3.150	**7.691**
5.22	Biogas supervisor refr trg (12 pers)	# of trg crs			1	2	3	**5**	539,31	-	-	295	885	1.756	**2.935**
5.23	Development supervisor manual	lump sum		1		1		**2**	500,00	-	500	-	500	-	**1.000**
5.24	Print & distrib supervisor manual	# of docs		8	8	8	17	**41**	2,50	-	21	21	20	42	**103**
5.25	ToT Biogas supervisor trainers	# of trg crs		1			1	**2**	855,60	-	856	-	-	856	**1.711**
5.26	ToT refresher Biogas supervisor trainers	# of trg crs			1	1	1	**3**	819,70	-	-	820	820	820	**2.459**
5.31	Biogas Programme (NGO / GO / PSD staff)	# of wsp	1	1	2	3	4	**11**	580,37	580	508	1.016	1.499	2.539	**6.142**
5.32	Village extension service providers	# of wsp	1	3	5	8	13	**30**	571,40	571	1.500	3.000	4.428	7.500	**16.999**
5.33	Loan officer (Bank / SACCO)	# of wsp	1	1	2	3	4	**11**	335,06	335	293	586	866	1.466	**3.546**
5.41	Operation & maintenance trg	# of trg crs	17	35	70	103	175	**400**	356,00	5.933	12.460	24.920	36.787	62.300	**142.401**
5.42	Bioslurry application trg	# of trg crs	20	42	84	124	400	**670**	460,71	9.214	19.350	38.699	57.128	184.283	**308.674**
5.43	Develop user man & guar card	lump sum	1		1			**2**	1.500,00	1.500	-	1.500	-	-	**3.000**
5.44	Reproduction user man & guar card	# of docs	600	1260	2520	3720	6300	**14400**	1,50	900	1.890	3.780	5.580	9.450	**21.600**
5.45	Develop bioslurry application manual	lump sum	1		1			**2**	1.250,00	1.250	-	1.250	-	-	**2.500**
5.46	Reproduction bioslurry application manua	# of docs	500	1050	2100	3100	5250	**12000**	1,00	500	1.050	2.100	3.100	5.250	**12.000**
5,51	ToT Awareness & promotion	# of trg crs	1	1	1	1	1	**5**	439,77	440	440	440	440	440	**2.199**
5,52	ToT Awareness & promotion refresher	# of trg crs		1	1	1	1	**4**	517,55	-	518	518	518	518	**2.070**
5,53	ToT Operation & maintenance	# of trg crs	1	1	1	1	1	**5**	302,15	302	302	302	302	302	**1.511**
5,54	ToT Operation & maintenance refresher	# of trg crs		1	1	1	1	**4**	445,75	-	446	446	446	446	**1.783**
5,55	ToT Bioslurry application	# of trg crs	1	1	1	1	1	**5**	460,71						
5,56	ToT Bioslurry application refresher	# of trg crs		1	1	1	1	**4**	505,58						
5,61	Consultancy trg development	# of adv days	40		10		10	**60**	90,00	3.600	-	900	-	900	**5.400**
5,62	Curricula dev technical trg	ls/curr	1		1			**2**	1.750,00	1.750	-	1.750	-	-	**3.500**
5,63	Dev & distrib technical manuals	ls/year	1		1				2.000,00	2.000	-	2.000	-	-	**4.000**
	Total training									**50.509**	**67.966**	**138.084**	**173.908**	**400.555**	**831.022**
									TZS x 1000	*92.860*	*124.953*	*253.864*	*319.725*	*736.410*	*1.527.813*

6	Extension	unit	Planned activities						rate	Budget					
			1	2	3	4	5	total		1	2	3	4	5	total
6.11	Bioslurry demo plots	plots	20	42	84	124	210	**480**	30,00	600	1.260	2.520	3.720	6.300	**14.400**
6,21	Bioslurry - fertilizer study	study		1		1		**2**	4.500,00	-	4.500	-	4.500	-	**9.000**
6,22	Bioslurry - sanitation study	study		1		1		**2**	4.500,00	-	4.500	-	4.500	-	**9.000**
6,24	Biogas - organic farming study	study			1			**1**	4.500,00	-	-	4.500	-	-	**4.500**
	Total extension									**600**	**10.260**	**7.020**	**12.720**	**6.300**	**36.900**
									TZS x 1000	*1.103*	*18.863*	*12.906*	*23.385*	*11.582*	*67.840*

7	Institutional support	unit	Planned activities						rate	Budget					
			1	2	3	4	5	total		1	2	3	4	5	total
7,01	National Steering Committee	ls/yr	1	1	1	1	1	**5**	1.750,00	1.750	2.750	1.750	2.750	1.750	**10.750**
7,02	BCE association support	ls/yr	1	1	1	1	1	**5**	3.000,00	3.000	3.000	3.000	3.000	3.000	**15.000**
7,03	Village network support	ls/yr	1	1	1	1	1	**5**	1.500,00	1.500	1.500	1.500	1.500	1.500	**7.500**
7,03	NGO network support	ls/yr	1	1	1	1	1	**5**	3.000,00	3.000	3.000	3.000	3.000	3.000	**15.000**
	Total institutional support									**9.250**	**10.250**	**9.250**	**10.250**	**9.250**	**48.250**
									TZS x 1000	*17.006*	*18.844*	*17.006*	*18.844*	*17.006*	*88.706*

8	Monitoring & evaluation	unit	Planned activities						rate	Budget					
			1	2	3	4		total		1	2	3	4	5	total
8.01	Domestic energy baseline	survey	1					**1**	3.263,57	3.264	-	-	-	-	**3.264**
8.02	Biogas user survey	survey		1	1	1	1	**4**	3.263,57	-	3.264	3.264	3.264	3.264	**13.054**
8.03	Environmental impact study	study				1		**1**	4.500,00	-	-	-	4.500	-	**4.500**
										-	-	-	-	-	**-**
8.41	External project evaluation	evaluation			1			**1**	8.000,00	-	-	8.000	-	-	**8.000**
8.42	External project final evaluation	evaluation					1	**1**	10.000,00	-	-	-	-	10.000	**10.000**
	Total extension									**3.264**	**3.264**	**11.264**	**7.764**	**13.264**	**38.818**
									TZS x 1000	*6.000*	*6.000*	*20.708*	*14.273*	*24.385*	*71.366*

9	R & D / Standardization	unit	Planned activities						rate	Budget					
			1	2	3	4	5	total		1	2	3	4	5	total
9.01	Modified Camartec design & boq	ls	1					**1**	1.250,00	1.250	-	-	-	-	**1.250**
9.02	Modified Camartec field testing	ls	1					**1**	5.000,00	5.000	-	-	-	-	**5.000**
9.03	Constr std development & formulation	ls	1			1		**2**	500,00	500	-	-	500	-	**1.000**
9.04	A.S.S std development & fomulation	ls	1			1		**2**	500,00	500	-	-	500	-	**1.000**
9.04	Appliances std dev & formulation	ls	1			1		**2**	500,00	500	-	-	500	-	**1.000**
9.04	Standards printing & distribution	booklet	38	51	89	84	181	**443**	3,00	113	153	266	253	544	**1.329**
9.11	MSc / BSc study support	ls/study		1	2	3	4	**10**	500,00	-	500	1.000	1.500	2.000	**5.000**
9.12	R&D support	ls/study		1	2	2	2	**7**	1.000,00	-	1.000	2.000	2.000	2.000	**7.000**
9,21	R&D biogas stove	ls/study			1			**1**	4.000,00	-	-	4.000	-	-	**4.000**
9,22	R&D biogas lamp	ls/study			1			**1**	1.500,00	-	-	1.500	-	-	**1.500**
	Total research & development									**7.863**	**1.653**	**8.766**	**5.253**	**4.544**	**28.079**
									TZS x 1000	*14.455*	*3.040*	*16.116*	*9.658*	*8.354*	*51.622*

10	HR & management	unit	Planned activities						rate	Budget					
			1	2	3	4	5	total		1	2	3	4	5	total
10.01	Programme Coordinator	pers month	12	12	12	12	12	**60**	1.835,76	22.029	22.029	22.029	22.029	22.029	**110.146**
10.02	Chief Finance & Administration	pers month	12	12	12	12	12	**60**	1.321,75	15.861	15.861	15.861	15.861	15.861	**79.305**
10.03	Finance officer	pers month	12	12	12	12	12	**60**	1.028,03	12.336	12.336	12.336	12.336	12.336	**61.682**
10.04	Officer Promotion and PR	pers month	12	12	12	12	12	**60**	881,16	10.574	10.574	10.574	10.574	10.574	**52.870**
10.05	Training Officer	pers month	12	12	12	12	12	**60**	1.101,46	13.217	13.217	13.217	13.217	13.217	**66.087**
10.06	Extension officer	pers month	12	12	12	12	12	**60**	881,16	10.574	10.574	10.574	10.574	10.574	**52.870**
10.07	ICT Officer	pers month	12	12	12	12	12	**60**	954,60	11.455	11.455	11.455	11.455	11.455	**57.276**
10.08	Chief Biogas Technician	pers month	12	12	12	12	12	**60**	1.174,89	14.099	14.099	14.099	14.099	14.099	**70.493**
10.09	Exec secretary	pers month	12	12	12	12	12	**60**	734,30	8.812	8.812	8.812	8.812	8.812	**44.058**
10.10	Biogas Technician	pers month	24	24	48	72	72	**240**	734,30	17.623	17.623	35.247	52.870	52.870	**176.233**
10.11	Data processer	pers month	9	12	24	24	24	**93**	587,44	5.287	7.049	14.099	14.099	14.099	**54.632**
10.12	Support staff	pers month	12	12	24	24	24	**96**	257,01	3.084	3.084	6.168	6.168	6.168	**24.673**
															-
10.21	Indirect support staff costs	ls						**0**		7.248	7.336	8.724	9.605	9.605	**42.516**
10.22	Staff development	ls/pers						**0**		14.495	14.671	17.447	19.209	19.209	**85.032**
10.23	DSA (ex technical staff)	days out	240	240	240	240	240	**1200**	21,76	5.222	5.222	5.222	5.222	5.222	**26.109**
10.24	Transportation	trip km	20000	25000	30000	30000	30000	**135000**	0,15	3.000	3.750	4.500	4.500	4.500	**20.250**
10.25	Motorcycle Honda XL 125	pcs	1	1					1.359,82	1.360	1.360	-	-	-	**2.720**
10.26	Vehicle Toyota pick-up double cabin	pcs	1						16.317,87	16.318	-	-	-	-	**16.318**
10.41	Office rent	ls/month	12	12	12	12	12	**60**	750,00	9.790	9.992	13.185	15.211	15.211	**63.389**
10.42	Utilities	ls/month	12	12	12	12	12	**60**	250,00	9.032	9.310	12.577	14.604	14.604	**60.127**
10.43	Office expenses	ls/month	12	12	12	12	12	**60**	400,00	9.655	8.301	11.432	13.458	13.458	**56.303**
10.44	Office furniture	ls						**0**		10.000	750	2.000	1.000	1.000	**14.750**
10.45	Office equipment	ls						**0**		15.000	1.500	1.500	1.500	15.000	**34.500**
10.46	Other office expenses	ls	12	12	12	12	12	**60**	500,00	6.000	6.000	6.000	6.000	6.000	**30.000**
	Total operational expenses									**252.071**	**214.906**	**257.056**	**282.403**	**295.903**	**1.302.339**
									TZS x 1000	*463.426*	*395.099*	*472.591*	*519.191*	*544.010*	*2.394.318*

1	Technical assistance	unit	Planned activities						rate	Budget					
			1	2	3	4	5	total		1	2	3	4		total
1,01	Senior Technical Advisor (International)	pers day	100	100	100	100	100	**500**	850,00	85.000	85.000	85.000	85.000	85.000	**425.000**
1,02	Medior Technical Advisor (International)	pers day	150	150	150	150	150	**750**	750,00	112.500	112.500	112.500	112.500	112.500	**562.500**
1,03	Junior Technical Advisor (International)	pers day						**0**	600,00	-	-	-	-	-	**-**
	Total ITA									**197.500**	**197.500**	**197.500**	**197.500**	**197.500**	**987.500**

1	Camartec service fee salaries	unit	Planned activities							rate		Budget						
			1		2	3	4	5	total	TZS	€	1		2	3	4	4	total
			a	b								a	b					
1.01	Director General	days/month	4	4	3	2	2	2		183.848	100,00	2.400	2.400	3.600	2.400	2.400	2.400	**15.600**
1.02	Acting Programme Coordinator	days/month	20							147.078	80,00	9.600	-	-	-	-	-	**9.600**
1.03	Senior Biogas Technologist	days/month	15	10	5	5	3	2		128.693	70,00	6.300	4.200	4.200	4.200	2.520	1.680	**23.100**
1.04	Biogas Engineer	days/month	15	10	5	5	3	2		73.539	40,00	3.600	2.400	2.400	2.400	1.440	960	**13.200**
1.05	Manager Finance	days/month	10	5	4	4	4	2		91.924	50,00	3.000	1.500	2.400	2.400	2.400	1.200	**12.900**
1.06	Internal Auditor	days/month	5	5	3	2	2	2		36.770	20,00	600	600	720	480	480	480	**3.360**
1.07	Manager Human Resources	days/month	5	5	3	2	1	1		55.154	30,00	900	900	1.080	720	360	360	**4.320**
1.08	Administrative Assistant	days/month	5	5	3					18.385	10,00	300	300	360	-	-	-	**960**
	Total Camartec service fee salaries											**26.700**	**12.300**	**14.760**	**12.600**	**9.600**	**7.080**	**83.040**

2	Camartec service fee operations	unit	Planned activities							rate		Budget						
			1		2	3	4	5	total	TZS	€	1		2	3	4	5	total
			a	b								a	b					
2.01	Office rent	ls/month	6	6	12	12	12	12	**60**	735.390	400,00	2.400	2.400	4.800	4.800	4.800	4.800	**24.000**
2.02	Utitilities, consumables, other	ls/month	6	6	12	12	12	12	**60**	459.619	250,00	1.500	1.500	3.000	3.000	3.000	3.000	**15.000**
2.03	Transport	ls/month	6	6	12	12	12	12	**60**	459.619	250,00	1.500	1.500	3.000	3.000	3.000	3.000	**15.000**
	Total Camartec service fee operatios											**5.400**	**5.400**	**10.800**	**10.800**	**10.800**	**10.800**	**54.000**

Summary Camartec sevice fee *[Euro]*

Description		Budget						
		1		2	3	4	5	total
		a	b					
1	Salary costs	26.700	12.300	14.760	12.600	9.600	7.080	**83.040**
2	Operating costs	5.400	5.400	10.800	10.800	10.800	10.800	**54.000**
	Total Camartec service fee	**32.100**	**17.700**	**25.560**	**23.400**	**20.400**	**17.880**	**137.040**

Summary project budget by activity *(corrected for inflation)* *[Euro]*

		Summary project budget							*[Euro]*
		1	2	3	4	5	total	total / plant	share
	Forecast production	*500*	*1050*	*2100*	*3100*	*5250*	***12000***		
	Total investment *(incl subsidy and financing)*	432.883	963.438	2.041.449	3.191.622	5.722.435	**12.351.827**	1.029,32	*74%*
								1.029,32	*74%*
1	Promotion & marketing	25.040	46.858	90.134	116.215	194.523	**472.770**	39,40	*3%*
2	Finance	3.595	5.139	3.840	6.012	1.899	**20.484**	1,71	*0%*
3	Private sector development	-	2.241	7.161	8.469	9.848	**27.719**	2,31	*0%*
4	Quality management	8.406	5.778	14.948	21.710	31.127	**81.969**	6,83	*0%*
5	Training	50.509	70.005	146.494	190.034	450.828	**907.869**	75,66	*5%*
6	Extension	600	10.568	7.448	13.899	7.091	**39.606**	3,30	*0%*
7	Institutional support	9.250	10.558	9.813	11.200	10.411	**51.232**	4,27	*0%*
8	Monitioring & Evaluation	3.264	3.361	11.950	8.483	14.928	**41.986**	3,50	*0%*
9	Research and development	7.863	1.703	9.300	5.740	5.115	**29.720**	2,48	*0%*
10	HR and management	252.071	221.353	272.711	308.589	333.041	**1.387.766**	115,65	*8%*
								255,09	*18%*
	Contingencies *(activities only)*	18.030	18.878	28.690	34.518	52.941	**153.056**	12,75	*1%*
	International technical assistance	197.500	201.450	205.479	209.589	213.780	**1.027.798**	85,65	*6%*
	Camartec service fee	49.800	24.948	23.814	21.949	23.046	**143.557**	11,96	*1%*
								110,37	*8%*
	Total project	**1.058.809**	**1.586.277**	**2.873.229**	**4.148.029**	**7.071.014**	**16.737.357**	**1.394,78**	***100%***
	million TZS	*1.947*	*2.916*	*5.282*	*7.626*	*13.000*	***30.771***	*2.564*	

Application of funds		[Euro]	[%]	per plant	[Euro]
	Investment				
1a	Household investment	8.111.411	*66%*	675,95	
1b	Credit financing costs	1.955.914	*16%*	162,99	
1c	Investment subsidy	2.284.502	*18%*	190,38	
	Total investment	**12.351.827**	*74%*		**1.029,32**
	Techncial assistance				
2a	Support activities	3.214.176	*73%*	267,85	
2b	International technical assistance	1.027.798	*23%*	85,65	
2c	Camartec service fee	143.557	*3%*	11,96	
	Total project support	**4.385.531**	*26%*		**365,46**
	Total application	**16.737.357**			**1.394,78**

Source of funds		[Euro]	[%]	per plant	[Euro]
a	**Households**				
a1	Household investment	8.111.411	*81%*	675,95	
a2	Credit financing costs	1.955.914	*19%*	162,99	
	Total participating farmers	**10.067.325**	*60%*		***838,94***
b	**Government of Tanzania**	*(not yet committed)*			
b1	REF (subs comp)	1.357.851	*100%*	113,15	
	Total Gvt of Tanzania	**1.357.851**	*8%*		***113,15***
c	**Official Development Aid**	*(not yet committed)*			
c1	ABPP (subs comp + act comp)	3.580.000	*67%*	298,33	
c2	SNV (ITA comp)	1.027.798	*19%*	85,65	
c3	Other (act comp)	704.384	*13%*	58,70	
	Total ODA	**5.312.182**	*32%*		***442,68***
	Total source	**16.737.357**			***1.394,78***

1 List of meetings.

Friday 25th of July 2008		
16:30 – 21:30	Travel Appingedam – Utrecht	
Saturday 26th of July 2008		
06:15 – 08:00	Travel Utrecht – Schiphol	
10:20 – 22:00	Travel Schiphol/Netherlands – Arusha/Tanzania KL 0571	
Sunday 27th of July 2008		
10:00 – 13:00	Inception meeting	– Peter Bos, SNV Advisor Market Access, [pbos@snvworld.org]
Monday 28th of July 2008		
08:00 – 08:30	SNV-Arusha	– Mr. Joel Kalagao, Portfolio Coordinator SNV-Arusha, [jkalagao@snvworld.org]
09:00 – 13:30	Camartec inception meeting	– Dr. Patrick J. Makungu, Director General Camartec, [pjmakungu@yahoo.com] – Mr. Harold Z. Ngowi, Principal Technologist, [haroldngowi@yahoo.com] – Mr. Evarist Ng'wandu, Director R&D Renewable Energy and PID team member, [evarist_ng@yahoo.com] – Mr. Lehada C. Shila, Shebrila & Co Consultant, PID team member, [clshila@yahoo.com]
13:30 – 16:30	Visits biogas household Visit non-biogas household	– Mr. Ndelekwa Ayo – Mr. Felix Urassa – Team
Tuesday 29th of July 2008		
08:30 – 10:00	Camartec compound tour	– Mr. Harold Ngowi – Mr. Peter Bos – Team
10:30 – 12:30	Evangelical Lutheran Church in Tanzania	– Mr. Brighton B.L. Killewa, Secretary General, [bkillewa@yahoo.com] – Mr. Noah Mollel, Diocesan Project Secretary – Mr. Peter Bos, SNV northern portfolio – Team
13:30 – 14:45	Arusha Biogas Constructors	– Mr. Sanford Kombe, Director – Mr. Peter Bos – Team
15:00 – 16:00	SIDO Arusha	– Mr. I.B. Kiyenze, Regional Manager, [ibkiyenze@yahoo.com] – Mr. Stefano Leyani – Mr. Peter Bos – Team
19:00 – 20:30	SNV office team meeting	– Mr. Peter Bos – Team
Wednesday 30th of July 2008		
08:00 – 09:00	SNV office, preparation biogas task force meeting	
09:00 – 14 :30	Biogas task force meeting	–
17:00 – 18:30	FIDE	– Mr. Mgalla, Director
Thursday 31st of July 2008		
08:00 – 09:00	SNV-Arusha	
09:00 – 12:00	Travel Arusha - Babati	
12:00 – 15:00	FIDE Babati	Mr. Innocenti Zacharia, FIDE staff
	Visit biogas household	Mr.& Mrs Kasmir Haloa
15:00 – 21:30	Travel Babati – Dodoma	- The team
Friday 1st of August 2008		
09:00 – 10:00	MIGESADO	Mr. Herbert Kitange ,Director
10:00 – 12:00	Visit Nane-nane Dodoma	Team
13:00 – 19:00	Visit biogas household Dodoma Rural	Mrs. John Kongola
	Visit KISEDET, Kigwe. Biogas institution	Mr. Nino Trangi
Saturday 2nd of August 2008		
08:30 – 11:00	Visit Nane-nane Dodoma	Team
	Meeting REA	Mr. Jaina Msuya, Public Relations Officer, [jdmsuya@rea.gov.tz]
	Meeting Ensol Tanzania (Solar company)	Mr. Lauden S. Mwamelo [solartz@yahoo.com]
	Meeting Rex Solar Energy Contractors (ICS manufacturer)	
	Meeting SIDO	Mr. Henrick L. Mdede, Marketing Manager, [chamlemdede@gmail.com]

11:00 – 14:00	Meeting biogas appliance manufacturer	Mr. Ali Hussein
16:00 – 17:00	Visit Nane-nane Dodoma	
	Introduction MIGESADO board chair	Mrs. Mary Bonaventure
Sunday 3rd of August 2008		
09:00 – 11-00	Visit Nane-nane (Farmers Day) Dodoma	
	Meeting ARTI-TZ	Mr. Joy Desai, Operations Director
	Meeting MIGESADO board chair	Mrs Mary Bonaventure
11:00 -	Travel Dodoma – Dar Es Salaam	Team
Monday 4th of August 2008		
09:00 – 10:00	Meeting Ministry of Trade, Industries & Marketing	Mrs Eline S Sikawe ,Director for Industry Development, Mrs Elly Pallangyo ,Asst Director R&D
10:00 – 12:00	Meeting Private Companies in Biogas-Dar-Es salaam.	Mr Hamisi Kalumenza,CEO AEC Mr.Ainea Kimaro 0754 898 227 Mr. Bakili Ally 0713 608 388
13:00 – 17:00	SNV offices in Dar	Mr. Jan de Witte, Country Director
18:00 - 20:00	Meeting Tanga Dairy	Mr. Fischer, Technical Adviser
Tuesday 5 th of August 2008		
09:00 – 11:00	Meeting Ministry of Energy and Minerals	Mr Paul Kiwele , Principal Forest Officer Mr. Mkoma Masanyiwa, Forester (Biogas)
12:00- 01:30	Meeting Assistant Commissioner Renewable Energy-MEM	Mr. Ngosi N.Mwihava, Eng
02:30 – 17:00	Meeting Ministry of Livestock Development and Fisheries	Mr.Dickson Koggani, Livestock Officer
Wednesday 6th of August 2008		
09:00 –10:30	Meeting Rural Energy Agency	Mr Lutengano U Mwakahesya,Director General
11:00 – 12:00	Meeting SCCULT	Mr Peter T. Mashingia, Operations Manager
02:00 – 03:30	Meeting Embassy of The Netherlands Dar	Ambassador Karel van Kesteren
Thursday 7 th of August 2008		
06:450 –7:30	Meeting Norwegian Embassy	Mr Ivar Jorgensen,Counsellor ,Environment/Climate Change
09:00 – 10:00	Meeting Vice President Office-Division of Environment	Mrs Angelina Madete,Asst Director Environment,Pollution control Mr Daniel Nkondolo,GEF desk Officer(Biogas)
11.00 – 12:30	Meeting TATEDO	Mr Estomih N. Sawe,Excutive Director Mr Godffrey Sanga,Eng Sustainable Energy Tech (incl Biogas) Mr Leonard Pesambili ,Biomas Energy
02:00 – 03:30	Meeting Embassy of The Netherlands Dar	Ambassador Karel van Kesteren
18:00 - 20:00	Meeting NMB Head Office	Mr Bas Nierop ,Chief Commercial Officer
Friday 8th of August 2008		
09:00 –10:30	Meeting Swedish Embassy	Mr Jan Graftstrom , Counsellor, Private Sector Development
12:00 –01:30	Visiting Kibaha Education Centre farmer using biogas	Courtesy of Mr E Mwsia
02:00 – 19.00	Travel Dar-Es Salam Tanga	Team
Saturday 9th of August 2008		
07:00 – 19:00	PID Draft preparation	Team
Sunday 10th of August 2008		
07:00 – 19:00	PID draft preparation	Team
Monday 11th of August 2008		
07:00 – 19:00	Refining of Draft PID	Team
Tuesday 12th of August 2008		
07:00 – 19:00	Refining of Draft PID	Team
Wednesday 13th of August 2008		
08:00 – 18:00	National Biogas Workshop, Tanga	Task force
Thursday 14th of August 2008		
08:00 – 16:00	National Biogas Workshop, Tanga	Task force
Friday 15th of August 2008		
09:00 – 18:00	Refining of Draft PID	Team
Saturday 16th of August 2008		
10:00 – 17:00	Travel Tanga - Arusha	Team
Sunday 17th of August 2008		
10:00 – 14:00	Evaluation mission	Team + Peter Bos
15:00 – 17:00	Evalation GIS data livestock	Peter Bos
18:00	Departure Kilimanjaro Airport	
Monday 18th of August 2008		
06:00	Arrival Shiphol Airport	
13:00	Arrival Appingedam	

1. Introduction and background

In the framework of the „Biogas for Better Life" an African Initiative, a number of Tanzanian stakeholders with defined interest in domestic biogas promotion aims to facilitate in setting-up and the concrete implementation of a large-scale domestic biogas programme in Tanzania. Referring to the history of former biogas initiatives in Tanzania, the present increasing need for renewable and environmental friendly energy sources and the mainly positive outcome of the feasibility study conducted by GTZ in 2007, Tanzanian stakeholders aim to formulate a Programme Implementation Document (P.I.D.) for a national programme on domestic biogas in Tanzania. Already they have identified Centre For Rural Mechanization and Rural Technology (CAMARTEC) to coordinate and manage this future programme, a responsability CAMARTEC management is willing to fulfil. The aim of this document is to present the Terms of Reference (ToR) for formulating of this P.I.D.

2. Objective of the proposed programme

The overall objective of proposed national programme on domestic biogas is to further develop and disseminate domestic biogas in rural and semi-urban areas offering the Tanzanian population various advantages coming with the use of clean biogas for cooking and lighting and using the bio-slurry to increase agricultural yields with the ultimate goal to establish a sustainable and commercial biogas sector in Tanzania.

The tentative specific objectives contributing to its overall objectives are:

- To develop a commercially viable, market oriented biogas industry in Tanzania,
- To further strengthen involved institutions for sustainable development of the biogas sector,
- To provide low cost, clean and environmental friendly energy for cooking and lighting and reduce respiratory and eye diseases caused
- by indoor pollution from smoke inherent to traditional cooking,
- Improved sanitation both in the houses and environment,
- Time saving for mostly women and youth especially in rural areas for productive agriculture and family care & welfare,
- Creating jobs such as masons trained and involved in construction and management of biogas digesters at local level,
- Improved fertilization of the agricultural fields using the better and cheaper slurry compared to manure or synthetic fertilizers and promote organic farming.
- Environmental gains based in forest conservation reducing the use of firewood and charcoal and reduced Green House Gas emissions (GHG),

Based on the recent feasibility-study done by GTZ, there is ample potential for domestic biogas promotion and the initial targets are an increase of quality domestic biogas plants by 100.000 in ten years time.

3. Objective of the Terms of Reference

The main objective of the assignment is to prepare a detailed P.I.D. for the proposed national programme on domestic biogas in Tanzania to be presented to the African Initiative, Rural Energy Fund as established in 2005 by the Tanzanian Government and other interesting donors.

More specifically, the assignment will address the following in detail:

a) Overview of prices of construction materials in those locations suitable and potential for biogas promotion,
b) Propose an appropriate design of domestic biogas plant and its investment costs,
c) The implementation modalities of a national biogas programme,
d) Detail planning, budgeting and proposed financing structures with clear targets and human resources,
e) Propose institutional arrangements and their functions,
f) Propose strategies to overcome the issues and barriers.

4. Activities and methodologies

The following activities and methodologies are therefore proposed:

a) Study the feasibility report prepared by GTZ in 2007 and other relevant documents,
b) Linking with and incorporating initial lessons from ongoing national domestic biogas initiatives in line of the „Biogas for Better Life" an African Initiative,
c) As initial preparation, conduct a survey to identify prices of needed materials, agree on performance factors and match the CAMARTEC / MIGESADO and the Rwanda GGC designs (all 8 m3) with the performance factors as preparation for the constructors workshop.
d) Preparing an overview of the findings (= b and c) and present to a workshop which groups all identified biogas constructors both of the public, private or development institutions.
e) Facilitate the workshop to select;
   - a standard appropriate design + size(s) + investment costs for household based on agreed criteria and performance factors.
   - certification process for private sector constructors, and,
   - quality control mechanisms
f) Meetings with all relevant stakeholders.
g) Formulation of the preliminary draft P.I.D.

Time	Activities
3rd week of June.	Review of documents of the 3 selected designs, collection of information, drawing lessons from other national programmes, collect material prices, visit some biogas constructors and prepare the workshop for biogas constructors.
4th week of June	Facilitate the 3-days workshop of biogas constructors to select a standard model and agree on certification procedures and quality control mechanisms.
1st week of July to 4th week of August.	Interviews with all relevant stakeholders, formulation of draft P.I.D.
1st week of September	Presenting and facilitate discussion on the draft plan in a national workshop of all relevant stakeholders, to collect feedback and missing information.
2nd week of September	Submission of implementation plan to the Taskforce of Biogas stakeholders and M.E.M. Their observations on the document will be provided by email within one week!
3rd week of September	Submission of the final plan

h) Present and discuss the draft P.I.D. in a 2-days National Workshop involving all relevant major stakeholders, (see annexe-2 for proposed table of contents and list of stakeholders),
i) Incorporate the comments and suggestions from the National Workshop and submit the final draft plan to the task-force of Biogas stakeholders presided by CAMARTEC and the Ministry of Energy and
j) Minerals (M.E.M.), and others for comments,
k) Submission of the final document by incorporating the comments to the task-force of Biogas stakeholders presided by CAMARTEC and to M.E.M.

5. Time schedule
Preparation of the P.I.D. shall be started in June 2008 and completed by mid September 2008. The tentative time plan to accomplish the assignment shall be as follows:

6. Team composition
The execution of this T.O.R. will be done in two teams; the first technical sub-team will prepare the selection of the standard model and its characteristics to feature within the P.I.D. This sub-team will be guided by an experienced technical SNV biogas advisor from SNV Asia assisted by a technical biogas expert provided by CAMARTEC.

The second team will carry out the writing exercise of the P.I.D. consisting of the following 3 members:
- Senior Biogas Programme Advisor from SNV
- Biogas Expert from CAMARTEC
- Local consultant

The first sub-team will start its activities in June 2008 to collect all relevant information of the 3 selected (8 m^3) biogas models; CAMARTEC model, MIGESADO model and the Rwanda /GGC model, collect data on needed materials and prices, visit and interview the constructors, define performance factors and indicators and prepare an overview report of their initial findings. The sub-team will prepare a 3-days workshop of biogas constructors during which they will present the finding report and facilitate discussion with the following objectives;
- to agree on the final standard biogas plant model to be promoted
- to define certification procedures for biogas constructors
- to define the quality standards and control mechanisms.

In the second stage of the consultation, the second team of three members will start to prepare the draft P.I.D. to be presented to the National Workshop of all biogas stakeholders. The team will therefore visit all relevant stakeholders to collect data and information in order to prepare the draft P.I.D. Together with the taskforce they will prepare the national Workshop for Biogas stakeholders during which the team will present the draft P.I.D. and collect feedback, missing information and opinions.

The area of expertise, assignments and working days of the team members shall be as follows:

First sub-team to select the design to be promoted within the national programme.
- Technical Biogas Advisor (SNV-Asia): This advisor has considerable technical experience on the biogas technology and has the needed facilitation skills to assist the invited constructors to make a deliberate
- choice of the standard biogas design, agree on quality standards and mechanisms and propose the certification process of future biogas constructors (total of 30 days, 15 days within Tanzania).
- Technical Biogas Expert (CAMARTEC): The expert has good knowledge and experience in biogas construction and maintenance, is well informed of the local biogas sector and will assist the external SNV technical Biogas Advisor in the preparation and facilitation of the constructors workshop and the writing of the technical report. (25 days).

The team charged with the writing of the P.I.D. will consist of the following persons;
- Senior Biogas Programme Advisor (SNV) - The advisor will act as a coordinator of the team and will advise the team on the contents of the implementation plan, methodology to be applied, facilitate constructor workshop, gather important information from the main stakeholders, present the draft P.I.D. in a consultative workshop on the findings, finalize the plan with last editing and presenting to the task-force of biogas stakeholders + representative of MEM. (total of 40 days, 20 days in Tanzania).
- Local Biogas expert (CAMARTEC) – The expert shall be an engineer with substantial biogas expertise especially in the field of research, evaluation and professional report writing. The expert shall be responsible for the write up of the technical part of the P.I.D. with the close advice of the Senior Biogas Programme Advisor. S/he will assist the Senior Biogas Programme Advisor during the visits of stakeholders and the preparation and facilitation of the National Biogas Workshop and the writing of the P.I.D.. Total working days required for this person shall be about 40 days.
- Local consultant, The local consultant will be an expert on rural development / renewable energy and will have good experience and or good understanding of social aspects and institutional set up in Tanzania. S/he will assist in the formulation of the P.I.D. with financial and institutional analysis, facilitating meetings, organizing and facilitating the national Workshop, collecting information on Micro-Finance Institutions, gender organisations, carbon credit finance opportunities and indicate potential linkages with other renewable energy programmes. S/he will take part in the writing and editing of the plan. Total time required shall be 30 days.

7. Budget

The costs of this assignment will mainly consist of expenses for consultant fees, travelling and DSA fees for the team members and expenses for the constructor's workshop and the national workshop. Some local expenses may be required to collect data from the fields. The costs for Technical Assistance from out side of Tanzania (Technical Biogas Advisor and the Senior Biogas Programme Advisor) will be borne by SNV. CAMARTEC as future lead organisation will bear the cost for its own experts joining the team. Part of the stakeholders will finance their own costs related to the participation in the National Biogas Workshop. All other costs including the hiring of the local consultant from Tanzania will be borne by SNV (more detailed budget in Annexe-3).

8. Expected output

In line with the above objectives and activities the Senior Biogas Programme Advisor will present the biogas stakeholder taskforce presided by CAMARTEC and M.E.M. a well structured and clearly written P.I.D. for national programme on domestic biogas promotion in Tanzania. The P.I.D. shall be written in line with the table of contents attached to this TOR not exceeding 50 pages (excluding annexes). Besides the P.I.D. a separate report on the most appropriate model for dissemination in Tanzania shall be submitted.

8. References

- Feasibility Study for the Northern Zone, Fred Marree and Marloes students from the Utrecht University in The Netherlands, May 2007.
- Feasibility Study for a National Domestic Biogas Programme in Tanzania, Thomas D. Schmitz, GTZ, June 2007.
- Concept paper „Biogas for Better Life" Tanzanian Initiative, prepared by the task-force of Tanzanian biogas stakeholders, September 2007.
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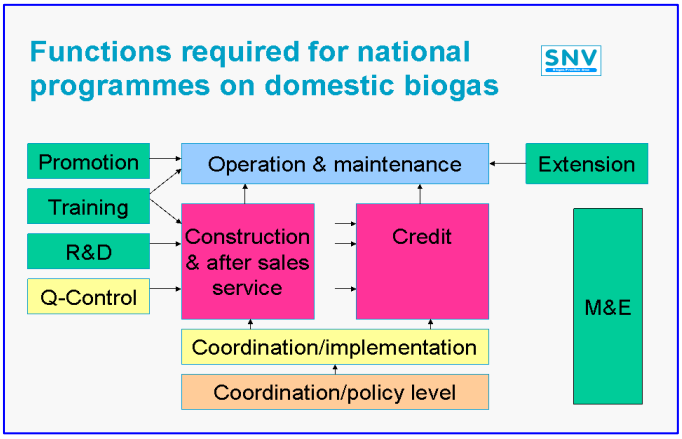
DRAFT Terms of Reference National Biogas Steering Committee Tanzania Domestic Biogas Programme

1 Rationale

This Terms of Reference serves to define the role, responsibilities and procedures for the National Biogas Steering Committee of the Tanzania Domestic Biogas Programme.

2 Introduction

The "Feasibility Study for a National Domestic Biogas Programme in Tanzania" [Schmitz, T, June 2007] indicates a significant market for domestic biogas of roughly 165,000 units. Following the feasibility study, the Tanzania Biogas Task Force, assisted by SNV-TZ, prepared a Programme Implementation Plan (PID) [ter Heegde, F, et al, August 2008] detailing technological, organizational and institutional aspects for a national biogas programme, including activity schedule and budget. The PID "National Programme on Domestic Biogas Dissemination in Tanzania", which was completed in August 2008, formulated Phase I of a national programme supporting the construction of 12,000 installations over a period of 5 years. The twin objectives of the Tanzania Domestic Biogas Programme (TDBP) are to establish a commercially viable biogas sector and at the same time to increase energy access to the poor and maximize the poverty reduction and gender benefits to biogas users.

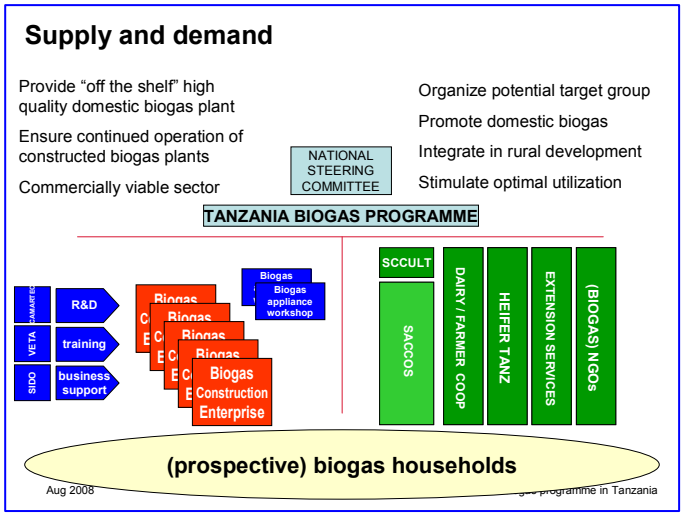


The programme will be developed in a multi actor approach, linking actors from the private sector, Government and civil society to those programme functions they –depending on their individual commitments- are best placed to execute.

2.1 Institutional overview

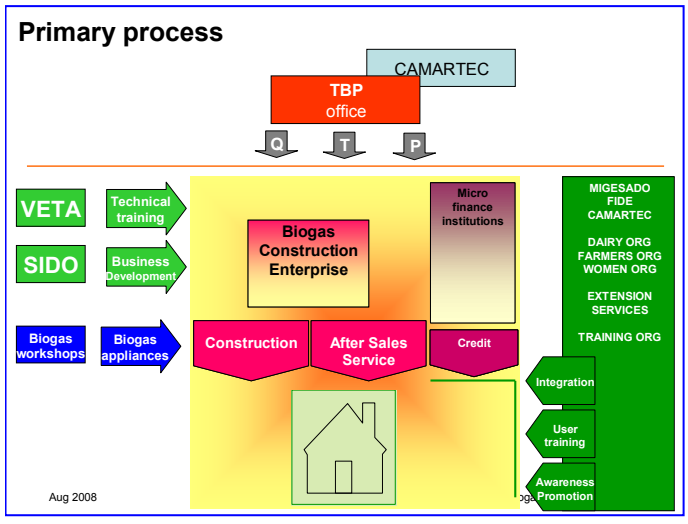
Central in a commercially viable approach is the household and its demands in view of agriculture, health and sanitation, environment and energy services. *Characteristics of a prospective biogas household* thus would include:

- farming households, having 2 (zero-grazed) to 10 cattle or 8 to 40 pigs (or a combination thereof);
- real demand for alternative domestic energy sources, whereby it is helpful when the household already (partially) uses commercial energy;
- opportunities for meaningful application / marketing of bio-slurry;
- organized in dairy collection, micro-credit, women or rural development groups.



In concept, then, the domestic biogas sector can be segmented in a *demand and supply side* whereby:

- the main responsibility of the sector's supply side is to establish a commercially viable biogas sector that provides "off the shelf" high quality biogas installations and ensures the continued operation of all biogas plants installed under the programme, and whereby:
- the demand side of the sector will be involved in organizing the potential target group to increase public awareness of the technology, provide credit to prospective biogas households, stimulate optimum use of the installations, and to integrate the technology in rural development.



The core of the *primary process* is in the commercial transaction between the (prospective) biogas household and the Biogas Construction Enterprise, in which both parties aim to maximize their

returns. The first party by demanding the best possible service level at the lowest possible costs, the latter aiming for high profit and future market penetration.

In this process, the importance of the quality of domestic biogas cannot be overstated. Particularly in a rural setting, a household that is satisfied with the benefits of a biogas plant is by far the most powerful promotional tool for the technology. Clearly, however, this works in two ways; an unsatisfied owner will cast a bad reputation on the technology, with a disastrous effect on market development. An enabling environment for the primary process to blossom would have the following salient features:

- Potential customers are well informed on costs and benefits, but also limitations, of the technology.
- Biogas service providers are rooted in the local society, to ensure that initial as well as follow-up services are easily available.
- BCEs operate on a level playing field; standardized technology is marketed together with transparent quality standards and quality control and enforcement.

In such an environment, BCEs have a vested interest in providing high quality services at competitive rates as a means to safeguard and expand their market. Hence, the main responsibility of the Tanzania Biogas Programme is to create and maintain the required conditions.

2.2 The role of the Tanzania Domestic Biogas Programme Office.

The *Tanzania Domestic Biogas Programme Office* (TDBP-Office), with the NBSC as its Governing Board, has coordinating, regulating and facilitating functions in the above-sketched sector.

CAMARTEC was selected by the stakeholder meeting in Tanga as the host organization for the TDBP-Office, whereby the TDBP-Office will be established in the premises of CAMARTEC in Arusha. The scope of CAMARTEC's support will be detailed in the Memorandum of Understanding with SNV-TANZANIA (for the period up to July 30, 2009) and the Memorandum of Understanding with HIVOS for the programme period thereafter. Key in the hosting arrangement will be the creation of an organization with a fair degree of autonomy and business orientation, able to react pro-actively to developments in the sector.

3 The National Biogas Steering Committee

The TDBP-Office will be governed by the National Biogas Steering Committee.

As per the Programme Implementation Document, the National Biogas Steering Committee (NBSC) will facilitate the establishment of a commercially viable domestic biogas sector in Tanzania. To that extent, the NBSC will:

- Ensure that the TDBP is implemented in line with the Government's policies on rural energy, rural development, livestock and agricultural development, employment creation and poverty reduction.
- Oversee the TDBP, ensuring the implementation is according to the Programme Implementation Document and subsequent Annual Plans, and meets generally accepted standards for project management and administration.
- Assist the TDBP in developing domestic biogas as a mainstream domestic energy source in Tanzania.
- Review performance of TDBP including its being hosed by CAMARTEC with a view of establishing it as an independent legal entity.

3.1 Composition of the NBSC

The NBSC will consist out of maximum 10 members. Members will represent the Government and relevant line ministries, civil society, end-users and the private sector, CAMARTEC and SNV as follows:

Representative of MEM	1	
Representative MLF	1	
Representative of civil society	1	
Representative of financial sector	1	
Representative of Biogas Construction enterprises	1	
Representative of end-users	1	
Representative of development partner	1	
TDBP Programme Coordinator	1	ex-officio, secretary
CAMARTEC Director General	1	ex-officio
SNV Director	1	ex-officio

Initial members (at least 6) of the NBSC will be appointed by the Minister of Energy and Mines on the proposal of the Interim Executive Committee (IEC) according to the schedule above. The NBSC will choose on annual basis its chairperson.

The TDBP will be governed by the Interim Executive Committee (IEC) until the establishment of the NBSC, latest up to the 30th of June 2009.

The NBSC will make decision with a quorum of at least 50% of members in attendance.

3.1.1 NBSC membership duration

The selected representatives, excluding the ex-officio members, will be member of the NBSC for a period of 2 years, whereby for the initially selected representatives half will be member of the Committee for 2 years, the other half will be member for 3 years as appointed by the Minister.

3.1.2 Selection of replacing members.

NBSC members will be representatives of active actors in the sector they represent, and will be proposed by the sitting NBSC for appointment by the Minister of Energy and Mines.

3.2 Responsibilities of the NBSC

3.2.1 Responsibilities of the NBSC in general include:

- Endorsement of the programme's strategy;
- Ensure conducive programme environment;
- Establishment and assessment of an autonomous and effective organization
- Approval of rules and regulations for the programme
- Establishing high-level linkages between relevant policies and organizations and the programme;
- Programme monitoring.

3.2.2 Responsibilities of the NBSC regarding programme supervision and monitoring include:

- Approval of the annual activity plan & budget and the mid-term activity & budget review;
- Approval of the annual report
- Approval of the management reply on the programme's audit reports.
- Approval of the management reply on the programme's evaluation reports

An approved annual activity plan & budget will create the mandate for the TDBP to implement activities and corresponding expenditures. Approved annual reports, together with the management reply on audit reports, will form the justification of the programme to its partners. The NBSC will meet three times per annum:

- in March to discuss and approve the programme's annual plan;
- in September to discuss and approve the programme's annual report, audit report and audit-management reply, and;
- in November to discuss and approve the programme's mid-term activity and budget review.
- in addition, the NBSC may meet as decided by the Executive Committee

3.3 The NBSC Executive Committee

To assist the NBSC, it will have an Executive Committee. The NBSC Executive Committee (NBSC-EC) consists of:

- The chair person of the NBSC,
- Two members selected by the NBSC
- the TDBP Programme Coordinator, ex officio, as the NBSC-EC-Secretary

The NBSC-EC will meet as needed but at most four times per year, and will prepare consolidated annual plans and reports and the management reply to the annual audit report. To that extent, the Executive Committee will:

- oversee the day to day management of the programme;
- commission annual programme audits;
- commission programme evaluations;
- formulate monitoring and reporting requirements for sector partners, and,
- approve appointments of senior programme staff.

4 Allowances

a. NBSC members will receive daily subsistence allowance, transport allowance and accommodation allowance as per the programme's regulations.
b. NBSC members will receive, in addition to allowances mentioned a sitting allowance per attended meeting.
c. Allowances will be as per the regulations of the host organisation.