ASIAN DEVELOPMENT BANK

A Demonstration Plan

for

Application of Renewable Energy and

Reduction, Reuse, and Recycling of Resources (3Rs)

December 2010

EXECUTIVE SUMMARY

I A proposed loan project to improve public service delivery in five county seat towns across Altay Prefecture has concentrated on the improvement of road networks and the provision of potable water, wastewater collection and treatment, solid waste management and district heating services. The Project Preparation Technical Assistance took place during the summer of 2010. This parallel Technical Assistance was undertaken during July and August of 2010 in support of the main project components but focussed on the specific application of the 3R principles of Reduce demand, Reuse of resources, and Recycling of waste materials together with identifying options for the introduction or expansion of the use of renewable energy technologies. This Technical Assistance also provides a public awareness and training component, the design for which is included within this Report.

II A review has been carried out of the existing opportunities within the county seat towns of Buerjin, Habahe, Jimunai, Fuhai and Qinghe for reducing water demand, grid electrical power usage and district heat consumption. The review also covered the options for reusing treated wastewaters and sludges, heating boiler clinker, various wastes from domestic and commercial activities and the possibility of maximising the recycling of waste materials for processing at industrial centres. A parallel review considered the options for developing wind and solar energy sourcing and for the application of ground heat source technology to provide or supplement conventional building heating.

III The findings of these reviews have suggested a range of possible interventions for promoting the 3Rs and increasing the use of renewable energy. A reduction in the demand for both water and electricity is available through awareness and small changes to lifestyle habits whist the existing practices of recycling waste materials can be strengthened by a better appreciated of benefits and improved recycling facilities. Changes in institutional procedures will focus on the reduction of water losses and the reuse of recovered wastes from the wastewater treatment process. Renewable energy will be introduced where-ever practical and affordable within the budget context of the Project.

IV By applying the principles of water conservation to domestic household practice across the five project towns it is predicted that a saving of between 200~225,000 m^3 / year will be achieved and, by reducing unaccounted-for water by 5%, would add a further water saving of about 20~22 million m^3 / year. Whilst this quantity is freely available at source, there is an associated treatment cost when raw water turbidity is high. More importantly, there is the capacity cost for conveyance and treatment of wastewaters. For a given light output, Compact Fluorescent Lamps use 20 to 33 percent of the power of equivalent incandescent lamps. It is clear that they should be in use wherever possible. Recycling waste materials will provide a number of advantages, including (i) increased employment opportunities for the poor; (ii) encouragement for the entrepreneurial business sector; (iii) reduction in loss of materials and need for generation of replacements; and (iv) reduction in capacity need at engineered landfill. If, as has been suggested, 20~25% of solid waste is recyclable then between 13,000 and 17,000 tonnes of material per annum is saved from landfill with the corresponding reduction in volume required.

V The experience of existing renewable energy installations in Altay is good. Whilst winter conditions in Altay are admittedly harsh, the renewable energy options are sufficiently resilient to enable a positive return on capital and operating expenditure. The comparative cost benefit

of using solar water heating as against that of electrical heating is demonstrated to be good and capital cost recovery may be achieved within a year or two of operation. The estimated cost of treating wastewater for a typical county town (e.g. Buerjin) by utilising grid electricity is about US$ 0.25 million per annum whilst the use of wind energy will cost only that for maintenance plus the amortised capital cost[1]. It is likely that the break even points will occur in less than 5 years but this does depend upon meteorological variations. The potential is for saving an average 2660 tonnes of carbon dioxide per town per annum. Ground heat source pumping can provide a return of between 4kW and 5kW of heat or 3kW to 4kW of cooling for every 1kW of pumping energy used. The cost recovery periods are short, being three or four years.

VI The community awareness and training will be carried out over three periods, commencing in October 2010 with completion by August 2011. The awareness will be provided through the local media and a poster and leaflet campaign. The training will involve workshops in town community centres, schools and public assembly rooms where the principles of 3R and their applications will be discussed, demonstrated and feedback gathered. It is planned that between 300 and 400 persons in each of the 5 towns will have direct exposure to the training sessions whilst all urban inhabitants will have exposure to the awareness campaign.

VII The interventions proposed for incorporation into the loan Project are summarized in Table A whilst the budget costs for the public awareness and training initiatives are summarized in Table B:

Table A: Package 1 – Physical Interventions

Activity		**CNY**	**US$**
1	Solar Tube Water Heaters – 3 sets/town	37,500	5,555
2	Equipment for Transfer Station and Landfill Pickers	6,750	1,000
3	Recyclable Waste containers – 10,000	[80,000]	Included in training budget – item 5
4	Contingency	4,500	545
	Totals	48,700	7,100

Table B: Package 2 – Community Awareness and Training

Activity		**CNY**	**US$**
1	Support Staff Remuneration / Per diem	12,300	870
2	Travelling Expenses	29,700	4,400
3	Workshop Expenses Room Hire	24,000	1,630
4	Materials – incl. waste bins	132,500	19,600
5	Publicity and communication Expenses	17,500	2440
6	Contingency	27,000	4000
	Totals	243000	36,000

[1] **400 kW at CNY0.54/kW.hr multiplied by 8760 hrs/yr**

CURRENCY EQUIVALENTS

Currency Unit	–	RMB (CNY)
RMB 1.00	=	$0.148
$1.00	=	RMB 6.75

ABBREVIATIONS

ADB	:	Asian Development Bank
AMG	:	Altay Prefecture Government
DI	:	Design Institute
DRC	:	Development and Reform Commission
EA	:	Executing Agency
EASS	:	East Asia Social Sectors
ESD	:	Environmental
FB	:	Finance Bureau
FSR	:	Feasibility Study Report
IA	:	Implementing Agency
IBT	:	Incremental Block Tariff
kW	:	kiloWatt
O&M	:	Operation and Maintenance
PMU	:	Project Management Unit
PRC	:	Peoples Republic of China
PV	:	Photovoltaic
RET	:	Resource Efficient Towns
SOE	:	State Owner Enterprise
SWM	:	Solid Waste Management
TA	:	Technical Assistance
TOR	:	Terms of Reference
XUAR	:	Xinjiang Uighur Autonomous Region
WTW	:	Water Treatment Works
WWTP	:	Waste Water Treatment Plant

NOTES

(i) In this report, "$" refers to US dollars.

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I INTRODUCTION

1. A proposed loan for the Xinjiang Altay Urban Infrastructure and Environment Improvement Project[2] aims to adopt an integrated approach to urban development by combining infrastructure construction with ecosystem rehabilitation in Altay Prefecture in 5 counties; namely Buerjin County, Fuhai County, Habahe County, Qinghe County, and Jimunai County. The Loan covers five sectors: (i) road, (ii) water supply and drainage, (iii) centralized heating, (iv) ecological environmental improvement, and (v) solid waste management. The Project will significantly improve basic municipal services and attract more people to live in the urban area. Urbanization will change people's lifestyles and generate increased demands for water resources, wastewater treatment and disposal, heating energy and solid waste management, which could further threaten the already fragile ecology unless appropriate mitigation measures are taken and awareness built.

2. EASS proposes to develop resource-efficient towns (RET) in Altay by promoting water conservation, wastewater reuse, energy efficiency and solid waste reduction, recycling and reuse. Through a demonstration plan, the objectives of this initiative are to (i) increase wastewater reuse to irrigate the ecological forest or vegetation; (ii) optimize water usage and improve people's awareness of water conservation and 3R principles[3]; and (iii) carry out public awareness education and public consultation on 3R principles for overcoming behavioural, institutional, financial, and policy/regulatory barriers in order to replicate and scale up RET development in Xinjiang Uygur Autonomous Region (XUAR) and the People's Republic of China (PRC). The output will be incorporated in the proposed loan Project.

3. Through the implementation of the Project and the application of 3R principles in resource conservation there is the potential to improve urban service delivery, increase sustainability, restrict rises in tariff charges and hence provide better protection for the poor, promote economic growth and employment opportunities, upgrade the urban environment, and improve the health and living conditions of people in the urban communities.

II THE TECHNICAL ASSISTANCE (TA)

2.1 Objectives, Impact and Overall Scope of the TA

4. The objectives of the technical assistance (TA) are to (i) identify and develop the most appropriate, practical and sustainable methods for implementing 3R principles in municipal services delivery; (ii) prepare a demonstration plan for 3R application within the Loan Project (the Project); (iii) develop a program for public awareness and training in the application of the 3R principles within the demonstration area of the Project; (iv) review and evaluate feasible options and recommendations for incorporating renewable energy sources and expanding 3R principles for municipal services delivery; and (iv) formulate a suitable pilot plan for possible funding by the Asian Development Bank (ADB) to improve and expand the application of 3R principles and renewable energy within a town in Asia.

[2] The PPTA concept paper was approved in June 2009, with the amount of $800,000 from ADB. The PPTA consultants commenced their field work on 8 March 2010.

[3] 3R principles are Reduce demand for resource, Reuse resources where possible and Recycle waste materials.

5. The impact of the demonstration plan to be incorporated in the Project will be to reduce reliance on carbon usage, minimize wastage of limited natural resources, maximize the options for recycling of materials and develop the attitudes and living practices of the population towards a more sustainable future. The outcome will be a change in attitude and practice of the population towards the use of limited resources and an acknowledgement of the benefits of using renewable energy. The Design and Monitoring Framework (DMF) is included in Appendix 1.

6. The TA Consultants[4] have worked closely with the Project Management Office (PMO), the Executing Agency (EA), the PPTA consultants and the Implementing Agencies (IA) established for each of the town subprojects, together with the Design Institute (DI) in order to (i) prepare the demonstration plan, including public awareness and training components and an assessment of the financial, social and environmental impacts on the Loan Project; (ii) formulate a pilot plan to apply for a possible urban infrastructure investment project through which the 3R principles will be demonstrated by improving urban service delivery and the application of renewable energy specifically to reduce reliance on the electrical grid system and so reduce carbon emissions; and (iii) investigate, assess and report on the application and use of pre-paid metering in utility service delivery. Proposals for a pilot plan and the findings on pre-paid metering are the subject of separate reports.

7. In support of the ongoing policy dialogue between the ADB and the PRC, in conjunction with ADB's urban lending program and to strengthen the dialogue in conjunction with the Project, the Consultants have prepared notes for policy dialogue, based on discussions with the Altay Prefecture Government and town administrations on (i) potable water supplies; (ii) wastewater control and environmental planning and management; (iii) domestic and commercial solid waste management including collection, minimisation and transport for disposal; (iv) cost recovery and tariff reform; (v) urban poverty reduction and social protection policies; (vi) regulatory enforcement and monitoring, and (vii) institutional strengthening.

2.2 TA Program and Report

8. The TA consultants were mobilised at the start of July 2010. The period for completion of the work in accordance with the terms of reference was 5 months, spread intermittently over the period to end May 2011. The TA Draft Final Report was required by 25th August 2010 with follow up reporting to be completed by 15th September and Community Awareness and Training activities to be concluded by mid July 2011. Various staff changes have occurred and the inputs of individuals have been reported to ADB on a weekly basis.

2.3 Activity Schedule

9. The Consultants' activities to date and those proposed to the completion of the TA are shown in the following Table 1;

[4] Staff consultants appointed for this TA were John Leleu, Municipal Engineer and Team Leader; Sheng Zelin, financial analyst; Zhou Shengbing, Community Development and Training Specialist and Li Anming, 3R specialist.

Table 1: Activities Schedule for TA

Year	2010						2011						
Activity	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July
Study	———	———											
Reporting		———	———										
Community Awareness And Training					———				———				———

2.4 Structure of Draft Final Report (DFR)

10. The Main Report comprises the following sections:

a) Introduction – describes the ongoing technical assistance provided to the Altay Prefecture and to which this Support TA is supplementary.

b) The Technical Assistance – objectives, impact and outcome, scope, activities and timescale are defined.

c) Existing Institutional Framework – briefly describes the organisations of the government of Xinjiang Uygur A.R., Altay Prefecture and the administrative management of the Project.

d) Policy Dialogue – sets out the agenda of issues that are the subject of discussions between Altay Prefecture and ADB.

e) Research and Investigations – stakeholder workshops, community feedback and lessons learned during the TA fieldwork.

f) Summary of Existing Situation in County Seat Towns – brief summary relating to provision of urban services

g) Options for Interventions – describes the feasible options available

h) Discussion – provides further commentary on the possible interventions and their likely environmental and social impacts.

i) Proposed Components – describes both physical and community awareness and training requirements.

j) Costs and Financing Plan – provides cost estimates of the proposed interventions and proposes the source of necessary funding.

k) Project Implementation – includes specific TOR for Project Management Consultants.

l) Project Risks and Assurances – discusses the risks that could affect the success of the Project and the mitigating measures that should be taken; assurances to be provided by government are also explained.

III EXISTING INSTITUTIONAL FRAMEWORK

3.1 Government Organisations

11. There exist a number of Ministries and other special commissions and administrative offices at State level that formulate and undertake policies and programs for infrastructural activities. Corresponding departments operate at the levels of XUAR and within Altay Prefecture. The main institutional bodies involved in project development at the State level are National Development and Reform Commission, Ministry of Finance, Ministry of Construction and State Environment Protection Agency. At Provincial level the Regional Development and Reform Commission (DRC) and Department of Finance (FB) have responsibilities and the city level departments include the Altay DRC, FB, Construction Bureau, EPB, Municipal Administration Bureau, ESD and Pricing Bureau.

3.2 The Executing Agency

12. The XUAR government is the EA for the TA. The XUAR government has established a Project Leading Group, chaired by a Governor of Altay, to provide overall guidance and support to the proposed Project. A PMO, comprising the Xinjiang Finance Bureau, DRC, Housing and Urban-Rural Development Bureau and Altay Prefecture Government, has been established and reports to the project Leading Group. The PMO maintains interdepartmental coordination and ensures the study team's access to relevant information and data, liaises with ADB on matters relating to the TA implementation and facilitates socio-economic, poverty and other surveys required. The PMO is led by a director and has experienced professional staff, including an interpreter / translator, who work with the project preparation technical assistance (PPTA) consultants on a full-time basis.

3.3 The Implementing Agencies

13. The five county urban and rural construction bureaux are the implementing agencies for the Project, responsible for implementing and managing the sub-components within their respective counties. The day-to-day operation of the IAs is delegated to Implementing Units who (i) manage the implementation of the assigned sub-component; (ii) engage tendering agencies, construction contractors and construction supervisory services; and (iii) prepare progress and other reporting requirements.

IV POLICY DIALOGUE

4.1 Water Conservation and Pumping

14. Water is a valuable resource in PRC and in Altay this is no exception. The ability to thoroughly understand the demand for and supply of water to the population centres and to manage this demand in a structured and efficient manner will bring benefits of reliability, waste minimisation and customer satisfaction. The development of demand management will encourage all consumers to be more aware of the value of water and to accept the need for measures to ensure sustainability of supplies. The pumping of water is reliant on electrical energy which, at present, is largely based on fossil fuel generation. Whereas source supplies for potable use are delivered by gravity under project proposals, wastewater removal relies on pumping in at least two instances. Appropriate renewable energy source could be developed to provide the necessary pumping power but such sources would not be continuously reliable, being dependent on wind and/or sunlight. Therefore conventional electrical energy is needed with the associated unit power costs and high carbon footprint. The introduction of such

pumping is therefore required for the foreseeable future, increasing in quantity as county seat towns develop and expand, and the lifetime costs of these pumping facilities must be carefully evaluated. The alternative of minimizing, or totally obviating, pumping head should be very carefully considered.

4.2 Reuse of Treated Wastewater Effluents and Sludges

15. Present proposals rely on the establishment of tree windbreaks and landscaping features for which treated effluent will be used as irrigation feedstock. Because of the prolonged winter periods prevalent in Altay, characterized by sub-zero temperatures, the ability to discharge effluents to crop areas is restricted. This introduces the need for on-site storage until irrigation flows can be re-commenced (after the ground has thawed) and the requirement for some protective bund to limit the over-land flow of both new effluents and those that have previously frozen but then thaw. It should be in the longer–term plan for these wastewater effluents to be used for more general irrigation, albeit limited to dry farm application, as defined under State Standard GB 5084-2005, because of the lower standard of wastewater treatment being provided under the Project.

16. The avoidance of use of polyelectrolyte as a sludge coagulant in the dewatering process will facilitate the wider use of sludges for agricultural fertilizer application. Whilst initially the partially dried sludges can be used for soil improvers in wind-break plantation areas, their more general acceptance will depend upon demonstrating to farmers that there is benefit from using the product without detrimental effect to ground workability, a problem that has beset polyelectrolyte conditioned sludges in the past. Therefore on-site storage and air-drying of sludges or the use of lime conditioning will assist in achieving this target and may, in the future, provide a saleable product.

4.3 Management of Solid Waste Materials

17. The separation of waste materials is currently carried out on an ad hoc basis, focussed mainly on cardboard and paper, glass bottles, plastic drink bottles and scrap metal. Although this present arrangement is fairly effective, nonetheless improvements were discussed, both in the physical mechanism of collection recyclable materials and the establishment of an association for solid waste management, involving all county seats and towns. These initiatives will require pro-active support for them to mature and become effective.

4.4 Cost Recovery and Tariff Reform

18. Whilst tariff increases are being introduced, the base price for water supply and wastewater treatment is currently low and associated revenues fall short of covering the full costs of operation and maintenance. Tariff recovery, on the other hand, is commendably high, helped in part by the pre-paid IC card system. In pursuance of the specific assurances identified by the PPTA consultants in Section 6 of their Interim Report concerning tariffs and cost recovery, discussions have been held with Altay Prefecture and county seat towns concerning the introduction of incremental block tariffs as a means of managing service demands in the future.

4.5 Poverty and Social Protection

19. In discussing tariff reform and extended use of IC card metering, it was recognized that the poor can be protected by a low entry level block tariff and the very poor assisted by the

provision of subsidized IC cards. The proposals for improvements in solid waste management, particularly in relation to separation of recyclable materials and removal of plastic bags, will assist the poor who generally comprise the workforce associated with these activities.

4.6 Regulatory Enforcement and Institutional Strengthening

20. Existing regulations concerning the management of solid waste and its safe disposal are not comprehensively applied and enforced and it has been recognized that procedures for strengthening these issues need to be put in place.

V RESEARCH AND INVESTIGATIONS

5.1 Meetings

21. Meetings and discussions have been held with a wide range of persons and organizations across northern Xinjiang and particularly within Altay Prefecture. The discussions were held against the background of improvements in public service delivery proposed under the Project and centred on the existing service operations and how these activities might be improved with respect to waste minimization, improving the reuse and recycling of waste materials and the maximization of renewable energy sources. A list of persons met, their affiliations and designations are included in **Appendix 2.** These include government staff, representatives of independent organisations and companies, and private individuals. This opportunity is taken to express gratitude for time, expertise and assistance provided by all those met.

5.2 Stakeholder Workshops

22. During the early phase of the support TA, three stakeholder workshops were arranged. These took place in the county seat towns of Buerjin, Jimunai and Qinghe. The workshops provided the opportunity for open discussion on the purpose of the TA: the investigation of feasible options for introducing renewable energy and its potential benefits; the promotion of the application of the 3R principles; and the possibility of forming a pilot demonstration area where green energy and 3R principles can be widely applied. Participants represented a cross-section of the communities of the county seats and included officials of local government, community representatives, members of local organisations and school children. Summary notes of each meeting are included in **Appendix 3.**

5.3 Studies into Existing Experiences and Lessons Learned

23. Two field trips were undertaken during the TA. The first concentrated on gathering information on existing arrangements for municipal service delivery across the five towns benefiting from the Project in order to assess the options for improving 3R principles. The findings of this field trip are discussed in the following Sections VI and VII. The second visit focussed on researching the experiences and lessons learned from the introduction and application of renewable energy sourcing in Buerjin County. The findings are summarized

herein and further detail is included in **Appendix 4.** The findings have also been incorporated within the recommendations offered in the Pilot Study Plan[5].

24. Altay Prefecture is a largely desert region and is exposed to sustained windy conditions. For this reason wind turbines are particularly effective. Four major wind farms are, or will shortly be, in operation in Altay Prefecture. They comprise numerous large turbines that are connected to the electricity grid system in Xinjiang. Other notable applications of wind turbines are those installed by China Mobile to assist in the power required for their communication relay stations, mostly in remote locations. The complimentary source of power is solar energy. The urban use of wind power is restricted to street lighting units (in Buerjin and Fuhai) where street lamps are powered by a combination of wind and solar energy. It is reported by wind farm operators and by China Mobile that their energy production is unaffected by the very cold, icy and snowy conditions prevalent in winter and the only bar to further and more general application of wind energy is the capital investments involved. The case for the use of wind energy to power street lighting is not so clear: where streets are relatively narrow and fronted by high buildings then wind turbines are adversely affected. The street should be aligned with the prevailing wind direction and should be open without close and high building frontages in order to maximize the potential for gaining energy from the wind.

25. Solar energy is also abundant with an excess of 2800 hours of sunshine per annum. The atmosphere is clean and a maximum of solar radiation is available. Photovoltaic (PV) panels are used extensively across Altay Prefecture and over a wide range of scale of application. Large banks of panels have been installed by China Mobile at their relay stations and small, single, panels are used by nomads to power a light bulb in their yurts (circular tent-like structures). Snow and ice would appear to be the main causes of power reduction. It is suspected that large PV installations are oversized to overcome this deficiency whilst small installations are often such that the panels can be kept clear manually. The experience of Buerjin County is that the performance of their PV panels on street lighting units does not suffer unduly from frost and snow. Roof-top mounted solar tube water heating is used very extensively across Altay Prefecture and, whilst they must be maintained free from banked snow, their performance is satisfactory.

26. The application of ground heat source pumping technology is in its infancy and there are at present a limited number of installations. However from those that have been investigated the responses are very positive with a good cost-benefit ratio. The winter freezing in Altay penetrates to 1.8 metres and it is therefore necessary to ensure that the heat source is below this level. Ground water has been used as the source of heat in all cases and only minor teething problems have been noted.

27. The existing application of 3R principles is fairly mixed. Potable water supplies would appear not well managed with little or no control on demand. However, feedback from the stakeholder workshops and a review of metered consumption suggests that the population is aware of the value of water and the need to avoid waste. In part this may be driven by the difficulties of wastewater disposal during winter freezing from properties without mains drainage. District heating is a difficult area where much energy is wasted. The heating systems (boilers and primary mains) are not generally very efficient and, except for very modern buildings, thermal efficiency in residential units is low. Heat metering is only slowly being

[5] A report entitled A Pilot Study Plan for Resource Efficient Towns has been prepared in parallel with this report and uses the same data from the research and investigations carried out.

incorporated and there remains the inequities associated with a tariff structure if it were to be based on heat metering in old apartment blocks where location within the block can alter significantly the unit heat demand. There is a widespread acknowledgement that improvements have to be made to reduce heat energy demand but this will involve a long-term program of works.

28. Possibly the best example of 3R operating in the community is that of solid waste management. Reuse and recycling have become widespread, largely on private sector initiatives. Small businesses repair and on-sell unwanted or broken household items, such as TVs and white goods, whilst other businesses collate and transport specific materials for both reuse and recycling at process industries. Intermediaries in this process are street cleaners and sweepers who separate and recover items such as paper, bottles and metals and sell them to the recyclable waste depots. An entrepreneurial hierarchy has thus become established. To an extent its success depends upon volume since individual items have minimal value. As a result the general public have little interest in waste separation and this deficiency needs to be encouraged by the public administrations. Rubbish bins along streets are divided between recyclable and non-recyclable sections but little attention is given to their use. Public awareness is therefore a major requirement in improving the success of waste management and the minimization of material to be disposed of to landfill. A present failing is in the enforcement of regulations controlling the separation and disposal of specified solid waste materials. Institutional strengthening measures are required.

29. It is concluded that, in principle, all three forms of renewable energy resourcing are suitable for appropriate application in Altay Prefecture, although wind energy is a problem in Qinghe. There is considerable scope for institutional strengthening on issues of water delivery and solid waste management and the application of 3R principles may be improved by relatively small investments in infrastructure and by a public awareness campaign.

VI SUMMARY OF EXISTING SITUATION IN COUNTY SEAT TOWNS

6.1 Buerjin

30. A single company manages both water supply and wastewater treatment. The existing water supply is from shallow wells adjacent to the Buerjin River and is currently pumped to distribution. These can get polluted from run-off from nearby agricultural land and there is insufficient capacity for future demand. The existing water source wells, pumps and infrastructure will be retained as reserve once the new facilities are operational. A new supply will be from upstream river abstraction and will gravitate to town distribution system. There are no service reservoirs and mains pressure is (and will be) sufficient to command the 6 storey buildings throughout Buerjin.

31. Flow is metered out of main reservoir and each customer is also metered. Network losses are acknowledged in principle and some water conservation measures are already in place although the Water Company wants leak detection equipment providing through the Loan Project. In areas where the piped distribution network is not provided, ground water is hand-pumped as a water source. This water is reported as poor quality with periodic pollutants.

32. Wastewater is either discharged to the sewer system, where available, or otherwise discharged to the ground. This results in severe problems during the long period of winter freezing. Wastewater from the treatment plant (WWTP) either evaporates or percolates such that there is no formal discharge. Ground water is thus polluted. All wastewater is pumped into existing treatment plant. Sludge is dried and transported to landfill. Treated wastewater is stored in large, covered, lagoon and fed to irrigation at appropriate times of the year. The new WWTP will be 3kms from Buerjin but in an elevated location, some 45m above the town. Treated wastewater will be held over winter in storage lagoon and gravity fed to irrigation. The location of the new WWTP is in a windy area and would be most suited for wind turbine energy use. Solar energy can also be used.

33. Solid waste management comprises 168 skips, a large number of individual bins, 5 vehicles and an open dumping area. Recycling is undertaken by ad hoc pickers and private enterprises. There is a need for improvements in both waste separation and regulatory control of waste dumping.

34. District heating is operated under a build, own, operate and transfer contract. Fuel is locally sourced coal.

6.2 Habahe

35. The existing WTW was established in 2005 and provides a fully gravity fed supply to the town of Habahe. It is located at a relatively high elevation. The intake reservoir is 25m above the WTW and the WTW is a further 60m above the town. Pressure reducing valves limit the water delivery pressure. During the months of April to July, when source water is turbid, there is a need for operating the clarifier stage and this uses some 20kW of power. Disinfection by chlorine requires a further 10kW, but otherwise only lighting requires power. During the winter months heat is needed and this was provided by coal fired boiler using approximately 60 tonnes of 500 cal.kg coal. The new boiler uses only 20 tonnes of the same coal.

36. The supply flow from the WTW is metered. During the ADB fact-finding mission in 2009, it was thought that unaccounted-for water comprised 25 – 33% of production. However the latest prediction is 16 – 20%, as a result of investment in new mains during the past year. Flushing and wash-out water is used for irrigation, either directly to land in summer or to offsite storage in winter.

37. All consumer points are metered; either with the new IC card meters (60%) or the traditional analogue meter (40%). The water company provides new meters when existing become broken. New build is required to have IC card meters installed. Lost or stolen IC cards are replaced at a small charge. The maximum water that can be purchased at one time is 30m^3. The domestic tariff is RMB 1.73/m^3. There is a higher tariff for commercial users and the highest tariff is RMB 7.0/m^3. For the low income, meter is provided and installed free and for the poor, a water credit system applies.

38. The idea of using renewable energy for water supply is not too appropriate since very little energy is used. The water company manager is interested in demand management techniques and would like to pursue this through the Project.

39. Treated wastewater will be used specifically for irrigation of trees forming wind-break. These trees will, in turn, be harvested for their timber. The treated wastewater will be held in

open lagoon storage until irrigation can recommence after winter. Sludge will be dried and stored. After testing for any toxins / chemicals it will be spread across forest areas as fertilizer. If there are problems of toxins, then sludge will be disposed of to landfill.

40. The wastewater system discharges to the WWTP by gravity. Energy requirements are i) power for floating aerators; ii) treated wastewater pumping to irrigation; iii) buildings heat and lighting; and iv) sundry other. The use of wind power for pumping and solar energy for building heating is a distinct possibility and water company director was enthusiastic about this prospect. There is also the possibility for incorporating ground source heating system, particularly using aeration tank heat.

41. The separation of waste is not formally carried out at present, although there are separate compartments in town waste bins [organic and other]. There are many sweepers, directly employed by solid waste department, .who collect refuse from apartment households and then remove all recyclable material for which there is a market. Rubble and building materials are reused as road base for rural roads and organic waste from restaurants is collected by farmers for animal feedstock.

42. District heat supply does not, at present, involve any heat exchange station although this will be remedied under the Project. The heat supply plant has been equipped with heat meters and it is also a regulatory requirement that all new buildings be fitted with heat meters.

6.3 Jimunai

43. Potable water supply is by gravity feed, the only power requirement being for light and heat of staff facilities at intake and WTW. In these cases either solar power or mini-hydro would provide the maximum 10 kW power needed. The water supply network is 30 years old and is known to have losses but these were not defined but are probably significant. Under the Project there will be additional 30kms of supply network. There is a water meter at the WTW but no other district supply meter. Each consumer is metered by mechanical integrating meters. There are 4 levels of tariff applying at present: industry at RMB 1.8/m^3; commercial at RMB 1.3/m^3; domestic at RMB 0.6/m^3; and fire and greening at 0.2/m^3. New tariffs are planned for 2011 with domestic rising to RMB 1.0/m^3 but other tariff levels have not yet been decided. It is also planned to introduce IC card meters in about 2 years time.

44. Wastewater is collected by a separate sewerage system. It discharges by gravity to ponds and this arrangement will continue to the the proposed WWTP. There is a proposal for the treated wastewater to be fed, also under gravity, to wooded areas as a windbreak. This planted area is about 1000mu [67 hectares]. The water will be stored during the winter months and released during the growing season. The winds are strong in the area of the WWTP and it was agreed that wind power would be very suitable for energy requirements. There will be small buildings for staff use at WWTP and solar power would provide light and ground heat source pumping the necessary heating.

45. The existing set up is very primitive. The county seat town has a population of 13,000, divided into 4 community areas. Each community area is responsible for collecting its own solid waste and has a skip for solid waste but no formal location for siting it. The waste operation comprises the 4 skips and two lorries to transport the skips to the landfill. There is much inorganic material tipped, including mounds of cobbles and boulders, as well as building

materials. One of main community leaders admitted they need a lot of help, not just with landfill and equipment but with institutional strengthening and operation. However, by the time of implementation of Loan Project a new solid waste company will be established under Construction Bureau and will be responsible for all solid waste collection, transport, disposal etc. It is this Bureau that will need an operational plan and training.

46. The heating station operates nominally from 1 October to 1 May. Heat is metered out of station but nowhere else at present. The primary heat supply pipework is in good condition. There are no heat exchangers but these will be introduced in new buildings, as will heat meters.

47. Electrical demand at heat station is 800kW used for blowers, pumps, coal feeders etc. The total annual electricity bill is RMB 1.5×10^6 and when new areas are included under Project then electricity costs will increase to RMB 3.5×10^6. New buildings have heat meters but they are not used so far. The charge for heating is RMB 25.5 per m^2 per year and is standard across all customers.

6.4 Fuhai

48. The total population of Fuhai county seat is 20,000 and the water service has a coverage of 98%. The water resources are considered adequate for the foreseeable future. Consumer metering is by standard mechanical integrating meters although there are plans for introducing IC card meters in about 2 years. A ball-park figure for water consumption is $6m^3$ / household of 3 persons per month. This equates to about 70 lcd.

49. Wastewater is the responsibility of separate company from that for water supply, although it is still remains under the general umbrella of the Fuhai local government. Existing sewerage is on a combined system. The ground water level is high and there is high infiltration. The existing WWTP is located 8kms to east of the town and requires 5 No. lift pumping stations. The total lift is 30m and the installed pumping is: PS1 – 5.5 kW; PS2 – 11 kW; PS3 – 2 x 11 kW; PS4 – 37 kW; and PS5 – 75 kW. At an electricity tariff of RMB 0.58/kWhr., the total daily cost at 10 hours of pumping is RMB 870. The proposed WWTP has not yet been defined but is probably by surface aeration. Treated wastewater will be stored and then pumped to irrigation of new tree plantation wind-break. The area of trees is not yet known. The location for the new WWTP is energy inefficient in that it is on high plateau above the town and all sewage will have to be pumped *ad infinitum*. A better location would be down river

50. The site for the new WWTP is near to the existing wastewater lake (but exact location was not known) and about 2kms from the landfill site. There are good reasons for locating the two facilities (WWTP and landfill) adjacent to one another to benefit from combined power supply, access road, fencing, wind-break tree screening etc.

51. A total of 60 cleaners collect solid waste from each domestic property each day. Of these cleaners, 60% are women. There is no formal recycling arrangement at present but cleaners and sweepers carry out first removal of glass bottles, plastic bottles, paper, and metals. Pickers at landfill carry out second stage sorting and recycling.

52. Rubble and building materials are transported by contractors directly to landfill. The tipping charge is RMB $1.5/m^3$. With the planned transfer of the Prefecture Government to Fuhai there are extensive plans for reconstruction of the town and much more rubble will be

generated. A precise strategy for dealing with this material needs to be in place: at present the manager has no idea what to do.

53. Fuhai suffers from strong winds and solid waste needs to be protected to prevent wind-blown debris. In addition the manager thought that there should be separation facilities at each transfer station. For commercial areas, a skip is placed in an open area and restaurant owners and others must take waste to skip.

54. The existing heating plants comprise 2 x 40t in south and 1 x 20t + 2 x 15t in north. They are inter-linked by main hot water pipes and to the 10 heat exchange stations. The boiler plants are all coal fired, consuming 30,000t per annum. One particular problem is the high ground water table (1.0 – 1.8m deep) which often submerges the and conveys the heat away rapidly. As much as 50% of generated heat is estimated to be lost. There is a very clear need for new heat delivery mains.

55. At present 60% of population have heat supplied and this is expected to rise to 80% by 2015. There is an ongoing program for insulation of older buildings and the fitting of meters. All new buildings must be insulated and have heat meters in each apartment. There is little opportunity for using renewable energy because exposed sites, suitable for wind turbines, are remote from the town.

6.5. Qinghe

56. Permanent population in Qinghe is 14,000 of whom 4,300 households receive piped water supply. 2000 properties are fitted with a mechanical meter and 1700 have IC card meters. The remainder are not metered and are charged on a normative rate.

57. The existing water supply tariffs are: domestic RMB 0.99/m^3; industrial RMB 1.98/m^3; commercial RMB 1.85/$m^{3;}$ and special high users RMB 2.75/m^3. The wastewater tariff is RMB 0.2/m^3 and recovery rate is better than 98%. The director of water and wastewater services likes the idea of block tariffs and thinks they should apply to all services but other directors disagree. Losses in the supply system are very high. There is no bulk metering and hence means of checking supply and demand. It was accepted and agreed that demand management should be introduced. The new WTW is upriver and no pumping will be needed. The existing WWTP is 2 kms from town centre and sewage has to be pumped into the works. Treated wastewater is fed to irrigation of tree screens.

58. The township employs 64 cleaners / sweepers, of whom 60 are female. Landfill management is a problem because the perimeter fence has been stolen allowing animals to gain access and they frequently become ill as a result. This is perhaps not surprising since batteries of all types are buried at the landfill site, as are wastes from clinics, although hospital waste is transported for incineration. Also rubble and building materials are transported by contractors to landfill and there is no charge.

59. The need for separation is acknowledged by the existence of ‘recyclable’ and ‘non-recyclable’ refuse bins but the public do not comply with separate usage. There is a strong need for a public awareness campaign. Some progress has been made at schools where students can earn small prizes for practicing waste separation. It was agreed that the only likely renewable energy application would be for heat and light at the landfill office.

60. The existing heat supply comprises 2 x 20t + 1 x 40t boilers and 7 heat exchangers, providing heating to 4000 households. Water consumption was very high before heat exchangers were installed. It was 70,000m^3 per season but has dropped to 15 – 20, 000m^3. The reason given is that bursts are now very much easier to locate. One hundred percent of clinker is recycled to brick and cement manufacturing.

61. Cost of electricity at the heating stations is RMB 1.15 x 10^6 per season and cost of coal is RMB 4.7 x 10^6 per season. It was agreed that little help is available from renewable energy sources. The introduction of bulk metering at all buildings will help control of heat supply and charging for its use. Metering is installed at boiler plant and at the 7 heat exchangers.

VII OPTIONS FOR 3R and RENEWABLE ENERGY INTERVENTIONS UNDER THE PROJECT

7.1 Roads

62. All county seat towns have a roads component under the Project except for Qinghe. Included in the proposed works are road lighting and traffic signage. Road lighting can conveniently be provided by renewable energy by either or both of PV solar panels and wind turbines. Buerjin and Fuhai already have such facilities, albeit with limited application. Road traffic controls, such as traffic lights, illuminated speed check signage and other illuminated control signage can also be powered by renewable energy and it is recommended that these be considered for future funding. The possibility for reducing energy use by switching off street lighting during the late night / early morning dark period has not found favour with the police on the grounds of crime prevention.

7.2 Potable Water Supply

63. Proposals under the Project for water supplies generally include enhanced source works and supply network pipelines. In one instance, Buerjin county seat, provision is made for a coagulation, flocculation and filtration plant located near to the new raw water intake to eliminate suspended particles during spate rivers flows when turbidity becomes a problem. All potable supplies are fed to distribution by gravity, requiring pressure reducing valves in some instances to avoid local pressure high spots. Most consumer supplies are metered[6].

64. Electrical energy is required at all water treatment works for building heat, light and small power requirements. In the case of Buerjin, it is also needed for the seasonal water treatment process. Buildings at the various water treatment works (WTW)s will comprise typically: an office, testing laboratory, store, chlorine room and workshop. Under the project proposals, a 10 kV electrical supply transmission line is included to satisfy the necessary heat, light and power requirements. This supply could be provided by locally generated renewable energy. Three options are available: hydro-energy, wind turbine and solar radiation. Hydro-energy has, for the present, been ruled out on grounds of being good neighbours since many of the rivers in Altay Prefecture serve cross-border catchments and their flows are thus directly or indirectly politically sensitive. Although wind and solar energy are intermittently available, with battery back-up, they would suit the provision of heat and light energy, particularly in remote

[6] A report on pre-paid metering has been prepared in parallel with this report.

locations. Electrical transmission lines would then become unnecessary. It is recommended that the option of solar and wind energy is investigated in detail during the detailed design phase of the Project to determine the relative whole-life costs of these compared to that of conventional energy supply. A final decision may then be taken on the most appropriate means of power supply.

65. The water supply and distribution networks have not been the subject of active leakage control measures and repairs to the aging mains have been on a reactive basis, responding to problems as they occur. Whilst new transmission mains and some zonal supply mains are provided under the Project, it is almost certain that a large quantity of unaccounted-for water will continue to prevail[7]. The 3R principle of reducing demand for resource is thus not yet applied, at least not on the supply side. It is therefore recommended that demand management techniques are introduced whereby full service metering is included and active leakage control measures become a standard element of service management. A corollary is the transparency in the cost of service delivery and the public perception of introducing incremental block tariffs to ensure both the cost-sustainability of operations and the control of demand.

66. Water delivered has suffered from a variety of problems and these are summarized through the results of a social survey undertaken by the PPTA consultants. The summary is included in Table 5.1 in **Appendix 5.** The reported problems would not appear severe and with the new water supply components many, if not all, of these complains should be resolved. However, water demand needs to be contained to avoid profligate use by some consumers, or excessive use by all in particularly dry years, leading to further problems of supply shortages in the future. Both this issue and that of effective management of the supply network can be addressed by the overall strategy of water demand management which must be supported by a public awareness campaign and training exercise.

67. Because the towns are not large and thus have limited financial and institutional capacities, it will be of considerable operational benefit to constitute a Water Users Association. This would comprise both supply-side and demand-side representatives to share resources (for example specialist equipment), know-how, experiences, lessons learned and expectations. It would be the forum for open discussion on cost of supply, demand management and tariff changes.

68. These interventions of resource planning and demand management are characterized by the list of actions in **Appendix 6**, wherein are provided the primary elements of water demand management: consumer feedback, resource planning (including the application of renewable energy), metering, active leakage control and tariff strategy. In addition there are opportunities for introducing 3R principles to water usage in order to minimize waste. The options for such interventions are given in Table 2.

Table 2: Options for Interventions in 3R and Renewable Energy in Water Supply Management

	Physical

[7] In the Interim Report by the PPTA Consultants, unaccounted-for water is predicted to represent 10% of demand in all towns. This is considered unrealistic and, unless all consumers are fully metered and their consumption is totally aggregated, the basis for calculating unaccounted-for water should be expressed as a percentage of production output, not consumption.

1	Solar water heating for hot water;
2	District bulk water supply meters;
3	Provision of leak detection equipment and training in its use;
4	Low energy light fittings to WTW;
5	Solar based energy for lighting to access road, WTW and building heat and light;
	Institutional / Managerial
6	Awareness and training in water conservation and cost benefits (including wastewater);
7	Establishment of a Water Users Association;
8	Introduction and implementation of water demand management techniques;
9	Training in the use of specialist equipment;
10	Review of tariffs and necessary increase to ensure sustainability. Introduction of incremental block tariffs (IBT)s.

7.3 Wastewater Collection and Treatment

69. Wastewater collection and disposal is seen as a major problem in many of the towns, as recorded by the responses in the social survey – see Table 5.2 in **Appendix 5**. In recognition of this all project towns have a component for the construction of a new wastewater treatment plant and most have trunk sewers and pumping stations in addition. The issue of pumping sewage has been raised under policy dialogue and is outside of the scope for introducing small-scale renewable energy installations, mainly because of the near-continuous power requirement. Indeed, the possible need for standby generation has not yet been addressed. The wastewater treatment process recommended by the PPTA consultants / DI is that of settlement followed by extended surface aeration for all wastewater treatment plants (WWTP)s. The retention time will be approximately 4 days.

70. The floating aerators proposed will each have a power rating of 66 kW and the numbers of units are summarized in Table 3. Other requirements for power will include screen raking, where applicable, return sludge pumping, site lighting, small power outlets and buildings' light and heat. There are, apparently, intentions for a laboratory at each WWTP but no details are yet available. Nevertheless some power will be required. It is therefore probable that power requirements will range from 150 to 550 kW across the range of WWTPs. Such requirements would be generally outside the practical range for PV solar panel installations but would be suitable for wind power. Solar panels may be used for building lighting and space heating whilst solar tube heaters can be used for water heating.

Table 3: Surface Aerators Proposed under Project

Location	Buerjin	Habahe	Jimunai	Fuhai	Qinghe	Takeshekim
Active	5	6	4	8	3	2
Standby	1	1	1	1	1	1
Total installed	330	396	264	528	198	132

Power kW						

71. It is proposed that treated effluent will be used for the irrigation of areas of tree plantations. The Interim Report suggests minimum areas of these plantations to optimize the water available yet avoid overland flow or pollution of the ground water. This principle provides an excellent example of reuse of resource, thus encouraging the growth of a further natural resource. Timber.

72. It is proposed under the Project that sludge is mechanically dried to a moisture content of less than 80% and transported to landfill. The PPTA consultants predict that the quantities of sludge at 80% moisture content will range from 0.35m^3/day at Jimunai to 0.82 m^3/day at Fuhai and are less than economic for attempting to recover methane gas for energy generation. However, space at the WWTP sites is not at a premium since they are located in remote desert areas and on-site drying and long-term storage to overcome persistence of pathogens may enable the sludge to be recycled as soil enhancer or agricultural fertilizer. This process may be accelerated by the addition of lime in solution.

73. The administrative building at each WWTP will include a minimum of office, laboratory, store, chlorine room, washroom and shower and workshop. In the majority of cases the building could conveniently be supplied with electrical power from either or both of wind and solar energy. The major restriction is in the case of Qinghe where wind energy is not normally sufficient. Nevertheless solar tube water heaters and PV panels could provide heat and electrical power to supply the needs of the building. In addition, sewage is usually warm with an average temperature of between 9 and 12 degrees Celcius. This heat can be tapped by introducing ground heat source pumping technology whereby small bore pipes would be routed adjacent to the wastewater treatment ponds or incoming trunk sewer to absorb the heat which is then transferred to a heat exchanger unit, housed in a convenient part of the building. The transferred and concentrated heat is pumped around the building to provide the necessary warming. This technology is becoming widely used and has current application in the county seat towns of Buerjin and Jimunai where ground water heat is harnessed.

74. Therefore there exist various options for 3R and renewable energy interventions under the wastewater components of the Project and these are summarized in Table 4 under physical sub-components and institutional and management changes.

Table 4: Options for Interventions in 3R and Renewable Energy in Wastewater Management

	Physical
1	Solar based energy for lighting to access road , WWTP and building heat and light;
2	Solar water heating for hot water;
3	Wind power for process power – limited to high wind areas.
4	Ground heat pumping based on wastewater heat for building heat;
5	Reuse of treated wastewaters for irrigation of tree plantations;
6	Reuse of wastewater sludges for soil improvement in plantation areas. In future this may be expanded to farmland fertilizer;

7	Low energy light fittings to WWTP;
	Institutional / Managerial
8	Sewer infiltration survey / training in methodology;
9	Pre-approval required from State to qualify for subsidy for ground heat source development;
10	Need for clear operating procedures to control of rate of effluent discharge to irrigation;
11	Limitations to heavy metals and other toxins discharged to sewers from industrial operations to be carefully monitored and taken into account within the planning process;

7.4 Solid Waste Management

75. Existing solid waste management arrangements comprise waste collection, the ad hoc removal of those items for which there is an established resale market, and transporting the waste materials for disposal at a landfill site (ground dump) all as illustrated in Figure 1. These arrangements are particularly criticized in Buerjin whose responses to the social survey are summarized in Table 5.3 in **Appendix 5** Proposals under the Project include the provision of solid waste collection vehicles, including compactor trucks, and the development of engineered landfill facilities. These include fencing, ground lining, leachate collection and recycle spray, weighbridge and building with electrical power supply.

76. The recycling of solid waste materials is undertaken by the private sector, usually individuals, who gather items of similar material type, and sell them on to family run small enterprises who package or bundle them and tranship to Urumqi where they are either reused (e.g. glass beer bottles) or recycled as raw material in another process. A typical urban recycling depot collects items as listed in Table 5 and on-sells them to bulk processing plants.

Figure 1: Solid Waste Processing Routes

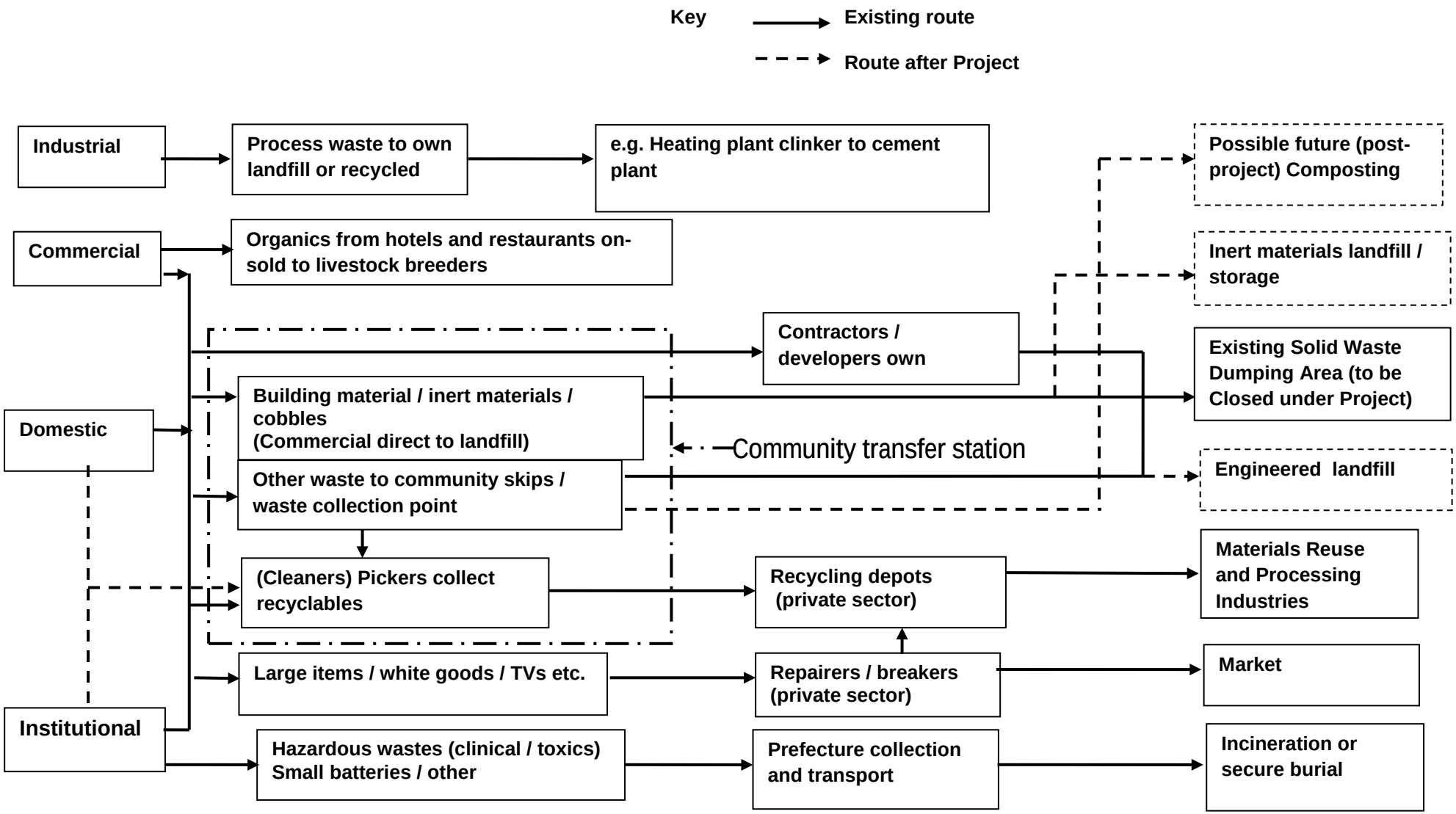


Table 5: Recyclable Materials and their Processing Routes (typical)

Material	Sent to	Frequency
Glass bottles – beer liquor	Breweries – Wusu and Yanjing Distillery - Fuhai	10 – 15 days
Paper / cardboard	Paper mill – Fuhai	10 days
Metals – ferrous Non-ferrous	Smelter - Urumqi Smelter – Urumqi	monthly
Plastics – bottles - bags	County factory for pelletizing, then Urumqi Landfill	
Tyres / rubber	Rubber factory – Urumqi	infrequently
Batteries	Urumqi	2 years
Bones	Fertilizer plant – Changji	infrequently
Fabrics	No market	

77. A State regulation was passed in 2007, outlawing the use of thin plastic bags and encouraging the reuse of thicker plastic bags. There was no mention of biodegradability of such bags. Details of this regulation are summarized in **Appendix 7.**

78. Solid waste in each of the five county seats is assessed by the DI to comprise 54% organic content at present and that this will rise to 57% by 2015 and 58% by 2025. Typical moisture contents are between 55 and 60% for organic wastes. Expressing these organic wastes as an annual tonnage and corresponding fill volume required per town landfill results in the figures given in Table 6. It follows that an alternative means of disposal (for example, composting) would save a very considerable volume of engineered landfill space and could contribute to soil improvement measures and green landscaping in otherwise barren areas around the towns.

Table 6: Annual Quantities of Organic Wastes

	Buerjin		Habahe		Jimunai		Fuhai		Qinghe	
	2010	2025	2010	2025	2010	2025	2010	2025	2010	2025
Total tonnage / yr.	13870	15330	21900	22995	18250	22630	21900	39420	10950	15330
Organic tonnage / yr.	7530	8891	11982	13337	9910	13125	11982	22864	5946	8891
Other waste tonnage / yr.	6340	6439	9918	9658	8340	9505	9918	16556	5004	6439
Volume of organic waste 1000 m^3 / yr	11.6	13.7	18.27	20.52	15.25	20.19	18.27	35.18	9.15	13.68

79. A significant proportion of non-organic waste at existing landfills has been noted as building rubble and inert material such as river cobbles and disposal fees are not imposed. Not only would this material occupy a significant proportion of the new landfill volume if allowed to be dumped along with domestic wastes, but the opportunity to reuse the material would be lost. Indeed, a State law specifies that the disposal of building materials should controlled, not dumped mixed with domestic refuse and should be subject to a disposal fee. Salient points from this law are summarized in **Appendix 7**. Therefore changes in operational management of the landfills are required.

80. Various options for 3R and renewable energy interventions under the solid waste components of the Project are therefore available. These options are summarized in Table 7 under physical sub-components and institutional and managerial strengthening.

Table 7: Possible Interventions in Solid Waste Management

	Physical
1	Separation of recyclable and organic wastes at source by multiple container system;
2	Transfer station at community centres where recyclables are taken out of container, sorted by type and sold on through market;
3	Organics are separately transported to composting or similar digestion plant;
4	Remaining waste transported to landfill;
5	Building rubble and inert materials to be stored at landfill site pending reuse in hard-standings road sub-bases and the like;
6	Landfill operation to i) weigh and record incoming waste; ii) contain in engineered landfill the waste materials, with building rubble being separately dumped; iii) provide separate temporary storage for hazardous and toxic wastes; and iv) deal with closure of existing landfill.
7	Solar based energy for heat and light of access road, yards and buildings at landfill site;
	Institutional / Managerial
8	Public awareness and training in benefits and practice of recycling materials;
9	Introduction / strengthening of deposit charge on some recyclable materials / products;
10	Enforcement of clinical waste management legislation with penalties;
11	Possible private sector involvement in separation and treatment of organic wastes
12	Plastic bag outlawing / enforcement / removal;
13	Building materials / rubble disposal strategy, regulatory control and imposition of dumping fees;
14	hazardous materials – batteries / asbestos – to be stored for bulk removal;

15	optimizing vehicle trips to minimize fuel use;
16	establishment of a Solid Waste Strategy Association. This will provide benefit of scale and cross-fertilization of ideas/lessons learned.

7.5 District Heating

81. The district heating plants all rely on locally mined coal for their energy source and on grid electricity supply for blowers, pumps, coal feed arrangements and the like. The ratio of used energy cost is typically 80% for coal and 20% for electricity. The heating plants are often located near to the housing blocks that they serve and this minimizes the lengths of primary heat supply mains. However it does mean that pollution from coal burning is a serious problem in residential areas and that the possibility of using wind energy to produce the necessary electrical power is restricted because of the built environment. A wind farm would have to be located remotely with the associated cost of electrical power transmission lines connecting to the heating stations. All ash and clinker from the heat stations is removed and sold on to local cement and brick making factories. Occasionally it is used as an insulating layer on roofs of apartment buildings.

82. A typical modern district heating installation consists of insulated heat mains of flow and return pipes distributing hot water past the buildings which might be connected. A junction point on the hot water mains allows easy connection to each building, from which hot water can be taken from the main to a heat exchanger (heat substation) within each building. The heating circuit within the building or group of buildings is thus isolated from the heat main. Unfortunately the district heating arrangements in the county seat towns do not follow this model and in some cases primary heating water is directly circulated through building heating mains, without heat exchangers. In other cases local heat exchangers serve a number of buildings.

83. Temperature measurement is restricted to the heating station and, in some cases to the local heat exchangers, but rarely is there building heat metering except in the latest constructions. The temperature of output from heat stations is normally around 110 deg.C but this drops to 70 deg.C or lower at the heat exchanger and there are further losses before apartments receive the hot water. As much as 50% of generated heat is thus lost. Output temperature at the heating station is controlled manually in response to the local weather forecast and is little more that an educated guess of likely demand. One particular problem is the high ground water table (1.0 – 1.8m deep) in Fuhai. The heating pipes are often submerged and ground water conveys the heat away rapidly.

84. There is an ongoing program of building renovation, involving the provision of roof and outer wall insulation, but building plumbing remains as installed providing residents with little control over heat consumed. Indeed, because of the lack of heat metering, payments for heat are calculated on an average use basis, either of the total heat supplied at the boiler plant or of the heat used by the exchanger. In older buildings where there are neither heat meters nor modern standards of insulation this averaging of use is only fair since some apartments are at the outside top of a building whereas others are in the centre, requiring quite different heat inputs.

85. There is little that can be effectively achieved within this sector under the Project in supporting 3R and renewable energy to the existing boiler and housing stock. The introduction

of improved building insulation is slow and costly and attempting to provide individual heat metering at old apartments would neither be practical nor equitable if meter reading were to be used as a basis for charging residents. Within new buildings, where the regulatory requirement is to install apartment heat metering and thermostatically controlled valves on the heating system, the choice of residence will exist and the opportunity will be available to reduce demand and thus save energy and related charges.

7.5 Other

86. Two possible initiatives to reduce energy demand, but which are strictly outside of the scope of the project components, are the use of low energy light bulbs and the careful scheduling of service vehicle trips. A comparison of energy requirements between incandescent and compact fluorescent (low energy) light bulbs is offered in **Appendix 8**. If the average number of light bulbs per household is 10 and the number of households in the county seats is Buerjin 6200, Habahe 4400, Jimunai 3600, Fuhai 6300 and Qinghe 4300, then the total light bulbs used will be 24,800, say 25,000. The difference in power demand between the two types of bulb will be initially 25000 x 60W x 0.3 = 450 kW or 0.45MW, although this will reduce over time. In addition the life of the compact fluorescent bulb is 10 to 15 times that of the incandescent bulb requiring many less changes and resulting waste material. The scheduling of motor vehicle trips can save considerable quantities of fuel but can only be assessed from a detailed study of the vehicles used, distances covered (for example to landfill or to WTW or WWTP etc), and the frequency of necessary trip.

VIII DISCUSSION

8.1 Water Supply

A. District Metering

87. Typically there exists a bulk meter at the potable water source works and no other metering until the individual consumer points. Whilst the county seat towns are not large, nevertheless there is no subdivision into supply districts or zones and a one-fits-all approach to water management applies. District metering areas should comprise 2000 to 3000 properties. Meters will normally be of the integrating type and record the total quantity of flow. Meters should be fitted at all open inflow points [some minor inflow points being closed off at the valve] and downstream areas supplied will also need to be metered and the flow subtracted from the sum of the inflow meters. The most appropriate arrangement of meters and valves will best be seen from a water supply network plan.

88. Following information should be recorded

- total number of properties within the area
- total number of metered consumers within the area
- the average daily metered consumption

- any metered consumers that use large quantities of water in relation to the rest of the area or, if rate of flow measurements are being made, who use high flow rates at specific times of the day or week
- for the peri-urban rural areas, the total length of main may also be required.

89. The meter size should be such that it is capable of recording the minimum night flow without loss of accuracy but must also be capable of supplying the peak flow without introducing a serious head loss. It is therefore unlikely that any meters of less than 80mm would be acceptable. There is considerable advantage in having the facility to record rate of flow from the integrating meters as it enables both minimum night flow rate measurement and total quantity measurements to be made by a single instrument. It also enables a district meter to be used for step testing purposes.

90. Normally all district meters are read at weekly intervals and, as far as possible, at the same time of day and day of week. The difference in balance 'in and out' of the district and taking into account metered consumers, can then be expressed in litres per property per hour. Inspection of supply districts normally comprises sounding all valves, hydrants and stop cocks searching for the characteristic noise of leaking water. The average inspection frequency for district meter areas is about once a year.

B. Leakage

91. Leakage from water supply and distribution networks in PRC is reported to be considerable and may exceed 50 percent of water produced. This constitutes not only wasted natural resource but a considerable increase in the unit cost of water actually delivered and consumed since that water must carry all production costs, including that of the unaccounted-for water. Furthermore, shortages of water are often blamed for irregular or intermittent supplies yet production can be in excess of the quantities actually required by consumers. The response is often to require additional production facilities [additional boreholes or pump sets] whilst ignoring the option for reducing losses as a means of increasing the availability of supplies.

92. Leakage control in PRC is generally limited to reactive (passive) repair work on water mains. This is necessitated through an inability to measure flows and lack of access to even rudimentary equipment to detect possible leaks. Therefore, by the introduction of such facilities through the Project, a number of long-term advantages may be obtained:

- Improved capacity to effectively manage the supply system;
- Reduction in losses from the networks;
- Improved efficiency in water distribution;
- Reduced cost of water delivered to consumers;
- Greater available capacity in existing assets [reservoirs, pipes etc.]; and
- Longer operational life of pumping and associated equipment.

93. There exist four fundamental leakage management activities which are complementary and inter-dependent:

- Infrastructure management,
- Pressure management;
- Active leakage control [ALC]; and
- Speed and quality of repairs

94. The economic level of leakage is that level where the marginal cost of active leakage control [see below] equals the marginal cost of leaking water, or, where the cost of reducing leakage by one cubic metre equals the cost saved of producing and distributing that one cubic meter of water. Clearly there is no advantage in pursuing leakage control when the cost of doing so exceeds the savings obtained unless raw water resources are so limited that, without maximizing such resource, alternatives would be needed [at possibly greater unit costs].

95. There are often benefits to be obtained from comparisons between levels of losses within different supply systems but great care must be taken to ensure comparisons are on a like for like basis. Losses expressed as a percentage of production inherently include legitimate consumption: as consumption increases so percentage losses reduce since system losses themselves are often fairly constant. Therefore, if the legitimate consumption in one town is considerably higher than another, its losses will appear as a smaller percentage although in every other respect the actual losses from the respective systems may be identical. To overcome this problem a different approach to reporting losses is usually adopted but is outside the need and scope of this report.

96. District metering and night flow measurements are proposed as a means of targeting leakage detection activity but other benefits will also accrue viz:

- A knowledge of the flow of water from source to point of consumption;
- An opportunity to install pressure control;
- Optimization of network operation and control.

97. In order to address the deficiencies previously noted and minimize the need for additional capital works it is proposed that active leakage control is introduced into all water supply systems. The principal methods of ALC are:

- Regular inspection and sounding of all mains, fittings and connections;
- Zonal metering – if large district;
- District metering;
- Continuous and intermittent night flow measurements;
- Short period measurements at any time of day;
- Temporary placing of leak noise detectors.

C. Tariffs

98. The final building block in demand management is that of tariff payable for the service delivery. By use of tariffs consumers can be persuaded to reduce their demand by considering the value of the resource. The use of incremental block tariff ensures more is paid for higher usage but also a minimum cost is available for a basic water demand of, say, one cubic meter per month. This will encourage immediate repairs of domestic leakage and will minimize wastage.

D. Water Users Association

99. The establishment of a water users association amongst the towns in Altay Prefecture is recommended to provide the following benefits:

- Shared use of equipment purchased under the Project but for which there is an intermittent requirement;
- Exchange of ideas and approaches to water resource planning, including the application of treatment processes and renewable energy provisions;
- Agreement on standards of service to be adopted – to include minimum pressure and flow rate; water quality; maximum frequency of interruptions and bursts; leakage levels etc.;
- Provision of customer complaint response procedures;
- Common stance on public awareness into 3R principles and practice;
- Procurement of engineering services – to include performance specifications and contract management;
- Procurement of equipment;

8.2 Wastewater and Sludges

100. The average annual wastewater is estimated at about 6000m^3/day in each of the county seat towns (except for Qinghe which is lower). Buerjin also has a high seasonal difference in flow because of summer visitor numbers and summer and winter flows are estimated at 7500m^3/day and 4800m^3 respectively. It is recommended for there to be infiltration surveys carried out on the sewerage systems to determine minimum night flows and diurnal variations and thus establish the flow patterns in the sewerage system of each town. The results will be significant for two reasons: (i) excessive minimum night flow will highlight infiltration and structural problems and the need for repair or replacement, and (ii) the mean summer and winter sewage flows will determine the quantity of expected effluent after treatment which will be available for reuse (irrigation) in the summer but which will need to be retained by some method in winter. If winter flows are reduced then so too is the storage problem.

101. The proposal to reuse treated wastewater effluents for irrigation has two major advantages: (i) it provides a source of water which would otherwise have to be abstracted from natural reserves; and (ii) it enables wastewater treatment to be undertaken to a lower standard (water quality) than would be the case if effluents were to be discharges to open water courses. However, during the period when the ground is frozen irrigation percolation cannot occur and storage is needed. On sloping ground, such as at Buerjin, the effluent could run off forming

large sheets of surface ice, extending well beyond the limits of the plantation unless retaining dykes are formed. The risk return period for a severe, prolonged, winter must be defined from which the required period and hence volume for wastewater effluent storage will be determined. The complete reuse of effluents as irrigation waters for tree plantations will be determined from ground percolation tests and will dictate the area of plantation that must be developed. The irrigation rate to fully consume all available stored final effluents, plus that added on a daily basis, such that the use of storage is at a minimum by the start of ground freezing will determine the minimum area of plantation required. A factor of safety should also be applied. The resulting means of storage must ensure that under no circumstance will wastewater escape overland to the natural river system. The exact method for irrigation is not yet defined but will be from wild flooding, border check terracing, basin area (such as paddy), furrow, sprinkler or drip. From the irrigation efficiency this list runs in ascending order, drip irrigation being the most efficient. However, from an economic perspective, it may not be appropriate and furrow irrigation is probably the best option. A very detailed operational plan must be prepared to ensure that effluent flows are only released when a sufficient percolation rate is available.

102. The use of wastewater sludges for soil improvement and farmland fertilizers also has its problems. The addition of a polyelectrolyte to aid coagulation and dewatering results in an unworkable material, disliked by farmers who now boycott its use. If sludges can be thickened in decanting tanks and air dried on open beds in non-freezing months, then the sludge can be both handle-able and beneficial to the land. Initially this would be to the proposed tree plantation areas but, thereafter, on demonstrating no adverse soil effects, it may be adopted again by farmers.

103. The epidemiological characteristics of domestic wastewater sludges are significant because of the life-spans of pathogens. These are indicated in Table 8 and care must be taken that sludge age is sufficient that numbers of Helminths, in particular, have declined to an acceptable environmental level.

Table 8: Epidemiological Characteristics of Enteric Pathogens

Pathogen	Persistence in environment	Minimum effective dose	Immunity	Latency soil development stage	Routes of infection
Viruses	Medium	Low	Long	No	Food and water
Bacteria	Short/medium	Medium/high	Short/Medium	No	Food and water
Protozoa	Short	Low/medium	None/little	No	Food and water
Helminths	Long	Low	None/little	Yes	Mainly soil

Source: Feacham et al 1980

104. The occurrence of industrial effluents and toxic contaminants from the county seat towns is not seen as a problem at present and should not be so for future industrial developments whose effluents must be pre-treated to remove toxins all in accordance with PRC Integrated Wastewater Standard GB 8978-1996, Table 4 Maximum Allowable Discharge Concentrations for Pollutants of Second Category – enterprises build after 1998. Sludge contamination should not, therefore, be an issue provided care is taken during the planning process.

8.3 Solid Waste Management

105. There are numerous state regulations controlling the use and safe disposal of various materials, including hazardous substances, clinical waste, building materials and plastic bags. The regulations concerning these materials are summarized in **Appendix 7.** From site inspections it has become apparent that some of these regulations are often not strictly adhered to and others are totally ignored. Clinical waste appears at landfill sites and is fly-tipped at the road-side; building materials are dumped haphazardly at waste sites, intermingling with domestic refuse, and plastic bags are ubiquitous.

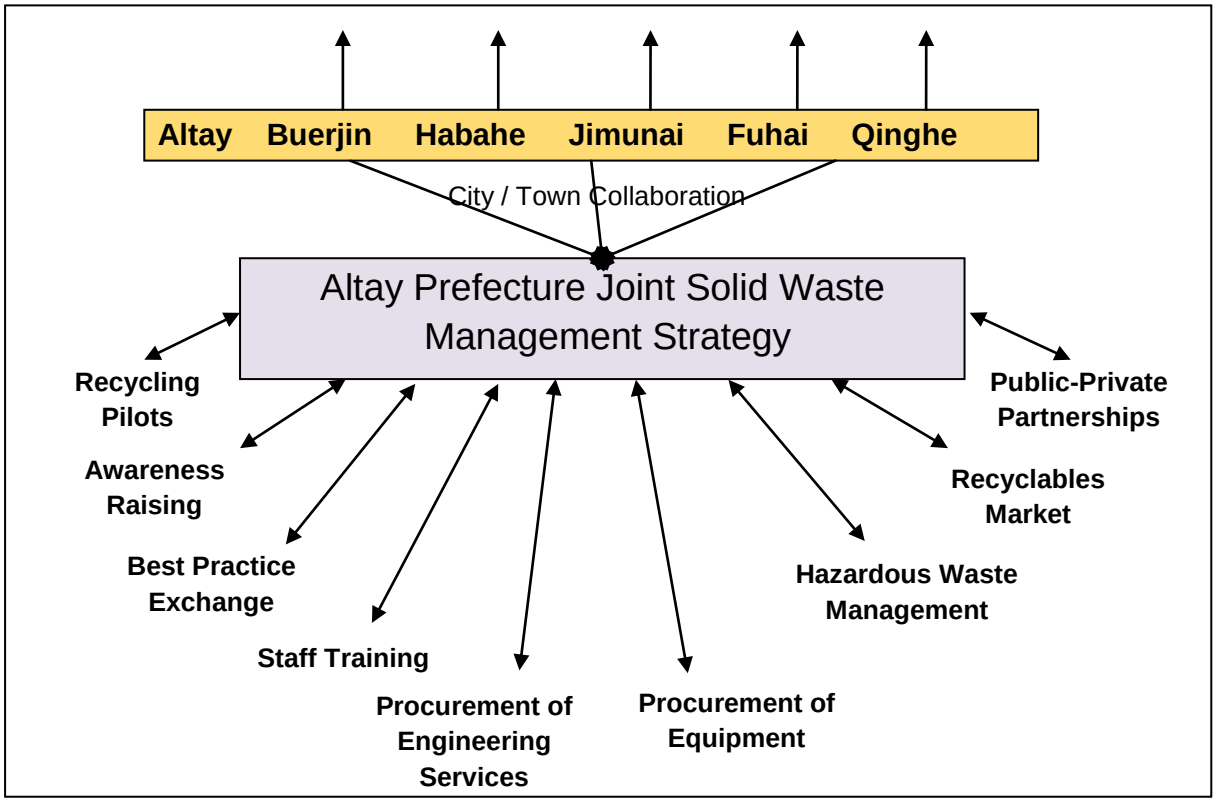
106. Whilst clinical wastes are required by State Regulation [2003]-380 to be disposed of by incineration or controlled burial, this clearly does not always occur and evidence exists of dumped syringes, tubing and bottles. Because of the geographic distances from medical centres to incinerators it may not be conducive to abide by the letter of the law and hence both fly and landfill tipping of medical wastes occurs. A severe tightening of regulatory control is thus urgently required and the necessary institutional strengthening and strict imposition of appropriate penalties should be implemented.

107. As a means of addressing this and other related problems, it is recommended that it would be beneficial for the establishment of a sub-regional joint association of solid waste management (JWMS), in much the same way as has been recommended for water users association. Such an association might be structured as shown in the illustrative diagram, Figure 2, where clinical waste is collected and transported on a collective basis thus reducing transport costs and also providing a regular and accessible outlet for clinical wastes. It will have many other benefits as listed on the diagram and, particularly initially, for recyclable solid waste disposal it will provide the benefits of scale of operation and marketing power.

108. The JWMS would be a joint approach to collection of recyclables and any future procurement of waste treatment services for the towns of Buerjin, Habahe, Jimunai, Fuhai and Qinghe. A joint working approach will offer support, shared learning and importantly economies of scale for the improvement of recycling markets. Concurrently, improved landfill management practices will reduce the risk of negative impacts on the environment and human health from waste disposal.

109. One item which is very successfully recycled is the standard 520ml beer bottle. It will attract RMB 0.05 for the collector and a similar amount for the recycling wholesaler. Assistance for the recycling market of other materials may be provided through the JWMS.

Figure 2. Schematic of Joint Solid Waste Management Association



IX COMMUNITY AWARENESS AND TRAINING

9.1 Objectives

110. The objectives of the community awareness and training are to:

(i) highlight the limitations of water resources and the need to conserve these resources through careful abstraction and control of use;

(ii) improve the general understanding of the minimization of waste and foster the concepts of waste reuse and recycling;

(iii) advertise and promote the options and benefits for using renewable energy where-ever possible; and

(iv) provide examples of the application of 3R principles in everyday life to demonstrate the financial savings and benefits that can be achieved.

9.2 Requirements for Community Awareness

111. Water is still commonly perceived as a public good to which everyone should have a right of access. Therefore economic approaches to water (whether it is in the form of pricing for the sustainability of the service or of strong private sector involvement) continue to be controversial. For those having a mains water supply in the towns, the quantitative availability of water has never been an issue. Disposal of wastewater to the sewerage system, where there is coverage, is taken for granted. The tariff charge of CNY 0.6/m^3 is low by most standards and there is little incentive to restrict water demand. For those not on mains water supply, or served

by a sewerage system, life is more difficult: ground water needs to be manually pumped and wastewater disposal has its problems, particularly in winter when the ground is frozen. However the coverage of piped water supplies is generally good, ranging from about 80 to 90 % in the towns and hence the majority of inhabitants do not experience restrictions on water use.

112. The adage ‘out of sight, out of mind’ applies particularly to the water cycle and the general public is often unaware of the impact of water abstraction on natural water bodies or of the cost and difficulties faced in treating and disposing safely of wastewaters. Particularly where either crude sewage or wastewater effluents need to be pumped there are continuous and unavoidable operational and maintenance costs. These issues now need to be brought to the attention of the population, presented in clear, simple, ways that impact on the public conscience and lead to a fuller understanding of the need for water conservation.

113. The response by the public for the need to conserve water use will be reinforced if it is clearly seen that the water supply company (whether public or private sector) is also taking steps to reduce both its production and operational water losses. Indeed the first water-saving activities should be by the water company, providing a lead which the public may then support. Only when the public sees an effort being made by the water company will they respond and have greater understanding and acceptance of the need to increase water and wastewater tariffs, whether this be for a standard amount or an incremental block tariff.

114. Solid waste management has not, in the past, been seen as any more than a requirement to remove rubbish from the urban scene and dispose of it in some less obvious location. An economic refinement to this concept has been the opportunistic recovery of some materials for which a market has developed and, hence, some income can be derived. This has changed significantly in recent times with the understanding of the need to protect the environmental and of the impact that the degradation of the waste has on air, soil and ground waters. The attempts to provide this protection have resulted in much higher costs for disposal and economic limitations to the volumes of waste that can be accommodated in new engineered sanitary landfills.

115. Solid waste can be classified into three groups of materials: biodegradable organics, oxidizable compounds and non-biodegradable materials which will persist indefinitely for all practical purposes. This last group will comprise inert rubbles as well as manufactured products such as glass, many plastics and ceramics. With the inexorable depletion of limited natural raw materials, the law of supply and demand ensures that the cost of these materials will increase significantly with the passing of time, as is now occurring with many minerals. Therefore the economic driver for reusing and recycling ‘waste’ material is both from the supply side and disposal cost. Many of the materials in the three groups of waste can be reused or recycled, thus reducing the quantities of waste for containment in landfills and providing an alternative source of materials for new manufactured products.

116. The private sector has recognized this opportunity and an informal operation now exists whereby a whole range of materials are recovered from rejected waste material and are sold back into the manufacturing stream. However, there is still much that is needed to be done to achieve necessary improvements to biodegradability, waste separation and recycling in order to reduce required landfill volumes and reduce the demand for the depleting raw material resources. Non-biodegradable plastic bags are a major hindrance to the decomposition of organics. Inert materials, such as stone and building rubble, can occupy unnecessarily large

volumes of landfill space, and other materials have recyclable value provided this is economically recoverable by restricting contamination. It follows that separation of waste materials at source provides the best opportunity, both practically and economically, for recycling and the maximization of value of the asset.

117. Whilst the public may understand the value of, for example, saving a drinks bottle which can be reused after processing, there is much more that can be gained by raising community awareness to reuse and recycling. This awareness will be reinforced by the changed operational capacity provided by the Project of the solid waste management organization. The Project will facilitate the new approach to waste minimization but the opportunities and benefits of waste minimization must be clearly emphasized to the public.

118. Many of the domestic residences are served by a centralized heating supply. The supply commences mid October and ends late March or early April. The tariff charged for this heat is mostly on a square metre floor area basis although heat metering is gradually being introduced. The ability to regulate the heat available to each property is very limited at present and, with the present tariff structure, there is little incentive to do so. However, in order to prepare for the future it will be beneficial to make the public aware of simple approaches that can be made to saving heat and so reduce the demand on production, and hence the production cost, and the heating charges that are imposed on the household. Similarly, the recognition of simple measures to reduce electricity demand will benefit not only the power generation industry but also the tariff charge of energy to the home.

9.3 Achieving Public Awareness and Response

119. Getting the message across in a clear and understandable manner that leads to monitorable results will not be an easy task. It will require a diversity of approach and may be considered under the headings of (i) community awareness and (ii) training. The former will raise the issues and expound the benefits whilst the latter will provide the methodology and practical assistance to achieving tangible results. Training will also be given to the responsible departments to assist them to deliver the services in an effective and sustainable manner. The proposed detailed implementation plan is given in Section X hereunder but will be subject to updating and revision as a result of experience gained during the awareness process and in response to the development of detailed designs and project implementation.

X PROPOSED COMPONENTS UNDER THE PROJECT DEMONSTRATION PLAN

120. Proposed interventions to support the 3R principles and those for renewable energy under the Project fall into three stages: implementation during the loan phase; follow-up actions to ensure sustainability; and future additions which may compliment the initial initiatives. Reference should be made to the parallel report ‘Pilot Plan for 3R and Renewable Energy in Small Towns in Asia’, ADB August 2010, which offers recommendations for a range of interventions to support the principles of 3R and green energy development in smaller urban settings.

10.1 Physical Components

A. Renewable Energy

121. Limitation of funding at this stage has restricted the available options for introducing renewable energy facilities into the Project. Large capital sums are required to establish reliable renewable energy sources that are independent of conventional power supplies and these are outside the scope of the agreed budget and loan capacity for the Project. However, it has been agreed that water heating for domestic type use at the landfill sites at Buerjin, Habahe and Jimunai will be provided by solar tube units which involve only small capital expenditure. Similarly the lighting of access roads will be powered by PV panels. These sites are remote from urban development and, whilst there is not yet the confidence to obviate the grid electricity supply, they may be seen as particularly suitable for the use of renewable energy in the same way as China Mobile have invested in renewable energy sourcing for their remote communications relay stations. The provision of PV solar panels for building lighting and small power at all utility sites (WTWs, WWTPs and landfill sites) should be considered for the next stage of development.

122. The solar tube water heaters will be of sufficient size to provide an adequate quantity of hot water for personal hygiene use. The unit(s) will be mounted on the roof of the amenity building and will be permanently plumbed in. The access road lighting units will provide sufficient light for general mobility and safety onto the landfill sites. The full specification for these components will be prepared during the detailed design phase by the D. I. and incorporated into a suitable national shopping procurement package.

B. Solid Waste Management

123. The provision of a suitable container to households in all five project towns for use in temporary storage of recyclable materials will demonstrate commitment on the part of the waste management companies and provide encouragement to the population to participate in recycling activities. The containers will be introduced, initially, at the planned public training sessions and will be more widely distributed as the scheme develops. In order to maintain this initial separation of recyclable materials, two containers will be required at each of the community centres (transfer stations) where solid waste is currently brought for onward transport by lorry. Where solid waste is collected directly by a lorry travelling to pre-determined points at an appointed times, then that lorry will either be required to have two separate compartments or have to make two trips. The alternative will be for the lorry to collect waste for landfill as at present and another, possible smaller, vehicle will shadow it to collect recyclables. This secondary vehicle could ideally be a private sector initiative – under an annual tendered contract with the waste management department of the urban Authority.

124. The provision of suitable equipment to enable workers at the transfer stations and (as a last resort) at the landfill site to remove plastic bags from the landfill waste and to contain them will reduce the problems of biodegradability in landfill and will also protect the surrounding environment from pollution by wind-blown bags. Discussions have prompted the recommendation to include a voucher incentive scheme to reinforce the effectiveness of plastic bag removal: landfill site operatives qualifying for vouchers corresponding to volume of plastic bags recovered from landfill waste. The vouchers would be redeemed against their own domestic charge for solid waste management. This scheme will be developed through discussions with the relevant authorities during the detailed design phase and will be implemented on a trial basis.

10.2 Public Awareness Campaign

A. Community Awareness Publicity

3R Principles

125. The principles to be promoted through the 3Rs publicity are: Reduce (consumption), Reuse (use repeatedly, sometimes after repair), and Recycle (cyclic utilization but not necessarily in the same form). These will apply to everyday life, both within the home and externally to it. In support of the project components and related issues, these principles will be developed under the sectors of water cycle, solid waste management and heating and electricity.

126. Publicity will use the mediums of print (poster / leaflet / press), vision (TV) and sound (Radio) or a combination of all three (theatre / presentation / reporting). Publicity will seek to reach every person in the town community and express the concepts of the 3Rs. Provided the concepts are offered in a light-hearted and readily understandable way, then school children will adopt them and disseminate them through their families. The classroom is thus seen as a primary location for publicizing the 3R principles.

127. Each town comprises a number of community areas, each with a focal administrative office centre. Here, meetings and activities take place, the very poor are recognized and assisted and matters of communal interest are discussed and actions organized. These community centres will be from where printed material is distributed and where focus and stakeholder meetings and training sessions will take place. As mentioned above, the classroom will also be a focal point for awareness and training. Hospitals and clinics are also suitable venues for accessing publicity material.

128. Local newspapers, radio and television will be used to develop community awareness into the need for reduced consumption, the reuse through repair or on-lending, and recycling by material separation at the earliest opportunity. Newspapers will include advertisements and also reports on community activities involving the local application of the 3Rs.

129. Towns include large community areas, or town squares, where performances are provided during summer weekends. This will provide further opportunity to engage the public in the 3R concepts by the inclusion of simple street theatre. It will be necessary to research the future program for such events and arrange for appropriate ‘slots’ to be included for 3R productions.

130. The publicity campaign will therefore comprise a number of steps:

- design of posters / leaflets providing simple but powerful messages; (it is recommended that each sector is treated separately);
- ascertain program dates for open theatre productions at the towns;
- obtain information from local press on the cost and conditions for publishing advertisements and for willingness to report on publicity events promoting the 3Rs;
- similarly discuss with local radio and television the options for publicity through their medium and formulate a program for so doing;
- visit schools and obtain their support for the campaign; possibly arrange a school quiz related to 3R and renewable energy issues with suitable prize to encourage

knowledge and understanding; (this will be reinforced during the training phase);

- discuss with community centres the most appropriate means (venue, timings, dates etc.) of holding public meetings;
- decide on number of posters and leaflets to be printed and order their production and distribution;
- design advertisements to be printed in the local press and agree dates for their appearance;
- agree announcements on the local radio and/or television and the timing of these; (perhaps to coincide with other activities);
- prepare a program of school visits and implement;
- design and produce street theatre productions;
- purchase appropriate containers for recyclables from the household and including a sticker clearly listing items to be included therein;
- hold public meetings, possibly in community centres, to obtain feedback from the publicity campaign;
- re-structure or re-design future publicity accordingly.

B. Training

131. The next stage of the technical assistance will comprise the training. This will seek to provide practical examples and means of achieving the goals set out in the publicity campaign. It is here that the proposal for issuing plastic containers for recyclable solid waste will play a dramatic part – a tangible asset will be given for people to utilise in support of the 3R principles. Provided its use is carefully explained and that, certainly initially, the recyclable waste is kept simple, without complications on sub-divisions of material type, so that the choice of whether a material should go in the container or be rejected to general waste is quickly understood, then there should be a high level of success. Some abuse of these containers is inevitable but the objective will be to show them as a must-have accessory in the home.

132. Training for the public will be carried out in each county seat town at a minimum of six community centres, three schools and one convenient public centre where the concepts of 3R can be practically demonstrated. The attendees at each community centre will include the community leaders and a minimum of 20 residents making a group total of about 30 persons. Within the schools a mixed age group of about 50 children will be invited by the school staff to attend the training session. The public centre training will be pre-advertised and will be open on two separate occasions to all members of the public who wish to attend. It is therefore expected that a minimum of 300 – 400 persons in each town will have attended a training session and that the target gender split will be 50:50 male to female. The ethnicity of attendees at the training sessions will not be dictated but every attempt will be made to invite representatives of small ethnic minorities to the community centre meetings.

133. The training session, which will commence with the recording of information on each trainee, is expected to last for a minimum of 3 hours. It will conclude with each participant completing a feed-back questionnaire. An example of such a questionnaire is given in **Appendix 10**. Each training session will comprise (i) periods of explanation to ensure that 3R principles in each sector are understood and that there is a need for conserving resources; (ii) a series of illustrative demonstrations of the potential impact of applying 3R principles; (iii) open discussion periods with concerns and ideas being shared; (iv) period during which the financial and global implications of 3R are examined; and (v) a closing review session to include the identification of suitable 3R performance monitoring indicators and completion of participant questionnaire feedback. The components of the training session are summarized in Table 9.

Table 9: Components of Training

	Topic / Activity	Time (minutes)
	Record of Attendees	
1	Introduction	5
2	Water Conservation and the Costs associated with excessive use	15
2	Approaches to Minimizing water demand (with demonstrations)	20
3	Public Sector Demand Management Techniques	15
4	Creation of Water Users Association	
5	Question and Answer / discussion	15
6	Break	10
7	Solid Waste Management – over-view	10
8	Regulatory controls	5
9	Principles of Recycling Domestic Wastes (with demonstrations)	15
10	Recycling container for the home	5
11	Deposits on reusable products	10
12	Creation of Joint Solid Waste Management Organisation	10
13	Question and Answer / discussion	15
14	Break	
15	Use of electrical energy	5
16	Introducing the Potential for Renewable Energy	15
17	Closing Review and identification of monitoring indicators	15
18	Questionnaire	15

134. Examples of practical demonstrations with strong visual impacts which may be offered are: (i) water run to waste during teeth cleaning or vegetable washing activities – a clear container with perhaps dyed water and a rubber outlet pipe with tap or bung can be used to demonstrate the volume of water run in either the period of the teeth cleaning or per minute during vegetable washing – both activities being performed on stage to strengthen the visual impact of the message; (ii) sorting domestic solid waste – 5 or 10kg bucket full of mixed typical domestic waste can be emptied onto a table (with plastic sheet cover) and sorted into categories with each category then being weighed. An immediate concept of weight and volume of waste is thereby provided and the potential benefits of separation and recycling can be explained (iii) the use of a compact fluorescent light bulb – the bulb can be switched on adjacent to an incandescent bulb to show the comparative light output and a stack of blocks placed by each to show the energy used per hour, and cost, for each respective type of bulb. Such visual images will have a lasting memory impact and can be supported by explanation and printed facts and figures where necessary.

135. The financial impacts of the water usages / wastages can then be explained, citing the cost of treatment and distribution of water supply and, similarly, for wastewater with the added complication of final disposal, particularly during winter when the ground is frozen. The quantity of wastewater that requires storage during the entire frozen winter period can be illustrated by polystyrene blocks against some recognizable object at the same scale.

136. Explaining the concept of solid waste separation has been referred to above. However, it will be necessary to start separation in as simple a manner as possible because, if there is lack of clarity, then incorrect selections will be made. This is the existing problem with street bins where materials are added in a fairly random manner because there is a perceived lack of definition of types of waste. To be successful, separation needs to be progressively applied.

137. The impact on the planet and environment of electricity and heating production will be explained in terms of carbon production and the possible effects on the phenomenon of global warming. In parallel with the application of 3R principles in the home it will be important to stress the measures being undertaken within the public sector through the Project. Included in this will be an examination of the project performance monitoring system whereby indicators will have been identified through which the effectiveness of the project components may be measured. This will provide confidence to the public that they are participating in a concerted effort to reduce, reuse and recycle and to achieve measurable reductions in reliance on fossil fuel energy.

10.3 Institutional Strengthening

A. Regulatory

138. There are a number of weaknesses in the present regulatory system and there is an urgent need for improvement. In addition, where regulatory control is absent, but is required, then such necessary local laws should be provided. The major concerns centre around solid waste management. There is a need to provide training to the relevant department which will be provided under the Project and will include the following issues:

(i) Clinical Waste.

139. The responsibility for clinical and hazardous waste collection and disposal rests with the prefecture level government. However, local policing of disposal of such waste rests with the county authority and this responsibility is in need of strengthening. The training will comprise the preparation and issue of an operational manual for solid waste management which will incorporate a section on clinical waste. All hospitals, clinics and other establishments where hazardous waste is generated will be recorded on a register and consignments of waste will be recorded. In the event that hazardous waste is illegally dumped then a procedure will be established for determining the source and the imposition of appropriate sanctions.

(ii) Building Materials and Rubble

140. The State regulation governing the disposal of waste building materials will also be the subject of similar controls. This will be considerably easier to monitor once the new landfill is completed and operational since the site will be fenced and entry will be regulated, with all incoming deliveries weighed and recorded. Again, if fly tipping is found then a procedure will be

applied for determination of the origin of the material and the imposition of appropriate sanctions.

(iii) Batteries and Other Hazardous Substances

141. Whilst the recycling of commercial-scale batteries (from goods vehicles and cars) is already established, small scale battery disposal is not effectively carried out and expired batteries are generally discarded along with general household refuse. There is a need for local regulations to outlaw this practice but it must be backed by the provision of community awareness that batteries must be added to recyclable waste. The same provision goes for CDs and small electronic goods.

(iv) Plastic Bags

142. The State regulation on the availability and use of plastic bags must be enforced locally and can be strengthened over time by (i) banning the free issue of all plastic bags and (ii) ensuring that all plastic bags available are fully biodegradable. Meanwhile plastic bags should be removed from landfill disposal and an incentive scheme for the official landfill operatives to carry out this function should be introduced. This scheme was applied some years ago and was very successful – so much so that the local authority was unable to meet the financial commitment. Therefore the scheme must be restricted to official landfill operatives and a cap placed on the value of the vouchers that can be earned in any time period.

B. Operational

143. Training will involve two operations: demand management in water supply and strategic operations in solid waste management. For water supply, this training will focus on the components, structure and implementation of demand management techniques, as outlined in **Appendix 6.** It will include the use of leakage detection equipment within active leakage control and procedures for supply zoning and flow measurement and the introduction of incremental block tariffs. There is an inherent need for the inclusion of sufficient metering and valving under the Project and this will be defined during the detailed design phase when supply districts are identified and metering can be specified introduced accordingly. A contract package for the supply of valves and meters should be included in the Project implementation plan. For solid waste management the training will include procedures for remedial engineering of the current landfill area, solid waste collection, engineering and operation of the new landfill, monitoring and emergency procedures, recycling of materials and possible future composting. The suggested outlines of such operational approaches are included in **Appendix 11**.

XI COSTS AND FINANCING PLAN

144. There are reports that the State government provides a subsidy to ground heat pumping installations. Whilst initially this was understood to cover all projects, in practice there are strict limitations. The subsidy of RMB 50 per $1m^2$ of floor area heated by this means is available only if (i) the proposed scheme has full approval of government before construction is commenced and (ii) the minimum floor area to be heated is $200,000m^2$.

145. The costs herein are based on market prices obtained during August 2010 and as relevant to Altay Prefecture. The cost of community awareness and training is derived from

itemized costs given in **Appendix 12**. A contingency of about 10% has been allocated to the cost of each intervention.

Table 10: Package 1 – Physical Interventions

Activity		CNY	US$
1	Solar Tube Water Heaters – 3 sets/towns	37,500	5,555
2	Equipment for Transfer Station and Landfill Pickers	6,750	1,000
3	Recyclable Waste containers – 10,000	[80,000]	Included in training budget – item 5
4	Contingency	4,500	545
	Totals	48,700	7,100

Table 11: Package 2 – Community Awareness and Training

Activity		CNY	US$
1	Support Staff Remuneration / Per diem	12,300	870
2	Travelling Expenses	29,700	4,400
3	Workshop Expenses Room Hire	24,000	1,630
4	Materials – incl. waste bins	132,500	19,600
5	Publicity and communication Expenses	17,500	2440
6	Contingency	27,000	4000
	Totals	243000	36,000

XII PROJECT COMPONENT IMPLEMENTATION

12.1 Components

146. The physical interventions and their benefits to be provided under the Project are itemized in Table 12 and the institutional / managerial strengthening components to be included are listed in Table 13.

Table 12: Physical 3R and Renewable Energy Interventions to be Implemented under Project

	Intervention	Potential Benefits
1	Solar water heating at WTW;	Reduction in reliance on grid electricity usage;
2	Solar water heating at WWTP	Reduction in reliance on grid electricity usage;
3	Solar water heating at SW Landfill	Reduction in reliance on grid electricity usage;
4	Reuse of treated wastewater for irrigation of plantations	Reduction in standard of treatment of effluents with corresponding savings in cost; Availability of water for irrigation purposes; Growth of trees providing carbon capture.
5	Reuse of wastewater sludges as soil enhancers	Fertilizer to improve soil and enhance growth of trees; Growth of trees providing carbon capture.
6	Separation of recyclable solid wastes at source	Maximize potential for recycling; Reduction in demand for landfill volume; Reduction in transport and landfill costs; Saving in materials needed to replace reusable articles.
7	Introduction of transfer stations in community areas where separation of wastes can be controlled	Facilitates reuse and recycling of materials; Facilitates removal of plastic bags.

8	Provision of equipment for cleaners / pickers	Facilitates removal of plastic bags.
9	Engineered Landfill Operation to i) weigh and record incoming waste; ii) contain in engineered landfill the waste materials, with building rubble being separately dumped; iii) provide separate temporary storage for hazardous and toxic wastes; and iv) deal with closure of existing landfill	Supports regulation of waste materials handling and dumping; Protection of environment including sub-surface waters; Facilitates waste management operations, cost recovery and records;

Source: PPTA Consultants. August 2010.

Table 13: Institutional / Managerial Strengthening

	Intervention	Potential Benefits
1	Application of water demand management techniques	Reduction in water production; Reduction in leakage from supply and distribution networks; Improved management of WTW and supply and distribution networks; Facilitates linkage of tariff structure to production costs and sustainability of operation.
2	Application of regulations governing handling and disposal of various specified wastes	Environmental protection; Cost recovery; Management and operation of landfill with improved biodegradability; Reduced volume use of engineered landfill;
3	Review of tariff structures	Supports sustainability of service; Protection of poor; Reduction in consumer demand.

Source: PPTA Consultants. August 2010.

147. The provision of solar tube water heaters at new buildings to be constructed under the Project will be included in the detailed final design of the component. The heaters are standard, off the shelf, products and will be mounted on the roof of the administration block at the landfill sites at Buerjin, Habahe and Jimunai. The units suggested are 20 tube / 150 litre capacity are will be plumbed into the hot water system of the buildings as part of the plumbing sub-contract(s). The total cost of approximately $1,200 per town is very modest, particularly in the context of the whole project works and should not pose any problem of affordability. There is no training required for operation and maintenance since this product is well know and universally used across Xinjiang.

148. The lighting of the access roads at landfill sites at Buerjin, Habahe and Jimunai by PV panels will be specified under the detailed design phase. The capital cost should not exceed CNY 2000 per unit, excluding column and erection.

149. The provision of equipment for pickers at the transfer stations and landfill sites will facilitate the retrieval of plastic bags. The capital cost is small at US$ 200 per town. However, of greater impact will be the long-term commitment to provide incentive payments from the municipal solid waste operating budget to landfill operational staff for collecting plastic bags.

150. The community public awareness and training component is funded through the Support TA 7450 and will not impact on the main Project costs or budget. However the institutional elements of enforcement of State regulations pertaining to toxic materials and clinical waste, building materials, and plastic bags will impact on departmental staff budgets and due allowance should be made annually for the necessary staff costs. The community awareness

and 3R training component will be implemented during the detailed design phase of the Project and will require inputs from the design institutes and, once appointed, also from the project management consultants, particularly regarding the institutional strengthening aspects of: (i) potable water demand management strategy and implementation schedule; (ii) establishment of a Water Users Association across the Prefecture; (iii) infiltration survey on sewerage network; (iv) solid waste operational guideline manual; and (v) establishment of a Joint Solid Waste Management Association between County towns in Altay Prefecture.

12.2 Implementation Schedule

151. Physical components will be implemented in accordance with the construction schedule defined under the Project. Equipment for cleaners and landfill operatives may be purchased at the earliest opportunity to enable the removal of plastic bags from the present landfill. The associated incentive scheme should also be implemented at the same time.

152. The community awareness and training will be carried out over three periods:

- Buerjin 1/11/2010 – 10/11/2010 total 8 days
- All 5 towns 28/02/2011 – 02/04/2011 total 34 days
- All 5 towns 01/07/2011 – 03/08/2011 total 34 days

153. The initial visit to Buerjin will be used to introduce and test the awareness campaign and training procedures, their effectiveness and to obtain feedback. Some adjustments to content and delivery may then be designed into the procedures for subsequent visits.

12.3 Terms of Reference (TOR) for Project Management Consultants

154. The project management consultants, who will be appointed to assist with the implementation of the Project, will be required to provide specific assistance relating to the issues of introducing renewable energy and 3R principles. These are primarily concerned with operational procedures required for water supply, wastewater management and solid waste management and thus come within the umbrella of institutional strengthening. The specific outline terms of reference are given in **Appendix 13** and should be incorporated into the overall TOR for the consultants.

12.4 Gender Issues

155. Traditionally women are most aware of water service delivery and quality since it is they who are responsible for food preparation. It is also they who provide the most child care and have to respond to child illnesses, some of which will be water-related. The reliable provision of high quality potable water will thus be first recognised by women. It follows that women will exert most control over water use, and misuse, and should therefore be the primary target for awareness and training on issues of 3R. With the increasing use of IC card water meters there will be greater ability to monitor and control the consumption of water. This issue will impact largely on women but also on children who must also be a focus of awareness training to cause behavioural change.

156. Reducing water demand will also impact on wastewater generation and the cost of its treatment. During the social survey complaints were received from women on the surface ponding of sewage and the proposed project works should obviate this problem. The infiltration survey will also highlight problems existing within the sewerage system so that remedial action can be taken.

157. Solid waste generated in the home will arise from food preparation and general living activities. Therefore each family member will create waste but the most will arise from the kitchen, followed by ash production from coal burning where district heating is not provided. With a two bucket system for domestic solid waste, the recyclable items are just as likely to be generated by the men and children as the housewife. Maintaining separate recyclable materials will therefore be a family responsibility.

158. Solid waste collection and street sweeping duties are shared by men and women in the proportion 30:70 respectively although there is no active bias to employment, rather a low wage which tends not to be acceptable to men. Providing incentive payments (credit vouchers) to pickers to remove plastic bags at the community waste stations and at the landfill will assist the poor by increasing their income since it is these poor that mostly work as cleaners / sweepers and pickers.

159. At one recycling centre, the manager was a woman and it was noted that at other depots, employment of the sexes appeared roughly equal. The improvement of waste separation at source will assist the cleaners and sweepers and also the downstream recycling enterprises.

XIII PROJECT COMPONENT RISKS AND ASSURANCES

13.1 Risks

(i) That solar water heaters at municipal service buildings are incorrectly sized for the intended use and are not maintained, especially in very cold weather.

(ii) That intended funding for physical components under 3R and renewable energy are not forthcoming during the development of the Project.

(iii) That the provision of containers for recyclable materials is abused and that they are not used as intended: possibly even sold on.

(iv) That the training campaign fails to get its intended message across to the population and that the recycling scheme is therefore not understood.

(v) That the collection of recyclable materials is not undertaken expeditiously and people are left with accumulated materials or that separated materials are subsequently re-mixed with other waste materials.

(vi) That the market for recyclable materials changes and loses any incentive for separation and recycling.

13.2 Assurances

(i) Altay Municipal Government (APG) commits to ensuring sufficient funds are earmarked and applied for the renewable energy elements of the Project.

(ii) APG provides assurances that institutional change recommended for the support of 3R initiatives will be implemented during the Project.

(iii) ADB commits to funding the provision of community awareness and training relating to 3R issues under the Project.

(iv) APG shall ensure that the water and solid waste subproject IAs review the impact of increased tariffs on the poor and maintains the provision of tariff waiver to protect the basic living standard of the poor.

(v) To mainstreaming gender aspect during Project implementation, the PMO will take necessary measures to (a) encourage women to participate in Project implementation activities; (b) monitor effects on women during Project implementation through the monitoring and evaluation system, in consultation with local governments and local women's federations; and (c) conduct a gender awareness program on water, sanitation and solid waste management for key stakeholders, particularly staff at the PMO and implementing agencies.

(vi) APG will ensure that public awareness and education programs about the Project, its benefits and on changing attitudes and behavior of the consumers on clean water saving, managing wastewater disposal and recycling solid wastes will be conducted in all subproject areas.

XIV CONCLUDING REMARKS

14.1 General

160. The study of options for introducing or strengthening 3R principles and for applying renewable energy sourcing where appropriate has highlighted areas of the Project where minor re-focussing of both capital investment and institutional change can bring significant improvements and advantages to the municipal service delivery. The principles reviewed in this report can be applied to many urban situations, the limiting factors being the availability of wind and solar power and the willingness of the public administration and the urban citizens to adopt a 'greener' lifestyle.

14.2 3R Principles

161. By applying the principles of water conservation to domestic household practice across the five project towns it is predicted that a saving of between 200~225,000 m^3 / year will be achieved and, by reducing unaccounted-for water by 5%, would add a further water saving of about 20~22 million m^3 / year. Whilst this quantity is freely available at source, there is an associated treatment cost when raw water turbidity is high. More importantly, there is the capacity cost for conveyance and treatment of wastewaters.

162. For a given light output, Compact Fluorescent Lamps use 20 to 33 percent of the power of equivalent incandescent lamps. It is clear that they should be in use wherever possible.

163. Recycling waste materials will provide a number of advantages, including (i) increased employment opportunities for the poor; (ii) encouragement for the entrepreneurial business sector; (iii) reduction in loss of materials and need for generation of replacements; and (iv) reduction in capacity need at engineered landfill. If, as has been suggested, 20~25% of solid waste is recyclable then between 13,000 and 17,000 tonnes of material per annum is saved from landfill with the corresponding reduction in volume required. This tonnage and

corresponding saving in volume of landfill may be considerably increased once organic material is separated at source and windrow composting is implemented.

14.3 Renewable Energy

164. The experience of existing renewable energy installations in Altay is good. PV panels are used extensively by China Mobile who use them to power their transmission relay stations throughout the year without problem and wind farm turbines are reported by their operators to be unaffected by cold, ice and snowy conditions. The existing ground heat sources are located below the penetration of frost (about 1.8 metres) and the residual water temperature throughout the year is sufficient to provide the necessary heat resource. Whilst winter conditions in Altay are admittedly harsh, the renewable energy options are sufficiently resilient to enable a positive return on capital and operating expenditure.

165. The comparative cost benefit of using solar water heating as against that of electrical heating has been covered in Table 11 and demonstrates that capital cost recovery is achieved within a year or two of operation. The estimated cost of treating wastewater for a typical county town (e.g. Buerjin) by utilising grid electricity is about US$ 0.25 million per annum whilst the use of wind energy will cost only that for maintenance plus the amortised capital cost[8]. It is likely that the break even points will occur in less than 5 years but this does depend upon meteorological variations. The potential is for saving an average 2660 tonnes of carbon dioxide per town per annum annum. Ground heat source pumping will provide a return of between 4kW and 5kW of heat or 3kW to 4kW of cooling for every 1kW of pumping energy used. The cost recovery periods are short, being three or four years.

Table 14: Cost-effectiveness of Installing and using different Solar Water Heaters

	purchasing cost (mid-range) (CNY)	Energy use cost for 30 minutes daily (CNY)	Energy use cost for 200 days annually (CNY)	Life of use (Year)	Convenience of use	Total costs for use of 10 years (CNY)
Gas water heater	800	1.80	360	3-5	Available for use at any time	5,200
electric water heater	1,500	1.44	288	5-8	having to be pre-heated	5,800
solar water heater	1,800	0	0	>15	available for use at any time through battery	1,800

Source: ADB Mission estimates

[8] 400 kW at CNY0.54/kW.hr multiplied by 8760 hrs/yr

APPENDIX 1

DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets and/or Indicators	Data Sources and/or Reporting Mechanisms	Assumptions and Risks
Impact Enhance the environmental sustainability in western area of the PRC, especially in Altay Prefecture, XUAR	Reduced raw water abstraction per capita, increased use of wastewater for irrigation and significant improvement in separation, reuse and recycling of solid wastes.	Provincial and national assessments and statistics	Assumption Government-conducive development and ecological policies
Outcome Improved water conservation and wastewater management strategy plan and higher awareness of environmental management in Altay	Cost-effective and technology-innovative systems for water conservation, wastewater reuse, and solid waste management	Project final report Demonstration report	Participation and strong support of prefecture and XUAR governments
Outputs Output 1: A demonstration plan of a resource-efficient town for 3R application to be incorporated in RRP	An innovative technology implementation, a set of integrated solutions and a road map for management of water, wastewater, energy and solid waste management.	PPTA reports Review mission Workshops and symposium proceedings	Participation and strong support of local and provincial governments
Output 2: A pilot project action plan for implementing a pilot 3R project in Altay.	A comprehensive recommendation on how to set up a pilot project in Altay's institutional context and how to replicate it elsewhere in the PRC.		
Output 3: public awareness education and public participation plan, highlighting children, ethnic minority and women.	A plan that at least 200 local officials and trainees (including ethnic minority and women) are educated in each county. At least two public consultation and participation meetings are held in each county. (disaggregated by ethnicity and sex)		
Output 4: study of water meter usage and associated tariff recovery.	An analysis of usage of prepaid IC card water meters and lessons learnt.		
Activities Component 1: a demonstration plan of RET town • Review applicable 3R technologies including		Inputs ($'000): $250.0 ADB financing (Total) 200.0	

wastewater reuse, water conservation, energy efficiency, renewable energy (solar and wind), and solid waste management. (by 1th week) • Field survey and collect background data in counties (by 3th week) • Develop the draft report (the 8th week)	Personnel 130.0 Travel 14.0 Reports and communications 10.0 Training, conference, and workshops 30.0 Translation, dissemination, administration, and others 16.0 Government financing (Total) 50.0 Office accommodation and transport 15.0 Training, conference and workshops 10.0 Remuneration and per diem of counterpart staff 15.0 Reports and publication costs 3.0 Office equipment and software 2.0 Contingency and others 5.0
Component 2: A pilot project action plan • Field survey and collect background data in counties (by 3th week), evaluate the possibility of 3R pilot application, such as setting up a community centre for material separation, secondary use, treatment and recycling of municipal solid wastes, or renewable energy application of solar or wind. • Develop the draft pilot action plan including financing plan for a potential future fund application (the 8th week) Component 3: public awareness education and campaign • Develop a training program and a public campaign program on promoting 3R. (by 10th week) Component 4: water meter usage • Field survey and background information collection (by 3th week) • Report (by 6th week)	

APPENDIX 2

LIST OF PERSONS MET

by ADB under TA 7450 – Xinjiang Altay 3R RET

Name	Organization/ Agency	Title
	XUAR Government	
Li Xiangqun	Urban-Rural Housing Development Bureau	PMO Director
Zu Zian	Design and Reform Commission (DRC)	Deputy Director
Xia Shuhui	Finance Bureau (FB)	Deputy Director
Ding Xuefeng	Urumqi Construction Commission	Chief Engineer
	Altay Prefecture Government	
Sheng Wei	DRC	Deputy Director
Xu Jingfeng	DRC	Deputy Director
Zhou Hui	DRC	Section Leader
Yu Caiyun	FB	Deputy Director
Cheng Ziyan	Environmental Protection Bureau	Deputy Director
Sun Wenbing	Construction Bureau	Staff
	PPTA Consultants	
Peter Shek	AECOM Asia	Team Leader
Tang Ying	AECOM Asia	Water Specialist
Li Shuliang	AECOM Asia	Solid Waste Specialist
Li Anming	AECOM Asia	Heating Supply Specialist
	Buerjin County	
Yu Guangpu	Construction Bureau	Director
Liu Shihong	Construction Bureau	Deputy Director
Wang Xinjun	Construction Bureau	Deputy Director
Lu Xingjie	Water Supply Co,	General Manager
Liu Kai	Urban Planning Office	Staff
Zhao Pengcheng	Solid Waste Co.	General Manager
Feng Xuedong	Solid Waste Co.	General Manager
Zhao Feng	Heating Supply Co.	General Manager
Mr Li	Wind Farm Co.	Deputy General Manager
	Habahe County	
Zhu Zanguang	Construction Bureau	Director
Wang Tao	Construction Bureau	Deputy Director
Lu Shaobo	Water Supply Co.	General Manager
Li Diangao	Heating Supply Co.	General Manager
Ma Wenquan	Solid Waste Co.	General Manager

Jimunai County

Xing Aijun	Construction Bureau	Director
Nie Guohua	Construction Bureau	Deputy Director
Wang Jingshan	Water/heating Company	Director of Board
Ta Shikent	Tuoputiereke community	Deputy director
Re Wan	Solid Waste Company	Director

Fuhai County

Dai Xiaodong	Construction Bureau	Deputy Director
Yu Rui	Construction Bureau	Staff
Xie Jingzhong	Water Supply	General Manager
Ma Wencheng	Waste Water	General Manager
Yan Yuguo	Heating Supply	General Manager
Duan Yuhong	Solid Waste	General Manager

Qinghe County

Zhou Xinmei	DRC	Staff
Ma Feifei	Construction Bureau	Staff
Hu Xiaolei	Construction Bureau	Staff
Huangjiangyun	Water/waste Water	Director of Board
Li Zhengguo	Heating Supply	General Manager
Ah Yiding	Township/Solid Waste	Director

APPENDIX 3

STAKEHOLDER WORKSHOPS

1. Buerjin (2010 – 07 – 13)

I. A stakeholder meeting was held on the morning of July 13, 2010, in Buerjin County. Participants of the meeting were representatives from the following agencies and institutions: Development and Reform Commission, Finance Bureau, Economic & Trade Commission, Construction Bureau, Environment Protection Bureau, Tourism Bureau, Women Federation, Meteorological Bureau, Water Supply/Waster Water Treatment Company, Solid Waste Company, Hospital, Junior Middle School, Senior Middle School, Township Government, and communities (6).

II. The TA mission initially introduced the 3R Concept and principles to the meeting participants for its application and practice in daily life both at domestic level and institutional level. The mission initiated discussion on 3R principles of RET for its practical application closely related to the on-going ADB loan project and by reference to the sectors involved.

A. Water Supply Sector: Almost 90% of urban people enjoy the piped water supply service and only 10% people living in shanty area or in outskirts have water supply by using their own pressure-pumped wells. Pre-paid IC card are used for water demand both for families and institutions, 50 cubic meter/2months for individual family and 100cubic meters/per month for institution is applied by buying from the community center and metering for apartment families and institutions. When the mission suggested the water-saving can be reached by reusing water at home everyday, the representatives from various sectors provided positive feedbacks and answers particularly from women of communities, and when the water demand management discussed for institutions to reduce the un-accounted water use and loss of the water, the water supply company representative say: a good governance should be maintained and monitoring system be established and detecting device be installed for monitoring the leakage, dripping, infiltration and pipe burst, in addition, water quota be imposed where appropriate for big water users and banded tariff be applied for families and institutions when necessary by establishing incentive and fine mechanism. The women representatives from communities and women federation said: most of the households have already done in reduction of water demand by reusing water at home daily, but public awareness and education needed to be intensified for sustainable water conservation and root-deep sense of energy-efficiency in a long run.

B. Wastewater Sector: Now in Buerjin County seat waste water treatment utility has covered nearly all urban area except the outskirts area. Wastewater is collected and discharged to waste water treatment plant and treated waste water usually pumped to reuse for irrigating the desert forest and windbreaks around the WWTP area of 7000mu. The waste water is charged combining together with water use (total 1.75RMB per cubic meter). The representative from water supply company recommended that reservoir/tank be set up in each of community area to collected domestic waste water for reuse in community area (watering greens, plants, flowers) after the sediment, and block-tariff be introduced to encourage people to reduce water consumption at source and so in this way reduce the waste water discharges and further in turn to reduce the energy consumption. This initiative gained a active response among the stakeholders.

C. Heating Sector: In Buerjin County seat, the district heating is provided for most of the urban people except those who are living in bungalow area where the coal-burning stove are mainly used for heating provision. The bulk heating meters are installed in block of apartment/buildings and no household meter installed individually in each of the family but a manual thermos controlling valves. The heating is measured and charged by area (square meter) rather than by volume used. In heating plant the manual thermostat installed to regulate the heating supply depending on weather/temperature changes by weather forecast. The household heating meter is not practical due to the large variation of heating consumption of different floor which is unfair for the top/ground/floor and side apartment inhabitants if the tariff is charged by heating amount consumed. To keep warm and reduce the heating demand, the insulation is mandatorily applied for new buildings and reconstructed old ones (roof, wall and windows), heating mains and distribution pipe line also insulated against the radiation and heating loss. Roof solar device are introduced and popularly used by institutions, hotels and households for domestic shower and warm water. When recommended using of ground heating, the stakeholders keep a little reserved and express their views that further study and research are needed considering its heavy capital investment, its operation and result. The local government encourage the private sector to involve the management of the heating supply by provide them with subsidies and cutting down of taxes.

D. Solid Waste Sector: Separate trash bins(recycle and non-recycle) are set up along streets, in public areas and urban centers, open trash boxes in outskirts, and collecting stations in each of the community areas and institutions, many cleaners are employed and subsidized by the government who clean up the streets, collect rubbish and do primary separation of the solid waste. In community areas the trash cabin are setup and the keeper designated in charge of the wastes collection and separation before transporting to the landfill. The representative from the community women said, it is a very good advice to conduct domestic waste separation at source, and still it is easy to setup trash bin separately, but it is hard to do at the moment. It is hard for people to change their minds, to change traditional accepted habits, to change the long practiced behavior, although we know good management and disposal of solid waste is good for environment protection and conducive for a qualified life of the people. So the public awareness and education is badly in need, the community-based driven campaign need to be developed. When incentive mechanism mentioned (credit coupon), they expressed their conservative views that it is hard to manage the overseeing system to ensure the honesty of the people. The two middle school students said, the education and lessons are necessary for increasing the sense and awareness of green energy, resource-efficiency and environment protection for the young generation, and they suggested young people should develop good habit to separate the wastes at source and starting from me and from now on, and a scheduled time be set to collect the separated solid wastes (organic, fabric, rubble and recyclables) at interval different time a day.

E. Renewal Energy: Some of stakeholders express strong interest in using wind power for waste water treatment and desert forest irrigation.

Jimunai (2010 – 07 – 19)

I. Per 3RTA Mission Schedule a stakeholder meeting was held on the morning of July 19, 2010, in Buerjin County. Participants of the meeting are the representatives from the following agencies and institutions: Development and Reform Commission, Finance Bureau, Economy & Trade Commission, Construction Bureau, Environment Protection Bureau, Tourism Bureau, Women Federation, Meteorological Bureau, Water Supply/Waster Water Treatment Company, Solid Waste Company, Hospital, Junior Middle School, Senior Middle School, Township Government, and communities(6).

II. In line with ADB's guideline the TA mission initially introduces the 3R Concept and principles to the meeting participants for its application and practice in daily life both at domestic level and institutional level. The mission tries to promote 3R principle of RET for its practical and potential application closely related to the on-going ADB loan project in 5 sub project counties in Altay Prefecture, by focusing its center on the following areas/sectors while addressing the existing problems.

a. Water Supply Sector: The total population of the urban area(county seat) is about 13000. Due to the under-developed economy and historical reasons, the tariff of water has been very low over past decades(0.6RMB /cubic meter), so the local people has inadequate sense of water conservancy although they know Jimunai is an area in short of water resource. The mechanical water meter was introduced and used in 1992, Almost 90-95% of urban people enjoy the piped water supply service and only 5-10% people living in shanty area or in outskirts have water supply by using their own pressure-pumped wells. No pre-paid IC card are in use at the moment, and no water demand limit both for families and institutions. When the mission suggested the water-saving can be reached by reusing water at home everyday, the representatives from various sectors provided positive feedbacks and answers particularly from women of communities, and when the water demand management discussed for institutions to reduce the un-accounted water use and loss of the water, the water supply company representative say: a good governance should be maintained and monitoring system be established and detecting device be installed for monitoring the leakage, dripping, infiltration and pipe burst. The women representatives from communities said: most of the households have already done in reduction of water demand by reusing water at home daily, for example, reusing the water by washing vegetable first then flushing toilet, or first washing clothes then mopping the floor, or re-using the settled water to water home plants and flowers. The teachers from primary school and middle school said: both at home and in school children's good habits be developed at early stage through education and adults action, and public awareness and social promotion should be intensified in communities. And the students from primary school and middle school had their says that they try to reduce the times of washing clothes , reduce the times of showering and reduce to using detergents.

b. Waste Water Sector: Now in Jimunai County seat, there is no formal waste water treatment utility yet. A proposed WWTP is included under the on-going ADB loan project.

c. Heating Sector: In Jimunai County seat, the heating supply is provided for 80% of the urban people except those who are living in bungalow area where the

coal-burning stove are mainly used for heating provision. The heating is measured and charged by area (square meter) rather than by volume used. In heating plant the manual thermostat installed to regulate the heating supply depending on weather/temperature changes by weather forecast. The household heating meter is not installed to meter the heating used individually. To keep warm and reduce the heating demand, the insulation is mandatory applied for new buildings and reconstructed old ones(roof, wall and windows), heating mains and distribution pipe line also insulated against the radiation and heating loss. Roof solar device are introduced and popularly used by institutions, hotels and households for domestic shower and warm water. When recommended using of wind energy for heating plant, the manager of the heating company expressed strong interest and said there is a great potential to use wind energy for powering heating plant, and in that way a lot of energy reduced and much cost saved.

d. Solid Waste Sector: At he moment in Jimunai County seat , the condition of solid waste management and disposal is quite poor. There is no formal established landfill, no wastes transfer station, and no collection points but only inadequate trash-bins set-up along the street and in some of the public centers. So now the random dumping of waste is seen anywhere. The representative from the communities and teachers and students from school said, it is a very good advice to conduct domestic waste separation at source, but the set-up of the trash-pan, collecting points, transfer station are needed and provided first. In addition the social awareness and environment protection sense should be greatly intensified and increased both at community level and in schools particularly. The teachers said they have environment protection lessons in school and provide education for young generations every month. For reuse of the old thing one doctor said in a community “a supermarket of love” is opened for people disposing their used materials (shoes dresses, small appliance, stationary) in a give-and-take way free of charges . For big items they have a good habits, giving their friends or relatives in rural area for further use. When asked how to separate the solid waste and what are the organic and inorganic wastes the young girl middle school students gave a correct answer by classifying the waste into four categories: organic, rubble, fabric and recyclables (glass, bottle, metal), and still the girl added that I know how to do it but don’t know where to put it. So the efforts should be made by local government to improve the solid waste management and disposal.

e. Renewal Energy: Some of stakeholders express strong interest in using wing power for waste water treatment and desert forest irrigation.

Qinghe (2010 – 07 – 25)

I. Per 3RTA Mission Schedule a stakeholder meeting was held on the morning of July 25, 2010, in Qinghe County. Participants of the meeting are the representatives from the following agencies and institutions: Development and Reform Commission, Finance Bureau, Economy & Trade Commission, Construction Bureau, Meteorological Bureau, Health Bureau, Women Federation, Mete0rological Bureau, Water Supply/Waste Water Treatment Company, Solid Waste Company, Junior Middle School, Senior Middle School, communities(6).

II. In line with ADB's guideline the TA mission initially introduces the 3R Concept and principles to the meeting participants for its application and practice in daily life both at domestic level and institutional level. The mission tries to promote 3R principle of RET for its practical application closely related to the on-going ADB loan project in 5 sub project counties in Altay Prefecture, by focusing its center on the following areas/sectors while addressing the existing problems.

a. Water Supply Sector: Qinghe County Seat area has a population of 14000, about 4300 households. Currently, around 3700 households have access of water supply service, of this 2000 households are metered by mechanical water meters and rest of 1700 metered by IC pre-paid meters and still some people living in shanty area or in outskirts have water supply by using their own pressure-pumped wells. Pre-paid IC card are mandatorily installed for all new buildings When the water demand management discussed for institutions to reduce the un-accounted water use and loss of the water, the water supply company representative say: a good governance should be maintained and monitoring system be established and detecting device be installed for monitoring the leakage, dripping, infiltration and pipe burst, in addition, banded tariff be recommendable and acceptable for families and institutions when necessary by establishing incentive and fine mechanism in the future. And the manager of the Water Supply Co added by giving a good example: a middle school reduced total amount of water use by half from 7000cubic meter to 3400 cubic meters in comparison with the same period of previous year since its installation of IC water meters in 2008. When the mission suggested the reduction of water use can be reached by reusing water at home everyday, the representatives from various sectors provided positive feedbacks and answers particularly from women of communities, representatives from women federation said: most of the households have already done in reduction of water demand by reusing water at home daily, for example, reusing the water by washing vegetable first then flushing toilet, or first washing clothes then mopping the floor, or re-using the settled water to water home plants and flowers. And the students from primary school and middle school had their says that they try to reduce the times of washing clothes , reduce the times of showering and reduce to using detergents. But still public awareness and education needed to be intensified for sustainable water conservation and root-deep sense of energy-efficiency in a long run.

b. Wastewater Sector: Waster water is collected and discharged to waste water treatment plant and treated waste water usually pumped to reuse for irrigating the desert forest and windbreak. The representative from water supply company recommended that reservoir/tank be set up in each of community area to collected domestic waste water for re-use in community area (watering greens, plants, flowers) after the sediment. A stakeholder for a community complained that in her community where most ethnic minorities are inhabited there is no

piped water supply, no district heating service and no sewer utility, it is totally a poor shanty area with out enjoying the public service.

c. Heating Sector: In Qinghe County seat, the district heating is provided for most of the urban people except those who are living in bungalow area where the coal-burning stove are mainly used for heating provision during the chilly winter time . The bulk heating meters are installed in heating exchangers and bulk meter in new buildings/apartments and no household heating meters installed individually in each of the family but manual thermos controlling valves. The heating is measured and charged by area (square meter) rather than by volume used. In heating plant the manual thermostat installed to regulate the heating supply depending on weather/temperature changes by weather forecast. To keep warm and reduce the heating demand, the insulation is mandatorily applied for new buildings and reconstructed old ones (roof, wall and windows), Roof solar tube panel are used by institutions, hotels and households for domestic shower and warm water. As for the demand management the manager of the heating supply said, thanks to setting-up of the heating exchangers the bursts, leakage and loss of water can be easily monitored and problems solved so in this way a huge amount of water saved and cost reduced.

d. Solid Waste Sector: At present in Qinghe County seat, the condition of solid waste management and disposal is not satisfactory. There is no wastes transfer station, and no collection points but only inadequate open waste boxes and trash-bins set-up along the street and in some of the public centers. So sometime the fly tipping is seen anywhere, even the clinical wastes are seen dumped along the roadside near the city. The representative from the communities complains that in their area no solid waste collection service, the people just dump, throw away and splash the waste water and pile up the waste near their own yards or road sides, and spring and summer comes, this causes a big problems of air pollutions and even ground water contamination. And teachers and students from school said, it is a very good advice to conduct domestic waste separation at source, but the set-up of the trash-pan, collecting points, transfer station are needed and provided first. In addition the social awareness and environment protection sense should be greatly intensified and increased both at community level and in schools particularly. The teachers said they have environment protection lessons in school and provide education for young generations every month. In some primary schools the pupils are encouraged to collect, separate and recycle the waste at source in school by awarding them pencils and pencil-boxes. For the old and used thing one stakeholder said in a community “a supermarket of love” is opened for people disposing their used materials (shoes dresses, small appliance, stationary) in a give-and-take way free of charges . For big items they have a good habits, giving their friends or relatives in rural area for further use, but when asked how to separate the solid waste and what are the organic and inorganic wastes the young girl middle school students gave a disappointing answer “sorry I don’t know”. So the social development and campaign is badly needed.

e. Due to the location of the town seat in a valley, and poor wind power there is little possibility or options for using renewable Energy in Qinghe.

APPENDIX 4

RENEWABLE ENERGY PROJECTS in ALTAY PREFECTURE

Table 4.1: Renewable Energy Projects in Altay Prefecture

Location	Energy Type	Name of Company	Number and capacity	year completed	total cost (1000 CNY)	Capacity / yr (10,000 kW·h)	hrs utilized / yr	Grid price
Habahe	Wind Power 1	XJ Tianfeng Wind Energy Co	33set x 1500kW	2011 under construction	410,000	11428		
Fuhai	Solar power street light 1		136pc	2008-2009	1100			
Buerjin	Wind power 1	Buerjin Tianyun Wing Energy Co.,Ltd	66set x 750kW	July,2005	400,000	12100	2450	0.58
	Wind power 2	XJHD Buerjin Wind Energy Co.,Ltd	33set x 1500kW	July,2005	508,000	12046.9	2434	0.58
	Ground heat pumping	Friend-ship Peak Hotel	Heat for 14,000m^2	June 2010	9,800			
	Ground heat pumping	Sports Hall	Heat for 4,000m^2	2008	5,000			
	Street Lighting		12	May 2008	1,800			
Jimunai	Wind power 1	XJ JMN ZGH Wind Energy Co.,Ltd	33set x 1500kW	under construction	478,900	12236	2742	

Notes on Renewable Energy Projects

A. Buerjin Wind Farm

1. Located in Irkys valley. Steady winds ranging up to 30 m/s with an average of 10 m/s.

2. The wind farm is connected to Xinjiang grid and under phase 1 has 33 turbines, each with a blade swept diameter of 82m. A second phase is planned for a further 33 turbines for completion in 2012.

3. The total capacity of phase 1 is 49500 kW [i.e.33 x 1500 each]. The production during June to August is 13 x 10^6 kW and is up to 18 x 10^6 during remainder of year. The average output is 15 x 10^6 kW per month.

4. There is a 3% power factor correction.

5. Cost of wind turbine is RMB 9 x 10^6 with a further RMB 3 x 10^6 for installation.

6. The size of turbines can be 750 kW but 1500 kW are more efficient (about 15%) and are more suited to this location.

7. Power produced is sold at RMB 0.5/kW. This is fixed by State. The alternative of coal power is RM 0.25/kW. The write down period is 8 – 10 years.

8. Cold, ice in winter have negligible effect on operation of windmill.

9. Production of energy from wind is very effective at this scale.

B. Jimunai Wind Farm

1. Jimunai has an identical wind farm of 33 x 1500 kW turbines (total 49500kW output). This generated capacity is fed to the electricity grid.

2. Other comments as above.

C. Buerjin Street lighting.

1. Installed in May 2008. 12 units in total comprising solar panel, wind turbine, low energy lamp, twin batteries and all wiring.

2. Since installation there have not been any problems or maintenance costs;

3. Snow and ice have not caused any problem;

4. When battery fully charged the wind turbine is automatically locked stop;

5. Battery life quoted as 5 years.

6. Total installed cost is RMB 15,000 per unit.

7. Each lamp saves a conventional operating cost of RMB 550 per annum.

8. Lamp brightness is limited and, in other locations, should be of greater intensity.

9. Detailed cost breakdown provided separately;

10. Cost breakdown for street lighting unit is given in the following table:

	Description	**Specification**	**Units**	**Cost RMB**
1	Solar panel	80W	1	1600
2	Controller		1	100
3	Battery	12V / 80A-hr	2	1000 each
4	Bulb	SOX 35W	1	120
5	Lamp post		1	2000
6	Wind turbine	200W	1	3800
7	Transformer	35W	1	340
8	Installation		1	5000
			Total, installed	15,000

D. Friendship Peak Hotel, Buerjin.

1. The ground heat pumping serving the large hotel has been in operation for only 2 months;

2. The hotel has 500 bedrooms and the energy system provides: hot water for 1000 people each day at maximum temperature of 50^0C , cooling for 300 rooms and heating for 500 rooms;

3. The floor area served is 14,000m^2.

4. The total installed cost was RMB 980,000.

5. No problems reported but condensation on the cooling output pipes in pump room is starting to cause weeping joints and rusting. This will become a problem.

6. Heat source is ground water with a temperature of 12 degree C. Ground water is pumped from one well and discharged back via two wells – thus an open system.

7. 1kW of electrical power used produces 4kW of hot water;

8. It costs RMB 3 / room/day to provide cooling (a/c) but for this there is a large quantity of free hot water;

9. The government subsidy is limited to projects for which approval is given in advance and which have a floor area of greater than 200,000m^2.

10. Owner / operator very happy with performance to date.

E. Community Sports Hall, Buerjin.

1. Heat unit was installed in 2008 and has been used throughout 2009 and 2010.

2. It provides under-floor heating to 4000m^2 sports hall.

3. The source heat is ground water with a background temperature of 9 – 10 degrees C.

4. The output heat is 35^0 C.

5. The running cost is RMB 14 – 15,000 / month.

6. The capital cost was RMB 500,000 fully installed.

7. The only problem to date was the need to replace the submersible pump which developed a split casing. The cost was RMB 6000.

8. Points are available on the unit for supplying hot water and cooling water but neither has been connected.

9. Manager of sports hall pleased with results to date.

F. Ground Heat Pumping, Jimunai

1. A new warehouse and offices complex has been developed based on import and export trade with Khazakstan. The office buildings are well insulated and have under-floor heating.

2. Heating provided by ground heat source pumping unit, housed in a room approximately 5 x 3 metres.

3. Borehole is 9m deep and penetrates into aquifer (former bed of river). The water temperature stays fairly constant at between 7 and 9 degrees C.

4. Heat is provided to 2100 m^2 of office space and temperature achieved is 22 deg. C. The refrigeration capability is not used [un-necessary].

5. The whole kit cost RMB 240,000, including installation, and was supplied by the manufacturer based in Nanjing.

6. The normal tariff for heating is RMB 25.5 / m^2, so the cost of conventional district heating (if available) would be RMB 53,550 / year. The cost of ground heat pumping is RMB 2,500 / year, hence a saving of RMB 51,000. Dividing this into RMB 240,000 gives a break-even at 5.2 years.

7. The equipment supplier provides a free maintenance service for 3 years but it is assumed a charge applies thereafter.

APPENDIX 5

OUTPUT FROM SOCIAL QUESTIONNAIRE ON SOCIAL SERVICE DELIVERY
[Issues attracting 50% or more responses have been highlighted]

TABLE 5.1 (TABLE 56)[9]: PROBLEMS EXPERIENCED WITH SOURCES OF DOMESTIC WATER[10]

➢ Problem with Main Source of Water	➢ Tap water main source				➢ Main source not tap water			
	Never	Occasionally	Often	Always	Never	Occasionally	Often	Always
Qinghe County Seat								
Unpleasant taste	60 (71%)	21 (26%)	3 (4%)	0	51 (72%)	18 (25%)	2 (3%)	0
Bad color	15 (18%)	67 (80%)	2 (2%)	0	39 (55%)	27 (38%)	4 (7%)	1 (1%)
Bad smell	70 (83%)	12 (14%)	2 (2%)	0	5 (83%)	11 (16%)	1 (1%)	0
Can make people sick if drunk un-boiled	21 (25%)	41 (49%)	8 (9%)	14 (17%)	34 (48%)	24 (34%)	4 (6%)	9 (13%)
Inadequate pressure	56 (67%)	22 (26%)	5 (6%)	1 (1%)				
Buerjin County Seat								
Unpleasant taste	63 (69%)	28 (30%)	1 (1%)	0 (-)	76 (70%)	15 (14%)	6 (%)	12 (%)
Bad color	49 (53%)	38 (41%)	5 (5%)	0 (-)	84 (77%)	22 (20%)	2 (%)	1 (%)
Bad smell	82 (89%)	9 (10%)	1 (1%)	0 (-)	93 (85%)	15 (14%)	1 (%)	0 (-)
Can make people sick if drunk un-boiled	36 (39%)	33 (36%)	6 (7%)	0 (-)	50 (46%)	47 (43%)	9 (%)	2 (%)
Inadequate pressure****	33 (36%)	44 (48%)	4 (4%)	17 (19%)				
Jimunai County Seat								
Unpleasant taste	114 (78%)	30 (21%)	0 (-)	2 (1%)	13 (87%)	1 (7%)	1 (7%)	0 (-)
Bad color	34 (23%)	102 (69%)	8 (5%)	2 (1%)	10 (67%)	5 (33%)	0 (-)	0 (-)
Bad smell	119 (82%)	25 (17%)	1 (1%)	1 (1%)	14 (93%)	1 (7%)	0 (-)	0 (-)
Can make people sick if drunk un-boiled	47 (32%)	46 (32%)	16 (11%)	37 (25%)	6 (40%)	6 (40%)	0 (-)	3 (20%)
Inadequate pressure	44 (31%)	50 (35%)	26 (18%)	23 (16%)				

*** Water source not specified by two households**
**** 12 missing cases from users of tap water as main source, and seven missing cases for users of other sources as main source**
******Missing cases: one.**
Note: Owing to an error in the questionnaire instructions, these questions were not asked in Habahe, where

[9] Table number in parenthesis refers to PPTA Interim Report. July 2010.

[10] Extracted from PPTA 7323 – Interim Report July 2010.

the Project will construct a new water pipeline network

TABLE 5.2 (TABLE 57): PROBLEMS ARISING FROM WASTEWATER DISPOSAL

➢ Problem	➢ Major Problem	➢ Minor Problem	➢ Not a Problem	➢ Do not know
Qinghe County Seat (n=157)				
Wastewater is always overflowing onto the ground	76 (48%)	2 (16%)	62 (40%)	3 (2%)
Wastewater overflows when it rains or snow melts	85 (54%)	45 (29%)	25 (16%)	2 (1%)
Bad smells	80 (51%)	24 (15%)	51 (33%)	2 (1%
Flies or mosquitoes	80 (51%)	41 (26%)	34 (22%)	2 (1%)
Children exposed to wastewater	64 (41%)	17 (11%)	71 (45%)	5 (3%)
Soiling clothes or shoes	67 (43%)	45 (29%)	42 (27%)	3 (2%)
Health risks	80 (51%)	35 (22%)	38 (24%)	4 (3%)
Difficulty for walking around*	82 (53%)	30 (19%)	44 (28%)	0 (-)
Harmful to domestic animals** which might drink it (e.g. chickens, goats, etc)	66 (43%)	13 (8%)	51 (33%)	16%)
Fuhai County Seat (n=212)				
Wastewater is always overflowing onto the ground	81 (38%)	23 (11%)	110 (48%)	0 (-)
Wastewater overflows when it rains or snow melts	106 (50%)	41 (19%)	64 (30%)	1 (<1%)
Bad smells	77 (36%)	40 (19%)	95 (45%)	0 (-)
Flies or mosquitoes	82 (39%)	59 (28%)	70 (33%)	1 (<1%)
Children exposed to wastewater	29 (14%)	36 (17%)	143 (68%)	4 (2%)
Soiling clothes or shoes	65 (31%)	48 (23%)	99 (47%)	0 (-)
Health risks	94 (44%)	32 (15%)	82 (39%)	4 (2%)
Difficulty for walking around	103 (49%)	33 (16%)	76 (36%)	0 (-)
Harmful to domestic animals* which might drink it (e.g. chickens, goats, etc)	59 (28%)	17 (8%)	85 (40%)	50 (24%)
Habahe County Seat (n=160)				
Wastewater is always overflowing onto the ground	60 (38%)	36 (23%)	64 (40%)	0 (-)
Wastewater overflows when it rains or snow melts	60 (38%)	45 (28%)	55 (34%)	0 (-)
Bad smells	47 (29%)	34 (21%)	78 (49%)	1 (1%)
Flies or mosquitoes	44 (28%)	34 (21%)	81 (51%)	1 (1%)
Children exposed to wastewater	27 (17%)	36 (23%)	87 (54%)	10 (6%)
Soiling clothes or shoes	39 (24%)	46 (29%)	75 (47%)	0 (-)
Health risks	55 (34%)	37 (23%)	66 (41%)	1 (1%)
Difficulty for walking around	30 (19%)	54 (34%)	76 (48%)	0 (-)
Harmful to domestic animals which might drink it (e.g. chickens, goats, etc)	40 (25%)	21 (13%)	91 (57%)	8 (5%)
Jimunai County Seat (n=162)				
Wastewater is always overflowing onto the ground	77 (48%)	28 (17%)	55 (34%)	2 (1%)
Wastewater overflows when it rains or snow melts	88 (54%)	44 (27%)	30 (19%)	0 (-)
Bad smells	86 (53%)	24 (15%)	51 (32%)	1 (1%)
Flies or mosquitoes	85 (53%)	31 (19%)	45 (28%)	1 (1%)

➢ Problem	➢ Major Problem	➢ Minor Problem	➢ Not a Problem	➢ Do not know
Children exposed to wastewater	54 (33%)	30 (19%)	74 (46%)	4 (3%)
Soiling clothes or shoes	36 (22%)	64 (40%)	62 (38%)	0 (-)
Health risks	98 (61%)	21 (13%)	42 (26%)	1 (1%)
Difficulty for walking around	77 (48%)	51 (32%)	34 (21%)	0 (-)
Harmful to domestic animals which might drink it (e.g. chickens, goats, etc)	64 (40%)	13 (8%)	47 (29%)	38 (24%)
Buerjin County Seat (n=202)				
Wastewater is always overflowing onto the ground	129 (64%)	27 (13%)	45 (22%)	1 (1%)
Wastewater overflows when it rains or snow melts	114 (56%)	60 (30%)	28 (14%)	0 (-)
Bad smells	146 (72%)	17 (8%)	39 (19%)	0 (-)
Flies or mosquitoes	151 (75%)	25 (12%)	26 (13%)	0 (-)
Children exposed to wastewater	94 (47%)	56 (28%)	52 (26%)	0 (-)
Soiling clothes or shoes	82 (41%)	75 (37%)	45 (22%)	0 (-)
Health risks	139 (69%)	29 (14%)	32 (16%)	1 (1%)
Difficulty for walking around*	107 (53%)	50 (25%)	44 (22%)	1 (1%)
Harmful to domestic animals** which might drink it (e.g. chickens, goats)	151 (75%)	9 (5%)	34 (17%)	8 (%)

TABLE 5.3 (TABLE 58): PROBLEMS WITH SOLID WASTE DISPOSAL

➢ Problem	➢ Number of Households			
	Major Problem	Minor Problem	Not a Problem	Do not know
Qinghe (n=157)				
Some people dump their rubbish in public areas	82 (52%)	25 (16%)	47 (30%)	3 (2%)
Exposed rubbish leads to problems with dogs and rats	70 (45%)	18 (12%)	59 (38%)	10 (6%)
Drains get plugged with garbage	70 (45%)	22 (14%)	51 (38%)	14 (9%)
Rotting garbage results in bad smells	87 (55%)	33 (21%)	3 (24%)	0 (-)
The garbage attract mosquitoes and flies	82 (52%)	57 (36%)	17 (11%)	1 (1%)
Children are exposed to germs as a result of the garbage	72 (46%)	15 (10%)	66 (42%)	4 (3%)
Garbage lying around leads to soiled clothing and shoes	65 (41%)	34 (22%)	58 (37%)	0 (-)
Garbage blows everywhere	81 (52%)	50 (32%)	26 (17%)	0 (-)
The environment looks untidy for visitors	76 (48%)	15 (10%)	61 (39%)	5 (3%)
Plastic bags can get caught in the wind and blow to other areas where they can harm animals grazing	70 (45%)	19 (12%)	50 (32%)	18 (12%)
Rubbish collecting in the street creates health risks*	80 (51%)	33 (21%)	40 (26%)	3 (2%)
There is a lack of public garbage bins in which people can put their garbage	67 (43 %)	28 (18%)	60 (38%)	2 (1%)
Fuhai County Seat (n=212)				
Some people dump their rubbish in public areas	101 (48%)	24 (11%)	83 (39%)	3 (1%)
Exposed rubbish leads to problems with dogs and rats	53 (25%)	59 (28%)	90 (43%)	10 (5%)
Drains get plugged with garbage	49 (23%)	31 (15%)	121 (57%)	11 (5%)

➢ Problem	➢ Number of Households			
	Major Problem	Minor Problem	Not a Problem	Do not know
Rotting garbage results in bad smells	93 (44%)	42 (20%)	77 (36%)	0 (-)
The garbage attract mosquitoes and flies	93 (44%)	71 (34%)	48 (23%)	0 (-)
Children are exposed to germs as a result of the garbage	48 (23%)	28 (13%)	133 (63%)	3 (1%)
Garbage lying around leads to soiled clothing and shoes	47 (22%)	45 (21%)	119 (56%)	1 (< 1%)
Garbage blows everywhere	104 (49%)	59 (27%)	47 (22%)	2 (1%)
The environment looks untidy for visitors	68 (32%)	33 (16%)	104 (49%)	7 (3%)
Plastic bags can get caught in the wind and blow to other areas where they can harm animals grazing	67 (32%)	22 (10%)	69 (33%)	54 (26%)
Rubbish collecting in the street creates health risks*	67 (32%)	35 (17%)	97 (46%)	13 (6%)
There is a lack of public garbage bins in which people can put their garbage	71 (34%)	25 (12%)	116 (55%)	0 (-)
Habahe County Seat (n=160)				
Some people dump their rubbish in public areas	92 (58%)	26 (16%)	42 (26%)	0 (-)
Exposed rubbish leads to problems with dogs and rats	40 (25%)	51 (32%)	68 (43%)	1 (1%)
Drains get plugged with garbage	42 (26%)	38 (24%)	75 (49%)	2 (1%)
Rotting garbage results in bad smells	68 (43%)	23 (14%)	69 (43%)	0 (-)
The garbage attract mosquitoes and flies	59 (37%)	38 (24%)	63 (39%)	9 (-)
Children are exposed to germs as a result of the garbage	44 (28%)	36 (23%)	67 (42%)	13 (8%)
Garbage lying around leads to soiled clothing and shoes	40 (25%)	41 (26%)	79 (49%)	0 (-)
Garbage blows everywhere	56 (35%)	53 (33%)	51 (32%)	0 (-)
The environment looks untidy for visitors	35 (22%)	48 (30%)	77 (48%)	0 (-)
Plastic bags can get caught in the wind and blow to other areas where they can harm animals grazing	43 (23%)	36 (23%)	76 (48%)	5 (3%)
Rubbish collecting in the street creates health risks*	37 (23%)	44 (28%)	78 (49%)	1 (1%
There is a lack of public garbage bins in which people can put their garbage	23 (14%)	43 (27%)	92 (58%)	2 (1%)
Buerjin County Seat (n=202)				
Some people dump their rubbish in public areas	159 (79%)	25 (12%)	18 (9%)	0 (-)
Exposed rubbish leads to problems with dogs and rats	130 (64%)	26 (13%)	40 (20%)	6 (3%)
Drains get plugged with garbage	129 (64%)	24 (12%)	44 (22%)	5 (3%)
Rotting garbage results in bad smells	163 (81%)	12 (6%)	27 (13%)	0 (-)
The garbage attract mosquitoes and flies	163 (81%)	18 (9%)	21 (10%)	0 (-)
Children are exposed to germs as a result of the garbage	118 (58%)	41 (20%)	43 (21%)	0 (-)
Garbage lying around leads to soiled clothing and shoes	92 (46%)	64 (32%)	46 (23%)	0 (-)
Garbage blows everywhere	122 (60%)	53 (26%)	26 (13%)	1 (1%)
The environment looks untidy for visitors	113 (56%)	41 (20%)	45 (22%)	3 (2%)
Plastic bags can get caught in the wind and blow to other areas where they can harm animals grazing	132 (65%)	38 (19%)	26 (13%)	6 (3%)
Rubbish collecting in the street creates health risks	141 (90%)	20 (10%)	40 (20%)	1 (1%)
There is a lack of public garbage bins in which	113 (56%)	10 (5%)	75 (37%)	4 (2%)

➢ Problem	➢ Number of Households			
	Major Problem	Minor Problem	Not a Problem	Do not know
people can put their garbage				
Jimunai (n=162)				
Some people dump their rubbish in public areas	102 (63%)	25 (15%)	34 (21%)	1 (1%)
Exposed rubbish leads to problems with dogs and rats	91 (56%)	36 (22%)	30 (19%)	5 (3%)
Drains get plugged with garbage	64 (40%)	27 (17%)	43 (27%)	28 (17%)
Rotting garbage results in bad smells	101 (62%)	39 (24%)	19 (12%)	3 (2%)
The garbage attract mosquitoes and flies	105 (65%)	39 (24%)	17 (11%)	1 (1%)
Children are exposed to germs as a result of the garbage	59 (36%)	34 (21%)	63 (39%)	6 (4%)
Garbage lying around leads to soiled clothing and shoes	36 (22%)	60 (37%)	65 (40%)	1 (1%)
Garbage blows everywhere	89 (55%)	56 (35%)	16 (10%)	1 (1%)
The environment looks untidy for visitors	71 (44%)	47 (28%)	44 (27%)	0 (-)
Plastic bags can get caught in the wind and blow to other areas where they can harm animals grazing	67 (41%)	26 (16%)	34 (21%)	35 (22%)
Rubbish collecting in the street creates health risks*	87 (54%)	36 (22%)	33 (20%)	6 (4%)
There is a lack of public garbage bins in which people can put their garbage	90 (56%)	21 (13%)	48 (30%)	3 (2%)

TABLE 5.4 (TABLE 59)**: PROBLEMS WITH HEATING IN THE COUNTY SEATS**

➢ Problem	➢ Number of Households			
	Major Problem	Minor Problem	Not a Problem	Do not know
Qinghe County Seat (n=157)				
The temperature that can be reached in houses with centralized heating from the city is sometimes a health risk for children and elderly if not supplemented*	49 (45%)	29 (19%)	14 (9%)	16 (15%)
The heating supplied by the city heating system is expensive to supplement*	54 (50%)	19 (18%)	17 (16%)	18 (17%)
There are a lot of fumes from the city heating system*	39 (36%)	12 (11%)	40 (26%)	17 (16%)
There are frequent stoppages of the city heating system*	43 (40%)	13 (12%)	35 (32%)	16%)
The cost of coal is very high for those without centralized heating**	90 (79%)	6 (5%)	7 (6%)	11 (10%)
Fuhai County Seat (n=116)				
The temperature that can be reached in houses with centralized heating from the city is sometimes a health risk for children and elderly if not supplemented	72 (34%)	11 (5%)	32 (16%)	72 (34%)
The heating supplied by the city heating system is expensive to supplement****	73 (34%)	8 (4%)	26 (13%)	73 (34%)
There are a lot of fumes from the city heating system*	66 (31%)	7 (3%)	33 (16%)	66 (31%)
There are frequent stoppages of the city heating system*	66 (31%)	8 (4%)	32 (15%)	66 (31%)
The cost of coal is very high for those without centralized heating**	69 (33%)	8 (4%)	18 (9%)	69 (33%)
Habahe county seat (n=160****)				
The temperature that can be reached in houses with centralized heating from the city is sometimes a health risk	75 (59%)	17 (13%)	29 (23%)	7 (6%)

➢ Problem	➢ Number of Households			
	Major Problem	Minor Problem	Not a Problem	Do not know
for children and elderly if not supplemented				
The heating supplied by the city heating system is expensive to supplement	39 (31%)	50 (39%)	31 (24%)	8 (6%)
There are a lot of fumes from the city heating system	28 (22%)	36 (28%)	57 (45%)	7 (6%)
There are frequent stoppages of the city heating system	43 (34%)	24 (19%)	52 (41%)	9 (7%)
The cost of coal is very high for those without centralized heating	48 (25%)	22 (14%)	29 (18%)	65 (41%)
Jimunai County Seat (n=162)				
The temperature that can be reached in houses with centralized heating from the city is sometimes a health risk for children and elderly if not supplemented*	119 (75%)	10 (6%)	9 (6%)	20 (13%)
The heating supplied by the city heating system is expensive to supplement*	104 (66%)	21 (13%)	9 (6%)	24 (15%)
There are a lot of fumes from the city heating system*	80 (51%)	21 (13%)	28 (18%)	29 (18%)
There are frequent stoppages of the city heating system*	103 (65%)	17 (11%)	16 (10%)	22 (14%)
The cost of coal is very high for those without centralized heating**	96 (61%)	24 (15%)	25 (15%)	13 (8%)

APPENDIX 6 a

WATER DEMAND MANAGEMENT

Definition: *the implementation of policies or measures which serve to control or influence the consumption or wastage of water.*

Why Manage ?: To reduce demand and conserve limited resources, thus ensuring that everyone has access to water at an affordable charge.

Recommended Controls:

i) a transparent water resources planning process
ii) all supply is metered
iii) banded tariff mitigates against profligate use of water
iv) mandatory leakage targets for operating companies
v) a six litre flush standard for new toilets
vi) new resources only being mobilised after clear demonstration that existing resources have been used to the full.

Resource Planning: clear and open guidelines, procedures and rules for using existing and developing future water resources. The development of new resources should only occur when all other options have been exhausted i.e. consumer demand minimized, supply losses reduced to economic level, supply operational management at maximum efficiency. Full environmental protection controls should apply within planning process.

Metering: Bulk metering for supplies and metering of consumer districts (1 to 3000 properties) and rapid response to reported and unreported bursts help to reduce leakage. More pressure management and, with it, a better understanding of the performance of the distribution network also reduced leakage. Consumer meters provide basis for charging but also allow consumers to monitor water use and adjust lifestyle practices accordingly.

Leakage targets: Economic levels of leakage (where the cost of saving one cubic metre of water through leakage control equals the cost of supplying one cubic metre of treated water) may be used as a target for overall leakage. This should seek to achieve 10 - 15% of water produced (not expressed as water consumed as so often occurs).

Tariffs: the use of an incremental block tariff ensures more is paid for higher usage but also a minimum cost is available for a basic water demand of, say, one cubic meter per month. This will encourage immediate repairs of domestic leakage and will minimize wastage.

APPENDIX 6 b

APPLICATION OF THE 3Rs – SOME DETAILS

Reduce - to buy less and use less.

Reuse – all or elements of any unwanted / discarded item to be used again.

Recycle - discards are separated into materials that may be incorporated into new products, often by an energy using process.

Examples of application of 3Rs in Project Seat Towns

A. Water demand / usage

1. Reduce demand for water production by demand minimization – don't waste water; turn off tap; repair leaks/dripping taps; take shower not bath; collect rain water for general non-potable use (and cover to stop evaporation);

2. Reduce peak demand by installing storage tank on mains supply and avoid effect of low mains pressure.

3. Reduce hydraulic losses by careful location of bulk water storage (reservoirs) – locate as near to centre of demand as possible.

4. Reduce treatment costs by careful design of intake – try to minimize suspended solids.

5. Where still relevant, reduce pumping costs by increasing efficiency of pumping – pump only water required at average daily rate; size pipes and mains for average, not peak, demand flows; consider using new, high efficiency pumps.

6. Reduce carbon energy demand by introducing or expanding renewable energy sources – is it possible / practical to use renewable energy, even for part of time.

7. Reduce inefficiency of supply / distribution – reduce leakage and wastage; calculate real leakage; consider pressure sustaining / reducing valves in supply districts; consider investing in leakage detection equipment.

8. Reduce unaccounted-for water by extending metering – use consumer meters for usage billing and bulk meters for supply management, including calculation of unaccounted-for water.

9. Reuse water required for flushing mains by collecting by hose into mobile tank and thence to irrigation.

10. Reuse sink water for plant watering / irrigation / livestock by using bowl.

11. Reuse meters by organizing repair and recalibration workshop.

B. Wastewater

1. Reduce volumes for treatment by minimizing flows – is there high ground water infiltration into sewers ? Can it be economically reduced to reduce volume of flow to be pumped / treated?.

2. Reduce / minimize pumping where possible – better to pump treated wastewater effluent than raw sewage (volume of water lifted / problem of odours at pumping / septicity etc.); consider use of low energy screw pumps.

3. Reduce energy costs – consider type of equipment used for treatment process – for example, if aerated lagoon treatment exists then consider introducing fine bubble submerged aerators instead of surface propellers.

4. Reduce reliance on carbon energy – is it possible / practical to use renewable energy, even for part of time?.

5. Reduce energy input to treating wastewater - Consider degree of treatment required for wastewater when reusing – a lesser standard could be accepted for, say, orchard or plantation irrigation; – another standard may be applicable for industrial re-use.

6. Reuse wastewater as much as possible – when irrigation not appropriate (e.g. ground frozen) consider maximizing storage potential.

7. Recycle sludge from wastewater treatment plant by composting provided sufficient land and retention time is available (3 years retention) – then used as soil improver for forest wind breaks or desert reclamation; alternative is digestion with methane capture for fuel and residue as agricultural fertilizer.

C. District Heating

1. Reduce fuel demand by increasing efficiency of heat generation plant – internal losses and boiler efficiency.

2. Reduce cost by choice of fuel – calorific value of source coal v. transport cost. Is there any advantage in bulk buying or seasonal buying of coal?

3. Reduce costs by improving efficiency of heat distribution – losses both of radiant heat from pipes and steam/hot water from joints and faults;

4. Reduce heat demand by improving building insulation – particularly roof and windows – to conserve internal heat in winter and keep heat out in summer.

5. Reduce costs by alternative heat source – consider ground heat source pumping, solar energy, wind energy and hydro power – look at feasible options especially for institutional users (probably not practical/economic for individual households).

6. Recycle waste ash/slag by considering of material for block manufacture or similar.

7. Maximize income by metering of heat provided at consumer – meter can be used to charge for heat consumed; consider installation and use of programmable thermostats to regulate heat consumed (often district heat is ‘switched on’ on a

particular day and, if weather is still warm, all windows are opened to keep building comfortable, thus wasting energy).

D. Solid Waste Management

1. Reduce wastage by buying only what is needed by household – avoid excess.

2. Reduce transport costs by use of local cycle collection and transfer stations; consider frequency of transfer station, use of compaction equipment and economics of haul distances to landfill.

3. Reduce waste generated by commerce and industry – consider charge for collection / disposal.

4. Reuse as much as possible – garage sales (these may be individual initiatives or a regular communal market sale at a local centre);
   – composting organic materials: (this could be a community initiative if individual households do not have land);
   – alternative is to feed organic materials to livestock.

5. Reuse by repair broken items and either continue to use or sell on – scale of demand may encourage repair enterprises.

6. Reuse by gifting to others of unwanted items, rather than throw away.

7. Recycle materials by separation for bulk collection and recycle as new product [paper, plastics, glass, metals etc.]
   – initiatives/incentives for public participation in collection of separate materials; will need support for on-selling to industrial processing; bulk handling, compaction and transport costs;
   – alternative is to consider materials separation at transfer station with employee incentive scheme.

8. Maximize waste collection by addressing problems / complaints such as fly tipping – improve waste collection service – reduces heath problems and wins support of community.

APPENDIX 7 a

PRC STATE STANDARD FOR WASTEWATER TO CROP IRRIGATION

GB 5084-(2005)

Table 1. Water Quality Standard for Crop Irrigation

Ser.N	Item	Crop Category		
		Water Crop	Dry crop	Vegetable
1	BOD_5 (mg/l) ≤	60	100	40[a], 15[b]
2	COD (mg/l) ≤	150	200	100[a], 60[b]
3	Suspended solids (mg/l) ≤	80	100	60[a], 15[b]
4	??? (mg/l) ≤	5	8	5
5	water temperature ^0C ≤	25		
6	pH	5.5 – 8.5		
7	Chlorine (Cl) (mg/l) salt ≤	1000[c] (non-salinity area), 2000[c] (salinity area)		
8	Chlorate (mg/l) ≤	350		
9	Sulphur (S) (mg/l) ≤	1		
10	Mercury (Hg) (mg/l) ≤	0.001		
1l	Cadmium (Cd) (mg/l) ≤	0.01		
12	Arsenic (As) (mg/l) ≤	0.05	0.1	0.05
13	Chromium (Cr) (mg/l) ≤	0.1		
14	lead (mg/l) ≤	0.2		
15	Coliform /100ml)	4 000	4 000	2 000[a] , 1 000[b]
16	number of insect eggs ≤	2		2[a] , l[b]

APPENDIX 7 b

REGULATION ON THE DISPOSAL OF BUILDING MATERIALS

Referenced (2005) – 139; Issued by Ministry of Urban-Rural Housing and Development

Key points:

1. No organisation is allowed randomly to dump building materials.
2. There must be a charge (fee) for the disposal of building materials.
3. If any agency needs to retain building demolition or construction materials temporarily in a street then approval must first be obtained from the local government administration.
4. A first warning followed by a RMB 3 - 5,000 penalty shall be imposed for the following violations

   (i) mixing waste building materials and domestic solid waste;

   (ii) mixing waste building materials with toxic waste substances;

   (iii) setting up a waste building materials collection point without approval of the local government administration.
5. If a contractor does not dispose of waste building materials in a timely manner such that environmental pollution occurs then he is liable to a fine of between RMB 5 – 50,000.
6. If a contractor or agency is proven guilty of fly-tipping there shall be a penalty of between RMB 5 – 50,000.
7. If any agency revises the official documentation issued by State Government then a fine of between RMB 5 – 20,000 shall apply.
8. The disposal of building materials at any unofficial site is punishable.

APPENDIX 7 c

CLINICAL WASTE DISPOSAL

The State Council Decree No.380; Issued June 16, 2003. Effective June 16, 2003

1. Definition of clinical waste: Directly or indirectly-contaminated waste or toxic waste generated by the medical institutions during medical operation or prevention activities.

2. Theis regulation is applied to clinical waste collection, transportation, storage, disposal and supervision, and other related activities.

3. The government carries out the policy of safe disposal of the clinical waste, and encourages the secure disposal and develop the new technology for the clinical waste disposal.

4. Medical and health departments above the county level take responsibility for the clinical waste collection, transportation, storage and supervision.

5. Management mechanism must be established at all levels for the clinical waste management and disposal.

6. Special training shall be conducted for the staff responsible for the clinical waste disposal.

7. The disposal agencies must list the clinical waste: its contents, source, type, weight, and numbers, and the means of disposal, and keep records.

8. The disposal agencies must take effective approaches to avoid the waste spillage, leakage, and spreading.

9. No body/agency is allowed to buy/sell or transfer the clinical wastes. And fly-tipping, and dumping into the unofficial sites, and mixing of domestic waste and clinical waste are extremely prohibited.

10. No post/mail of clinical waste is allowed. Clinical waste cannot be exported from the prefecture or province.

11. Clinical waste should be collected, transported and disposed immediately by all-level medical/health institutions.

12. Equipment should be set up for the storage of the clinical waste, open pile-up is not allowed, and the storage can’t be kept more than 2 days.

13. Special vehicles must used for the transportation of the clinical waste to avoid the spillage and spreading on the way, and follow the specified route, transport to and store at the specified sites.

14. The clinical waste should be disposed in close and centralized approaches.

15. The clinical waste should be disposed by incineration or burial.

APPENDIX 7 d

RESTRICTIONS ON PRODUCTION, SALE AND USE OF PLASTIC BAGS

Referenced: (2007) – 72; Issued by The State Council on 2007-12-31.

Key Points:

1. Super-thin plastic bag (less than 0.025mm) is prohibited to be produced, sold or used.

2. All supermarkets, shops and fairs must charge for the provision of a plastic bag.

3. The supervision and monitoring of production and use of plastic bags shall be increased and penalties imposed for violation of this regulation including the cancelling of production licenses.

4. Improvements in solid waste management shall be made to (i) facilitate solid waste separation, collection and transportation; (ii) attempt to reduce the amount of solid waste disposed into landfill; (iii) establish more collection points and transfer stations; and (v) improve the recycling of solid wastes.

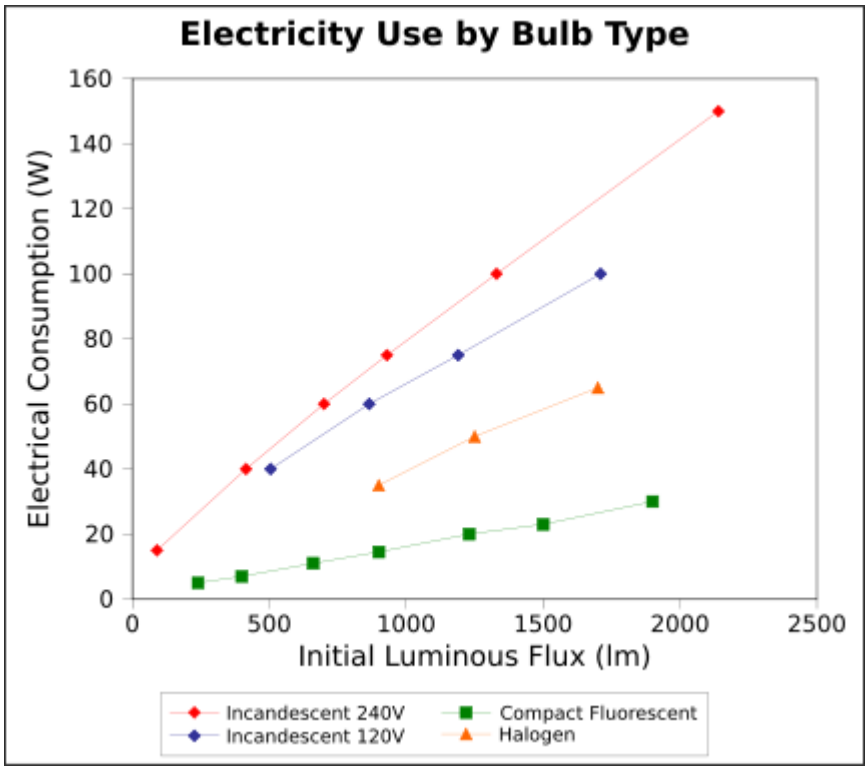
5. The Environment Departments should increase their supervision of the storage, transportation and recycle of the solid waste to avoid re-pollution and re-contamination of the environment.

6. Promote the public awareness of the above requirements, particularly in villages, communities, schools, supermarkets and fairs.

7. Effective as of June 1, 2008.

APPENDIX 8

EFFICIENCY OF COMPACT FLUORESCENT LIGHT BULBS



The chart shows the energy usage for different types of light bulbs operating at different light outputs. Points lower on the graph correspond to lower energy use.

For a given light output, Compact Fluorescent Lamps use 20 to 33 percent of the power of equivalent incandescent lamps.

Electrical power equivalents for differing lamps

Compact Fluorescent (W)	Incandescent (W)	Minimum light output (lumens)
9–13	40	450
13–15	60	800
18–25	75	1,100
23–30	100	1,600
30–52	150	2,600

APPENDIX 9

METEOROLOGICAL DATA

A. Buerjin

Rainfall

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Total
2005	4.6	6.8	6.0	18.2	27.3	53.1	23.7	6.4	1.3	11.7	37.2	6.7	203
2006	5.9	20.6	8.9	40.9	3.9	4.9	9.4	6.9	0.5	23.6	8.7	6.6	140.7
2007	4.1	7.1	5.4	4.4	31.7	28.9	23.8	20.2	7.8	17.0	14.5	5.3	170.2
2008	4.0	2.9	5.7	20.2	0	1.	16.3	9.1	11.6	5.2	14.9	9.4	101
2009	15.5	12.1	5.9	16.4	12.4	21.4	10.1	3.6	20.6	19.4	22.9	19.1	178.9

Evaporation

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Total
2005													1534.5
2006													1567.1
2007													1540.7
2008													1752.2
2009													1464.6

Buerjin is one of 9 windiest areas in Xinjiang

Annual average wind speed greater than 6.5 m/s and maximum sustained wind speed is 28m/s with gusts of 30m/s. The wind speed of greater than 3m/s occurs for 67% of the time and sums to a total of 5500 – 6000 hrs/yr.

The wind energy resource has a total capacity of 2×10^6 kW/yr in Buerjin and the current operational resource is 995,000kW.

The annual sunshine is 2894 hours equating to an average of 8 hrs per day.

B. Habahe

Rainfall [mm]

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Total
2005	5.0	11.7	4.0	33.9	22.6	73.5	7.0	5.7	1.9	7.8	49.0	6.2	228.3
2006	10.6	17.6	9.2	48.0	11.8	3.5	2.6	14.3	2.6	46.8	10.3	7.3	184.6
2007	5.9	10.0	10.6	16.4	54.2	22.5	37.6	11.2	4.7	30.0	18.2	8.7	230.1
2008	7.8	6.1	15.8	23.6	0.2	2.9	8.5	15.1	19.3	21.5	15.5	10.8	147.1
2009	23.9	16.1	9.8	35.6	12.0	22.9	4.5	17.2	39.2	16.3	40.2	31.9	269.6

Evaporation [mm]

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Total
2005	16.2	14.0	110.2	173.1	149.3	148.1	162.2	150.0	116.1	150.4	22.4	22.5	1234.5
2006	15.0	31.3	64.6	138.0	176.4	180.0	186.0	173.5	128.0	80.5	70.9	22.8	1267.0
2007	29.9	37.5	83.5	220.9	142.4	169.4	170.8	168.4	138.6	108.9	70.8	29.7	1370.8
2008	12.5	31.3	102.8	184.7	196.5	212.0	200.2	187.4	101.8	100.2	48.8	24.0	1402.2
2009	29.7	20.5	79.3	159.2	166.1	153.0	184.9	159.7	94.7	86.9	48.7	23.6	1206.3

Net negative – [Evaporation – rainfall] [mm]

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Total
2005	11.2	2.3	106.2	139.2	126.7	74.6	155.2	144.3	114.2	142.6	-26.6	16.3	1006.2
2006	4.4	13.7	55.4	90.0	164.6	176.5	183.4	159.2	125.4	33.7	60.6	15.5	1082.4
2007	24.0	27.5	74.9	204.5	88.2	146.9	133.2	157.2	133.9	78.9	52.6	21.0	1142.8
2008	4.7	25.2	87.0	161.1	196.3	209.1	191.7	172.3	82.5	78.7	33.3	13.2	1176.1
2009	5.8	4.4	69.5	123.6	154.1	130.1	180.4	142.5	55.5	70.6	8.5	-8.3	766.7

Temperature [deg C]

2009	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jly**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
	-11.1	-15	-2.5	10.3	15.5	17.8	22.4	20.5	13.8	7.3	-4.7	-14.3	

Wind Speed [m/s]

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Max
2005	3.4	2.9	3.9	3.6	3.2	2.5	1.8	2.2	2.0	3.0	2.6	4.3	1.5
2006	3.8	4.2	3.6	3.3	3.7	2.2	2.1	2.2	2.3	2.3	3.3	4.1	14.7
2007	4.3	3.6	2.7	3.2	3.4	2.6	2.0	2.0	2.3	2.5	3.6	3.2	14.3
2008	2.7	3.1	3.3	3.2	3.1	2.9	2.2	2.6	2.2	2.6	2.7	3.8	14.4
2009	4.1	3.0	3.2	2.9	3.1	2.4	1.8	2.0	2.1	2.2	3.4	4.1	14.3

Sunshine

Year	Hours
2005	3035.7
2006	2912
2007	2951.
2008	2972.6
2009	2772.1
Average	2929

C. Jimunai

Rainfall [mm]

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Total
2005	6.8	7.9	9.9	28.4	69.7	40.3	17.2	20.9	3.2	9.2	48.0	7.0	268.5
2006	6.7	23.8	17.0	45.2	20.3	28.1	17.2	18.8	4.9	28.5	13.7	11.2	235.4
2007	15.4	12.7	15.6	14.5	58.9	23.9	50.4	12.0	9.4	16.4	18.8	9.3	257.3
2008	4.3	7.8	23.7	16.2	1.7	3.8	18.0	16.1	21.1	5.3	21.9	10.1	150.0
2009	16.6	8.3	17.1	23.1	26.5	29.4	7.5	3.7	33.4	21.7	27.6	22.2	237.1

Evaporation [mm]

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Total
2005	14.8	18.6	117.6	190.5	161.3	179.8	182.1	163.9	135.0	120.9	23.8	20.4	1328.7
2006	13.8	30.8	69.7	140.6	169.8	192.5	188.8	195.6	140.6	78.2	33.7	14.3	1268.4
2007	20.6	30.4	61.9	182.1	122.7	179.8	177.8	192.6	143.6	101.5	37.2	16.0	1266.2
2008	10.4	26.5	92.3	168.5	201.2	233.2	288.5	208.2	107.2	101.5	38.6	14.6	1490.7
2009	16.9	24.2	72.6	130.8	153.4	156.0	208.8	190.4	104.4	93.4	22.2	13.8	1186.9

Net negative – [Evaporation – rainfall] [mm]

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Total
2005	8.0	10.7	107.7	162.1	91.6	139.5	164.9	143.0	131.8	111.7	-24.2	13.4	1060.2
2006	6.1	7.0	52.7	95.4	149.5	164.4	171.6	176.8	135.7	49.7	20.0	3.1	1033
2007	5.2	17.7	46.3	163.6	63.8	155.9	127.4	180.6	134.2	85.1	18.4	6.7	1008.9
2008	6.1	18.7	68.5	152.3	199.5	229.4	270.5	192.1	86.1	96.2	16.7	4.5	1340.7
2009	0.3	15.9	55.5	107.7	126.9	126.6	201.3	186.7	71.0	71.7	-5.3	-8.4	949.8

Temperature [deg C]

2009	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	

Wind Speed [m/s]

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Max
2005	1.8	1.0	3.5	4.5	4.5	4.1	3.0	3.3	3.4	3.0	2.1	1.6	15.4
2006	1.7	2.3	3.2	3.9	4.5	3.8	3.4	3.8	3.4	2.4	2.1	1.7	16.0
2007	1.6	2.1	2.7	3.7	2.9	3.8	3.0	3.2	3.1	3.1	1.9	1.	15.0
2008	1.4	2.0	2.9	3.6	4.0	4.2	3.5	3.6	3.0	2.6	2.2	1.9	14.7
2009	1.8	2.1	2.7	3.0	3.8	3.9	3.1	3.2	2.8	2.9	1.6	2.0	13.0

Sunshine

Year	Hours
2005	2931.6
2006	2912.0
2007	2907.5
2008	2935.6
2009	2703.4

D. Fuhai

Rainfall [mm]

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Total
2005	7.3	3.0	3.1	10.0	43.2	19.5	2.2	18.1	11.4	14.8	20.0	3.0	155.6
2006	2.3	13.1	5.0	15.8	7.4	6.5	5.8	13.0	3.1	11.1	5.0	7.2	95.3
2007	2.6	5.7	2.0	7.6	18.9	23.9	2.9	37.1	15.7	22.6	5.4	6.5	150.9
2008	4.4	2.5	4.3	10.5	1.8	3.0	23.6	6.6	12.4	7.1	7.5	4.1	87.8
2009	4.2	4.3	3.3	7.5	21.2	15.6	5.4	15.4	13.0	22.4	6.9	6.2	125.4

Evaporation [mm]

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Total
2005	7.9	13.9	68.4	98.3	141.4	169.0	157.7	128.5	102.8	88.3	21.9	9.9	1008
2006	7.9	16.9	48.0	151.5	178.8	178.0	169.5	164.0	104.0	76.5	36.5	8.7	1140.3
2007	10.9	22.8	70.5	187.2	122.5	170.6	169.1	129.6	112.0	80.5	31.6	12.4	1119.7
2008	8.1	18.7	88.5	158.7	193.0	214.7	189.6	171.5	92.7	87.5	23.9	9.6	1256.5
2009	11.2	14.3	67.1	175.9	164.8	172.8	194.5	158.5	96.3	91.5	22.5	8.8	1178.2

Net negative – [Evaporation – rainfall] [mm]

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Total
2005	0.6	10.9	65.3	88.3	98.2	149.5	155.5	110.4	91.4	73.5	1.9	6.9	852.4
2006	5.6	3.8	43.0	135.7	171.4	171.5	163.7	151.0	100.9	65.4	35.5	1.5	1045
2007	8.3	17.1	68.5	179.6	103.6	146.7	166.2	92.5	96.3	57.9	26.2	5.9	968.8
2008	3.7	16.2	84.2	148.2	191.2	211.7	166.0	164.9	80.3	80.4	16.4	5.5	1168.7
2009	7.0	10.0	63.8	168.4	143.6	157.2	189.1	143.1	83.3	69.1	15.6	2.6	1052.8

Temperature [deg C]

2009	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	

Wind Speed [m/s]

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Max
2005	1.2	1.4	2.0	3.0	2.9	2.3	1.9	2.0	1.8	1.8	1.9	1.8	16.3
2006	1.8	1.8	1.7	2.9	3.2	2.5	2.3	2.2	2.0	1.7	1.9	1.9	14.8
2007	1.4	2.0	2.0	2.5	2.8	2.8	2.3	1.6	1.8	1.9	1.8	1.7	13.5
2008	1.0	1.3	2.1	2.6	2.8	2.9	2.0	2.3	1.9	1.9	1.7	1.6	11.8
2009	1.5	1.8	2.3	2.7	3.1	2.8	2.3	1.0	1.9	1.8	2.1	2.1	12.7

Sunshine

Year	Hours
2005	3130.9
2006	3015.1
2007	2943.4
2008	3073.3
2009	2896.9

APPENDIX 10

TRAINING REVIEW FORM

1. Name :_____ Sex____ Age____ Education level____

2. I think that this training is meaningful. Yes ____No ____Partly____

3. The training session was: Too long Too short About right

4. Which was the best part of the training?

5. Which was the worst part of the training?

Tell us about the instructor

5. Will you make an effort to save water in the future ?

6. Do you have an IC card water meter ? Yes No

7. Would you like an IC Card meter fitted ? Yes No

8. If No in 7 above, tell us why .....

9. Have you been convinced that the domestic container should be use for recyclables ?

10. If No in 9 above, tell us why .....

11. Have you changed all your light bulbs to low-energy type ? Yes No

12. If No in 11 above, are you now convinced to do so ?

13. Have you or will you fit a solar water heater or PV panel at your residence ?

14. If No to 13, above, tell us why .....

15. What additional material / examples would you like included in future training ?

16. Will you introduce the training contents to the people in your community ?

Yes _____No

17. If No in 15 above tell us why.....

APPENDIX 11

SOLID WASTE MANAGEMENT

SUB-PROJECTS, 3R INITIATIVES, PUBLIC AWARENESS AND TRAINING

	Activity	Purpose
(i)	*Engineering the current tipping site*	The current tipping areas are poorly defined and not engineered. The use of each site requires improved management and supervision. • The parts of the site that are no longer active can be engineered into a suitable slope by moving the waste to create a gradient, thoroughly compacted and capped to prevent infiltration of moisture; • Until the time of availability of the new landfill, to be constructed by the Project, future tipping to be divided into discrete areas: i) for rubble and building materials and similar inert wastes; ii) for organic and other waste materials. • Separation to be undertaken to remove all recyclable waste; • Asbestos wastes to be removed and separately contained; • Hospital and clinical waste to be retained in separate, temporarily fenced area, pending transport to incineration or secure burial.
(ii)	*New Landfill Engineering*	The new landfill area is to be developed in accordance with the detailed engineering designs prepared and the condition of construction contract(s) for implementation. This work will generally comprise • Fully fenced land with entrance gates and guardhouse; • New engineered sanitary landfill area with discrete areas for i) building rubble, river cobbles and similar inert materials; ii) general household and commercial solid wastes, excluding organic material; • Discrete area for future windrow composting of organic wastes; • Buildings which include on-site staff accommodation with wash rooms, waste segregation area and a vehicle/equipment storage area and a weighbridge. • Planting of trees and shrubs with drip irrigation system will provide land rehabilitation, stabilization and, eventually, a wind-break.

(iii)	*Landfill Machinery*	Provision of machinery to allow operators to undertake required tasks such as waste compaction and application of daily cover, which reduces leachate and windblown litter. This includes: • A bulldozer, compactor and dumper truck for site operation and earthworks.
(iv)	*Hospital Waste.*	Reduce potential health risks associated with poor management of clinical waste; initial investigations have shown there to be a number of issues with waste disposal from hospitals, although infectious waste does not appear to be disposed of in landfills. This includes: • Procurement of a self-contained low-technology incinerator or, where one exists, enforcing its use; or • Controlled transport arrangements to ship clinical and hazardous wastes to central incinerator (at Altay); and, if applicable • Training on incinerator use and good waste management practice.
(v)	*Landfill Plan & Operations Manual*	Improve formal management of the old and new landfill sites through: • Developing and implementing a plan for organized and efficient fill of the site, including the maximization of separation of waste types; • Developing and implementing a Landfill Operations Manual in order to help staff and Authority Directors to effectively and safely operate a modern landfill.
(vi)	*Site Investigation and Environmental Monitoring*	Improve understanding of landfill gas and leachate which may arise from the new landfill site and pose a risk to the environment and human health. The sub-project includes: • Testing of soil and groundwater samples for contaminants; • Landfill gas monitoring.
(vii)	*Waste Collection.*	Improve and extend the service throughout the town. This sub-project includes: • Renewing official agreements with businesses which currently tip their waste privately at the landfill; • Extending coverage of collection to reduce fly-tipping in residential areas; • Initiate and impose strict penalties for fly-tipping; • Separate collection facilities for recyclables and/or organics; • Outlaw the use of plastic bags or, as minimum, their disposal in solid waste; • Consideration of variable collection schedules according to season; • Use of more waste-specific containers; and • Incentivize sweepers/cleaners to separate waste and remove plastic bags and polyurethane blocks and sheets.
(viii)	*Recycling & Composting Pilots.*	Identification of the barriers to segregation of waste at source though development of pilots. This includes: • Source segregation of recyclables such as at tourist hotels, offices and schools and encourage efforts of pickers at all waste collection points across town;

		• Expand initiatives for separation of materials at households; • Identification of barriers and planning for wider implementation. • Establishing an organics composting area which initially can pilot composting the town greening and parks departments green waste. Commercial and domestic organic wastes can be added as separation improves and increases. The resultant compost can be used for site rehabilitation and soil improvement in new greening areas.
(ix)	*Waste Strategy for Recycling*	Collaboration between city and towns and consultation of stakeholders in order to: • Reduce waste disposed of to landfill; • Increase recycling through feasibility pilots; • Share best practice and experience; • Encourage the participation of private sector companies, e.g. Public Private Partnerships (PPP).
(x)	*Institutional Strengthening.*	Improve the current situation by strengthening enforcement for waste offences, develop legal mechanisms to make people pay proportionately for waste management (e.g. through local taxes), and there is no enforcement of penalties for those who transgress. This sub-project will include: • Training and capacity building; • Updating legislation and/or policies if required; • Reviewing and clarifying the tariff structure and fines; • Enforcement of new policies.
(xi)	*Market Development.*	Identification of potential PPP opportunities or industries which may be able to support the separation of recyclables. This includes: • Research around potential for recycling high value materials such as metals; • Thorough understanding of recycling markets, both informal and formal, with a view to developing robust sustainable markets for materials collected through the JWMS; • Potential for development of cottage industries to support the recyclables market and increase employment opportunities for local communities.
(xii)	*Public Awareness Raising & Education*	Improving the current a low level of awareness around waste management in order to gain support and input for waste management decisions. This includes: • Involving stakeholders in the waste strategy; • Consultation on decisions around recycling; • Education materials to show what happens to household and commercial waste; and • Education around home composting and improving soil within the domestic compound, where applicable.

1. It is recommended that the waste management interventions which are instigated during

project implementation all take place under the umbrella of a Joint Waste Management Strategy (JWMS) for the Prefecture. This should help to develop sustainable waste management practices and engender support at an institutional and community level.

2. The JWMS would be a joint approach to collection of recyclables and any future procurement of waste treatment services for the towns of Buerjin, Habahe, Jimunai, Fuhai and Qinghe. A joint working approach will offer support, shared learning and importantly economies of scale for the improvement of recycling markets. Concurrently, improved landfill management practices will reduce the risk of negative impacts on the environment and human health from waste disposal.

3. The JWMS will develop an effective waste collection system in the towns; encouraging waste segregation at source; conducting public awareness campaigns; ensuring regular collection and safe transportation of waste; developing safe solid waste processing and disposal facilities, and developing appropriate waste reprocessing facilities where possible (preferably on public private partnership mode) to reduce the amount of waste to be dumped in landfill.

APPENDIX 12

DETAILED COSTS FOR COMMUNITY AWARENESS AND TRAINING

Project	Cost (Yuan/Person /Time)	Awareness Raising and training times (days)	Number of Persons	Total cost (Yuan)	Notes
Travelling Expenses				**5880**	
Urumqi—Buerjin	200	3	3	1800	
Urumqi—Buerjin	200	3	3	1800	
Buerjin—Habahe	20	2	3	120	
Habahe—Jimunai	30	2	3	180	
Jimunai—Fuhai	50	2	3	300	
Fuhai—Qinghe	80	2	3	480	
Qinghe—Urumqi	200	2	3	1200	
Accommodation Expenses				**6600**	
Buerjin	200	3	3	1800	
Habahe	200	2	3	1200	
Jimunai	200	2	3	1200	
Fuhai	200	2	3	1200	
Qinghe	200	2	3	1200	
Training Support Remuneration				**29700**	
Buerjin	900	3	3	8100	150Yuan/day,6 days for each county
Habahe	900	2	3	5400	
Jimunai	900	2	3	5400	
Fuhai	900	2	3	5400	
Qinghe	900	2	3	5400	
Communication Expenses				**1200**	
Communication Expenses	100	3	4	1200	Training Assistants and PMO Staff
Workshop Room Hire Fee				**11000**	
Buerjin	1000	3		3000	
Habahe	1000	2		2000	
Jimunai	1000	2		2000	
Fuhai	1000	2		2000	
Qinghe	1000	2		2000	
Banners / Sign Board				**3000**	
	600	5		3000	
Materials				**132500**	
Publishing promotional materials expenses	3000	3	5 counties	45000	
Fruit and Water at Workshops	500	3	5 counties	7500	
Recyclable Waste Bins					8 Yuan per rubbish bin)
Habahe/Jimunai/Fuhai/Qinghe	4000			32000	token 1000/town
Buerjin	6000			48000	6000 for Buerjin
Expenses for Transporting Waste Bins	400	0		400	
Adhesive stickers	10000	1		10000	
Service Expenses for PMO Staff - incl in Government Financing				**9900**	
Buerjin	150	3	7day/per	2700	150 Yuan/day,6 days for each county)
Habahe	150	2	7day/per	1800	
Jimunai	150	2	7day/per	1800	
Fuhai	150	2	7day/per	1800	
Qinghe	150	2	7day/per	1800	
Publicity Expenses				**16500**	
Buerjin	1500	3		4500	
Habahe	1500	2		3000	
Jimunai	1500	2		3000	
Fuhai	1500	2		3000	
Qinghe	1500	2		3000	
Contingency				**26750**	
(Total)				**243030**	
				US$	**36000**

APPENDIX 13

OUTLINE TERMS OF REFERENCE FOR CONSULTING SERVICES

A. General

1. In addition to domestic consultants and local design institutions, up to 5 person-months of international consulting input may be required over the five-year implementation period to:

   (i) Contribute to the successful planning, design and implementation of the 3R and renewable energy components of the Project through the provision of support to PMU, IAs and PIUs;

   (ii) Provide capacity buildings of the concerned agencies: strengthen the planning, engineering, management and financial capabilities of the IAs and PIUs through institutional development by way of on-the-job and external training;

   (iii) Assist in the monitoring of environmental, social and financial commitments.

B. Scope of Services

2. As the consultant will not be a prime operator and all proposed solutions must be fully supported by the agencies and units, the assignment of the consultants should include a strong consultative process and then proceeded into the following phases:

   (i) Wide discussions with the management, staff and stakeholders concerned leading to strategic project implementation procedures, agreed to by all and documented in a strategy paper;

   (ii) A specific action plan which defines in detail how the envisaged 3R and renewable energy goals would be achieved, including an implementation schedule with assigned responsibilities, outline of training needs and procurement of equipments, as needed (cost estimates, specifications, acquisition schedule);

   (iii) Implementation of the tasks in accordance with the plan of action; and

   (iv) Certification of task completion. i.e. new systems or processes are fully transferred to operations and consulting assistance is no longer required.

   The phasing of the assignment should allow for intensive interaction between the consultant, the operating agencies and stakeholders.

C. Main Activities

3. The consultants will advise and assist in undertaking the following tasks:

   (i) Assist the IAs with the preparation and implementation of national shopping (NS) contract procedures and analyses in accordance with ADB’s Guidelines for Procurement;

(ii) Assisting the IAs in reviewing the detailed design for solar water heating and street / access road lighting and identifying potential problems;

(iii) Reviewing technical specifications and bid documents for water heating, road lighting and solid waste operators' equipment to be purchased; make necessary adjustments to documentation;

(iv) Advise the local government departments on implementing and policing the compliance with State regulations concerning the collection and safe disposal of itemised solid waste materials; prepare detailed operational procedures and a quality assurance checking system to be implemented;

(v) Preparation of Solid Waste Management Procedures and Operation Manual incorporating and detailing all operational functions required of the department at all levels and including management, finance and accountancy, procurement, maintenance of assets, operation of transfer stations, waste transportation, landfill operations, response procedures for emergency situations, implementation and responsibilities of Joint Solid Waste Management Association and procedures and activities for the safe closure of the existing waste dumping areas;

(vi) Preparation of a full water demand management strategy and implementation schedule with associated records database and inputs into the Project Performance Monitoring System (PPMS); this will, *inter alia*, involve all aspects of resource planning, supply and consumer metering, valving of supply zones, active leakage control and tariff adjustment as listed in Appendix 6a herein but expanded to suit the specific requirements of each water supply network;

(vii) Assist IAs in organising a comprehensive sewer infiltration survey with itemized quantitative recording of all deficiencies detected and a costed schedule of prioritized remedial actions required; the unit cost of wastewater treatment will be used to determine the priority and cost-benefit of any remedial works identified;

(viii) Assist IAs in preparation of their annual budget to include for sustaionable operation and maintenance of renewable energy components and the activities required under 3R; and

(ix) Specifically, prepare a plan to optimize interface of solid waste community centre operation and waste transport so that improvement of efficiency in solid waste transportation under the Project will be ensured.