WINROCK INTERNATIONAL
Putting Ideas to Work

SNV
Connecting People's Capacities

Programme Implementation Document for a national programme on Domestic Biogas Dissemination in Pakistan

March 2008.
Revised October 2008

Felix ter Heegde
Bikash Pandey

0.1 Summary

The feasibility study of domestic biogas in Pakistan indicated a large potential for domestic biogas, and recommended to prepare a Programme Implementation Plan (PID) detailing technological, organizational and institutional aspects for a national biogas programme, including activity schedule and budget.

The PID mission, commissioned by Winrock International and SNV-the Netherlands Development Organization, was fielded in November 2007. The mission was divided in a technical and programmatic assessment. This report provides the details of the programmatic assessment and a summary of the technical recommendations. Furthering on the findings of the feasibility study, the PID formulates a national domestic biogas programme in four provinces of Pakistan (Punjab, Sindh, NWFP and Baluchistan), supporting the construction of 30,000 installations over a period of 4 years. In view of the higher reliability and lower overall costs, the PID takes over the recommendation of the Technical Assessment study to introduce the GGC fixed dome design.

The objective of the national domestic biogas programme is to establish a commercially viable biogas sector. To that extent, the main actors at the supply side of the sector are private Biogas Construction Enterprises (BCEs) providing biogas construction and after sales services to households. At the demand side of the sector, Rural Support Programmes organized under the RSPN will be the main implementing partners, but will also include NGOs, farmers' organizations and dairy organizations.

Initiating, coordinating and –partly- implementing the programme activities will be the responsibility of the Pakistan Biogas Development Enterprise (PBDE). The PBDE will be hosted by the RSPN but will become –over time- a fairly independent entity, able to swiftly act on the requirements of the sector. The PBDE will have a main office in Islamabad and provincial offices in the programme's provinces. A National Biogas Steering Committee (NBSC), with representatives of the main actors at supply- and demand-side, will oversee the PBDE and sector as a whole.

The PID details substantial investments in promotion, training and quality management. Other activities include private sector development, extension, institutional support, monitoring & evaluation and research & development.

To stimulate the demand for domestic biogas, lower the investment threshold for prospective households and create leverage for quality management, the PID proposes a flat rate investment rebate of PKR 6,000 per installation (PKR 10,000 for remoter areas).

The total costs of the programme are budgeted at PKR 2,801 million (€ 28 million). The participating households will bear the lion share of the costs (PKR 1,906 million). The investment-rebate component, supporting the investment of the household, amounts to PKR 244 million. Programme support, International Technical Assistance and RSPN management fee expenses add-up to PKR 485 million, PKR 145 million and PKR 26 million respectively.

Revenue of the programme over the firs phase is expected to be modest; total fees levied to the households for participation and quality control will arrive at PKR 15 million and carbon revenue is estimated at PKR 510 million.

To cover the programme budget, funds are sought from the Government of Pakistan (PKR 200 million) and ODA / investors (PKR 643 million), of which an amount of PKR 115 million has been committed by SNV.

Over a ten-year period, the programme strives to cover expenses for the investment-rebate and the supply-side support activities by revenue resulting from the biogas installations reducing greenhouse gas emissions.

0.2 Notes to the revisions of the PID

Following the PID formulation mission end 2007, the programme was designed to have an autonomous coordinating entity coordinating and implementing the supply-side activities of the programme while the demand-side activities would be coordinated by RSPN and implemented through its network of RSPs and NGOs. The reason for this division was in the fact that, over a time period of 10 years, carbon revenue could make the supply side activities financially sustainable whereas demand-side activities would probably continue to require public funding assistance.

Three considerations led to altering this initial approach:

- Programme partners questioned the wisdom of the dividing the responsibility for supply and demand side activities over two entities. They rightfully worried about practical coordination in the field.
- Prospective donors found the institutional configuration top heavy and recommended a simpler 'private sector oriented' structure to implement the project with an advisory role for government.
- SNV received approval from its Board of Directors to finance from its core funding all activities for the first year (2009) to “kick-start” the programme.

As a result, the revised PID combines coordination and implementation of both supply and demand side activities in one entity, the Pakistan Domestic Biogas Enterprise. Over time, it is envisioned that the PBDE will become a fairly autonomous (section 42) not-for-profit organization coordinating domestic biogas dissemination all over Pakistan. The programme expects funding from public funds (ODA and the Government of Pakistan), carbon revenue and, possibly, private investors.

The first year of the programme, entirely under SNV funding, should be considered as a (fairly large) pilot. During this year, the RSPN will host the programme as a separate activity under its “Special Projects Wing” and will, together with potential stakeholders, explore the options and details for operational and institutional arrangements. Regarding the latter, it will be key to shape “productive” linkages for the programme; as domestic biogas impacts on rural development in a holistic way, the institutional framework should as much as possible include environment, agriculture, health & sanitation and (domestic) energy aspects. At the end of the pilot and based on the experiences over this period, RSPN and programme partners will suggest such a framework.

It’s probably important to note that the revision does not depart from the earlier PID as:

- the numerical targets remain the same;
- programme design remains based on SNV’s multi-actor sectoral approach;
- the main stakeholders identified during the PID mission are still expected to play their important role;
- the aim remains to establish a commercially viable domestic biogas sector in Pakistan, and;
- the main actor in the primary process remains the private sector (through local biogas construction (micro-) enterprises.

0.3 Acknowledgements.

It was a pleasure to conduct this mission on the formulation of a national biogas programme in Pakistan. 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 assessment will serve its purpose.

March 2008,

Felix ter Heegde,
Appingedam, the Netherlands.

Bikash Pandey,
Islamabad, Pakistan.

0.4 Table of content.

0.5 List of tables, pictures and graphs.

0.6 List of Annexes.

sn	
1	Livestock population in Pakistan
2	Biogas and sustainable development
3	Biogas and the UN Millennium Development Goals
4	Financial and economic analysis
5	Expected results
6	Evaluation of designs for domestic biogas installations in Pakistan
7	PBDE organizational charts
8	Detailed activity plan and budget
9	Mission itinerary and interview list
10	ToR PID mission
11	Biogas loan – monthly repayment overview

0.7 Exchange rates used.

1 Euro	= PKR 100
1 US Dollar	= PKR 70

0.8 List of acronyms and abbreviations.

ADB	Asian Development Bank
AEDB	Alternative Energy Development Board
BAP	Biogas Awareness & Promotion workshops
BSA	Bio-slurry Application training
BBA	Biogas Branch Organization
BCE	Biogas Construction Enterprise
NBSC	National Biogas Steering Committee
BMT	Biogas Mason Training
BOM	Biogas Operation & maintenance training
BST	Biogas Supervisor Training
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CFI	Commercial Financial Institution
CNG	Compressed Natural Gas
CO	Community Organization
EIRR	Economic Internal Rate of Return
EUR (€)	Euro
FIRR	Financial Internal Rate of Return
FIDA	Foundation for Integrated Development Action
FS	Feasibility Study
GDP	Gross Domestic Product
GHG	Greenhouse gas
GoP	Government of Pakistan
GWP	Global Warming Potential
IEK	Idara-E-Kishan
ITA	International Technical Assistance
KPF	Kushhal Pakistan Fund
LDDB	Livestock & Dairy Development Board
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MDG	Millennium Development Goal
MFB	Micro Finance Bank Licensed by the SBP)
MFI	Micro Finance Institution
MINFAL	Ministry of Food, Agriculture and Livestock
MoE	Ministry of Environment
MW	Mega Watt
m^3	Cubic meter
NGO	Non-Governmental Organization
NPK	Nitrogen, Phosphorus and Potassium, soil macro-nutrients
NPV	Net Present Value
NWFP	North West Frontier Province
PARC	Pakistan Agricultural Research Council
PBO	Provincial Biogas Office
PBsO	Provincial Biogas Satellite Office
PCRET	Pakistan Council for Renewable Energy Technologies
PID	Programme Implementation Document
PPAF	Pakistan Poverty Alleviation Fund
PRSP	Punjab Rural Support Programme
PKR	Pakistan Rupee
PMN	Pakistan Microfinance Network
RSPN	Rural Support Programme Network
SSGC	Sui Southern Gas Company
SNGPL	Sui Northern Gas Pipelines Limited
SNV	Netherlands Development Organization
TEVTA	Technical Education and Vocational Training Association
ToT	Training of Trainers
tCO_2eq	Tons of Carbon dioxide equivalent
toe	Tons of Oil Equivalent
UNDP	United Nations Development Programme
USD ($)	United States Dollar
VER	Verified Emission Reduction
VMC	Village Milk Centre

1 Introduction and background.

The Government of Pakistan, including the Planning Commission, the Alternative Energy Development Board, the Pakistan Council for Renewable Energy Technologies and the Ministry of Environment, is keenly interested in promoting domestic biogas as an alternative energy for fuel and fertilizer and has sought expertise and support for setting up a national biogas programme to significantly scale up the number of well performing digesters in the country. Shortage of energy and the high prices of petroleum are considered to be road blocks to the country's rapid economic growth and poverty reduction. Although the household biogas technology is well known in Pakistan, the numbers of installations so far are limited to around six thousand – only a fraction of the potential believed to exist in the country. Rural people are currently cooking largely on unsustainably harvested fuel wood, agricultural residue and dried animal manure to the detriment of local forests and agricultural productivity. The country has to a great extent been deprived of the proven benefits of household biogas – particularly to women and children in terms of reduced burden of firewood collection and less indoor air pollution.

Previous experiences of biogas in Pakistan have been mixed with digesters constructed in the 1980s widely considered to be failures. Plants constructed in the late 1990s appear to be technically sound and are generally functioning well. However the numbers of plants have remained small with no more than a few hundred being constructed each year. Programs are dependent on government grants and no market mechanism is in place for interested users to routinely purchase systems.

Based on the successful experience of implementing biogas programmes in a number of other Asian countries, where tens of thousands of biogas plants are being installed annually, UNDP Pakistan, Winrock International and SNV (Netherlands Development Organisation) carried out a feasibility study for establishing a large-scale household biogas programme in Pakistan in early 2007. The study examined the potential for household scale biogas in Pakistan for cooking and lighting in rural areas based on the availability of sufficient numbers of stall-fed livestock and other enabling conditions such as availability of water and warm temperature. After establishing that there was a sufficient market for biogas plants, the report then examined how a program might be set up in Pakistan to supply large numbers of high quality biogas digesters in the country[1].

This Programme Implementation Document (PID) furthers on the earlier distributed Feasibility Study (FS), providing the design for the proposed biogas programme in Pakistan. The PID works out the overall goal and purpose in specific objectives and expected results for the programme. It suggests the institutional and organizational arrangements and implementation modalities and from there details output targets, type and scope of the activities and their budgetary implications.

1.1 Country background.

Lying between latitude 23°N and 37°N and longitude 60°E and 76°E, Pakistan is a geographically divers country with a long coast line and tropical mangrove swamps in the south and snow-covered peaks and glaciers in the north. The middle of the country is a mix of fertile irrigated farms as well as deserts. It has an estimated population of 160 million which continues to grow at a high rate of over 2.5%. The economy has been growing fast at 6-8% a year for the past decade. The high population growth and fast growing economy have put a lot of pressure on the country's energy resources as well as on agricultural production. The livestock sector plays a key role in the agricultural economy of Pakistan. Its share in the country's agricultural production is around 49%, while its contribution to the GDP is just over 11%. Some 57 million cattle and buffaloes and an estimated 100 million sheep and goats and 400 million poultry birds in the county can also provide sufficient raw material for substantial production of biogas. The country has among the highest unexploited potential for biogas production in the region.

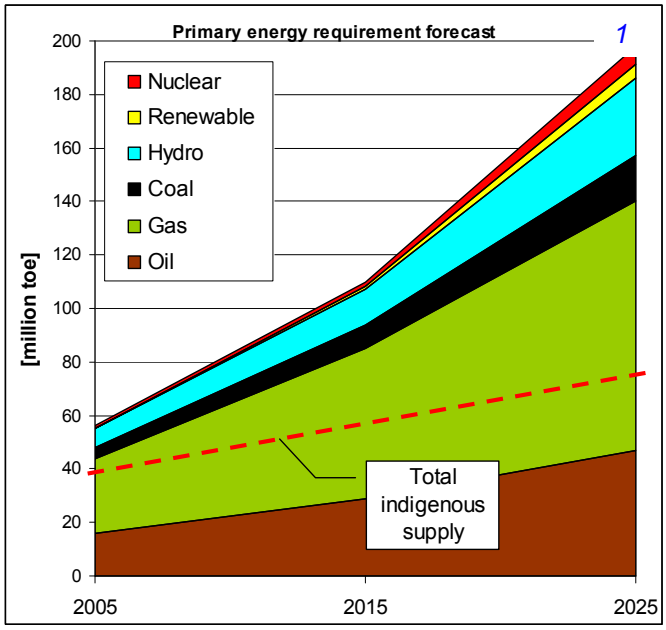
[1] At present around 18% of households, mostly in urban centres, have access to natural gas. Although it is uneconomic and probably unfeasible for large numbers of rural households to have access to piped natural gas, the anticipation of extension of pipelines is a major deterrent to investment into alternatives such as biogas, particularly in areas close to urban locations that are served by the gas pipeline.

1.2 Political situation.

Despite the conflict in the areas bordering Afghanistan, Pakistan remains a largely peaceful country. The peaceful elections in February 2008 promise to herald in a stable democratic government committed to economic growth and poverty reduction. The energy crisis which has hit the country since 2007 is expected to be high on the list of priority areas for the new government to tackle. The donor community is expected to resume its aid support to the country after the conduct of relatively uncontroversial elections.

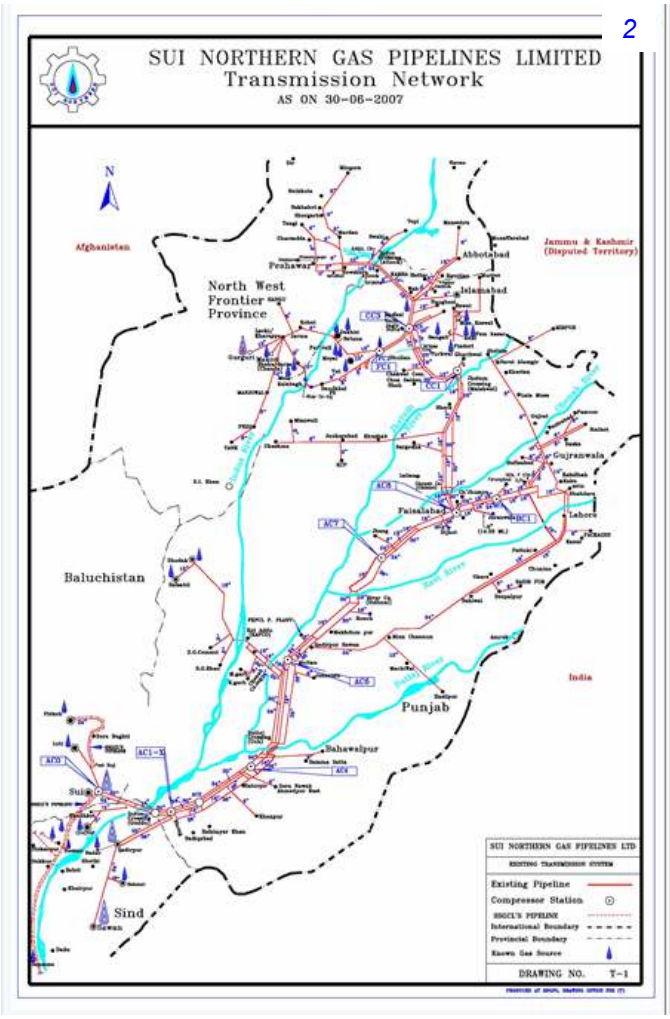
1.3 Energy situation.

Pakistan is a net importer of energy. In 2006, it spent $7 billion, equivalent to over 40% of total imports, to import petroleum to meet its energy needs. Oil importation is a heavy burden on the country's foreign exchange. Recent high oil prices and their continuous fluctuation have further increased this burden. As per the forecast of the National Planning Commission, the reliance on imported primary energy will further increase over the next two decades, from 30% of the total demand in 2005 to 62% of the demand in 2025.



Most of the imported oil is for electricity generation and transportation. Only 59% of Pakistan's population has access to electricity from the national grid. In rural areas, the percentage with electricity access falls to 37%. Even with all this imported energy, Pakistan currently faces a 20% power shortage, resulting in frequent load shedding.

Indigenous natural gas dominates the commercial energy sector of the country accounting for 48.5% of primary commercial energy used in the country. This is followed by oil (30.5%), hydro (12.6%), coal (7.3%), and nuclear 1%[2]. Roughly 30% of the country's total primary energy comes from traditional biomass fuels. The majority of the rural population uses firewood and other biomass fuels for cooking and heating and kerosene for lighting and some cooking.



[2] Pakistan Energy Yearbook 2007.

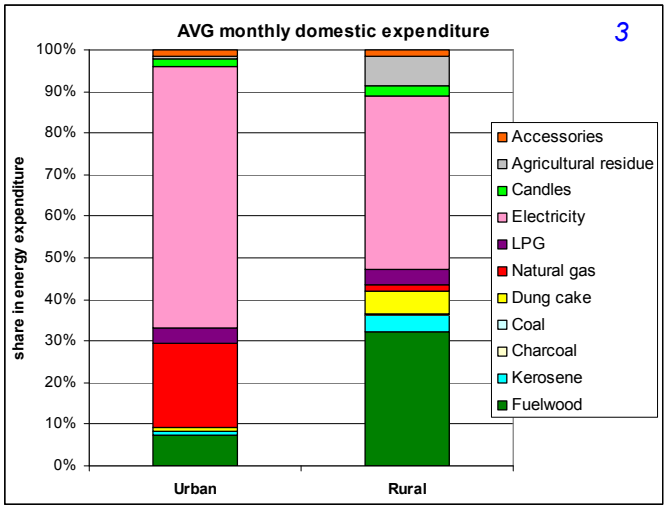
initiated discussions to import natural gas, both through pipelines and as LNG, from Iran and Turkmenistan.

The Government of Pakistan had set a goal of doing away with most natural gas tariff subsidies as well as subsidies on petroleum fuels by May 2005, but against the backdrop of rapidly rising world oil prices driven by lower production, the government had to reconsider and continue to subsidize natural gas as well as petroleum prices. To provide a buffer to people from the persistently high international oil prices, the government announced in the 2007-08 national budget that it will provide a subsidy of PKR 15 billion ($ 250 million) to keep diesel, kerosene, and LPG prices at affordable levels. This is an increase of 50% over the subsidy of PKR 10 billion provided in the 2006-07 budget. An additional subsidy of PKR 72 billion ($ 1.2 billion) is projected to be provided in 2007-08 to the power sector to keep electricity prices affordable[3]. It would thus be logical for the Government of Pakistan to strongly support and contribute to a future national biogas programme as investment in biogas will reduce the recurrent subsidies needed each year on fossil fuels.

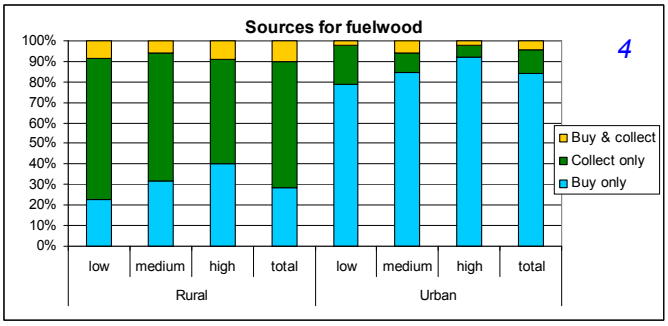
Pakistan's renewable energy potential is substantial and the vast majority of it remains untapped. The Government of Pakistan has decided to put greater emphasis on renewable energy. In May 2003, it announced that it had set a target of 5% of the country's total power generation to be from renewable energy by 2030 (9,700 MW) and established the Alternative Energy Development Board (AEDB) as the apex organization to coordinate renewable energy promotion. AEDB has been tasked by the government under the Roshan Pakistan Programme to electrify the remaining villages in the country within the next three years using distributed renewable energy technologies. In terms of off-grid renewable energy systems, 140 micro wind turbines of 500 Watt capacity have been installed to meet the needs of rural households and institutions and 400 villages are being electrified using solar home systems through micro-finance.

1.4 Domestic energy.

The average monthly expenditure on domestic energy amounts to PKR 713 (Pakistan Household Survey 2004-05) whereby urban households spend 45% more then rural households (PKR 904 and PKR 622 per month respectively).



Of this, the largest single expenditure item in both urban and rural areas is for electricity. The next largest expenditure in urban areas is on natural gas. In rural areas, as can be expected, the next largest energy expenditure is on fuelwood. However it is clear that after adding the different fuel sources, rural areas spend most of their energy expenditure on cooking fuels: around 45% of their energy expenditure goes on solid biomass fuels; firewood, agricultural residues, and dung cakes. An additional 12% goes to LPG, kerosene, natural gas and candles, which are used for cooking and for lighting.

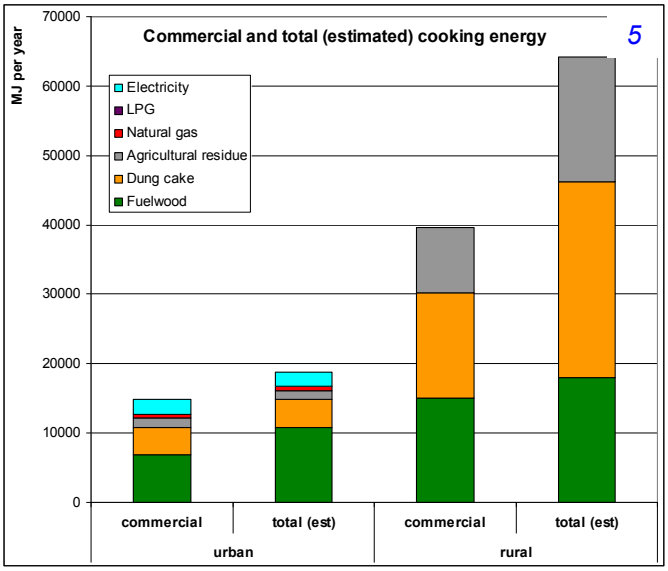


The available data from surveys depicts the commercial energy component only. From observation, however, it is evident that a significant share of the domestic energy requirement is not sourced from commercial markets. The Household Energy Survey 1992, quite dated by now, provides insight in this by tracing the source of fuelwood. The graph shows that on average over 60% of the rural households and 12% of urban households collect fuelwood free of financial costs. Similar data on animal

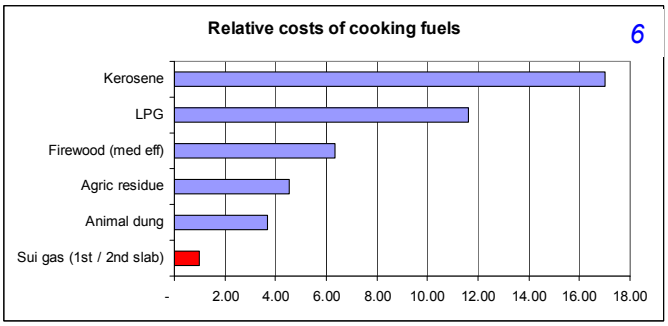
[3] http://www.dailytimes.com.pk/default.asp?page=2007\06\10\story_10-6-2007_pg7_9

dung is not available, but the non-commercial share for this energy source –widely used in rural areas, is likely even larger. Kojima (WB-Household use of commercial energy, Feb 2006) argues that, induced by rising energy prices, the household energy price increase outstripped general inflation over the period 1994-2001, the uptake of "free" biomass has increased further since. This uptake increase is measured for both rural as well as urban households (but relatively more for urban households), and is valid in particular for poorer households.

Hence, domestic energy expenditure data only shows (a small) part of the total domestic energy use. Responses on the interviews of the Winrock / SNV technical assessment survey, based on a –very- small sample, indicate the energy consumption for cooking at a level of 62 GJ per year per household. The HESS 1992 measured a total annual household energy use of 130 GJ. This would indicate that approximately 50% of the domestic energy is used for cooking, a share which corresponds with the analysis of Pandey & Bajgain (Feasibility study of domestic biogas in Pakistan, 2007). Triangulating the above mentioned sources would indicate the gross domestic energy use for cooking in Pakistan at 19 and 64 GJ per year respectively for urban and rural households[4]. The triangulation further indicates that commercial cooking fuel provides about 60% of the total cooking fuel demand. For urban households the commercial share amounts to 80%. For poorer households, both rural and urban, the commercial share is likely significantly smaller.



As shown in the graph (data adopted from the FS), modern and clean domestic energy sources, except for SUI gas, are on average twice as expensive as traditional –biomass based- energy. The low tariff in natural gas, particularly to the lower slab lifeline user, makes this a very attractive domestic energy source for those households that are connected to the gas-grid (18% of the households, mostly urban). For the remaining part of the population, traditional biomass-based fuels remain their best option, despite their intrinsic risks regarding family health and environmental.



[4] The large difference between gross domestic energy consumption for cooking can partly be explained by the larger size of rural households and, probably for a larger part, by the higher efficiency of the more modern energy sources used by urban households.

2 Biogas in Pakistan

2.1 History of domestic biogas

Pakistan is typical of many countries around the world where the biogas technology has been tried with some success in the past but has yet to be widely adopted. The Government of Pakistan started a comprehensive biogas scheme in 1974 and commissioned 4,137 biogas units by 1987 throughout the country. These were large plants with capacity varying from 5 to 15 m^3 gas production per day[5]. This programme was developed in three phases. During the first phase, 100 demonstration units were installed under a grant of the government. During the second phase, the cost of the biogas was shared between the beneficiaries and the government. In a subsequent third phase, the government withdrew financial support for the biogas plants, although technical support continued to be provided free of cost. Unfortunately, after the withdrawal of the government's financial support, the project did not progress any further (World Energy Council)[6].

Most of the biogas plants installed in recent years have been smaller household designs (3 and 5m^3 gas production per day) compared to the larger plants in the 1970s and '80s. Current dissemination programmes still largely have a piloting character; commercial promotion is not taking place. Most involved organizations seem to follow the current Government's promotion arrangements by providing a subsidy of 50% on the installation costs.

2.1.1 Actors involved in biogas dissemination

The Pakistan Centre for Renewable Energy Technologies (PCRET).
PCRET, under the Ministry of Science and Technology, is leading in domestic biogas dissemination in the country and has installed around 1,600 biogas plants. Currently, PCRET is implementing a Government-financed biogas programme of 2,500 domestic biogas installations (2007 – 2008). To that extent, PCRET gradually seems to professionalize its approach; promotional and training material is distributed; its network of biogas experts over the country is expanding (currently 32 staff on biogas, divided over 8 offices); step by step modifications to the design of their floating drum are adopted (especially aiming at improved bio-slurry collection and correct plant-sizing), and; quality control is slowly taking shape. In addition to its own dissemination programme PCRET provides technical assistance to other organizations promoting domestic biogas.

NGOs involved in domestic biogas dissemination.

- The Initiative for Rural and Sustainable Development (IRSD) has installed around 150 biogas plants with support from the UNDP Small Grants Program.
- 'Koshish' in Sialkot, Punjab, assisted villagers to build over 200 biogas plants.
- The Green Circle Organization is building community based plants with funding from the Pakistan Poverty Alleviation Fund.
- The Punjab Rural Support Programme (PRSP), supported by the Rural Support Programme-Network (RSPN) installed 12 biogas installations (6 m^3) of the Nepalese GGC 2047 design in Sialkot district in June 2007.
- The Foundation for Integrated Development Action (FIDA), also supported by the RSPN and also in June of 2007, constructed 3 GGC 2047 installations (8, 20 and 35m3) in Dera Ismail Khan district.
- Rural Support Programmes, particularly NRSP and PRSP, have constructed over 200 biogas plants in the past using the PCRET design and include biogas among the projects they support.
- The Pakistan Dairy Development Company plans to include domestic biogas in the third phase of its programme and has budgeted support for 200 digesters. To that extent one pilot plant has been installed, creating over 50 applications from its members.

[5] The capacity of biogas installations is either stated in "volume of gas production per day" or "digester volume". A domestic installation with a digester volume of 8m^3 would produce about 2m^3 biogas per day.
[6] http://www.worldenergy.org/wecgeis/publications/reports/renewable/country_reports/chap_2_6_2.asp

2.1.2 Applied technology

The biogas technology most commonly used in Pakistan is (a very simple version of) the floating drum design as promoted by PCRET.

The Chinese fixed-dome design was installed on a pilot basis but was reportedly not successful, showing persistent leakage and seepage problems and low gas pressure. Also on pilot basis, a few "plastic bag" plants[7] have been constructed.

Recently, 15 fixed-dome 'Nepal design' biogas plants Model GGC 2047 were installed with the support of the Rural Support Programme Network.

The stoves used for biogas typically are LPG stoves, to some degree adjusted for biogas use.


7

2.1.3 Assessment of domestic biogas plants in Pakistan

In the framework of this mission (formulation of an implementation plant for a national domestic biogas programme for Pakistan), a detailed assessment of a small sample (38 installations) of domestic biogas plants was carried out by Mr. Prakash Ghimire (SNV) and Mr. Arshad Baryar (Koshish) in November 2007. As separate report[8] has been published on this assessment, here a brief summary of the main findings suffices:

- In general, the visited biogas plants are functioning at a satisfactory level although ample room for improvement remains. The operational status of 13 (34%) plants was satisfactorily, 17 (45%) plants were functioning partly and the remaining 8 (21%) plants were not functioning at all during the time of field investigation.
- The dissemination programmes so far have been instrumental in popularizing the technology but the failure-rate discourages many neighbouring households to adopt biogas technology.
- Domestic biogas dissemination has been isolated and uncoordinated. To effectively harness the high potential of domestic biogas plants, a coordinated approach and collaborative efforts of the sector institutions is called for.
- Plant sizing, and information on plant feeding, leaves lots to be desired; the majority of the plants under study were oversized as well as under-fed.
- The reported saving on traditional fuel sources is substantial; on average nearly PKR 8,000 per household per year.
- Nearly two-third of the visited users is using the bio-slurry and in general the superior fertilizing value of bio-slurry over farm yard manure was confirmed.

More in technical detail, the assessment informs that:

- The installation of biogas plants has been done by masons with minimal supervision from skilled technicians. Although this indicates the competency of the involved masons and fabricators, the absence of standards and control thereof results in erratic and variable plant quality.
- The mild-steel drum in floating drum installations causes frequent failure; the applied thickness seems insufficient to withstand wear and tear as well as the gas pressure. Lack of maintenance of the drums (regular painting) results in excessive corrosion, gas leakage and eventually an in-operational biogas plant.
- User training on routine operation and minor maintenance works is widely lacking, as is any mechanism for after sales services, resulting in poor O&M conditions for many installations.

[7] One plastic bag installation was found dismantled during the technical assessment.
[8] Prakash C. Ghimire, Final report on the technical study of biogas plants installed in Pakistan. SNV, December 2007

2.1.4 Barriers for large-scale dissemination.

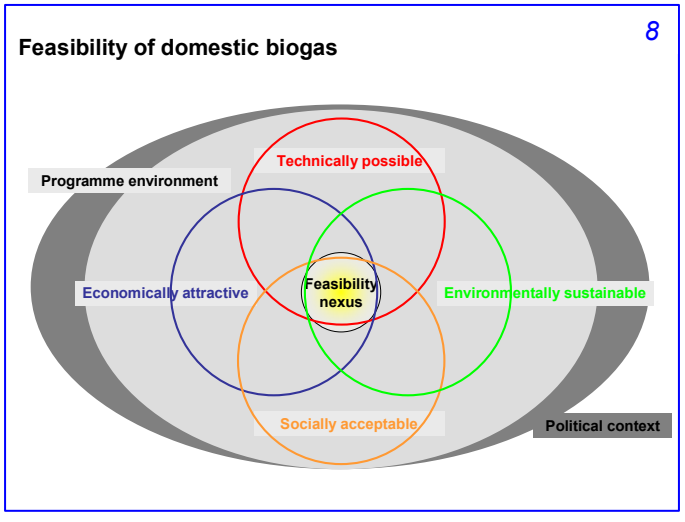
The technical assessment largely confirms earlier observations. In conclusion, the main barriers for a commercial, large scale domestic biogas programme in Pakistan include:

- The absence of a scaling-up strategy for domestic biogas. Although the technology has proven itself in many surrounding countries, biogas in Pakistan is still promoted in a pilot modality. The projects are characterized by a strong technology-drive; selection of households is not always based on a proper needs-assessment. The initiatives depend highly on limited and scattered Government support in which high subsidy levels have an inhibitory effect on the development of the market. This explains also the exclusion of the private sector without which a natural incentive for growth is missing.
- Limited awareness of the benefits of biogas, in particular regarding bio-slurry. in a total population of over 160 million, the installation of 6000 biogas plants can only be expected to go so far in terms of promotion of the technology. Even amongst biogas owners, the potential benefits of bio-slurry are often not duly appreciated.
- Limited access to the technology. Resulting from the strategy followed so far, the information and services for domestic biogas are few and far in between.
- Low consumer confidence in domestic biogas technology. Earlier initiatives did not always leave a good track-record. Unfortunately, particularly in a rural community, bad experiences tend to spread wider and stay longer in the memory than the good ones. The absence of user training and after sales services or a warrantee scheme, particularly in combination with floating drum installations, then quickly contributes to the disappointment.
- High investment costs. The design most widely used in Pakistan, the floating drum plant, is marginally more expensive but has high operating costs to replace the gas holder make the design more expensive that fixed dome plants. In addition, plants in general are far too large, adding unnecessarily to investment and operating costs.
- Limited access to credit. Rural credit facilities seem to have developed only recently, and tend to focus on commercial credit (short repayment periods, rather high interest rates). Credit schemes appropriate for biogas investments are not yet available.
- Expectations of imminent access to piped natural gas. Especially in urban and sub-urban areas, many households expect to be connected to the natural gas grid. Although grid expansion is close to what is economically feasible, households tend to postpone investment in biogas in anticipation of a future connection.

2.2 Potential for domestic biogas.

For a national domestic biogas programme, the notion "feasibility" is multi-facetted. The study applied a framework incorporating technical, economic, social and environmental elements within a programmatic environment and political context[9]. The nexus of these factors indicates the feasibility of a large-scale biogas programme.

The feasibility of domestic biogas in Pakistan is studied in a detailed manner in the Feasibility Study. For the PID, hence, it will suffice to briefly attend to the technical and economical potential.

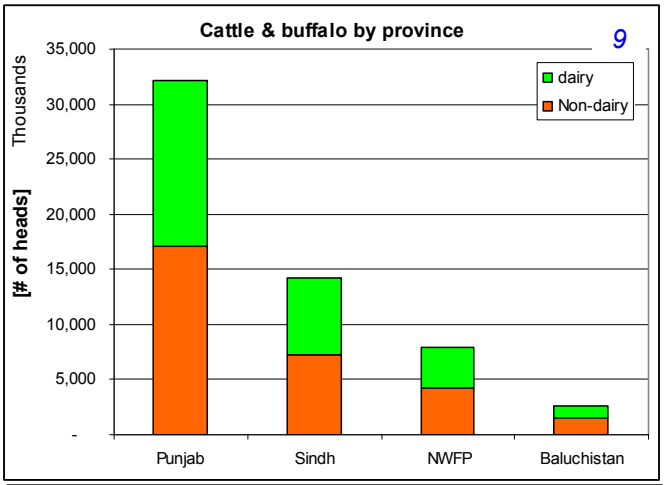


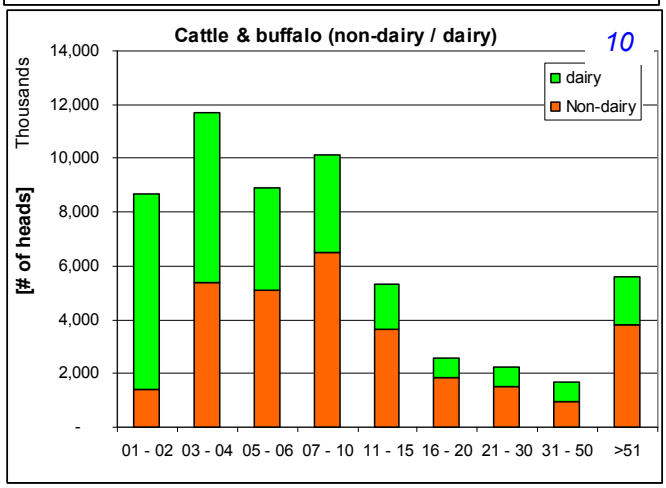
[9] A description of the feasibility factors is provided in Annex 7

2.2.1 Technical potential[10]

The technical potential for 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 floods, and availability of human resources for plant construction.

Livestock holding[11]*:* The livestock population (cattle and buffalos) amounts to nearly 57 million heads, divided over 29.5 million heads of cattle and 27.3 million heads of buffaloes. Over the past 30 years the cattle and buffalo population have shown a steady growth (average 3.2 and 2.3 % per year respectively). Out of this total, 26,8 million heads (47%) are milch cows and buffalos, confirming the high demand for dairy products. The division cattle/buffalo is about the same for the provinces Punjab, Sindh and NWFP, only in Baluchistan the share of cattle (88%) is significantly higher than the national average. Similarly, the share of milch cows and buffalos for all four provinces equally divided over the provinces, Sindh –with 49%- and Baluchistan –with 42%- have the highest and lowest share of milch cows respectively.





Punjab houses the largest cattle / buffalo population (32.2 million heads, 57% of the total population), followed by Sindh and NWFP (14.3 million heads / 25% and 7.9 million heads / 14% respectively). Baluchistan has the smallest herd; 2.5 million heads / 5% of the total population.

Smaller cattle and buffalo holdings have a significantly larger share of dairy cattle than the larger holdings; a large share of the dairy is produced by rural subsistence smallholdings and rural market-oriented smallholdings.

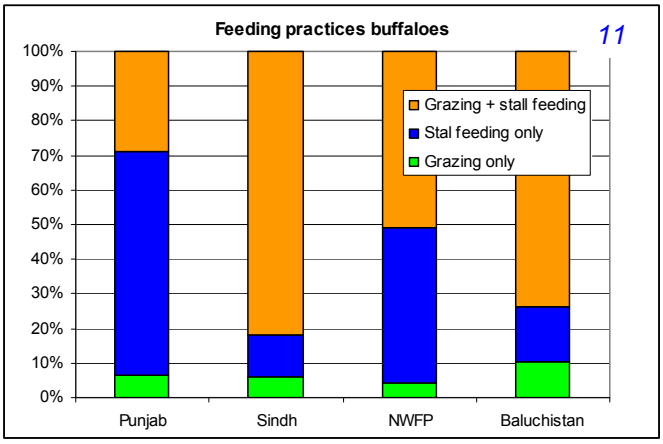
At domestic level, biogas installations are interesting for smallholdings keeping 1 to 15 heads of cattle. According to the census, over 6.0 million households are keeping cattle and 5.8 million households keeping buffalos would fall in this bracket (22.5 million heads and 22.3 million heads respectively). In this same range, 8.3 million households report keeping milch cows and buffaloes (22.9 heads).

The 2006 livestock census counted households with cattle and households with buffalos separately without counting the combination of cattle and buffalos. Therefore, the best approximation of the number of households having 1 to 15 buffalos and cattle would range from 8.3 million (households with milch cows & buffalos) as the lower bound to 11.8 million households (households with cattle + households with buffalos) as the maximum.

An overview of the cattle, buffalo and milch cows & buffalos by province is provided in annex 1

[10] More detailed information is provided in the feasibility study.
[11] Data from livestock census 2006.

Process water: Water is required in equal amounts to the animal dung fed, indicating biogas installations needing significant amounts of water on a daily basis. Although the process water does not have to be of drinking water quality, water sources should be in the vicinity of the installation, typically within 20 minutes walking distance. In Punjab and Sindh, together home to over 80% of the total cattle and buffalo population, at most locations water is accessible through irrigation canals and tube wells (also the high share of buffalo stall feeding only is an encouraging indicator for water availability). However, water is not easily accessible in arid parts of these provinces and some of the eastern and northern provinces are considerably drier.



Temperature: The temperature in Punjab and Sindh is high in the summer months (over 40 degree Celsius). In the winter the temperature can drop down to 2.0 degree Celsius in the northern parts of Punjab. In the northern areas average temperatures will be considerably lower, whereas areas bordering Afghanistan will show larger daily temperature gradients.

Construction materials: Construction materials are easily available in most areas of the country and the transportation network is well developed including in rural areas.

Construction space: Most of the farming households have enough land to install biogas plant and are safe from floods.

Human resources: Skilled and unskilled human resources are relatively expensive in Pakistan, compared to other countries in the region, but are easily available everywhere. While calculating the potential number of household biogas plants, households with a minimum of 2 adult cattle/buffaloes are considered as potential households.

Taking into account the above parameters, the feasibility study estimates as per the table below that at least 5 million biogas plants can be installed in Pakistan based on cattle/buffalo dung.

Estimate technical potential of household biogas plants based on cattle and buffaloes (FS)

Particulars	**No. of household**
Total households with cattle/buffalo	10 million
Households with only one cattle/buffalo	(2 million)
Households unsuitable for biogas since they are served by natural gas supply or likely to be, low temperature, insufficient water or land	(3 million)
Total biogas potential households	**5 million**

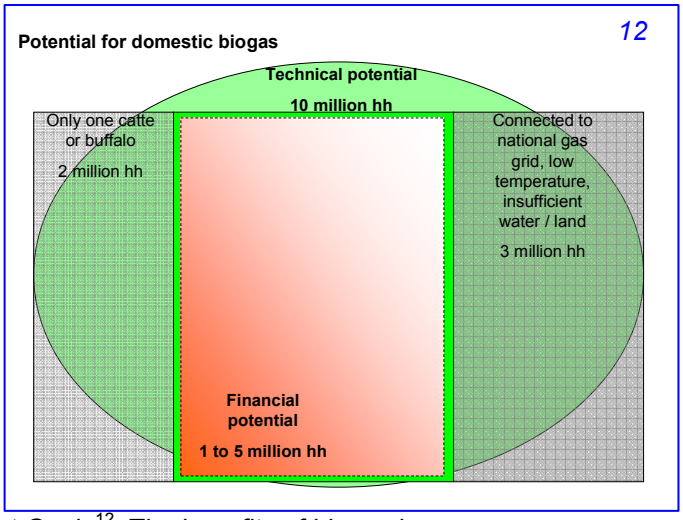
2.2.2 Economic and financial potential

Economic potential: Taking into account the energy crisis Pakistan is facing, the increasing costs of fossil fuels and the dwindling forest resources versus the EIRR of a domestic biogas programme (up to 49%, see chapter 2.3.1), the economic potential could well equal the technical potential. Indicative for this statement, perhaps, are the connection costs to the national gas grid, currently PKR 10,000 per household, through which the Government supplies natural gas at subsidized prices.

Financial potential: Based on avoided fuel expenses only, an average domestic biogas installation would have repaid itself in 3.5 to 4 years. Although the repayment period and other capital expenditure parameters indicate that a biogas installation would for most households be financially attractive (see chapter 2.3.1), the investment for the installation has to be made up front.

As the investment for a biogas installation is in the same range as the price for a mature buffalo, households keeping larger cattle / household herds (say 7 to 15 heads of cattle / buffalo) should be able to afford a biogas installation without credit assistance. These households, however, constitute only less then 10% of the total target population. A large share of the remaining households, keeping smaller herds, will need credit assistance to finance their installation. The average income of rural households, PKR 126,926, would indicate a fair share of the households should be able to take a loan for the investment.

PRSP and RSPN piloted a biogas credit facility whereby the monthly repayments match the habitual domestic energy expenses (about PKR 1000 per month). Although the pilot is quite recent (start June 2007), the participating households support the initiative and repayments have been 100%. Moreover, the pilot is generating more demand in the village. However, current "standard" (micro-) credit conditions are not tuned to biogas investment (see chapter 7.3.1). To reach poorer households, the biogas-credit facility, both in terms of conditions and outreach, will play a crucial role in the dissemination of the technology.



The lower bound of the financial potential for domestic biogas thus would be at –say- 20% of the technical potential, targeting households with larger cattle / buffalo herds and/or additional non-agricultural income. The higher limit would largely depend on the development of the biogas credit facility, and should improve in time.

2.3 Benefits of biogas

Domestic biogas contributes to sustainable development and reaching the UN Millennium Development Goals[12]. 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

[12] 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

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 water heaters;
- reduces greenhouse gas emissions emitted by the conventional energy sources;
- 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 20-40%.
- 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. The biogas tangibility matrix is provided in Annex 3.

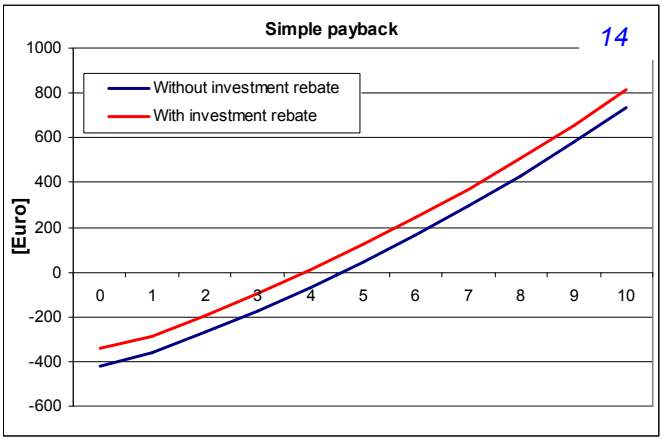
13

	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.

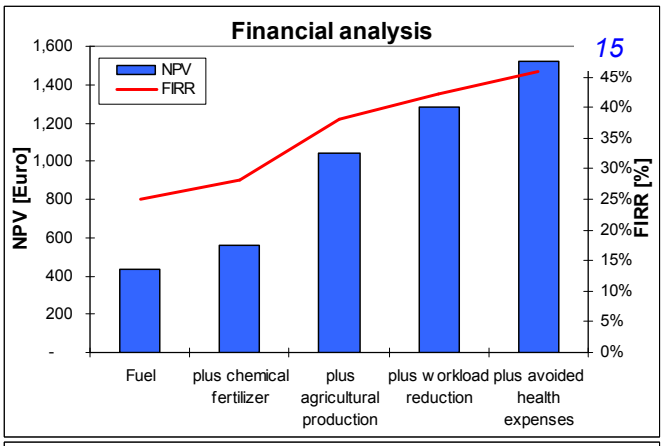
2.3.1 Financial and economic performance of a domestic biogas installation

Analysis in a number of countries confirms that the financial and economic performance of domestic biogas installations is good, and calculations for the situation in Pakistan are well in the expected range.

Simple payback period: As biogas installations substitute traditional fuel used for cooking and lighting, from the perspective of the household, the direct financial gain of a biogas installation will result from the reduction in expenditure for these fuels. Using a simple pay back calculation in which the value of traditional fuel prices has been corrected for inflation, the investment of a biogas installation will be repaid in 3.5 and 4 years with and without investment rebate respectively.

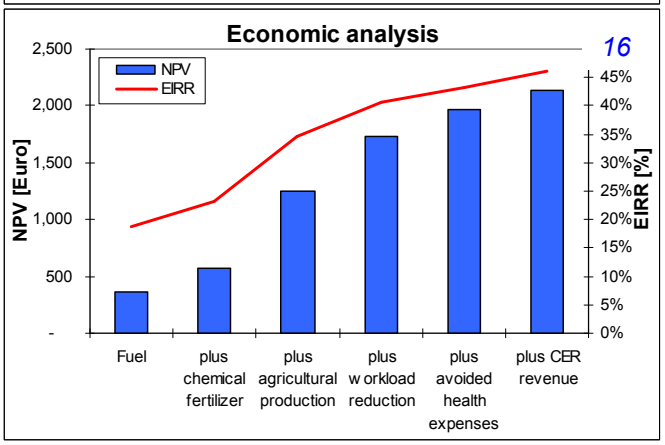


Financial Internal Rate of Return: Financial benefits of a biogas installation, however, go well beyond the reduction of traditional fuel expenses. In addition to fuel savings, a household properly applying bio-slurry as fertilizer will also be able to reduce expenditure on chemical fertilizer, and the agricultural yield will improve both in quality and quantity. Less easily convertible in financial terms, but no less significant, the biogas installation will also reduce the workload and eliminate indoor air pollution.



As a result, over a 10 year period, the Net Present Value (NPV) of a biogas installation will range from € 404 to € 1,450. Correspondingly, the Financial Internal Rate of Return (FIRR), will develop from 25% to 46%.

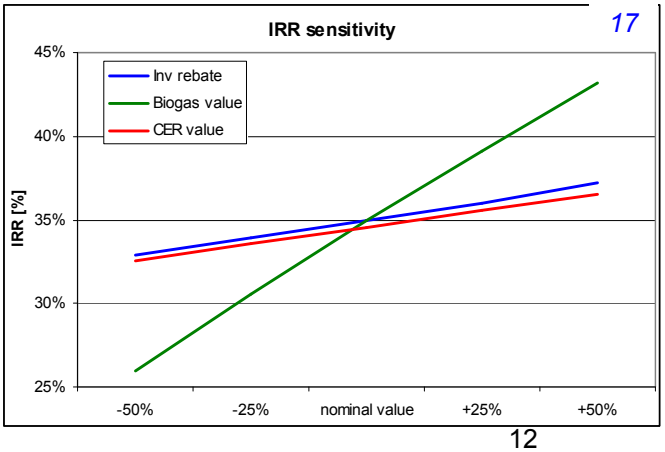
Economic Internal Rate of Return: The economic performance of a biogas plant includes the financial benefits, but also accounts for programme support costs and carbon revenue; cash flows that a household typically does not see.



The NPV will then range from € 371 to € 2,143 and the corresponding EIRR will develop from 19% to 46%.

Two notes are due with respect to this analysis:

- The capital expenditure parameters of biogas installations are sensitive to the value of –in particular- the substituted fuels. The sensitivity of the FIRR against the investment rebate, fuel substitution value and CER value against investment and operation costs is shown in the graph.
- The IRR calculation assumes that re-invested profits will have the same return as the “project investment”. Particularly with high IRRs, this assumption may prove incorrect; a Modified IRR calculation will in such cases present more realistic figures.



More detail on the financial and economic analysis is provided in annex 4.

2.4 Proposed plant design[13]

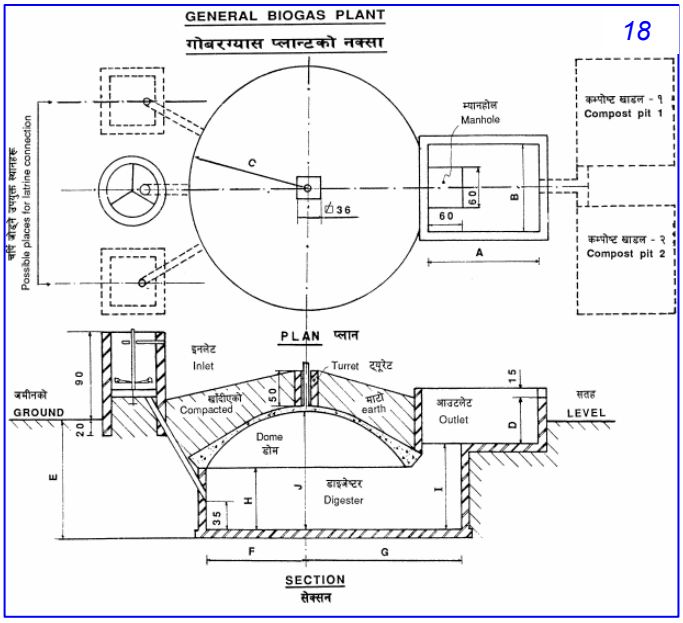
To successfully achieve the objectives of the proposed biogas programme, it is imperative that the best suited biogas plant design is selected. A range of designs for domestic biogas plants are being used in different countries in the world with successful track records. In Pakistan, long term experience has been gained with the floating drum design and, recently and on a limited scale, with the fixed dome model adopted from Nepal. For the selection, the following designs have been taken into consideration:

- Chinese fixed dome
- Pakistan floating drum
- Indian Dheenbandhu fixed dome
- Nepalese GGC 2047 fixed dome

2.4.1 Selection results

The four designs have been assessed on criteria as shown in the table on the next page, whereby scoring ranged from 1 to 5, a higher score indicating a more favourable performance. The outcome of the ranking exercise reveals that the difference on ratings among the four models under study is small. The GGC model, as disseminated under the Biogas Programme in Nepal and recently piloted in Sialkot and DI Khan districts in Pakistan, obtained the highest score. The suitability of this design for both brick and stone masonry work; the simplicity in construction; its higher resistance of the gas holder against ground tremors, easy access for cleaning and maintenance of digester and gas holder; higher level of user's satisfaction, and: its proven track record of successful functioning in different countries under SNV's biogas programmes make this model more suitable than others. The labour intensive construction of the gas holder, its relatively less suitability of the model in areas with high water table (flat bottom), and more time and efforts needed in quality control are the main shortcomings of this design.

18



2.4.2 Plant size range

The GGC 2047 biogas plant can be constructed in plant volumes ranging from 4m^3 up to over 20 m^3. For domestic use in Pakistan, taking into account the expected gas consumption of households, a size range from 4m^3 up to about 10 m^3, with a daily gas production of approximately 1m^3 to 4 m^3 will suffice. Development of an optimum plant size range[14], taking into account the variation of the climatic conditions in Pakistan, will be part of the early R&D activities of the programme. The tentative plant size range, required feeding and expected gas production is provided in the table below.

19

GGC 2047 plant volume range		4 m^3 plant volume			6 m^3 plant volume			8 m^3 volume			10 m^3 volume		
		min	max	avg	min	max	avg	min	max	avg	min	max	avg
Feeding	[kg dung/day]	36	48	42	48	72	60	72	96	84	96	120	108
Water requirement	[ltr water/day]	36	48	42	48	72	60	72	96	84	96	120	108
Cattle (night stabling only)	[heads]	3	4	4	4	6	5	6	8	7	8	10	9
Gas production	[m^3/day]	1.44	1.92	1.68	1.92	2.88	2.40	2.88	3.84	3.36	3.84	4.80	4.32

[13] This chapter summarizes the conclusions and recommendations of the Technical Survey report.

[14] The programme considers for Pakistan to develop the GGC 2047 biogas plant with a pre-fabricated (glass-fibre or HDPE) dome; optimizing the plant size range may reduce pre-fabrication and handling costs.

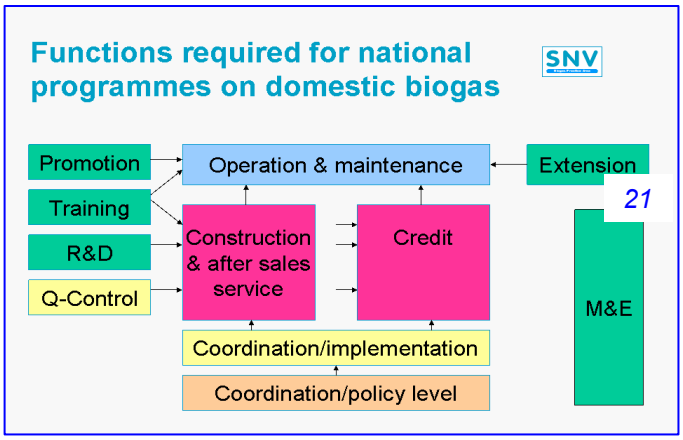
			Chinese fixed dome	Pakistan Floating Drum	Indian Deenbandhu	Nepalese GGC 2047
Climate and geology	1.1	Ambient Temperature	4	2	5	5
	1.2	Type of Soil	2	5	5	3
	1.3	Condition of Ground Water Table	4	3	4	4
	1	**Total climate & geological conditions**	**10**	**10**	**14**	**12**
Technology – Structural durability & funtionality	2.1.1	Inlet Chamber and Inlet Pipe	3	4	5	5
	2.1.2	Digester	5	4	5	3
	2.1.3	Gas Holder	4	3	4	5
	2.1.4	Outlet Tank	5	5	4	4
	2.1	Total structural durability & funtionality	17	16	18	17
Construction / supervision menthod	2.2.1	Digging of Pit	2	3	2	5
	2.2.2	Construction of Base	4	5	2	5
	2.2.3	Construction of Digester	4	5	3	5
	2.2.4	Construction of Gas Holder	4	5	4	2
	2.2.5	Inlet and Outlet Tanks	4	4	5	5
	2.2.6	Time and Efforts in Quality Control	3	5	3	3
	2.2	Total construction / supervision	21	27	19	25
Operation & maintence	2.3.1	Operational Activities	4	4	5	5
	2.3.2	Maintenance Activities	4	2	5	5
	2.3.3	Top-filling and protection of plant	3	2	4	5
	2.3	Total operation & maintenance	11	8	14	15
	2.4	Applicability/Adoptability	3	4	4	4
	2.5	Prospects for knowledge transfer	4	3	5	4
	2	**Total technology**	**56**	**58**	**60**	**65**
Affordability	3.1	Local availability of construction materials	5	4	4	5
	3.2	Availability of human resources	2	5	2	2
	3.3	Cost of Installation	3	3	3	3
	3.4	Operation and maintenance cost	4	3	5	5
	3.5	Transportation facilities	3	3	4	5
	3	**Total affordability**	**17**	**18**	**18**	**20**
Performance	4.1	Use of biogas / bioslurry	5	5	5	5
	4.2	Existing physical status and functioning	3	3	3	5
	4.3	Level of Satisfaction of Users	3	3	3	5
	4.4	Quality and quantity of available feeding	3	5	5	5
	4	**Total performance**	**14**	**16**	**16**	**20**
		Total	**97**	**102**	**108**	**117**

3 Objectives, output targets, expected results.

The design of this programme draws on SNV's experience in large-scale dissemination programmes for domestic biogas in Asia. For the past (nearly) two decades, SNV supported preparation and implementation of domestic biogas programmes in countries in Asia[15] and -more recently- Africa[16]. In particular the programmes in Nepal and Vietnam –our longest running initiatives- met with a fair amount of international acclaim[17]. Important elements of SNV's approach[18] include:

- Thorough, participatory and context-specific preparation;
- A sustainable sector as the ultimate long-term objective;
- Interlinking impact and capacity development targets;
- Promoting a market-oriented approach;
- Attributing sector-functions to multiple stakeholders.

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 Pakistan 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 would 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 4 years is proposed, aiming to construct 30,000 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 pluralistic 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 a conducive policy environment for the programme and will coordinate the supply- and demand-side support activities.

Single autonomous management entity: A single autonomous entity, hosted by the RSPN, will be responsible for coordination and management of the supply and demand side activities. This entity, the Pakistan Domestic Biogas Enterprise, will be able to swiftly react to the requirements of the sector and coordinate between supply side (construction, after sales service, quality control) and demand side

[15] Nepal, 1989; Vietnam, 2002; Cambodia and Bangladesh, 2005, Lao PDR, 2007; Pakistan, 2008.
[16] Rwanda, 2006; Ethiopia, 2007.
[17] Nepal: World Climate Award 1999, Ashden Award for Sustainable Energy 2005; Vietnam Energy Globe Award 2006.
[18] A more detailed description of SNV's approach can be found in the paper "Building viable domestic biogas programmes" by W. van Nes and F. ter Heegde (2008).

activities (awareness creation, promotion, extension). Over time it the PBDE will be established as a separate “section 42” not-for-profit company.

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).

Carbon rebate: Providing to households an upfront rebate on the investment, whereby the rebate is financed by the anticipated carbon revenue of the programme. The provided rebate will reduce the investment costs for participating households and creates leverage to manage the service quality as provided by the biogas construction enterprises. Two rebate-levels are proposed, regular and high, the latter one compensating higher investment costs in remoter areas. Investment rebate, approximately 18% of the investment, will be independent from the plant-size (“flat rate”).

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 and rural development funds (revolving loans).

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 necessary dissemination skills are as much as possible available locally- and on the demand side -to make sure households understand the operation and maintenance of their plants sufficiently and families apply biogas and bio-slurry to their maximum advantage.

Gender mainstreaming: The project expects to have substantial benefits for women’s welfare and empowerment. The baseline study, e.g., will provide the first quantification for how much time women and girls in rural areas currently spend in the collection of fuel, in other economic activities, in social activities, or in education. The baseline study will subsequently provide a clear way forward for increasing the role of women in the project activities on both the supply and demand side activities. The strategy will be based on identifying opportunities for women to be involved in the supply side of the biogas plants as owners or employees of the BCEs, as masons and in the demand side as trainers, community organizers, income-generation facilitators, micro-finance lenders, and as integrators of biogas into other social and economic activities.

Programme financing: The programme anticipates four different fund sources to finance its activities:

- Financial support of the Government of Pakistan, mainly to finance demand-side support activities;
- Carbon-revenue, as a result of the GHG emission reductions resulting from operational biogas installations constructed under the programme, to finance supply-side support activities and the proposed carbon-rebate to households;
- ODA support to fill the initial financing gap for supply-side activities resulting from the mismatch between programme expenditure and carbon-revenue in-stream, and;
- Fees from participating households, covering on -the longer term- the promotion and quality control activities of the programme.

3.2 Programme goal and purpose.

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

- 30,000 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[19];

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

- Programme implementation will follow the technical potential for domestic biogas. Operations will start in the Punjab and subsequently annually expand to Sindh, NWFP, AJK and Baluchistan. In order to be able to provide adequate support, full-fledged provincial biogas offices will be established in the larger provinces (Punjab, Sindh) and satellite offices (supported by the provincial offices) in the smaller provinces.
- To allow emerging Biogas Construction Enterprises to efficiently provide their services, biogas plants will be constructed in clusters of at least 20 installations per village.
- All plant owners will have access to credit for biogas construction and 75% of biogas owners utilise the credit facility by the end of the project[20].
- 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.

3.3 Specific objectives

To support the programme's purpose, specific objectives for each of the programme components are formulated as follows:

CN	Component	Specific objective
1	Promotion	To stimulate demand, informing beneficiaries and stakeholders on costs and benefits of domestic biogas.
2	Financing	
	Investment rebate	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.

[19] Surveys indicate that actual toilet connection will face significant 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.

[20] 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 75%.

3.4 Expected results

Over the first phase of the programme 30,000 installations shall be installed. Allowing for an annual failure rate of 2%, by the end of the first phase 29,454 installations will be operational. The gross energy production of these installations will be equivalent to 18,336 tons of oil. Combined, the installed net power of these installations will amount to nearly 62 MW.

Pakistan Biogas Programme *23*

expected results (provisional)

Biogas plant construction	**30,000**	[plants]
Energy		
Energy production	**17,701**	[toe]
Power installed	**59,797**	[kW]
Environment		
GHG emission reduction	**149,324**	[t CO_2eq]
Deforestation reduction	**7,857**	[ha of forest]
Soil nutrificaton	**126,024**	[t(DM) bio-slurry]
Fuel substitution		
Biomass	**160,445**	[t biomass]
Fossil fuel	**2,267**	[t]
Socio-economic		
Persons reached	**240,000**	[persons]
Workload reduction (women & children)	**1,945**	[pers years]
Exposure to indoor air pollution reduced	**150,000**	[women & children]
Toilets attached	**6,000**	[toilets]
Productive slurry use	**24,000**	[households]
Employment generation (direct)	**2,100**	[person years]
Training		
User training	**42,000**	[person days]
Professional training	**12,855**	[person days]

Based on the findings of the Technical Assessment survey, a biogas plant under Pakistani conditions will reduce GHG emissions with at least 3.3 tons of CO_2 equivalent per year; the programme expects to reduce over 159,000 tons of CO_2eq. The programme will contribute to reduction of the deforestation equivalent to nearly 8,500 ha of forest. Soil fertility will have improved as over 130,000 tons (dry matter) of organic material will have become available as organic fertilizer (including 8,000 t N, 0.8 t P and 3.3 t K).

A biogas installation will on average substitute 3.51 tons of biomass per household per year (0.66 t agricultural residue, 1.10 t dung cake and 1.75 t fuelwood). Programme wide, nearly 170,000 tons biomass will have been substituted. In addition, the biogas will have substituted nearly 2,500 tons of fossil fuel (LPG).

Assuming an average biogas-household size of 8 persons, by the end of the first phase 240,000 persons will reap the benefits of the technology. As a result of the workload reduction induced by a biogas plant, assumed conservatively at 1 hour per day per household, the total workload reduction will have amounted to just over 2000 person-years. For 150,000 women and children, the indoor air pollution resulting from the combustion of biomass will be virtually eliminated. Some 6,000 households will benefit improved sanitary conditions because they connected a toilet to their biogas installation and 24,000 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 42,000 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 2100 person-year. The programme will have provided nearly 13,000 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.

3.5 Linkages of programme objectives to Government objectives.

The Government of Pakistan has made a number of policy decisions in the past five years to increase investment into renewable energy. In May 2003, it announced that it had set a target of 5% of the country's total power generation to be from renewable energy by 2030 (9,700 MW) and established the AEDB as the apex organization to coordinate renewable energy promotion. The Policy for Development of Renewable Energy for Power Generation (Renewable Energy Policy 2006) focuses on increasing private sector investment into electricity generating renewables. The Government is in the process of preparing a Biomass Energy Policy which will include both renewable thermal energy sources such as biogas and electricity generating waste to energy activities.

Pakistan faces an energy crisis today resulting from shortages of both electricity production and supply of thermal energy sources. The two crises are linked since 29% of the natural gas produced in the country is used to generate power. Diverting more natural gas to meet the country's power needs would exacerbate the shortages of gas to the industry, transport, and domestic sectors. Inability to increase gas production in the country has resulted in sharp increases in consumption of imported oil. This is likely to accelerate in the coming years.

Around 4,000 villages out of a total of 68,000 in the country are currently served by the natural gas grid. The convenience of having access to natural gas and its low cost has resulted in tremendous pressure from rural areas for an extension of this network. This is often expressed as a popular sentiment through the political process as happened during the elections in 2008. Extending the pipelines further into rural areas is both loss making for the Gas utilities and puts further pressure on a resource which is not sufficiently meeting existing demand.[21] Any large-scale production of biogas in the country at the domestic level would reduce the demand for uneconomic expansion of the gas grid and limit growth in demand for the gas. The fertilizer sector is another large consumer of the country's natural gas. In 2006-07 the production of urea consumed around 13% of the natural gas produced in the country. Here too it is clear that bio-slurry from biogas could substitute for increasing use of natural gas.

The proposed biogas programme objectives have strong overlap with the Government of Pakistan objectives to manage the country's energy crisis without hurting industrial production and agricultural productivity or negatively impacting the quality of life of the population. The programme objectives also strongly overlap with the government's environmental, health, sanitation and gender objectives. In summary the programme promises to assist the government to achieve many of its MDG targets. This has resulted in broad and strong support from different sections of the Government to the proposed national biogas programme, including the Planning Commission, Alternative Energy Development Board, Pakistan Council on Renewable Energy Technologies, Ministry of Environment, and the Livestock Development Board.

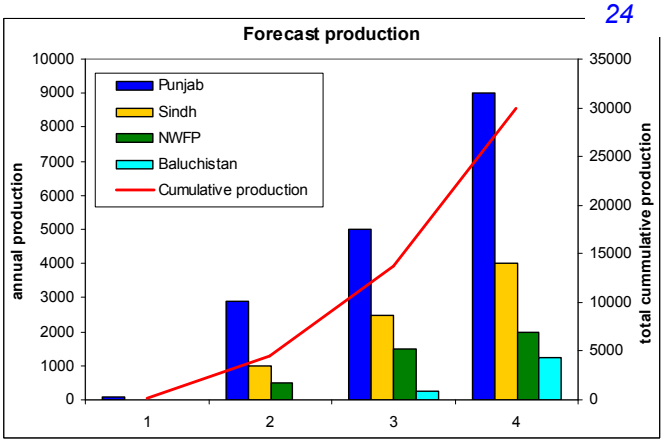
[21] Each rural connection is cost at PKR 10,000. The connection fee is Rs 3,000 and the government subsidies the Rs 7,000 through the Gas utilities. Consumption of gas in rural households is limited to the two lowest pricing slabs, which are subsidized by the government.

4 Output targets

4.1 Production

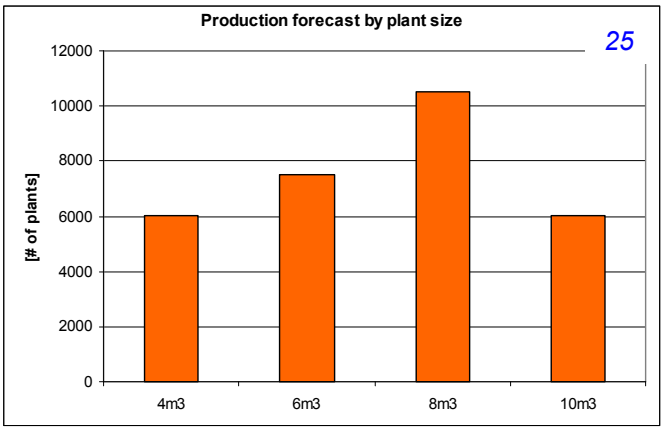
The total forecast production will amount to 30,000 installations. For the first programme year 100 installations are planned to be installed in the Punjab. In the second year, the production in the Punjab should increase to 2900 installations, and production in the provinces Sindh and NWFP will be started up (1000 and 500 installations respectively). For the third year the production in the Punjab, Sindh and NWFP should further grow (5000, 2000 and 1500 installations respectively), while production in Baluchistan will be started up (250 plants). In the fourth year, the programme will be active in 4 provinces, constructing in total 16,250 installations.

24



Domestic biogas installations typically range in size (say 4 to 10m^3 plant volume), whereby the actual size for a particular household depends on the amount of available substrate (for Pakistan mainly cattle dung) and the required (daily) biogas production. Surveys for Pakistan indicate that the amount of available dung is lesser a limiting parameter than the required gas production. Lacking comprehensive baseline data on household energy requirements, a survey based on a smaller sample 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 7.1 m^3.

25

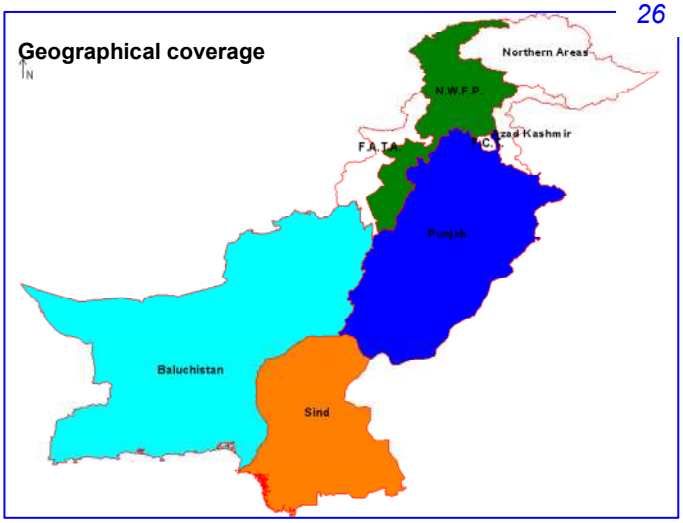


4.2 Geographical coverage

The programme, during its first phase, will operate in the provinces Punjab, Sindh, NWFP and Baluchistan. As explained above in 4.1, the programme will be introduced step-wise; the first year operations will start in the Punjab only, during the second year Sindh and NWFP will be included and the third year activities will start in Baluchistan.

During the second phase of the programme, inclusion of (some of) the remaining areas can be considered, although the livestock populations in these areas is significantly lower and the climatic (and political) conditions are less conducive to implementation of a large scale biogas programme.

26

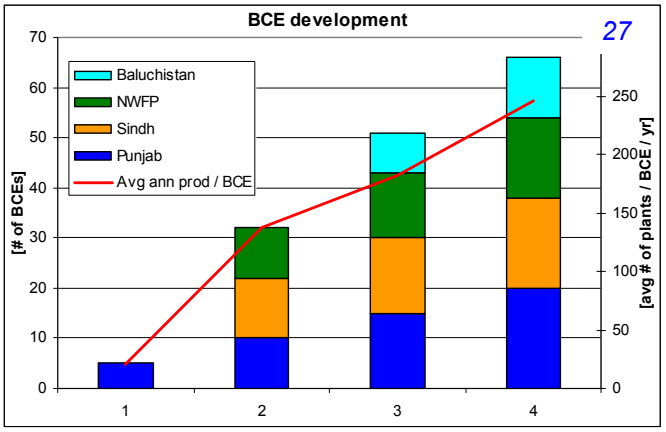


4.3 Biogas service providers

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) and –possibly- prefabricated plant components by biogas workshops.

4.3.1 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 then 100 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 5 BCEs in the Punjab to construct the first 100 biogas installations. Subsequently, the programme will move to other provinces and support establishment and growth of the BCEs. At the end of the first phase, about 66 BCEs should be in operation. Over this period, the average production will increase from 20 to 240 plants per BCE per year.

4.3.2 Biogas appliance manufacturers

Based on the typical average biogas installation of 7.1 m^3 plant volume, 1 installation would require the following biogas-specific appliances: 1 large and 1 small stove; 1 biogas lamp, 2 gas taps, 1 dome pipe and 1 mixing device. All these appliances can be fabricated in metal workshops with equipment that is generally available. In view of the high standard of metal fabrication in the country, it is expected that high quality appliances can be fabricated in-country at a competitive price; import from China seems not necessary. Also, the metal-manufacturing sector is well distributed over the country; most BCEs should be able to source appliances from within a reasonable distance.

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

A special note is due for pre-fabrication of plant components: The gas-holding part of the biogas plant, the dome, is very sensitive to the quality of masonry work regarding gas-tightness. In view of the large technical potential and rapid scaling-up, the programme formulation team therefore looked into opportunities of pre-fabricating this plant component. Pakistan has a well developed industry, meriting further study on manufacturing, costing and quality aspects of pre-fabricated glass-fibre domes. Assuming glass-fibre would technically and economically attractive, dome manufacturing would have to be established at local (district) level, as the transporting the sizeable domes over large distances would be costly.

4.4 Quality management

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

BCE: 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 three subsequent years annually for the contractual maintenance visit (100% cumulative check).

PBDE: Biogas Technicians, employed by the PBDE, 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, plants recently completed, and plants under the contractual maintenance scheme.

For the targeted 30,000 installations nearly 52,000 plant visits are foreseen; 48,350 by BCEs and 3,434 by the PBDE.

28

Quality control

			Plant visits 1	2	3	4	Total
BCE	Plant completion	PC	100	4400	9250	16250	**30000**
	Annual maintenance	PM	0	100	4500	13750	**18350**
	Total BCE plant visits		**100**	**4500**	**13750**	**30000**	**48350**
PBDE	Quality Control on completed plants	QC-Comp	6	264	555	975	**1800**
	Quality Control on plants under construction	QC-UC	3	132	278	488	**900**
	Quality Control on ASS	QC-ASS	0	4	180	550	**734**
	Total PBDE plant visits		**9**	**400**	**1013**	**2013**	**3434**
	Total plant vists		**109**	**4900**	**14763**	**32013**	**51784**

4.5 Training requirement

The programme proposes a comprehensive training component. Over the first phase, the programme plans to provide over 4000 training courses and workshops, reaching nearly 120,000 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 100 technical training courses, certifying 2184 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 (Rural Support Programmes, diary / farmer associations, micro-credit organizations, NGOs, Community Organizations, Village Extension Workers). The programme plans to provide 130 biogas programme workshops, reaching 2170 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 3700 user training courses, reaching 114000 household members.

ToT: Finally, to assure adequate training is provided, the programme will invest in Training of Trainer courses for both technical as well as user training. In total 27 ToT courses for technical training

and 74 ToT courses for user training are foreseen, aiming to reach 258 technical trainers and 998 user trainers. *29*

Training programme			batch size	Training courses 1	2	3	4	Total	Persons reached
Technical training	Biogas Mason	BMT	24	1	11	13	18	**43**	**1033**
	Biogas Mason Refresher	BMT-R	24	0	1	9	29	**39**	**937**
	Biogas Supervisor	BST	12	0	2	4	5	**10**	**122**
	Biogas Supervisor Refresher	BST-R	12	0	0	2	6	**8**	**93**
	Total technical training			**1**	**14**	**27**	**58**	**100**	**2184**
Programme	Biogas Programme Workshop	BPW	12	2	3	9	14	**27**	**328**
	Village Extension Worker	VEW	20	1	11	23	41	**76**	**1515**
	Loan Officer Training	LOT	12	1	4	9	14	**27**	**327**
	Total programme training			**4**	**19**	**40**	**68**	**130**	**2170**
User training	Biogas Awareness & Promotion	BAW	40	5	220	462.5	812.5	**1500**	**60000**
	Biogas Operation & Maintenance	BOM	30	3	147	308	542	**1000**	**30000**
	Bio-slurry Application	BSA	20	4	176	370	650	**1200**	**24000**
	Total user training			**12**	**543**	**1141**	**2004**	**3700**	**114000**
ToT technical training	ToT Biogas mason trainers	TBM	8	1	3	5	0	**9**	**72**
	ToT refresher Biogas mason trainers	TBM-R	16	0	1	2	3	**6**	**96**
	ToT Biogas supervisor trainers	TBS	6	0	1	3	5	**9**	**54**
	ToT refresher Biogas supervisor trainers	TBS-R	12	0	0	1	2	**3**	**36**
	Total ToT technical training			**1**	**5**	**11**	**10**	**27**	**258**
ToT user training	ToT Awareness & promotion	TAP	12	1	4	8	14	**26**	**311**
	ToT Awareness & promotion refresher	TAP-R	20	0	1	1	2	**4**	**80**
	ToT Operation & maintenance	TOM	12	1	2	5	9	**18**	**211**
	ToT Operation & maintenance refresher	TOM-R	24	0	1	1	1	**3**	**72**
	ToT Bioslurry application	TBA	12	1	3	6	11	**21**	**251**
	ToT Bioslurry application refresher	TBA-R	24	0	1	1	1	**3**	**72**
	Total ToT user training			**3**	**12**	**22**	**37**	**74**	**998**
	Total training			**21**	**592**	**1241**	**2177**	**4032**	**119609**

5 Institutional aspects.

5.1.1 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 to 10 buffaloes or cattle;
- no (expectation of) natural gas grid connection[22];
- real demand for alternative domestic energy sources, whereby it is helpful when the household already (partially) uses commercial energy[23];
- opportunities for meaningful application / marketing of bio-slurry;
- organized in dairy collection, micro-credit, women or rural development groups.

The prime characteristic, households having at least 2 heads of large cattle, 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). A micro-credit or a biogas revolving fund could improve access to biogas for this group of the society. (see 3.2.2).

[22] At the current (subsidized) prices, domestic biogas cannot compete with grid supplied natural gas, see Feasibility Study report, table 5.

[23] Commercial domestic energy: LPG, kerosene, but also purchased fuel wood.

5.1.2 Description of the sector

In concept, the (future) domestic biogas sector can be segmented in organizations operation predominantly in the demand and supply side, whereby the PBDE with its provincial Biogas Support Offices coordinates the activities between these two segments:

- organizations creating and organizing the demand for biogas services, the demand side, consisting of the Rural Support Programmes, micro-finance institutions, rural support programmes, dairy industry organizations, NGOs and GOs active in the field of agriculture or rural development and organizations active in the fields of environment and nature conservation, and;
- organizations providing the biogas services to the target group, the supply side, consisting of Biogas Construction (micro-) Enterprises and Service Organizations.

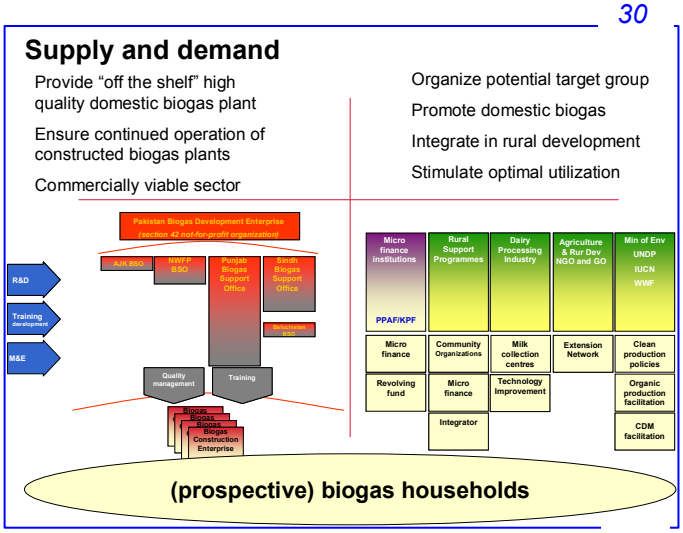
The main responsibility of the sector's **supply side** is to establish a commercially viable biogas sector that:

- provides "off the shelf" high quality biogas installations;
- ensures the continued operation of all biogas plants installed under the programme, and;
- coordinates supply and demand side activities at provincial and national level.

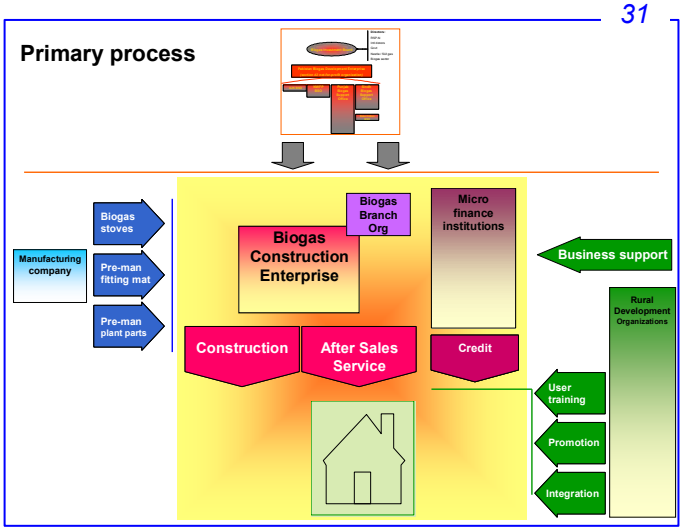
The **demand side** of the sector will be involved in organizing the potential target group to:

- 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

30



31



5.1.3 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.

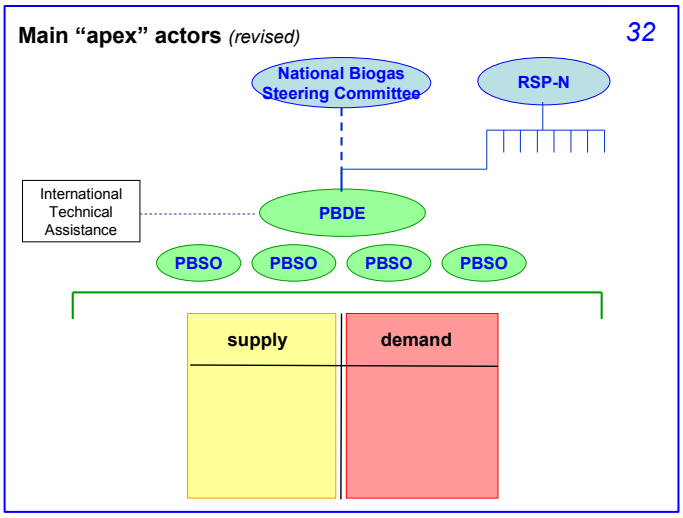
An enabling environment for the above described primary process to blossom would have the following salient features:

- 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 Pakistan Biogas Development Enterprise is to create and maintain the required conditions.

5.2 Main actors in the sector

Main actors include facilitating and implementing actors and government linkages.



5.3 Facilitating actors

The main facilitating actors include:

- the National Biogas Steering Committee;
- the Rural Support Programme Network;
- participating donor organizations.

5.3.1 The National Biogas Steering Committee

As the concept of the programme proposal is to formulate a biogas sector based on a multi-stakeholder participation, the programme's main stakeholders shall be represented in the programme's steering committee.

The NBSC full board will consist of five to seven persons. Members will represent the Government; the private sector; micro-finance organizations; participating NGOs and Rural Support Programmes, participating dairy development organizations; participating Rural Support Programmes; the chair persons of the Provincial Biogas Branch Organization, biogas appliance manufacturers; farmers' associations. Responsibilities of the NBSC full board include:

- Endorsement of the programme's strategy;
- Facilitation of a conducive programme environment;
- Establishing high-level linkages between relevant policies and organizations and the programme;
- Programme evaluation.

To enable effective programme monitoring, the NBSC's responsibilities include more in detail:

- 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 programme to implement activities and allow corresponding expenditures. Approved annual reports, together with the management reply on audit reports, will form the justification of the programme to its investors. The NBSC full board will meet three times per annum:

- in May to discuss and approve the programme's annual plan;
- in August to discuss and approve the programme's annual report, audit report and audit-management reply, and;
- in December to discuss and approve the programme's mid-term activity and budget review.

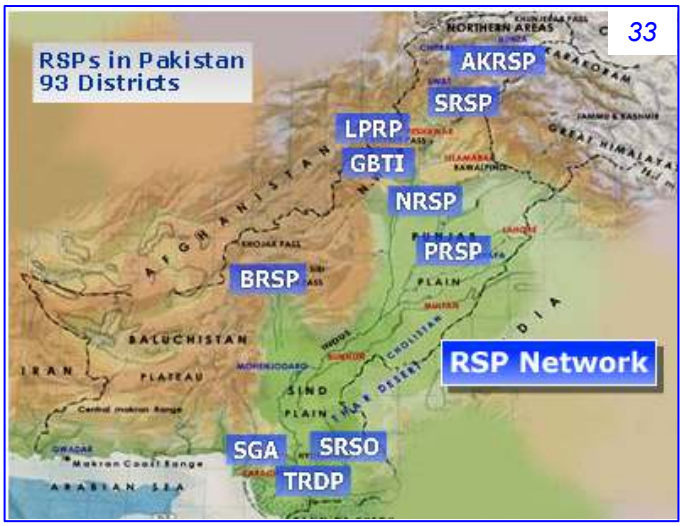
To assist the NBSC, it will have and Executive Committee. The NBSC Executive Committee consists of the chairperson, the CEO of the PBDE and the SPO of RSPN. One important aspect of the NBSC-EC is the coordination of activities at supply and demand side of the sector. The NBSC Executive Committee will meet bi-monthly. The NBSC Executive Committee 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;
- develop and maintain a programme monitoring database.

5.3.2 The Rural Support Programme Network

The RSP Network (RSPN) was registered in 2001 under Pakistan's Companies Ordinance (1984) as a non-profit company by the Rural Support Programmes (RSPs) of Pakistan. RSPN is a network of nine RSPs. The RSPs involve poor communities (mainly but not exclusively rural) in improved management and delivery of basic services through a process of social mobilization.

RSPN is a strategic platform for the RSPs, providing them with capacity building support and assisting them in policy advocacy and donor linkages. Currently the RSPs have a presence in 93 of the country's 140 districts, stretching from the mountainous north to the central plains and down to the southern coastline. (Including FATA/FANA) The RSPs collectively worked with a rural membership of community organizations of 1.2 million rural households[24].



For the programme, the RSPN will (initially) host the Pakistan Biogas Development Enterprise. Besides hosting the PBDE, the RSPN will:

- Make available to the programme its Government relations, donor network and resource mobilization capacity to secure funding for the remaining three years of the programme.
- Facilitate access for the programme to its community outreach facilities and network to include Rural Support Programmes, Community Organizations as well as local private micro-enterprises in the activities of the programme.
- Render services to the programme in the field of finance, administration, human resources, monitoring & evaluation and logistics, including facilitating the expatriate advisors to work on the programme.
- Facilitate and assist, through its network, social mobilization, awareness and promotion, training and extension activities for domestic biogas;
- Facilitate and assist, through its network, the development of micro-credit schemes and/or revolving funds for domestic biogas, and;
- Coordinate with other organizations to exploit the MDG potential of biogas.

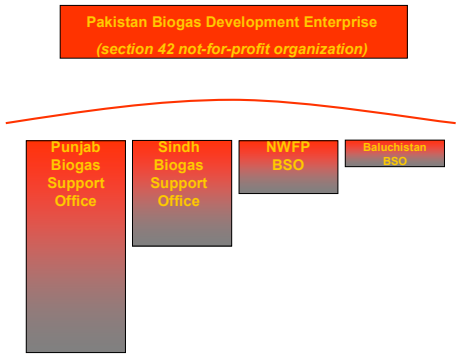
[24] Details on the RSPN and the RSPs pease visit: http://www.rspn.org/main.html .

5.3.3 The Pakistan Biogas Development Enterprise

The Pakistan Biogas Develop Enterprise (PBDE), with the NBSC as its Steering Committee, has coordinating, regulating and facilitating functions at the supply and demand side of the sector.

The Enterprise will consist of a main office in Islamabad and provincial (satellite[25]) offices in the programme's provinces and will interact directly with the Biogas Construction Enterprises and other supply-side organizations.

Pakistan Biogas Development Enterprise *34*



The main tasks of the PBDE include:

- Standardization of biogas plant- and appliance design, construction, after sales service and quality control routines;
- Technical training and subsequent certification of biogas masons and supervisors;
- Quality management and subsequent accreditation of BCEs;
- Management of carbon-rebate and carbon-revenue streams;
- Initiation and coordination of the programme's awareness and promotion activities;
- Initiation and coordination of the programme's extension activities, and;.
- Initiation and coordination of R&D and M&E activities.

The activities of the PBDE will initially be financed by ODA and public funds. Within a 10 year framework, however, carbon revenue is expected to make the enterprise increasingly financially sustainable. For the organization to become financially sustainable and work pro-actively with the private sector, a fair degree of autonomy and business orientation is required. To assure such a status, the programme aims to have the PBDE –in time- registered under Pakistan's company act as a "not-for profit Section 42" organization.

The PBDE will:

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

Kick starting the programme

In time, it is the intention to have the PBDE registered as an autonomous, not-for-profit "section 42" company, either on its own terms or as a subsidiary of the RSPN.

To "kick-start" the programme, SNV will make core-funding available covering the expenses of the first year. During this year, RSPN will host the biogas programme as one of its "special projects", taking management and financial responsibility.

In preparation of the establishment of the NBSC, an Advisory Committee will oversee the programme's activities.

Subsequent institutional arrangements will be agreed on before the end of the year. A separate MoU between RSPN and SNV will govern this first year.

PBDE organization: In view of the size of the country and the potential for domestic biogas, it is proposed to have a central Pakistan Biogas Development Enterprise with Provincial Biogas Offices (PBOs) for provinces with a large potential market (the Punjab and Sindh) and Provincial Biogas Satellite Offices (PBsOs) for provinces with a smaller initial potential demand for domestic biogas (NWFP and Baluchistan).

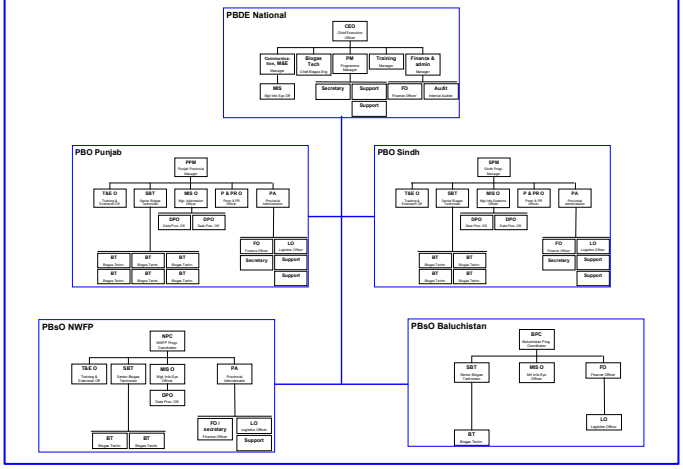
[25] Punjab and Sindh, will have a full fledged Biogas Support Office. NWFP and Baluchistan, however, for efficiency considerations, will work with a satellite offices for the prime functions, assisted by the head office or provincial offices for auxiliary tasks.

PBOs: Except for human resources management, the Provincial Biogas Offices are functionally autonomous; all required activities at provincial level will be dealt with by the PBO.

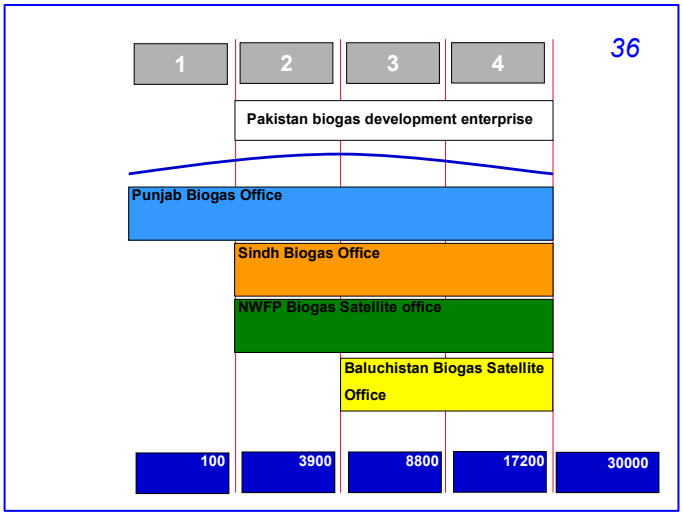
PBsOs: Provincial Biogas Satellite Offices, catering for the provinces with a smaller technical potential will be functionally autonomous regarding technical aspects, finance and data processing. Regarding administrative and training activities, however, the satellite offices will receive support from the national office and the PBOs. The organizational charts for the 5 PBDE offices are provided in more detail as annex 7.

Phasing-in of the PBDE organization will be province-wise. The enterprise will start-up with a Provincial Biogas Office in the Punjab, being the province with the largest potential. In the second year, a Provincial Biogas Office in Sindh and a Provincial Biogas Satellite Office in North Western Frontier Province will be opened. In the same year, the PBDE will establish its National Office in Islamabad. Finally, the third year will see the establishment of Provincial Biogas Satellite Offices in Baluchistan. At the end of the first phase, the PBDE will employ 69 persons divided over its 5 offices.

PBDE organizational chart *(revised)* 35



36



PBDE staffing *[# of persons]* 37

	National	Punjab	Sindh	NWFP	Baluchistan	Total
General management	2	1	1	1	1	**6**
Finance & Administration	3	1	2	2	1	**9**
Communication & Promotion	1	1	1	0	1	**4**
MIS & data processing	1	3	3	2	1	**10**
Technical & training	2	8	5	4	2	**21**
Support	3	5	5	2	4	**19**
Total staff	**12**	**19**	**17**	**11**	**10**	**69**

5.3.4 International Technical Assistance

Winrock International and 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.

5.4 Main actors at the supply-side of the sector

5.4.1 Biogas Construction Enterprises

The nature of envisioned BCEs has been described in chapter 4.3.1. As there is no commercial biogas sector in Pakistan, BCEs are currently non-existent. The programme targets, however, to have 82 BCEs established by the end of the first phase.

The following pathways can be explored to reach this target:

Selecting individual masons[26]*:* Rural Support Programmes recruiting masons for their community infrastructure works through their Community Organizations (COs). Similarly, RSPs can select masons willing to construct biogas installations. However, where masons working in 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[27]*:* The programme can formulate criteria for Biogas Construction Companies, 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 private organizations and NGOs[28] may choose to include providing biogas construction and after sales in their services.

Tendering[29]*:* 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 biogas sector, as the goal is to have biogas services, over a longer period of time, accessible to households. The programme will, therefore, use a mix of the first three modalities; selection of masons, advertisement and inclusion.

5.4.2 Biogas Branch Associations

The programme will stimulate the establishment of Biogas Branch Associations (BBAs) at provincial level. These associations 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.

[26] 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.

[27] 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.

[28] 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 enequal footings.

[29] Tendering of programme areas as tender-lots is applied by the SHS programme under ASER, Senegal.

5.5 Main actors at the demand-side of the sector.

5.5.1 Rural Support Programmes

RSPN provides networking support for 9 independent Rural Support Organizations (see map chapter 5.4.3). The 9 Rural Support Programmes combined have presence in 93 districts, organizing nearly 1.5 million households (over 10 million persons). The households are organized in over 88,000 community organizations (COs). The main activities of the RSPs include saving & credit and insurance, community physical infrastructure schemes, establishment of schools and training.

5.5.2 Dairy Development / Production Organizations

The Livestock and Dairy Development Board (LDDB): The LLDB was established in October 2007 as a not-for-profit company under Section 42 of the Companies Ordinance 1984. The objectives of the LDDB are to:

- plan, promote, facilitate and coordinate accelerated development of and investment in livestock and dairy sectors;
- promote and facilitate marketing of livestock & livestock products;
- encourage private sector investment in livestock and dairy;
- undertake capacity building of all stakeholders, and;
- facilitate, promote and support the development and dissemination of improved technologies.

In addition to sector research, advisory and facilitating functions, LDDB is implementing the “Livestock Production and Development for Meat Production” project and the “Milk Collection / Processing and Dairy Production and Development Programme”.

The Pakistan Dairy Development Company (PDDC): The PDDC was established to drive the development of the Pakistan dairy sector. The PDDC is a public-private sector joint initiative to bring about structural long term change in the dairy industry in Pakistan. With a vision to turn Pakistan into one of the top five dairy manufacturing countries in the world, the PDDC is embarking on a phased plan targeting all the key players in the dairy sector. The PDDC is chartered to coordinate, manage and facilitate initiatives leading to the development of the dairy sector in the country. The PDDC is a company established under Section 42 of the Companies Ordinance and was incorporated as Pakistan Dairy Development Company on the 9th September 2005. The establishment of Dairy Pakistan was a result of recommendations made by the Dairy SWOG (Strategic Working Group). SWOG is a body representing the major players and stakeholders in the dairy chain, including farmers, processors, marketers and the government. The Company is being funded primarily by the Government of Pakistan and partly by the private sector.

Nestle Pakistan: Nestlé started investing in Pakistan 18 years ago. The company has established the country's largest milk collection network, collecting milk from 140,000 farmers over an area of 100,000 square kilometers in Punjab. Nestle’s efforts focus on increased milk production and livestock development. To this end, the milk collection department operates an Agri-Service unit, providing services in the areas of breed improvement, animal health, better feeding and good animal husbandry practices. Nestle assists farmers to avial micro credit from banks for the purchase of dairy equipment and animals. Nestle Pakistan explained to be interested in domestic biogas as it would improve the livelihood of its dairy-households and would improve the sanitary conditions around milk production and collection.

Idara–E-Kishan (IEK): Idara-E-Kishan is a farmers organization established in 1981 with assistance of GTZ. The organization currently reaches 13,000 hh in 11 districts / 1500 villages in the Punjab for milk collection, transport and processing of milk and is operating its own dairy processing plant in Lahore. Surplus funds are channelled back to participating farmers by offering extension services on veterinary, marketing and feeding / fodder aspects free of costs. In addition, Idara-E-Kishan offers “women & development” services including literacy and child health care classes (including the social services, IEK is reaching 30,000 hh).

5.5.3 Natural gas suppliers

Sui Northern Gas Pipelines (SNGPL): SNGPL provides over 2.7 million consumers with natural gas in the Punjab and NWFP. In view of the energy shortage in the country and the high connection costs of rural households, SNGPL is interested to participate in a national domestic biogas programme.

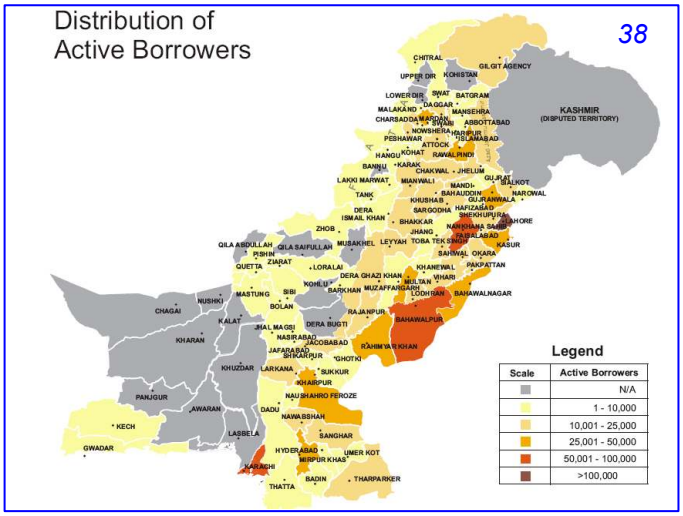
Sui Southern Gas Company (SSGC): SSGC, similar to SNGPL, provides natural gas to 1.9 million consumers in Sindh and Baluchistan province.

5.6.4 Credit organizations

The Pakistan Microfinance Network[30] (PMN) estimates that as many as 5.6 million households need micro-finance services, but services reach only a small fraction of this population. Currently 30 microfinance organizations are reporting to the PMN, including Microfinance Banks (6), Micro Finance Institutions (5), Rural Support Programmes (5), NGOs (12) and Commercial Financial Institutions (2). The microfinance organizations offer credit, savings and insurance services to their clients.

The licensed MFBs attract the largest share of active borrowers (36%) closely followed by the RSPs (34%). MFIs attract 24% of the active borrowers and the remaining market share it covered by NGOs (5%) and CFIs (1%)

As shown on the map, microfinance borrowers are concentrated in the urban areas around Karachi and Lahore and Faisalabad, eastern and northern Punjab and some districts in NWFP and Sindh. Overall, 44% of the borrowers reside in urban areas, the remaining 56% is rural.



Typical loans have a maturity of less than 1 year with an interest rate of 20% on the declining outstanding debt. The average size loan size is in the range of PKR 11,000 to PKR 24,000, with group loans and loans extended by RSPs covering the lower end of the spectrum and individual loans and loans by CFIs covering the higher end. Group loans make up 90% of the portfolio.

The composition of the borrowing clients of the microfinance organizations reporting to the PMN is reasonable gender-balanced: 53% male and 47% female. Sector-wise, most borrowers take loans for trade (36%) and 25% and 16% of the borrowers take loans for agriculture and livestock / poultry respectively. The remainder of the borrowers take loans for manufacturing / production (9%), services (8%), or other purposes (6%).

As the microfinance sector in Pakistan is still developing, the involved institutions are interested in expanding their client-base rather than diversifying their product range[31]. Hence, extending loans for biogas installations (requiring a longer maturity and a lower interest rate) may not be a priority for the sector as a whole. The RSPs, extending loans as part of their multi-dimensional rural development programmes, however, could be interested initial partners for the biogas programme.

Microfinance, particularly for the smaller group loans, comes at relatively high transaction costs (social mobilization, administration, repayment collection etc). Microfinance organizations would need an interest spread of about 14% to cover these costs.

Microfinance organizations are facing a fund shortage. To fully facilitate the biogas credit component, additional funds are required. For this, the most appropriate source seems the credit funds from the PPAF and KPF, as foreign funds would need an additional mark-up of 10% to cover the foreign exchange risk.

[30] The Pakistan Microfinance Network is a network of organizations engaged in microfinance, see www.pmn.org.pk

[31] Nevertheless, product diversification is taking place, with organizations pioneering housing loans.

5.6 Government linkages

5.6.1 The Alternative Energy Development Board

The AEDB was established in May 2003 as an autonomous body with the aim of promoting and facilitating the exploitation of renewable energy resources in Pakistan so as to achieve the GoP's RE deployment targets. AEDB has a particular role in encouraging private investment into the renewable energy sector. These investments will both improve the mix of renewable energy in the country's primary energy supply and ensure access to modern energy services to populations which are off-grid through provision of alternative energy technologies. It is anticipated that AEDB will play a 'sector facilitation' role in the national domestic biogas programme including linking the programme outputs with national targets for supply of renewable energy as well as with proposed and ongoing biomass energy projects and other alternative energy activities.

5.6.2 The Ministry of Environment

The MoE has multiple interests in expanding the availability of biogas technology -in terms of reducing pressure on forests, improving sanitation and health, promoting organic agriculture, and development of CDM projects to mitigate global climate change. It is anticipated that MoE will play a 'sector facilitation' role on the demand side of the national domestic biogas programme.

5.6.3 The Ministry of Food, Agriculture and Livestock

The Ministry of Food, Agriculture & Livestock is mainly responsible for policy formulation, economic coordination and planning in respect of food grain, agricultural & livestock. With the share of smallholder agricultural farms continuously increasing (from 45% in 1962 to 81% in 1990), Government intervention in the agricultural sector are designed to primarily focus on the drudgeries of small farmers. This together with the fact that some 7 million rural households are involved in livestock keeping makes the Ministry and its network a formidable partner for domestic biogas dissemination.

5.6.4 The Pakistan Council of Renewable Energy Technologies / MoST

The Pakistan Council of Renewable Energy Technologies (PCRET) under the Ministry of Science and Technology has been assigned the responsibility of Research and Development, dissemination, training to promote renewable energy technologies in the country. The Council, which has offices in Islamabad as well as the four provincial capitals of the country, is actively promoting household biogas plants. PCRET can be expected to make valuable contributions on biogas technology development in the national program.

5.7 Actor – activity matrix

39

Actor - activity	Promotion & marketing	Investment financing	Construction and A.S.S	Quality Management	Training	Extension	Institutional Support	Monitoring & Evaluation	Research & Development	Programme Management
Nat Biogas Steering Comm										●
Gov of Pakistan										●
PBDE	●	●	●	●	●	●	●	●	●	●
Credit providers		●								
RSPN	●	●			●	●	●	●	●	●
RSPs / NGOs	●	●			●	●	●			
PCRET									●	
Voc Training centres					●					
Biogas Branch org	●		●		●					
Biogas Constr Enterprises	●		●							
Consultancy orgs					●			●	●	

Initiating / coordinating	●
Executing	●
Supporting / assisting	●

6 Activities and inputs

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

6.1 Promotion

The PBDE will develop promotional material explaining costs and benefits of biogas installations. In addition, promotional activities including distribution of the annual biogas calendar, selection of best mason / supervisor / BCE of the year are budgeted for. At provincial level, promotional activities will include translation and reproduction of the developed promotional material, biogas awareness & promotion workshops (tabled under training hereunder) and funds for general promotional activities. For the first programme year in each province, funds are available to assess existing domestic biogas installations.

6.2 Finance

The main activity will be channelling and administration of the carbon-rebate to BCEs (see 6.2.1) by the provincial offices of the PBDE. Further activities include annual financial audits at national and provincial level and bi-annual management audits. At national level, development and installation of finance software and internal financial control visits to the provincial biogas offices are foreseen. At programme level, annual financial and management audits are planned. In addition, development and installation of finance software and internal financial control visits to the provincial biogas offices are foreseen.

6.2.1 Investment rebate

The programme will provide an investment rebate of PKR 6,000 (PKR 10,000 for installations in remote areas) to households. The investment rebate will be limited to:

- one biogas installation per households;
- biogas installations constructed strictly according to the design and quality standards of the programme;
- biogas installations constructed by certified biogas masons working for accredited BCEs.

The investment rebate will be flat-rate for the different plant sizes supported by the programme because:

- A flat rate system stimulates proper sizing of installations, and;
- Households with larger livestock herds, requiring a larger biogas plant, can be expected to make a larger contribution to the investment by themselves.

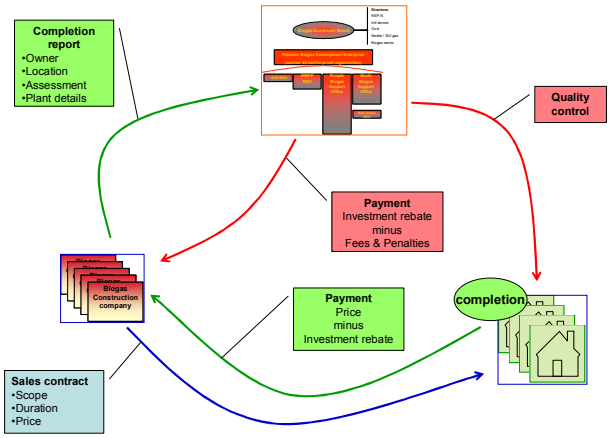
Providing the investment rate will serve a triple purpose:

- Obviously, the investment rebate will reduce the investment costs for the households, making domestic biogas obtainable for poorer households
- A transparent and simple investment rebate arrangement is a powerful promotion tool, and;
- The investment rebate offers the programme leverage on the quality of the services as provided by the BCEs.

Channelling of investment rebate: For the transfer of investment rebate and maintenance fees, each BCE will open two accounts with a bank selected by the programme; one biogas current account and one biogas savings account. The biogas savings account will be a joint account, in which the management of the BCE and the PBE/PBO both are signature holders. The administrative process regarding payment of investment and investment rebate 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 BCE for the services extended as per the sales contract, deducting the programme's investment rebate 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 its Provincial Biogas Office.

Investment rebate channelling



- *Investment rebate payment:* Based on the received Plant Completion Reports, on a monthly basis, the PBDE/BPO will transfer the investment rebate (minus fees) to the BCE's biogas current account.

Channelling programme fees: The programme will levy one-time fees, deducted from the investment rebate, to be transferred to the BCEs' current account, to support the financial sustainability of the programme as follows:

- Participation fee (PKR 250 per plant): The participation fee is a contribution of the households to the demand-side activities of the programme. The participation fee will be levied by the PBDE and transferred to a savings account of the RSPN/*Biogas*. The participation fee will be used in the demand-side budget of the following year.
- Quality Insurance fee (PKR 250): At programme level, the PBDE will guarantee proper functioning of all the installations for a period of 4 years. The PBDE will perform extensive quality control to safeguard the quality of construction and after sales service of the biogas plants constructed under the programme. Households will contribute to the expenses of this service by paying the Quality Insurance fee. The QI fee will be levied by the PBDE and transferred to a separate QI-savings account of the PBDE. QI fees will be used in the supply-side budget of the following year.

Channelling Annual Maintenance fees: BCEs will provide their installations with a 4-year guarantee. The guarantee includes 3 annual maintenance visits, at which a qualified biogas mason or 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 PKR 600 will be withheld from the investment rebate and transferred to the joint savings account of the PBDE/BPO 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 PBDE/PBO. Based on the submitted Maintenance Reports, the PBDE/BPO will release the maintenance fee in three amounts of PKR 200 over three years. 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 levied in the last quarter of the construction season, and will be deducted from the outstanding investment-rebate amount.

Bonuses will be provided to BCEs providing outstanding service quality (high and consisitend 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 investment rebate to the BCE rather than the household, the programme's penalty / bonus system becomes an effective instrument for quality management.

6.3 Private sector support

Central in the concept of the programme is the inclusion of the private enterprises in the primary process leading to sector growth. Technical training alone will unlikely suffice to support BCEs in this process. Therefore, under coordination of the NRSP*/biogas,* after the second programme year, biogas sector surveys will be commissioned at provincial level. Following the survey, biogas business development seminars will be organized at provincial level. At these seminars, the business growth concept will be explained and BCEs will be able to exchange best practices.

As a follow up to these seminars, BCEs will be offered to participate in an individual business-growth trajectory. Such a trajectory, which may span over a couple of years, will assess the enterprise and offer tailor made support on business administration and marketing.

The programme plans for 4 provincial biogas sector surveys, followed by 7 provincial business development seminars and anticipates 66 BCEs to participate in the business-growth trajectory.

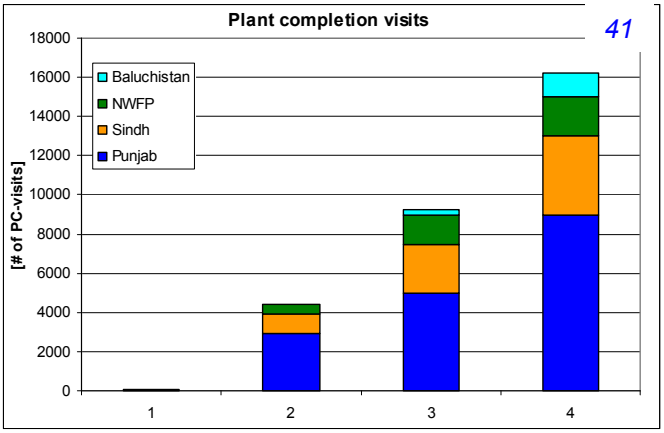
6.4 Quality management

The programme –in close cooperation with PCRET- will develop detailed standards for the desired quality of construction and after sales service. Adherence of the standards by the construction companies will be controlled by representatives of the companies themselves and Biogas Technician of the PBDE.

6.4.1 Quality control by the BCEs

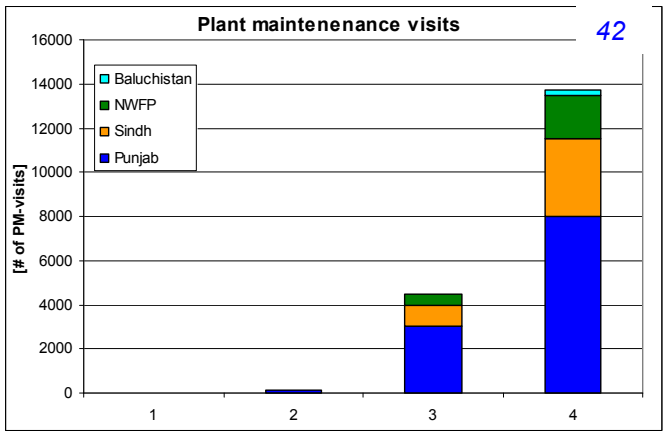
Participating Biogas Construction Enterprises carry the prime responsibility for the quality on their services; they execute the works and their future depends on the user satisfaction of their products. In addition to ensuring that only certified masons are involved in construction and after sales service of the installations, BCEs therefore will check each installation upon completion and re-visit the installation annually after the first year of operation for 3 consecutive years for a maintenance inspection.

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, and that the installation is functional, and 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 PBDE/Provincial Biogas Office as a legal document confirming existence and proper functioning of the installation. The PBDE/PBO will enter the information in the biogas data base.



BCEs will perform a 100% check on plant completion: hence 30,000 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 3 subsequent years (Installations under the programme come with a 4 year construction and after sales warrantee). 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 PBDE as a legal document confirming proper operation if the installation. The PBDE/PBO will enter the information in the biogas data base.



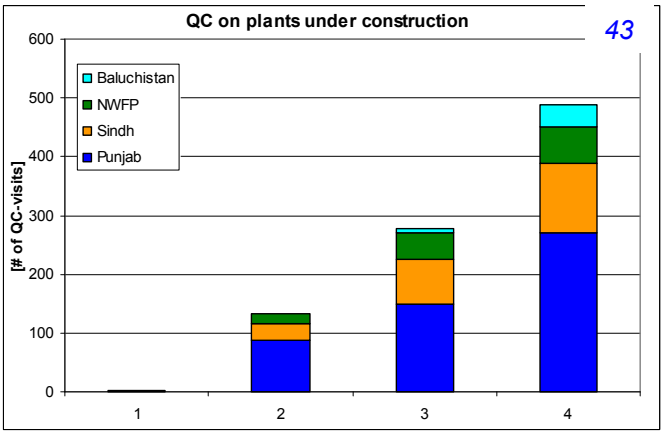
BCEs will perform a cumulative 100% check on plant maintenance; hence in total 16,900 plants will be visited during the 1st phase of the programme.

6.4.2 Quality control by the PBDE

The Pakistan Biogas Development Enterprise 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 PBDE will perform quality control visits on installations under construction, installations recently completed and installation under the guarantee scheme. In total, 18 PBDE Technical staff will visit a total of 3,434 biogas plants during the four years of phase 1.

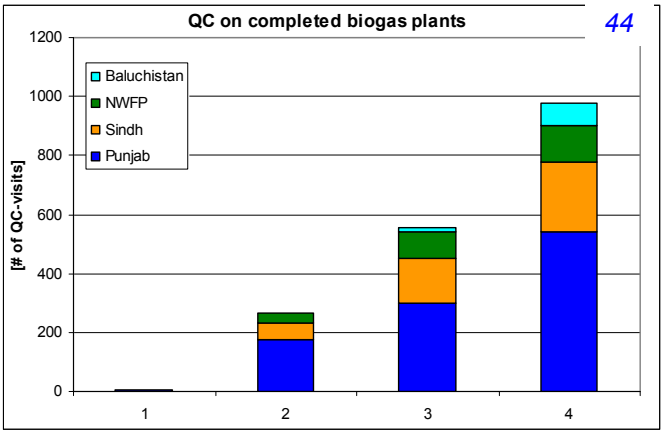
Quality control on installations under-construction: Biogas Technician teams (2 persons) will visit commissioned installations for control of the quality of construction. Control, together with a representative of the constructing BCE, will take place on-site against the agreed construction standards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

Biogas Technician teams will perform a 3% check on the plants while under construction; hence 900 installations will be visited.



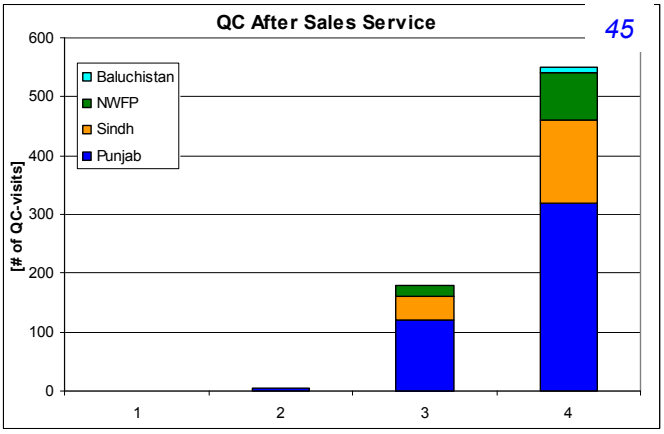
Quality control on completed installations: Biogas Technician teams will visit recently completed installations for control of the quality of construction and user-instruction. Control, together with a representative of the constructing BCE, will take place on-site against the agreed construction standards and according to the QC-Comp protocol. The QC-Comp form, countersigned by the BCE representative, will be submitted to the PBDE/Provincial Biogas 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 1800 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 PBDE/Provincial Biogas Office, where the information will be entered in the biogas data base.

Biogas Technician teams will perform a 4% cumulative check on biogas plants under guarantee; hence 734 installations will be visited.



6.4.3 Managing quality

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

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

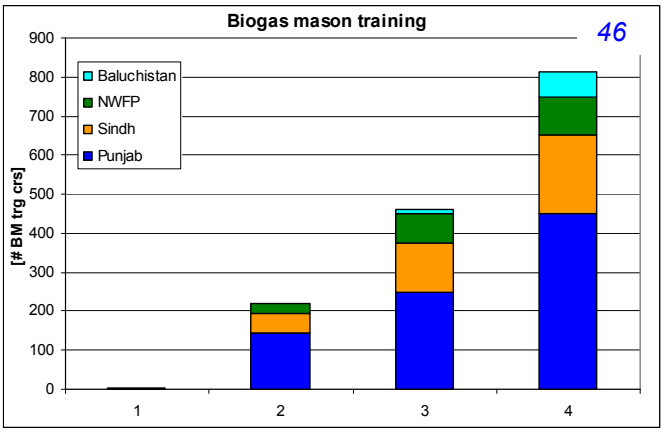
Based on this information, BCEs will annually receive a quality rating (5 steps, A to E). Companies with a high grading (A and B) will be able to use this in the marketing of their services, and will receive privileges from the programme (work advance, unlimited construction quota, etc). Companies with an average or low grading (C and D) will in the following year receive assistance of the PBDE/BPO 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.

6.5 Training

6.5.1 Technical training

Technical training will be provided by selected existing vocational training institutes. 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 (TEVTA) will be made available for curriculum development, development of training material and Training of Trainers (ToT).

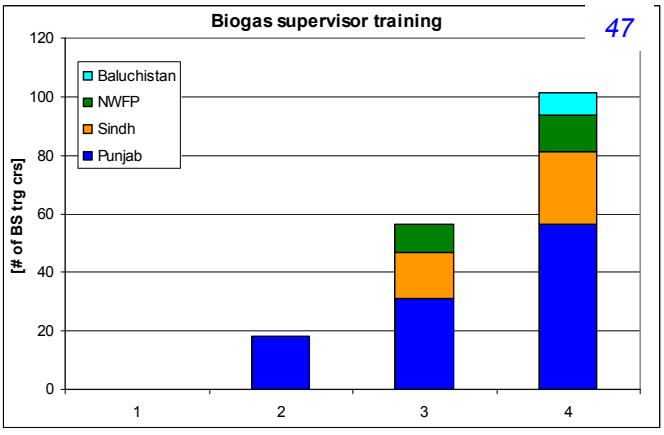
Biogas Mason Training: During the first phase, the programme will train and certify 1,500 biogas masons. Biogas Mason Training will grow from 5 certified masons in the first year to 813 in the last year of the first phase. The training will have a theoretical and a practical component, the course durations will be 10 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 25% training over-capacity, the programme will run 46 training courses of batches of 24 trainees for initial Biogas Mason Training.

Biogas Mason Refresher training: In addition, and not depicted in the bar chart, 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 36 Biogas Mason Refresher courses in batches of 24 trainees, reaching approximately 864 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 170 biogas supervisors. Supervisor training will only start in the second programme year, targeting 14 candidates, and will grow to 108 supervisors for the 4th programme year. The 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.

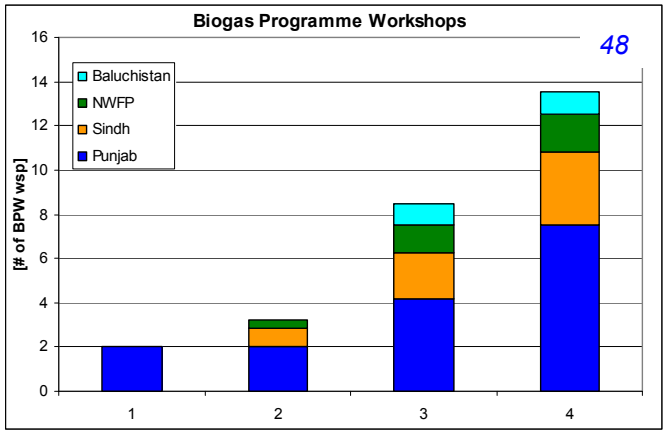
Based on batches of 12 trainees and allowing a training over-capacity of 20%, the programme will run about 11 training courses for initial biogas supervisor training.

Biogas Supervisor Refresher Training: In addition, and not depicted in the bar chart, 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 7 Biogas Supervisor Refresher courses, reaching approximately 100 biogas supervisors

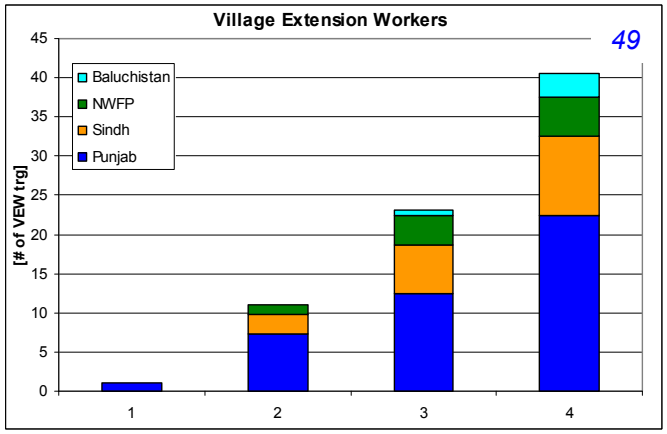
6.5.2 Training programme partners

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.

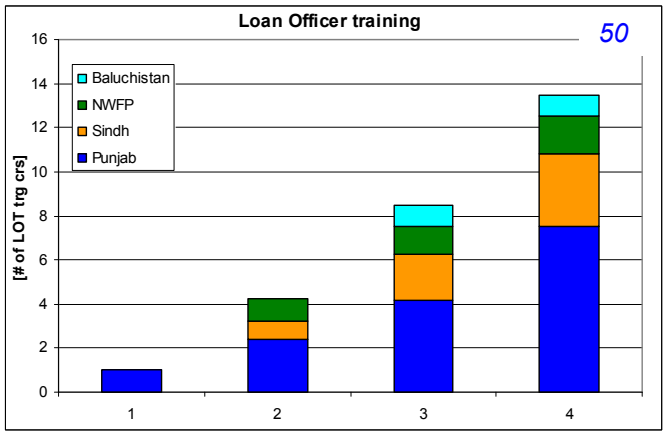
Biogas Programme Workshop: The programme will provide biogas programme workshops to interested Rural Support Programmes, dairy / farmer associations, NGOs and Community Organizations. Workshops, planned in batches of 12 persons, will take 1 day. In total, the programme plans to provide 28 BPWs.



Village Extension Workers: 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 76 VEW training courses.



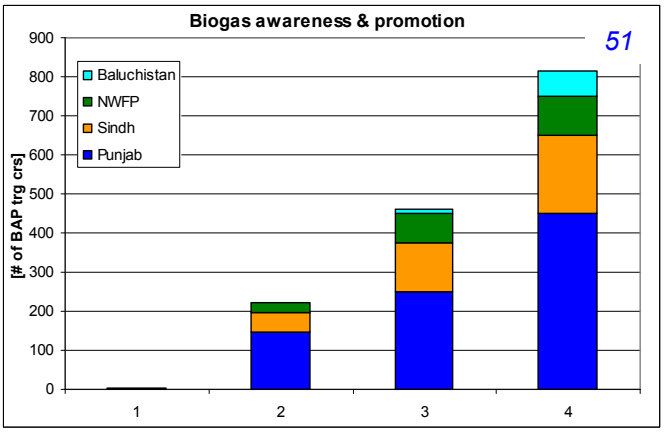
Loan Officers: Loan officers sanctioning loans for biogas installations should have a good knowledge of biogas and the programme modalities. This holds true for loan officers at micro-finance installations, and even more so in case a revolving fund approach is followed. In addition, loan officers play 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 28 Loan Officer training courses.



6.5.3 (female) User training

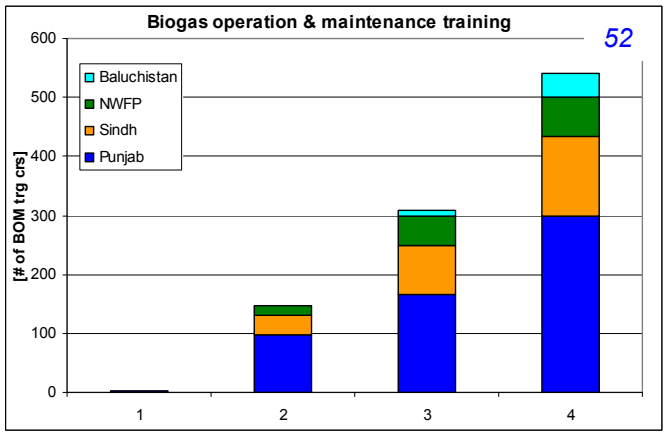
The programme will provide training to biogas households thrice. As women are the prime beneficiaries of a biogas installation, and, in practice, they will operate the plant, the programme's user training, in particular the second and third course[32], is focussed on women. In total, the programme will run 3,700 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 60,000 persons with biogas awareness & promotion workshops / pre-construction training (1500 training courses in batches of 40 participants).



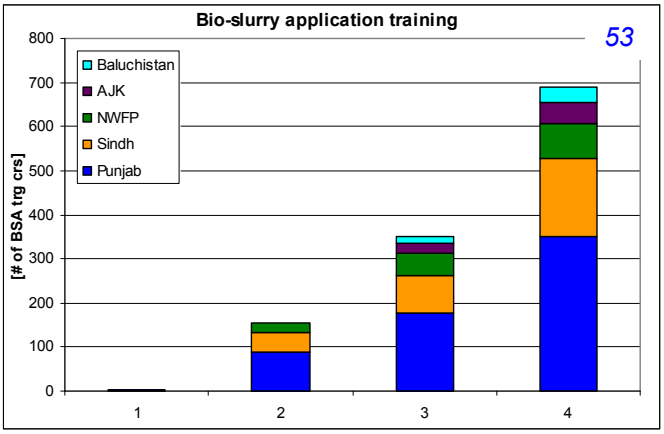
BAP training will be provided by (preferably female-) biogas promoters recruited by BCEs and demand-side organizations like Rural Support Programmes, NGOs and dairy development organizations.

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 30,000 persons with post-construction training (1000 training courses in batches of 30 participants).



BOM training will be provided by (preferably female-) staff of participating Rural Support Programmes, NGOs and dairy development organizations.

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, the programme will reach 24,000 persons with bio-slurry application training (800 training courses in batches of 30 participants).



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

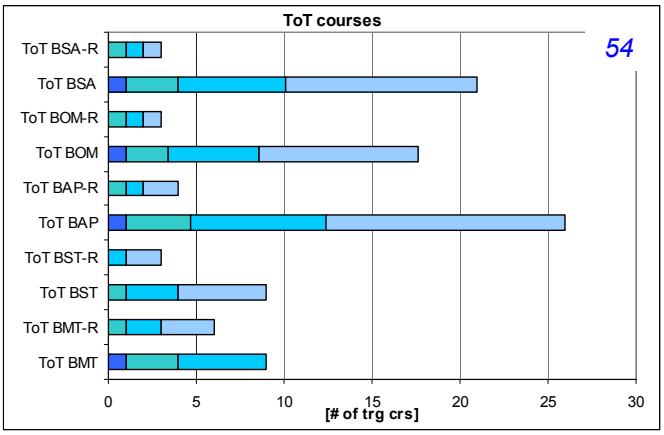
[32] For post-construction training courses, the programme pre-scribes that at least 80% of the course participants is female.

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 30,000 users will be reached individually with operation & maintenance instruction.

6.5.4 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 101 ToT training courses.

ToT training courses will be provided by staff of the biogas programme, enforced by experts for specific topics.



6.6 Extension

Initiated and coordinated by the PBDE, some 600 bio-slurry demonstration plots will established at provincial level. To support extension of proper bio-slurry use, extension material will be developed and made available to the households. At national level, the PBDE will commission studies on bio-slurry and fertilizer, sanitation, dairy farming and organic farming.

55

Bio-slurry demonstration plots	1	2	3	4	total
Punjab	2	58	100	180	**340**
Sindh	0	20	50	80	**150**
NWFP	0	10	30	40	**80**
Baluchistan	0	0	5	25	**30**
Total	**2**	**88**	**185**	**325**	**600**

6.7 Institutional support

The PBDE will initiate and support BCE associations, village extension networks and NGO networks to be established at provincial level.

6.8 Monitoring and evaluation

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

Monitoring and evaluation of the carbon-component of the programme resorts under the PBDE, as it directly impacts its sustainability. Carbon M&E will include PDD development, pre-validation and validation. Subsequently, funds are allocated for registration of the programme and 6 verification missions.

6.9 Research and development

The PCRET will be requested to support the programme for its R&D activities. Research and development is planned for biogas stoves and lamps, pre-manufactured (components of) biogas installations and slurry processing.

6.10 Human resources, operations and management

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

7 Programme costs and financing.

A detailed activity plan and budget is provided in Annex 8.

7.1 Biogas plant costs.

Based on actual prices of December 2007 and the well documented experience with the 10 pilot plants built by RSPN and PRSP, construction prices for a GGC 2047 domestic biogas installation would range from PKR 28,421 (€ 317) to PKR 44,469 (€ 497) for installations of 4 to 10 m^3 plant volume respectively.

56

Investment costs GGC 2047 biogas plant for Pakistan *for construction in bricks* *[PKR]*

		unit	4 m^3 digester qty	4 m^3 digester costs	4 m^3 digester total	6 m^3 digester qty	6 m^3 digester costs	6 m^3 digester total	8 m^3 digester qty	8 m^3 digester costs	8 m^3 digester total	10 m^3 digester qty	10 m^3 digester costs	10 m^3 digester total
1	**Contribution farmer in kind**													
1.1	Unskilled labour	[person days]	20	4,000		25	5,000		30	6,000		35	7,000	
1.2	Sand	[bags]	60	4,017		70	4,686		80	5,356		90	6,025	
1.3	Gravel	[bags]	30	1,275		35	1,488		40	1,700		50	2,125	
1	**Total farmer contribiution**				**9,292**			**11,174**			**13,056**			**15,151**
2	**Supplied materials**													
2.1	Cement	[bags]	12	2,700		14	3,150		16	3,600		20	4,500	
2.2	Bricks	[piece]	1200	3,600		1,400	4,200		1,650	4,950		1,750	5,250	
2.3	Reinforcement rod	[kg]	10	400		12	480		14	560		16	640	
2.4	Fitting material	[set price]		3,385			3,385			5,495			5,495	
2.5	Appliances	[set price]		850			1,650			2,050			2,050	
2	**Total materials**				**10,935**			**12,865**			**16,655**			**17,935**
3	**Technical services**													
3.1	Skilled labour	[person days]	2	800		2	800		2	800		2	800	
3.2	Semi skilled labour	[person days]	8	2,400		9	2,700		11	3,300		12	3,600	
3.3	Annual maintenance fee	[fee per visit]	4	600		4	600		4	600		4	600	
3	**Total services**				**3,800**			**4,100**			**4,700**			**5,000**
4	**Company fee**													
4.1	Overhead	[person days]	1	400		1	400		1	400		1	400	
4.2	Risk coverage	[share of 2]	5%	547		5%	643		5%	833		5%	897	
4.3	Company profit	[share of 2+3]	20%	2,947		20%	3,393		20%	4,271		20%	4,587	
4	**Total company fee**				**3,894**			**4,436**			**5,504**			**5,884**
5	**Programme fee**													
5.1	QC insurance fee	[fee per visit]	2	250		2	250		2	250		2	250	
5.2	Participation fee	[once]		250			250			250			250	
5	Total programme fee				**500**			**500**			**500**			**500**
	Total investment				**28,421**			**33,075**			**40,415**			**44,469**

Based on the expected average daily biogas requirement, it is assumed that 20%, 25%, 35% and 20% of the installations have the sizes 4 m^3, 6 m^3, 8 m^3 and 10 m^3 respectively. The average plant size would thus arrive at 7.1 m^3, with a corresponding average investment cost of just over PKR 36,992 (€ 413).

57

Investment costs *[Euro]*

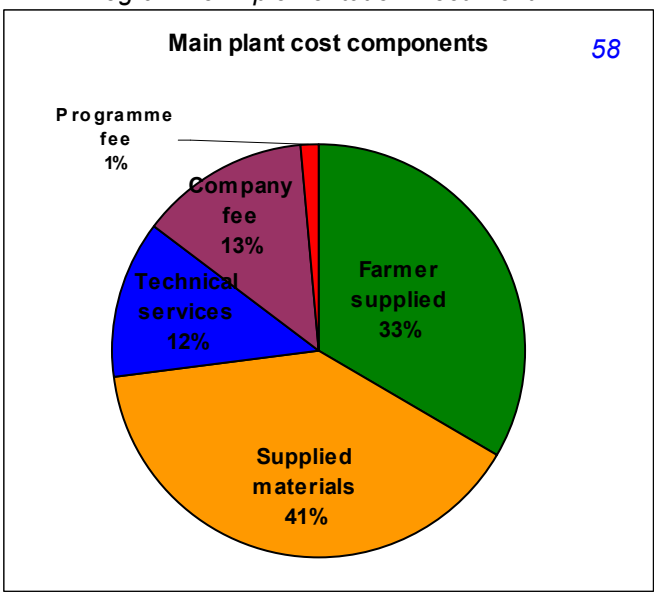
		4m^3	6m^3	8m^3	10m^3
Investment costs	[Euro]	317	369	451	497
Size share	[%]	20%	25%	35%	20%
Average size	[m^3]	**7.1**			
Average costs	[Euro]	**413**			
	[PKR]	*36,992*			

The costing is made up by the components: farmer-supplied labour and materials (33%); supplied materials (40%), technical services (~12%), company fee (13%), and; programme fee (2%).

The Bill of Quantities presented above is based on a fixed dome plant with a concrete dome. Although this design has proven itself extensively in Nepal, for Pakistan the programme will consider constructing the installation with a pre-fabricated glass-fibre dome.

Material and labour costs of the concrete dome amount to PKR 8,000 to PKR 13,000. Although detailed costing has yet to be done, indications are that glass-fibre domes may be cheaper and less sensitive to variations in workmanship.

58



7.2 Investment rebate requirement

The programme intends to generate carbon revenue resulting from the reduction of GHG emission by the biogas installations constructed under the programme. The carbon revenue will be applied for:

- Covering, on the long term (10 years) the supply side activity costs of the programme, and:
- Reducing the investment costs for the participating households by offering them an investment rebate (hence called carbon-rebate)

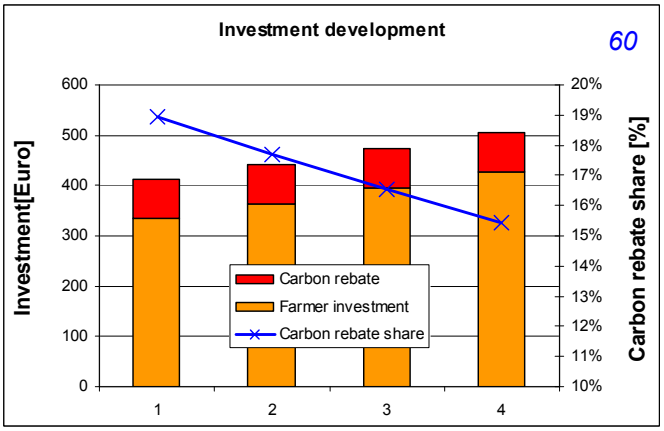
In the preliminary analysis, the proposed carbon-rebate levels are flat-rate (uniform for all plant-sizes) at two levels, regular and high, whereby the higher rate should compensate higher investment costs in remoter areas. For the first phase it is estimated that 23% of the programme's installations will be constructed in remoter areas. The average carbon rebate amount required thus results to nearly PKR 7,000 (€ 78).

59

Carbon rebate	**rates** PKR	Euro	**share**
Regular	6,000	67.00	75%
High	10,000	111.67	25%
Avg carbon rebate	**7,000**	**78.17**	100%

The flat-rate carbon rebate will not be corrected for inflation. As a result, the share of the carbon rebate in the total investment will gradually reduce from 19% in the first project year to 15% in the 4th. The average investment for the household (investment minus carbon-rebate) will develop from € 335 to € 429 (PKR 29,992 to PKR 36,534).

60



The total Rebate fund requirement for the first phase of the programme will amount to PKR 210 million (€ 2.3 million).

61

Rebate fund requirement	**1**	**2**	**3**	**4**	**Total**
					[Euro]
# of plants	*100*	*4400*	*9250*	*16250*	*30000*
Carbon rebate requirement	**7,817**	**343,942**	**723,060**	**1,270,240**	**2,345,059**
			PKR x 1000		*210,000*

For the 30,000 installations, the total direct investment component (including carbon rebate) will amount to PKR 1,310 million (€ 14.6 million).

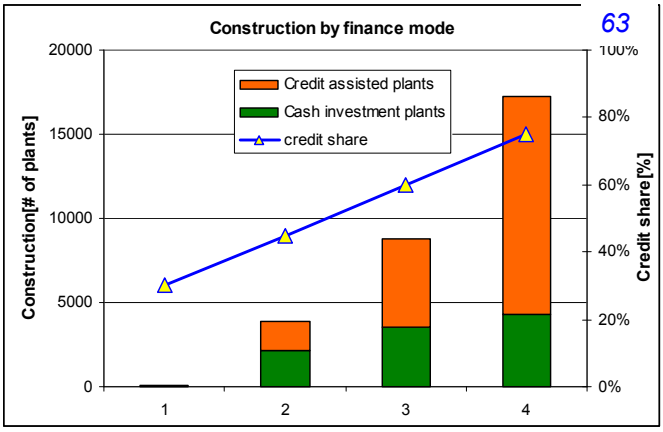
62

Direct investment	*(inflation correction in farmer investment)*				*[Euro]*
	1	**2**	**3**	**4**	**total**
Annual production biogas plants	*100*	*4400*	*9250*	*16250*	*30000*
Farmer investment (avg)	33,492	1,600,882	3,651,689	6,953,105	**12,239,168**
Investment subsidy (avg)	7,817	343,942	723,060	1,270,240	**2,345,059**
Total direct investment	**41,309**	**1,944,824**	**4,374,749**	**8,223,345**	**14,584,227**
PKR x 1000	*3,699,214*	*174,158,980*	*391,758,751*	*736,400,571*	*1,306,017,515*

7.3 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 however, 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 75% of the households in the 4th programme year.

63



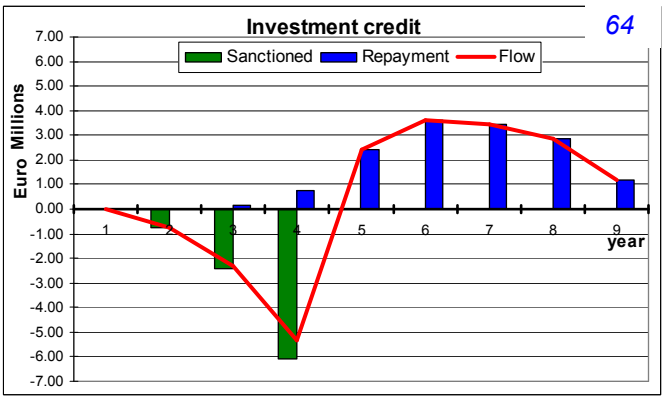
7.3.1 Credit conditions

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. From our surveys it transpired that households would on average spend between PKR 800 and PKR 1300 per month 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: 20% on outstanding debt.
Repayment: monthly, interest + principal at PMT

A household taking a loan for the investment costs minus the carbon rebate would under the above proposed conditions repay PKR 1,162 per month; in tune with the expected traditional fuel savings by the installation[33].

64



Based on this scenario, at the end of the first phase of the programme the total amount of credit that has been sanctioned will amount to PKR 932 million (€ 9.3 million). The total repayment at the end of year 8 will amount to PKR 1,439 million (€ 14.4 million). The maximum required credit fund will amount to PKR 534 million (€ 5.3 million) in year 4 of the programme.

[33] A detailed overview on the relation between crfedit conditions and monthly repayment is provided in annex 11.

7.3.2 Micro Finance Organizations

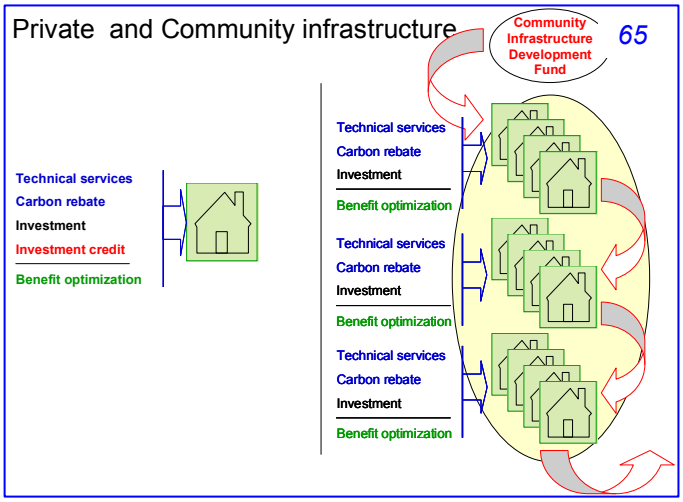
As explained above, in view of the status of development of the microfinance sector in Pakistan, the Rural Support Programmes will –at least initially- prove the most promising microfinance partner for the programme.

7.3.3 Domestic biogas and Community Infrastructure Development Funds

Another interesting financing opportunity is provided by Pakistan's Community Infrastructure Development Funds (PPAF, KPF)[34]. These funds provide capital for community infrastructure whereby 80% of the amount is granted after successful implementation, and 20% is extended as a loan / community contribution.

For these funds to work for domestic biogas, the case has to be made that although the installation is operated at individual household level, its benefits will spread to the community at large. This is justifiable in two ways:

- Firstly, as presented in annex 3, benefits of domestic biogas extend from micro to macro level, whereby meso-level benefits are particularly relevant for a community.
- Secondly, if a community infrastructure development fund were to be allowed to act as a revolving fund for biogas installation in communities, such a revolving fund could actually ensure that a large share of the community –say 50%- would be able to own an installation over a period of 3 to 5 years[35].



The Kushal Pakistan Fund showed interest in an approach whereby its Community Infrastructure Development Fund (CID fund) would first be deployed as a revolving fund for domestic biogas and after 2 or 3 cycles the fund would become available to the community for infrastructure investment. Preliminary calculations show that a typical CID fund of PKR 500,000 can finance 71 and 79 biogas installations over a 2 and 3 year period respectively[36]. Although applying the CID fund for domestic biogas would for both funds, PPAF and KPF, require board approval, this KPF fund manager expressed that the merits of the approach justify a detailed proposal.

[34] PPAF: Pakistan Poverty Alleviation Fund. KPF: Khusal Pakistan Fund.
[35] In July 2007, RSPN and PRSP implemented a pilot in fashion in Sialkot, Punjab, for batches of 10 plants annually.
[36] Based on a revolving fund without interest charge. A similar fund installed at 12% interest per year can finance 77 and 87 installations in 2 and 3 years respectively.

7.4 Programme costs.

The total budget for the first phase of the programme amounts to PKR 2,783 million (€ 27.8 million), equalling PKR 91,900 per installation.

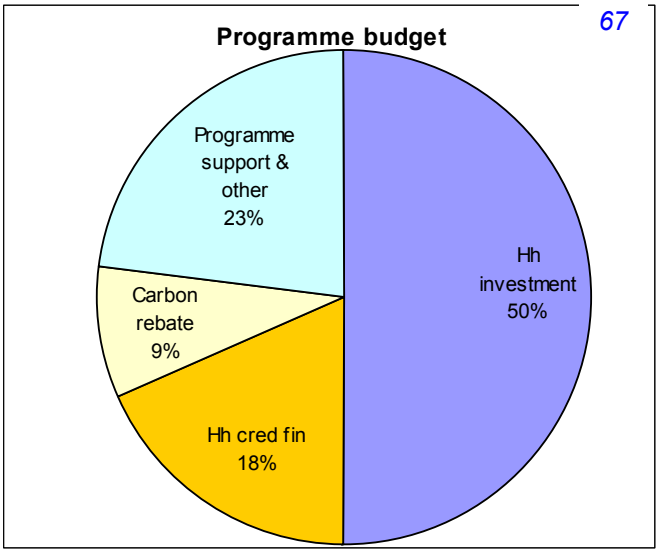
66

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

		Summary project budget						*[Euro]*
		1	2	3	4	total	/ plant	share
	Forecast production	*100*	*3900*	*9000*	*17000*	*30000*		
	Total investment *(incl rebate and financing)*	55,011	2,391,513	6,136,876	12,860,330	**21,443,731**	714.79	*78%*
							714.79	*78%*
1	Promotion & Marketing	23,000	51,450	89,854	148,755	**313,059**	10.44	*1%*
2	Finance	4,550	13,860	20,672	31,545	**70,627**	2.35	*0%*
3	Private Sector Development	4,500	27,300	34,729	50,936	**117,464**	3.92	*0%*
4	Quality Management	7,804	22,730	29,714	54,875	**115,123**	3.84	*0%*
5	Training	19,310	69,741	170,656	312,044	**571,751**	19.06	*2%*
6	Extension	40	18,438	21,609	26,394	**66,481**	2.22	*0%*
7	Institutional Support	11,000	107,100	235,935	444,528	**798,563**	26.62	*3%*
8	Monitioring & Evaluation	65,000	23,625	70,560	64,827	**224,012**	7.47	*1%*
9	Research and Development	40,000	12,075	9,923	8,682	**70,680**	2.36	*0%*
10	HR and Management	173,524	598,954	683,792	816,163	**2,272,433**	75.75	*8%*
							154.01	*17%*
	Contingencies *(activities only)*	17,436	47,264	68,372	97,937	**231,010**	7.70	*1%*
	International technical assistance	240,000	344,000	344,000	344,000	**1,272,000**	42.40	*5%*
	RSPN service fee	65,940	69,237	62,115	65,221	**262,512**		
							50.10	*5%*
	Total project	**727,115**	**3,797,287**	**7,978,807**	**15,326,237**	**27,829,445**	**918.90**	***100%***
					PKR x 1000	*2,782,945*	*91.9*	

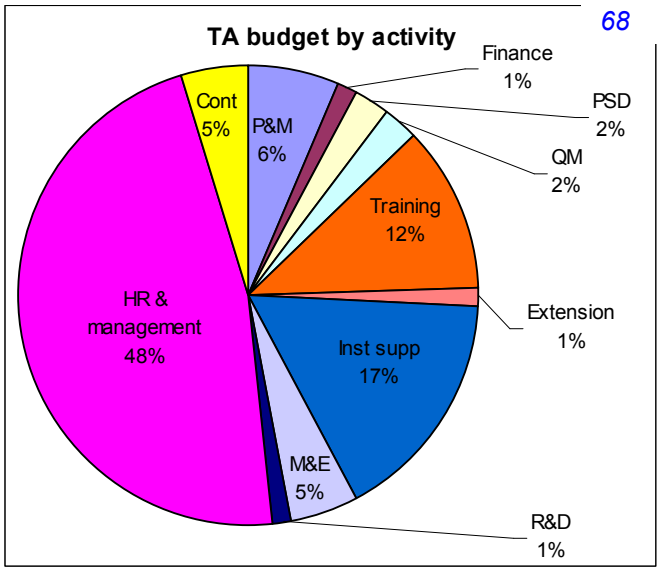
Participating households, with € 13.9 million in direct investment and € 5.1 million in credit costs, will contribute 68% of the total budget. Investment support, in the shape of carbon rebate amounts to € 2.4 million (9% of the total budget). Programme support costs, including activities, contingencies, International Technical Assistance and RSPN management fee, amounts to € 6.4 million (23% of the total budget).

67



7.4.1 Detailed activity budget

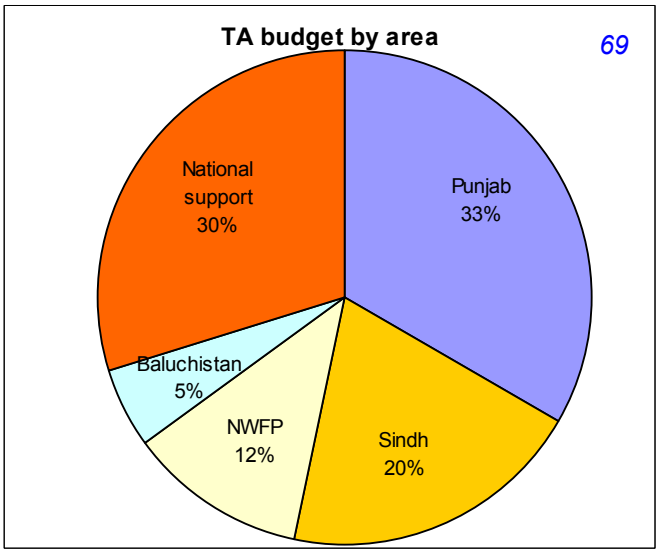
The total budget for activities amounts to € 4.9 million. Human Resources and management take the lion share of the budget (48%, € 2.3 million). Other large expenses are expected for Institutional support, Training, Promotion and marketing and Monitoring and Evaluation.



7.4.2 Detailed area budget

With the largest forecast share in construction, the Punjab will require 33% of the total activity budget. Sindh and NWFP follow with 20% and 12% respectively. Balochistan, in view of its (very) limited technical potential, is expected to require only modest funding.

The National PBDE office will require € 1.4 million (30%).



7.5 International technical assistance

Winrock International and SNV-the Netherlands Development Organization will provide technical assistance to the programme. ITA will be provided at the sector as a whole (demand- as well as supply-side). One Senior Technical Advisor will provide support to the financial, administrative and carbon components of the programme, and one STA will assist the programme on programmatic and technical aspects. The Junior Technical Advisor will focus supporting the promotional and business development activities.

Summary International Technical Assistance *(corrected for inflation)* *[Euro]*

	Description	Budget 1	2	3	4	total
1.01	Senior Technical Advisor (SNV)	120,000	120,000	120,000	120,000	**480,000**
1.02	Senior Technical Advisor (WI)	120,000	120,000	120,000	120,000	**480,000**
1.03	Junior Technical Advisor (SNV)	-	104,000	104,000	104,000	**312,000**
	Total ITA	**240,000**	**344,000**	**344,000**	**344,000**	**1,272,000**

PKR x 1000 *127,200*

7.6 RSPN service fee

During the first year, the national biogas programme will start-off as a "special project" under the RSPN. In the course of this first year, RSPN and SNV, together with other the programme stakeholders will decide on the longer-term institutional imbedding of the programme, aiming to create an independent entity that is able to swiftly act on the requirements of the (emerging) sector.

For budgeting purposes it is assumed that RSPN, in some way or another, will continue assisting the biogas programme. Therefore, service fees are budgeted for the entire first phase. Clearly, actual expenses will depend on the future relation between RSPN and the programme.

The RSPN service fee consists of salary costs (time RSPN managers dedicate to the programme) and operating costs (share of accommodation, utility and transport costs of the RSPN), and amount to € 265,512 for the first phase. *71*

Summary RSPN overhead *(corrected for inflation)* *[Euro]*

	Description	Budget 1	2	3	4	total
1	Salary costs	47,940	50,337	42,270	44,383	**184,930**
2	Operating costs	18,000	18,900	19,845	20,837	**77,582**
	Total RSPN overhead	**65,940**	**69,237**	**62,115**	**65,221**	**262,512**

PKR x 1000 *26,251*

7.7 Programme revenue

The programme expects to generate revenue from three sources: participation fee, quality control fee and carbon revenue. The total anticipated revenue over the first phase of the programme amounts to PKR 66 million (€ 660,481).

72

	Revenue	
b1	Carbon revenue	510,481
b2	Participation fee	75,000
b3	QC fee	75,000
	Total revenue	**660,481**

7.7.1 Participation fee

Households will be levied a participation fee to the amount of PKR 250. The participation fee will be deducted from the investment-rebate channelled to the households through the constructing BCE. For the first phase of the programme, the anticipated revenue from the participation fee will amount to PKR 7.5 million (€ 75,000). The levied participation fee will be reinvested in the programme's demand-side promotion activities in the year following reception.

7.7.2 Quality control fee

Households will be levied a quality control fee of PKR 250. The quality control fee will be deducted from the investment-rebate channelled to the household through the constructing BCE. For the first phase of the programme, the anticipated revenue from the quality control fee will amount to PKR 7.5 million (€ 75,000). The levied quality control fee will be reinvested in the programme's supply-side quality management activities in the year following reception.

7.7.3 Carbon revenue

The carbon revenue of biogas installations is based in greenhouse gas reduction through a change in manure management and fossil / non-renewable biomass substitution. Depending on the methodology applied (in particular the share of non-renewable biomass that will be allowed in the baseline), preliminary calculations indicate that biogas plants under Pakistani rural conditions would reduce greenhouse gasses with 3 to 5 tons of CO_2 equivalent per plant per year.

For budgeting, a conservative GHG emission reduction of 3 t CO_2 eq per plant per year has been used. Further, a CER/VER price of € 10 per t CO_2 eq and a one year delay in carbon revenue are assumed. For the first phase of the programme (30,000 installations) and with a 10 year crediting period, the anticipated

carbon-revenue will amount to € 8.2 million. On the long term, then, the carbon-revenue (and to a far lesser extent the Quality Control fee) is expected to make supply-side activities financially sustainable.

As carbon revenue, however, will only become available upon delivery, the total revenue available during the first phase will only amount to € 510,481. Although buyers increasingly offer upfront payment facilities for carbon revenue, this budget takes a conservative approach and does not take up front payments into consideration, pending agreements with the buyer.

7.8 Programme financing

Clearly, the anticipated programme revenue is insufficient to finance the entire programme costs – especially during its first phase. Therefore, the programme will request financial assistance from the Government of Pakistan as well as Official Development Assistance.

7.8.1 Financial support by the Government of Pakistan

The GoP will be requested, through its PC1 modality, to finance the programme's R&D, M&E and demand-side support activities. To this extent, the programme plans to request Government co-financing to the amount of approximately € 2 million. Although initial contacts with the Government of Pakistan have been encouraging, no formal commitments have been made.

7.8.2 Financial support by ODA / Investment

The programme will seek ODA / investment support to finance the investment-rebate component, the supply-side activities and the International Technical Assistance. Although preliminary contacts with interested donors have been established, except for SNV no commitments have been made so far. The total ODA / Investment funding sought amounts to € 5.0 million, out of which € 1.1 million has been committed from SNV core (TA) and activity (first year) funds.

7.9 Application and source of funds

Tentatively, application and source of funds is proposed as presented in the tables below.

73

Application of funds		*[Euro]*	*[%]*	*per plant*	*[Euro]*
	Investment				
1a	Household investment	13,927,261	*65%*	*464.24*	
1b	Credit financing costs	5,078,970	*24%*	*169.30*	
1c	Carbon rebate *(investment subsidy)*	2,437,500	*11%*	*81.25*	
	Total investment	**21,443,731**	*77%*		***714.79***
	Project support				
2a	Sum activities	4,851,202	*76%*	*161.71*	
2b	International technical assistance	1,272,000	*20%*	*42.40*	
2a	RSPN management fee	262,512		*8.75*	
	Total project support	**6,385,714**	*23%*		***212.86***
	Total application	**27,829,445**		-	***927.65***

Source of funds		*[Euro]*	*[%]*	*per plant*	*[Euro]*
a	**Households**				
a1	Household investment	13,927,261	*73%*	*464.24*	
a2	Credit financing costs	5,078,970	*27%*	*169.30*	
	Total participating farmers	**19,006,231**	*68%*		***633.54***
b	**Revenue**				
b1	Carbon revenue	510,481	*77%*	*17.02*	
b2	Participation fee	75,000	*11%*	*2.50*	
b3	QC fee	75,000	*11%*	*2.50*	
	Total revenue	**660,481**	*2%*		***22.02***
c	**Technical assistance**				
c1	SNV core and activity funds	1,212,000	*15%*	*40.40*	
c2	Government of Pakistan	2,000,000	*25%*	*66.67*	
c3	Other	4,950,733	*61%*	*165.02*	
	Total technical assistance	**8,162,733**	*29%*		***272.09***
	Total source	**27,829,445**			***927.65***

8 SWOT analysis

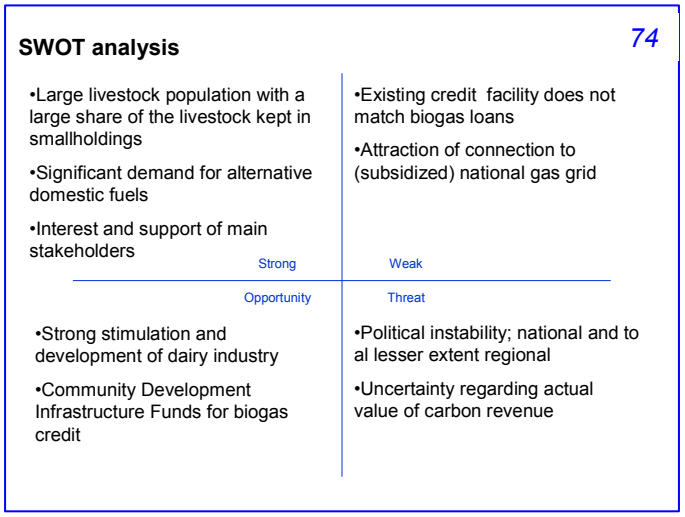
Strong and weak points of the programme, opportunities and risks

Strong: Pakistan has a large livestock (cattle and buffalo) population and a large share of the livestock is kept in smallholdings owned by individual households. The country at large and many (rural) households are challenged to satisfy their current domestic energy demand with "traditional" fuel sources. Both during feasibility as well as the formulation stage, the proposed programme was received with great support and interest by all main stakeholders (GoP, NRSP and RSPs, KDF, NGOs)

Weak: Although Rural Support Programmes have a large micro-credit outreach, the current credit conditions do not match the requirements for a biogas loan for poorer households. For (pheri-) urban households the attraction of (a possible connection to) the national grid for natural gas will keep them from investing in a biogas installation.

Opportunity: The demand for dairy products in Pakistan is growing, followed-up by a growing support for development of the dairy industry (including smallholdings). The Community Development Infrastructure Funds of PPAF and KPF –after Board approval- could provide biogas loans under conditions that match the habitual domestic energy expenses.

Threat: Although the elections earlier this year indicate that Pakistan will further develop as a democratic nation, tensions in the region may jeopardize donor involvement and (in some areas) implementation of the programme. The financial sustainability, particularly after the 1st phase, leans heavily on the anticipated carbon revenue whereas there are no precedents yet that justify this anticipation.



9 Reviews and evaluations

The programme plans for an external mid-term evaluation early in year three of the first phase. The mid-term evaluation will focus on programme progress and provide recommendations on programme implementation for the remaining 1st phase period.

A final evaluation / review of the 1st phase is planned in the 4th year of the first phase. The final evaluation will screen the programme against its objectives and make recommendations for the formulation of the 2nd phase of the programme.

10 References

Kojima, M. WB Esmap, February 2006: Pakistan household use of commercial energy

WHO, 2005: Situation analysis of household energy use and indoor air pollution in Pakistan

Ahmed, M. Text of presentation delivered at Woodrow Wilson International Centre for Scholars, June 2006: Meeting Pakistan's energy needs.

Country Analysis Briefs Pakistan, December 2006: Pakistan energy data, statistics and analysis. (www.eia.doe.gov).

World Bank, August 2006: Pakistan strategic country environmental assessment volume I and II.

Pakistan Microfinance Network: (www.pmn.org.pk).

Siddiki, M., June 2007: Biogas reactor construction training and installation for initiative pilot programme, Pakistan.

Ghimire, P.C., December 2007: Final report on technical study of biogas plants installed in Pakistan

Pandey, B. and Bajgain, S, July 2007: Feasibility study of Domestic Biogas in Pakistan.

Riaz, R.A. December 2007: Report exploration of vocational training opportunities for biogas masons in the Punjab.

Agricultural Census Organization, Statistics Division, GoP, 2006: Livestock Census 2006.

SEBCON, 2006: Baseline survey of livestock sector in 30 districts of Pakistan.

Hanif, M, Kahn S and Naumann, F, January 2004: Agricultural Policy and Perspective, Ministry of Food, Agriculture and Livestock

Nes, van W and ter Heegde, F, June 2008, Building viable domestic biogas programmes; success factors in sector development.