

Strategic Development Framework for Creating a Sustainable Business and Residential Neighbourhood (SBRN) in a Disused Cement Factory in Philippi, Cape Town



Prepared by:

Sustainability Institute
Jo Noero Architects
Interactive Development Systems (Project Management)
Agama Energy
Genesis Eco-Energy
De Villiers and Hulme Civil Structural Engineers
Triocon Electrical Engineers
CP De Leeuw Quantity Surveyors
E-Systems (Netherlands)
Chris Posma (Netherlands)
Council for Scientific and Industrial Research

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Acronyms

BAT	British American Tobacco
BPP	The Business Place, Philippi
Capex	capital expenditure
CBO	community-based organisation
CDF	Conceptual Development Framework for BPP
COURC	Community Organisation Resource Centre (formerly Community Organisation Urban Resource Centre)
Devco	development company
EWSSCO	energy and water and sanitation services company
FEDUP	Federation of the Urban Poor
LPG	liquid petroleum gas
NGO	non-governmental organisation
POA	property owners' association
PV	Photovoltaic
RED	regional electricity distributor
RED1	Regional Electricity Distributor 1 [for the Cape Town area]
SBRN	Sustainable Business and Residential Neighbourhood
SDF	Strategic Development Framework
SMME	small, medium and microenterprise
SWH	solar water heating

1 Background

1.1 Context

This Strategic Development Framework (SDF) is a proposal for recycling the ruined grounds and derelict buildings of an abandoned cement factory in Philippi, Cape Town into a Sustainable Business and Residential Neighbourhood (SBRN). The 12ha property, known locally as ‘the old cement factory’, is owned by The Business Place Philippi (BPP), a Section 21 company¹ established by two large companies and two NGOs: Investec Bank, British American Tobacco (BAT), the Sustainability Institute, and Abalimi.² Investec leads this multi-stakeholder initiative dedicated to development via empowerment of communities through encouraging entrepreneurial activity. Philippi is one of several ‘Business Place’ sites in major South African urban centres, but it is unique in that it includes tracts of neglected land and several historic buildings.

In November 2005 the BPP Board adopted a Conceptual Development Framework (CDF) to develop the site as an SBRN. This has been further developed into an SDF with the following purposes:

1. To describe the SBRN that has been designed for construction on BPP property.
2. To provide the relevant government authorities with a preliminary strategic concept of the proposed development as a basis for further discussion and joint planning.
3. To provide a basis for meaningful interaction with networks of local business and community-based organisations (CBOs) active in the Philippi area that have an interest in the SBRN satisfying as many local needs as possible (without assuming that all needs can be satisfied).
4. To describe the type and scale of investment required to realise this vision for further discussion with potential investors.

The design for the site is intended to meet two major criteria:

- Local requirements for entrepreneurship, commerce, agriculture, housing and community development.
- Sustainable resource use, namely that the energy, waste, water, construction and operating systems must be designed to significantly enhance biodiversity and reduce the consumption of natural resources.

1.2 Design principles

The following design principles were adopted as a guiding framework for the development:

1. Entrepreneurship, equity and fair trade at all levels (global, regional and local).
2. Satisfying fundamental human needs and promoting the reduction of inequalities.
3. Valuing authentic cultural diversity, community solidarity, child-centred activities and citizen participation.
4. Being in transition to renewable energy alternatives and energy efficiency.
5. Zero waste via re-using all waste outputs as productive inputs.
6. Sustainable transport, with a major focus on public transport.
7. Sustainable construction materials and building methods.
8. Local and sustainable food.
9. Sustainable water use and re-use of treated sewerage.
10. Enhancing biodiversity and the preservation of natural habitats.
11. Health, well-being and soulfulness.
12. Democratic and effective governance.

The design principles have been developed by the Sustainability Institute over the past three years through applied and academic research work related to the design and construction of sustainable urban systems. The principles described above have been used to define specific objectives that need to be achieved through the design of physical structures and infrastructure, the facilitation of social processes, and energising the local economy from below by an entrepreneurial approach (see Section 2.6 for the summary statement).

¹ A non-profit company registered under Section 21 of the Companies Act.

² Abalimi is the Xhosa word for ‘farmers’.

The emerging conception of the SBRN is the outcome of the confluence of two processes: the first is referred to above, namely a vision of sustainable urban living and the principles that should guide the way this is achieved; the second is via close interaction with the local community. The two go together – one makes no sense without the other. Vision and principles without close interaction with community needs results in idealistic planning-driven developments that fail when challenged by the opposing community dynamics. Relying purely on the articulated needs of communities can result in the entrenchment of conventional approaches that communities are familiar with. We believe in maintaining a creative tension between community needs and a vision based on a clearly-defined set of sustainability principles. In this regard the Federation of the Urban Poor (FEDUP) and the Community Organisation Resource Centre (COURC)³ – which is the NGO that supports FEDUP – have agreed to work in partnership with BPP to realise the SBRN vision. FEDUP and COURC have mapped out a community participation process that will be implemented during the next phase of planning. FEDUP will identify groups of well-organised homeless people in the Philippi area who will participate in the gradual development of the final plans, and eventually set up the infrastructure required to support the community-based housing process. Preliminary meetings have generated very positive responses from FEDUP/COURC representatives, in particular the design for high-density housing.

1.3 Project summary

For the moment the project can be conceptualised as comprising five components, namely:

1. The energy, water, waste, road and stormwater infrastructure which will cost R28 million to construct.
2. The property, which has been valued at R12 million.
3. An integrated mixed-use commercial and community area located within a cluster of renovated and new buildings which will cost R55 750 000 to construct (including a 55% contribution to the property value and to the total infrastructure cost), of which R2.2 million has already been raised and spent on existing renovated buildings.
4. An intensive commercial agricultural area (5ha) which will cost R4 million to establish (excluding a 5% contribution to the property value and infrastructure cost) and will include an organic demonstration and training farm.
5. A residential area comprising 350 housing units that will cost R78 million (including a 45% contribution to the property value and the total infrastructure cost), including a 500m long pedestrian boulevard, bounded by shops and bazaars of various descriptions, with live-above, work-below accommodation.

The total construction cost (which includes provision for price escalation) is estimated to be R138 133 553.

Integrated mixed-use area

The integrated mixed-use commercial and community area will comprise the following (excluding contributions to property value and infrastructure costs):

- The *existing office block* which has already been renovated at a cost of R1.2 million.
- The *meeting and training hall* which has already been renovated at a cost of R200 000.
- *Offices for the urban agriculture NGO* (Abalimi) and related entrepreneurs: R500 000 (grant funding that has already been raised).
- A *packhouse* for packaging vegetables grown locally for the market: R300 000 (grant funding that has already been raised)
- An *amphitheatre* for performances and public meetings: R300 000.
- A *courtyard space* near the amphitheatre for markets and arts/crafts: R100 000
- *The White House* for office and business services accommodation: R6 million.
- *The Round House* for office and business services accommodation: R1 million
- A *renovated bulk steel structure for multi-purpose use* including a market, arts/craft production, small-scale manufacture, education and training: R20 million.
- *Renovated 6-set silos* for advertising space and other purposes: R2 million.
- *Renovated 4-set silos* for various purposes: R100 000
- The *main reservoir* for water storage: R100 000.

³ Formerly the Community Organisation Urban Resource Centre.

- A *renovated ablution block*: R300 000.
- A *storage room* for farming equipment: R30 000.
- *Storage tanks* near the amphitheatre that must be demolished: R20 000.
- *Parking facilities* for Business Place and tourist buses: R1 million.

The abovementioned physical structures will make spaces for flourishing entrepreneurial and social activities, *inter alia*, the following:

- A *'farmer-to-fork' market*, bringing organic farmers and consumers together in one place, thus increasing the returns that the farmers receive and reducing the purchase prices for the consumers.
- Space for *value-add manufacturing businesses*, working alongside the primary production role of the farm.
- An *arts and crafts village*, where products are manufactured and sold on site.
- An *early childhood development (ECD) centre*.
- A *recycling operation*, collecting household waste not only from the proposed houses, but also from the surrounding communities.
- An *energy and water and sanitation services company* (EWSSCO) to service the needs of the residents.
- A *tourism hub* where visitors can experience local fare and crafts in a secure environment, either as a stop-over for their 'township tours' or as a dedicated visit to the site (including accommodation).
- A *'great ideas' college*, feeding into the *entrepreneurial information centre*.

At this stage it is envisaged that the approximately R55.7 million that will be spent on the construction of the integrated mixed-used area and structures (including contributions to infrastructure and property value) will create assets that will not be sold. Instead, they will be retained and used to generate a long-term annuity income. It has been assumed that rental income will cover financing costs and capital redemption for the first ten years if the cost of capital can be pegged at 9% over a ten-year redemption period.

Residential area (including pedestrian boulevard)

The envisaged expenditure of R78 million to construct this area will result in the following (all prices include contributions to infrastructure costs and property value):

- 120 x 56m² double storey houses that will each cost R101 864 and sell at R328 000.
- 88 x 32m² houses that will each cost R20 576 and sell at R60 000.
- 88 x flats (varied between 30m² – 50m²) that will cost on average R24 322 and sell at R105 000.
- 54 x 47m² houses that will each cost R37 293 and sell at R184 000.

It has been assumed that these residential units will be sold against a regulated freehold title. At least a third will be built by the buyers themselves in accordance with the 'people's housing process'⁴ methodology and using government housing subsidies. The remainder will be contractor built for buyers who do not qualify for a housing subsidy. The FEDUP/COURC group will help facilitate the people's housing process.

There are in-built cross-subsidies in the above set of arrangements. Firstly, some of the smaller houses designated for lower-income families will cost less per square metre than some of the higher income houses. Secondly, the residential area is carrying 45% of the land and infrastructure cost for the whole development, whereas the commercial developments will carry 55% of the land and infrastructure cost of the development.

All the houses will be built in accordance with ecological design principles, including north-south orientation, effective insulation, solar water heating, low-energy lighting, liquid petroleum gas (LPG) stoves for cooking, energy-efficient home appliances, and low-impact non-toxic building materials.

⁴ The 'People's Housing Process' (PHP) is the official term given to a specific approach to housing delivery that excludes private sector developers. In essence it involves the direct transfer of housing subsidies to an organised group of homeless people, often supported by some kind of NGO support organisation. The houses are built by the beneficiaries often using free family labour, and subsidies are spent almost exclusively on building materials. Land in most cases is made available at no cost to the beneficiary. Although initially developed by NGOs, the PHP process was taken over by the state in the 1990s after which it went into decline. Under the new housing policy known as 'Breaking New Ground', PHP has been revived. In 2006 a landmark summit took place between the Minister of Housing and the Federation of the Urban Poor at the end of which the Minister pledged R185 million in housing subsidies to support a PHP process designed and driven by FEDUP.

Infrastructure

The R28 million expenditure to provide infrastructure for the entire site taking into account current and future expansion needs will result in the following:

- A *supply of potable water from the municipal bulk water supply* which will be used for all normal purposes excluding toilet flushing and irrigation, and based on the assumption that all residential and non-residential facilities will be fitted with water saving devices.
- A *rainwater harvesting system* that will capture and supplement the municipal water supply – this will not be an individual house approach, but rather a site-wide approach to ensure affordability, possibly using an infiltration and aquifer management approach.
- An *on-site sewage treatment system* that will treat all black and grey water on site, re-using the treated water for toilet flushing and the sludge for capturing nutrients via composting and biogas extracted through biogas digesters. The exact selection of the mix of on-site treatment technologies will be made during the next phase of the design and planning process.
- A *stormwater drainage system* that maximises water capture from the site.
- A *road infrastructure* that meets design requirements, but which is pedestrian and cycle friendly (and therefore not car friendly).
- An *energy infrastructure* that connects all facilities to the electricity grid, but with an underground cabling infrastructure that assumes that water heating and cooking requirements will not primarily be met using grid electricity, plus maximum use, where economically feasible, of solar, wind and biomass on-site generation opportunities.
- *Solid waste* will be separated on site, recycled for use on site where possible, with the remainder sold to recyclers – there will be no need for municipal recovery to landfill.

It is important to note that by not discharging sewage into the municipal system, it should be possible to obtain a waiver of bulk connection fees to the municipal sanitation system. Similarly, Eskom pays an offset fee to those who meet their energy requirements using off-grid measures. These, plus other similar mechanisms, will help finance any extra costs that the application of sustainability criteria might generate. As already noted, 55% of the cost of the infrastructure will be carried by the integrated mixed-use area plus the farm, and 45% will be carried by the residential area.

Farm

This will be developed as a working, and profitable, training and demonstration farm. BPP will work closely with Abalimi and its networks to further develop the business plans for this project. The entrepreneurial assistance centre already operating on the property attracts local residents who have land either in their traditional home areas of the Eastern Cape, or are looking to enter agriculture. When the vision of a sustainable neighbourhood for the site is added, it is clearly vital that a space be set aside for agriculture. The funding for the farming operation will be raised as part of the total capital requirement for the development. This means that the farming operation is effectively cross-subsidised by the remainder of the development. This is probably the only way to make the farming operation financially viable.

As far as institutional and governance arrangements are concerned, the following will apply:

- The property is currently owned by a non-profit company called The Business Place Philippi.
- A new company will be required to act as the developer – the so-called Devco.⁵
- Once construction of the residential component is complete, the owners will be required to establish a property owners' association (POA) for managing their assets, social relations and gardens.
- Non-residential owners and renters will be required to join a business association to co-manage the assets, shared spaces and social relations.
- Trade union membership will be encouraged.

⁵ Development company.

2 First phase

2.1 The site and the opportunity it represents

Set on the Cape Flats some 25km east of Cape Town, the property has a diverse history. In the early 1900s it was part of a vegetable and dairy farm and in 1938 a large cement factory was built on the site. The factory provided the concrete for much of Cape Town's infrastructure, including its harbour walls. Abandoned in 1978, the few remaining factory structures form part of a heritage site. For instance, a huge 200m long, 10 storey high steel-frame structure is an icon of early industrial history of Cape Town. The suburb of Philippi is the largest in the metropolitan area, and it incorporates farms, industrial areas, informal and formal housing and commercial shopping centres. Philippi is inhabited by approximately 250 000 people, most of whom are among the poorest households in Cape Town.

Around the BPP property dense informal and formal settlements have mushroomed. In principle, it has been accepted that development cannot be seen in isolation. It is not the intention to develop a classic South African 'walled suburb', but rather to involve the surrounding population in design decisions they can participate in. The development team began by looking beyond the property itself.

Cape Town as a city is struggling to define a functional integrated development plan for itself. It has developed in an ad-hoc fashion for decades. Public transport is poor and the roads barely cope with the strain of the only reliable mechanism for mass transport – the private car. Heavily reliant on oil as an energy input for transportation, the city would grind to a halt if bulk oil tankers failed to berth on time at the terminal some 80km to the north. The oil supply is likely to become unreliable in the future. A single overloaded electricity transmission cable transmits Cape Town's energy from Mpumalanga's coal-fired power stations, and a local nuclear power plant provides an unreliable support supply. Landfill sites and cemeteries are reaching capacity, and water supplies are set to be exhausted by 2025. A full 50% of the effluent discharged into the sewers never reaches the overloaded treatment plants because it leaks from the disintegrating pipeline systems. No-one believes that Cape Town as it is currently configured is sustainable. And yet, there is little evidence that urban developers are utilising sustainable approaches which have been tried and tested elsewhere in the world.

Given this background, the idea of a 'sustainable neighbourhood' on the BPP site was the logical solution. In September 2005, the eight directors of BPP signed a resolution, paving the way for the first-phase design of the sustainable business and residential neighbourhood.

2.2 Initial funding

The Business Place Information Centre and offices for tenants

In September 2005, BPP owners raised the first tranche of grant funding for developing an entrepreneurial assistance centre, with office space for like-minded tenants and training facilities. Refurbishment capital was provided by BAT and Investec. The full list of assets for effective use of this funding were:

- Offices for The Business Place Information Centre at a capital cost of R200 000.
- Offices for various NGOs and businesses, at a capital cost of R1 200 000.
- A meeting hall that cost R200 000 to refurbish. This hall was originally the building that housed the power transformers for the massive machinery on site.
- A greening programme and 15m deep borehole to provide irrigation water.
- Formalisation of a 50-bay parking area.
- A palisade security fence to define what will become a thriving business campus, including an amphitheatre for cultural events and open-air meetings.

Already, the local community has benefited from the services provided by The Business Place Information Centre and co-located tenants, with the adjacent area suddenly coming to life after 30 years.



Figure 1: Before and after: The Business Place Information Centre and offices for tenants

The Amphitheatre

This wonderful asset may immediately be put into use for an array of activities, but some investment would enhance its appeal. Already, the local public has requested permission to use it for staging small jazz concerts. A local church that hires the hall on the weekends has used the open air venue on several occasions when the weather has been good.

The amphitheatre can be transformed into a high-usage indoor/ outdoor arena that simply does not exist anywhere else on the Cape Flats. It has the ability to be a central point in the business zone area, with a farmers' market, training halls, business assistance centre and open courtyard all within a few metres.



Figure 2: The Amphitheatre

2.3 The development company (Devco)

It is envisioned that The Business Place Philippi will sign an agreement with a separate development company (Devco) for development rights on the remainder of the property. In the business zone of the development (as opposed to the residential, agricultural or trading zones), much of what will be developed will dovetail with the entrepreneurial framework already established by the Information Centre. Devco will be responsible for securing the R3 million required to develop the asset base on the agricultural portion of the land. It will also assist with the financing of the residential areas and potential trading zones.

2.4 The Conceptual Development Framework

The Sustainability Institute, in partnership with E-Systems Foundation (Holland) used the first document produced – a Conceptual Development Framework – to raise grant funds from the Dutch funding agency Cordaid for the purpose of appointing a design team to develop an initial strategic plan for the sustainable neighbourhood vision.

2.5 The Strategic Development Framework

This Strategic Development Framework is the product of the work that began in November 2005, and the outcome of the grant funds provided by Cordaid.

The strategic planning stages can be summarised as follows:

- Stage 1: November 2005–August 2006: Completion of this SDF.
- Stage 2: August 2006–November 2006: To use this document to secure commitments from various funding and financial organisations, including funding to complete and submit the rezoning and development plan to the Cape Town City Council.
- Stage 3: December 2006–April 2007: Completion of the rezoning and development plan, including submission.
- Stage 4: May 2006–October 2007: Acquisition of all the required approvals for development.
- Stage 5: November 2007 onwards: commencement of construction.

The professional team that produced the reports that were used as the basis for this integrative report comprised the following:

- Sustainability Institute.
- Jo Noero Architects.
- Interactive Development Systems (Project Management).
- Agama Energy.
- Genesis Eco-Energy.
- De Villiers and Hulme Civil Structural Engineers.
- Triocon Electrical Engineers.
- CP De Leeuw Quantity Surveyors.
- E-Systems (Netherlands).
- Chris Posma (Netherlands)

2.6 Summary

It is fully acknowledged that the development vision and strategies that lie at the heart of this business plan could change in many respects as a result of interactions with the networks of Philippi-based CBOs (in particular FEDUP's various formations), the funding and financial institutions, and relevant government authorities. Our intent here is to provide a design vision as a starting point inspired by the design principles. The final outcome will embody the interaction between this design vision, stakeholder engagements and the requirements of the funding and financial institutions. Various funding scenarios are possible, including phasing options, and different ways of mixing debt, equity and grant funding to achieve specific objectives.

The development vision is a Sustainable Business and Residential Neighbourhood that demonstrates in practice that residential spaces need to be embedded in local economies driven by entrepreneurship, and, that this can be done in ways which sustain rather than degrade or inefficiently over-consume natural resources. The SBRN on the grounds of the old cement factory will comprise the following:

- The facilities that have already been constructed are described above: *The Business Place Information Centre including offices for tenants*, and the preliminary development of the *amphitheatre*.
- 350 units for *housing unites*, comprising various accommodation types that can potentially satisfy a range of housing needs - a deliberate choice has been made to meet a range of housing needs in order to foster social integration and cohesion within an economically viable neighbourhood.
- A 50-unit *rental stock* of flats and small commercial units.
- Upgrading the existing 180 000m³ '*shed*' for various commercial, sporting and community purposes.
- A 500m long *pedestrian boulevard*, bounded by shops and bazaars of various descriptions, with live-above, work-below accommodation.
- 5 hectares of intensive *urban agriculture* with an organic demonstration and training farm.
- A '*farmer-to-fork*' market, bringing the organic farmer and the consumer together in one place.

- Space for *value-adding manufacturing businesses*, working alongside the primary production role of the farm.
- An *arts and crafts village*, where products are manufactured and sold on site.
- An *early childhood development centre*.
- A *recycling operation*, collecting household waste not only from the proposed houses, but also from the surrounding communities.
- An *energy and water and sanitation services company* to service the needs of the residents.
- A *tourism hub* where visitors can experience local fare and crafts in a secure environment, either as a stop-over for their ‘township tours’ or as a dedicated visit to the site.
- A ‘*great ideas*’ college, feeding in to the Entrepreneurial Information Centre. See Addendum.
- *Other buildings* of various sizes and descriptions, as detailed in Table A.

3 Driving forces

3.1 Financially viable neighbourhoods

Over the past ten years, property developers and municipalities have rarely attempted to integrate richer and poorer sections of the community into financially viable neighbourhoods. Instead, rich security enclaves have tended to emerge on one side of town, while sprawling financially unviable low-income townships have emerged on the other. Ironically, government housing subsidies tend to foster the latter because these subsidies favour cheap land (because cheaper land means more can be spent on the top structure). At the same time, municipal infrastructure spending has tended to follow private developers in the hope of enlarging the tax base to recoup revenues for dealing with backlogs in low-income areas. Like in many other parts of the world, it is necessary to integrate richer and poorer parts of the market in order to promote more robust housing markets and to ensure that the subsidised assets created by government subsidies translate into significantly higher values than would be the case if these assets were created in spaces where demand is low and therefore values are low. Furthermore, to locate poor families on the outskirts of the cities means they must use up scarce resources on ever-rising transportation costs to get to work. The Philippi project will demonstrate that it is possible to build a financially viable neighbourhood that integrates richer and poorer people. However, overall it is clearly the primary intention of the project to make sure that it is able to at least break even, i.e. that revenue from sales plus the annuity income will cover the up front capital investments costs, and that fees and levies payable by residents, businesses and organisations will cover ongoing operational and maintenance costs. Nevertheless, there will be components within the Philippi development that will be cross-subsidised by others. This includes cross-subsidies of lower-income housing by higher-income housing, and the cross-subsidy of the residential component by the commercial component of the development.

3.2 The planning context

A number of national, provincial and local government policy and planning frameworks have been used by the authors. It is suggested that the relevant authorities take these into account when they review this development application.

It is appropriate to start with a definition of sustainable development adopted by the Provincial Government of the Western Cape (PGWC):

For the Western Cape Province, sustainable development will be achieved through implementing integrated governance systems that promote economic growth in a manner that contributes to greater social equity and that maintains the ongoing capacity of the natural environment to provide the ecological goods and services upon which socio-economic development depends.⁶

The most relevant strategic, policy and planning frameworks are described below.

International

1. *Millennium Development Goals*. Annual reports prepared by the government since 2000 commit South Africa to achieving poverty reduction within a sustainable development framework.
2. *Johannesburg Plan of Implementation (JPOI) and reports of the Commission for Sustainable Development*: The JPOI and annual reports prepared for the Commission since the World Summit on Sustainable Development in 2002 commit South Africa to a wide range of sustainable development objectives, with special reference to local development planning.
3. *The Environmental Initiative of the New Partnership for Africa's Development (Nepad)*.
4. *The Biodiversity Protocol*.

National

1. *The National Strategy for Sustainable Development (NSSD)*, approved by the Cabinet in 2006. The five priority areas of the NSSD are:
 - a. Sustaining our ecosystems and using resources sustainably.

⁶ Page 2, Western Cape Provincial Development Council & Department of Environmental Affairs and Development Planning. 2005. *Towards a sustainable development implementation plan for the Western Cape: Concept paper on sustainable development May 2005*. www.capegateway.gov.za/Text/2005/8/sdip_august05_eadp.pdf (Accessed 10 September 2006).

- b. Investing in sustainable infrastructure.
 - c. Creating sustainable communities.
 - d. Enhancing systems for integrated planning.
 - e. Building capacity for sustainable development.
2. *The Accelerated and Shared Growth Initiative for South Africa (ASGISA)* which commits government to the notion of a 'developmental state', i.e. a lead role for the state in the development process rather than leaving everything to the market and the private sector.
 3. *The Accelerating Economic Growth Strategy* prepared by National Treasury (June 2005) which states that one of the six obstacles to accelerated economic growth is an 'inefficient urban landscape and under-development of low-income residential areas'.
 4. *Breaking New Ground*, which is the National Department of Housing's overarching policy framework. This which makes explicit the need to design and build socially mixed communities that foster poverty eradication, include mixed use areas, and take into account sustainability.
 5. *The National Spatial Development Perspective*, which promotes densification and the need to ensure that public investments promote economic growth.
 6. *The National Environmental Management Act* and the *National Environmental Management: Biodiversity Act*: which strengthen the biodiversity conservation framework.
 7. *The White Paper on Renewable Energy* (2003) and the *Energy Efficiency Strategy for South Africa* (2005) which commit South Africa to renewable energy and energy efficiency strategies that must be translated into local development planning with respect, in particular, to the use of solar power, wind and biomass (including biogas, biofuels, etc.).
 8. *The White Paper on Integrated Pollution and Waste Management* (1998) and subsequent updates and reviews, which focus attention on the need for local governments to commit themselves to a recycling approach to waste management.
 9. *The Air Quality Act* which makes various commitments and regulations to ensure cleaner production and consumption in line with the JPOI.
 10. *The National Water Resources Strategy* (2004) which makes it clear that, in order to prepare South Africa for water scarcity as demands for water arising from population and economic growth outstrip available supply, development plans must build in water saving and recycling technologies.
 11. *The National Sustainable Development Strategy* which was triggered by the call in the Presidency's Ten Year Review for a 'framework of encompassing interest'. Cabinet has approved the need to formulate a national strategy that integrates the economic, social and environmental policy clusters at all levels of government in order to ensure that development meets the requirement in Section 24(b) of the Constitution which states that government must 'secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development'.

Provincial

1. *The Draft Western Cape Provincial Spatial Development Framework* (PSDF) which provides a set of spatial guidelines for the future development of the Western Cape, with special reference to how this can be done in accordance with sustainable development principles and criteria.
2. *The Western Cape Planning and Development Act*, in particular Chapter 1 which prescribes various norms and standards for integrated planning and the achievement of sustainable development.
3. *The Bioregional Planning Policy for the Western Cape* (2003) which makes explicit the need to prepare integrated development plans (IDPs) and local development plans in accordance with sustainable development principles, and bioregional planning principles in particular – the distinctions between 'core' conservation areas, 'buffer zones' such as agriculture and 'transition zones' where human settlements are located apply perfectly to the CDF proposed in Section 4.
4. *iKapa Elihlumayo, Home for All* and the Provincial Growth and Development Strategy, when read together call for development strategies that promote job-creating economic growth, poverty eradication and social integration.

5. The *Draft PSDF* situates the economic and social development goals within a spatial context and well developed ecological sustainability framework, including a clear call for densification, bringing the poor back into the city, and extensive use of sustainable design approaches.
6. The *Integrated Energy Strategy and Programme for the Western Cape* which explicitly commits the Western Cape to a gradual transition to renewable and affordable energy solutions.
7. The *Provincial Housing Policy* which explicitly commits the Western Cape to the ‘integrated sustainable human settlements’ framework, including the need for socially integrated mixed-use settlements that promote sustainable development.
8. *The Sustainable Home for All: Now and Forever Declaration of Intent* adopted at the PGWC’s Sustainable Development Summit held on 22 June 2005 included a declaration of intent to develop a Sustainable Development Implementation Plan for the Western Cape which referred specifically to the Oude Molen eco-village as potential lead project and expressed the following guiding principles for all planning in the Western Cape:
 - a. Promoting greater equity in wealth and land distribution.
 - b. Satisfaction of fundamental human needs.
 - c. Job creation through economic development and investment strategies.
 - d. Incorporation of biophysical and ecological limits in planning and decision-making.
 - e. Conservation and sustainable use of biodiversity and other natural resources.
 - f. Sustainable living within peaceful economically viable communities.
 - g. Recognition of the innate cultural beauty and spiritual healing value of nature for all.
 - h. Adoption of the precautionary principle in decision-making.
 - i. Internalisation of environmental and social costs in the design and operation of production and consumption systems.
 - j. Co-operative governance through vertical and horizontal co-ordination.
 - k. Promotion of partnerships between social partners.
 - l. Promotion of access to information, transparency, and accountability.
 - m. Empowered participation by civil society.
 - n. Promotion of environmental, social and economic justice.
 - o. Ongoing monitoring, evaluation and reporting.
 - p. Promotion of education and capacity building for sustainable development.
 - q. Mainstreaming sustainability principles into all policies, plans and decision-making.

Local

1. The *Integrated Development Plan for Cape Town*, which calls explicitly for socially integrated mixed use developments, and the strategic use of public assets for bringing the poor back into the city coupled to an environmental management plan that conserves biodiversity and public open space.
2. The *Cape Town Energy Strategy*, which commits Cape Town to far reaching renewable energy targets, strategies and approaches.
3. *Draft by-laws on green buildings* which will provide the parameters for sustainable construction.
4. The *Water Demand Management Strategy* (2005) and *Sewerage Treatment Investment Plan* which makes it clear that water efficiency will have to be a key part of all future development plans and that recycling will become a necessity.
5. The *City Development Strategy* which, although still being drafted, is clearly going to commit Cape Town to promoting intensive urban development, densification, social integration and mixed use.

3.3 Footprinting

Using the increasingly popular quantitative measurement known as ‘ecological footprinting’, it has been estimated that South Africa’s footprint is 4.02ha per person. ‘Footprinting’ is an accounting tool used by governments, city administrations, businesses and individuals throughout the world to measure how much biologically productive land is required to support the living standards of an individual, a city or a country. This includes the land required to produce

the physical resources consumed (food, building and packaging materials, fuels, water, clean air, etc.); absorb the wastes generated (liquid, solid and airborne), and sequester CO² emissions associated with energy demand (by planting forests etc.). As economies expand to support a growing population, more and more of the earth's resources are required when it is a proven scientific fact that these resources are finite. The World Wildlife Fund estimates that the global 'fair share' is 1.8ha/person, if we are all to live within the carrying capacity of the planet's ecosystems. This means that if everybody lived like the average South African, we would need two planets like earth to be able to live sustainably. This average, however, masks gross inequalities. A recent study of Cape Town found that the footprint of some of Cape Town's richest suburbs (which make up 16% of all households) was so large that 14 planets would be required if everyone lived like people in Camps Bay and Constantia. This is higher than the average United States footprint (5.2 times the carrying capacity of the planet). The footprint of Cape Town's middle class suburbs (31% of households) is 5.4 times the carrying capacity of the earth, and the footprint of the poor suburbs (53% of households) is less than 1 planet (similar to averages in India and Bangladesh). Poverty eradication means poor households must get access to a greater proportion of their fair share. However, it is highly unlikely that there are sufficient financial and natural resources to achieve this goal if the footprint of the rich remains so large, inefficient and costly to maintain.

3.4 *Moving from context to design criteria*

The BPP is about demonstrating in tangible ways that an alternative is possible. This means using the guiding principles to generate design criteria for results that are aimed at resolving problems that characterise the current context.

Current global and South African context	Guiding principle	Design concept for the BPP alternative
<p>Persistent poverty (with signs of slight reductions) with growing inequalities, growth without fast enough job creation, unsustainable household consumption, mismatch between skills required by the economy and skills levels of South Africans, and the need to build household assets in poor communities</p>	<p><i>Entrepreneurship, equity and fair trade at all levels (global, regional and local)</i></p>	<p>Support services and skills training for entrepreneurs, CBOs and NGOs; focus on local savings and credit systems; establish a 'farmer-to-fork' market as the 'heart and soul' of the community; investment in the establishment of SMMEs wherever possible to build, operate and co-locate within the development</p>
<p>An economic system, planning approach and consumer culture that generally does not address the needs of the poorest people in the communities. The poor are often blamed for their own poverty</p>	<p><i>Satisfying fundamental human needs and reduction in inequalities</i></p>	<p>Finding satisfiers via participatory processes that are context-specific, namely mixed decent housing to ensure the development of balanced communities, full services that are affordable, and the construction of streets and public spaces that are safe, sociable and encourage commerce and trade</p>
<p>Rising social conflicts (insiders vs. outsiders, ethnic, rich and poor, race, gender); ongoing costs of crime and social fragmentation; marginalisation of children coupled to rising number of child-headed households; poorly organised forms of citizen participation; and youth culture that make it almost impossible to forge identities that are free from violent and drug sub-cultures</p>	<p><i>Valuing authentic cultural diversity, community solidarity, child-centred activities and citizen participation</i></p>	<p>Encouraging the co-location of organisations that promote and value cultural development across sectors such as agriculture, learning, arts, child development, leadership and organisation development, entrepreneurship, safety; integration of child-related activities into everyday life (including special facilities such as a new kind of orphanage); formalised relations with CBO and local business networks to embed the planning process in community values and needs; continuous emphasis on social solidarity and co-operation; recording, exhibiting and valuing local histories and memories (even if these are painful ones)</p>
<p>South Africans contribute to rising levels of CO² emissions – now over 7 tons/person/annum. CO² will cause rising global temperatures of 1.4–5.8° by 2100, with major implications for the Western Cape (less winter rain, shrinkage of the fynbos, crop failures). 50% of all CO² is generated by the construction and operation of buildings. Each South African uses on average 4 500KWh/annum – one of the highest levels in the world, with many poor South Africans averaging as low as 500KWh/annum. 92% of Cape Town's energy comes from imported non-renewable fossil fuels: 33% from coal via the electricity grid, 3% from burning coal, and 56% from oil (petrol and diesel). Only 1% is renewable, i.e. from wood. City of Cape Town has set a target of 10% renewable energy. The average middle- to high-income household consumes 774KWh/month releasing 750kg of CO²/month. Low-income houses consume 274KWh/month releasing 265kg of CO²/month</p>	<p><i>Transition to renewable energy alternatives and energy efficiency</i></p>	<p>Reduce energy consumption (measured in terms of KWh/annum) by 60% per household, and CO² emissions (in tons/annum) by 50%/household, and increase the use of renewable energy to 25% of the total energy requirement for the site by:</p> <ul style="list-style-type: none"> • orienting and operating all buildings in ways that reduce energy consumption and increase use of renewable energy (north orientation, effective insulation, effective use of natural lighting, etc.) • building buildings and infrastructure using low energy materials • maximise on-site generation from low carbon and renewable energy sources (e.g. solar water heaters) • only use low-energy lighting systems • use LPG for all cooking, and possibly backup water heating • reduce the energy content of food consumption by providing access to locally grown and supplied food • consider using solar roof tiles and off-site generation.

Current global and South African context	Guiding principle	Design concept for the BPP alternative
<p>Cape Town generated 2.1 million tons of waste in 2002/3. This equates to 2.1 kg/person/day which is higher than the EU average. Low-income households generate an average of 0.3kg/person/day, while high income households generate up to 2.5kg/person/day. 38% of this waste stems directly from households, 42% was commercial and industrial, 5% was green/garden waste, and 15% builders' rubble. 87% of all waste is unrecycled and goes to 6 public and 1 private landfill. 1 of the 6 has been closed, and 3 more are due to close in 1–3 years. Most landfills are located above the Cape Flats Aquifer which is an important water resource – pollution from the landfills is infiltrating the aquifer. Costs of disposal have increased 100% between 2000 and 2004. Waste generation increased by 3.8% between 1996 and 2001, whereas the population growth rate for the same period was 1.5%</p>	<p><i>Zero waste via re-use of all waste outputs as productive inputs</i></p>	<p>Demonstrate that it is possible to reduce solid waste outputs to zero by:</p> <ul style="list-style-type: none"> • separating waste at source • setting up a waste recycling depot managed by an entrepreneur to facilitate sale of waste to recyclers • composting organic wastes on site for resale to households and farmers • encouraging households to minimise the purchase of packaging • developing strategies to reduce construction waste.
<p>54% of the total energy used in Cape Town is used for transportation. Low levels of public investment in rail and public transportation encourages private car use</p>	<p><i>Sustainable transport, with a major focus on public transport</i></p>	<p>Maximise access points to public transport, and lobby all private and public stakeholders involved in the transport sector to improve the provision, affordability and safety of public transport facilities</p>
<p>Building materials and associated building methods can determine the embodied energy of a building, and its thermal performance (cement block is the least efficient, hemp is the most efficient). Some materials are more dependent on fossil fuels (such as coal or oil to heat up cement kilns) than others (e.g. wood or clay), and some are more toxic than others (e.g. most cheap commercial paints are far more toxic than lime-based paints)</p>	<p><i>Sustainable construction materials and building methods</i></p>	<p>Taking into account affordability, durability, cultural acceptability and low impact, a range of materials and methods will be used, including:</p> <ul style="list-style-type: none"> • recycled bricks • adobe brick • maximum use of other recycled building materials • sand infill • hemp. <p>Some low-income houses will need to be self-built by owners who cannot afford contractors – adobe brick can be very efficient in these circumstances</p>
<p>Cape Town's 800 000 households and visitors consume about 1.5 million tons of food per annum, or an average of 1.8 tons per household per annum. This average ignores differences between poorer and richer households, and non-household consumption like visitors to the city. The large bulk of this food is imported from outside city boundaries and bought from major supermarket chains who like to use expensive packaging. The bulk of the food is not organically cultivated</p>	<p><i>Local and sustainable food</i></p>	<p>Set up an organic urban agriculture project on 5ha of the site. Aim to meet 25% of household food needs with affordable, healthy organic food. Set up a 'farmer-to-fork' market accessible to all the surrounding areas where farmers from the local area and surrounding the city can sell directly to the public</p>

Current global and South African context	Guiding principle	Design concept for the BPP alternative
<p>Biodiversity and natural habitats are virtually non-existent in the Philippi area. However, this area is nevertheless located within the uniquely diverse fynbos biome. Urban design and urban sprawl has been planned in ways that disconnect urban neighbourhoods from an experience of biodiversity</p>	<p><i>Enhancing biodiversity and the preservation of natural habitats</i></p>	<ul style="list-style-type: none"> • Up-front investment in the planting of indigenous communal and private gardens, including large numbers of trees. • Creation of a network of indigenously-planted public and semi-public spaces. • Rejuvenation of the soils via organic farming. • Skills development in biodiversity, and home care.
<p>The combined socio-cultural impacts of pandemics, unhealthy living conditions, poorly-built buildings, inadequate health care facilities to deal with a rapidly expanding population, excessive noise, endemic crime, and social dislocation make it difficult to generate a sense of health and well-being</p>	<p><i>Health, well-being and soulfulness</i></p>	<p>Focus on primary health care and prevention; foster a reputation for BPP as a safe place where community solidarity can help resist control through fear by criminal or political elites; promote healthy lifestyles and diets; ensure that buildings are treated with materials that do not damage health; and support community-building activities, including freedom to worship, safe play spaces for children, public spaces for public community-wide activities (e.g. the proposed market), spaces for growing things, and the arts to unify people</p>
<p>South Africa has one of the most progressive constitutional democracies, an emerging rights-based culture, and a sophisticated three-sphere structure of governance. A vast array of legislative arrangements exist that can be used by sustainable neighbourhoods to maximise participatory and democratic self-governance. The well-known lack of capacity at local government means that communities must take greater responsibility for the governance of their own neighbourhoods</p>	<p><i>Democratic and effective governance</i></p>	<ul style="list-style-type: none"> • Eventual governance of the area will be taken over by a property owners' association that will be a Section 21 company with a comprehensive memorandum and articles of association that defines every property owner as a member who must, in turn, abide by an agreed code of conduct. • Service delivery will take place via an energy and water and sanitation services company that operate in accordance with agreed efficiency criteria. • A wide range of partnerships will govern common facilities, such as the 'farmer-to-fork' market', public spaces, etc.

4 Detailed design concepts

4.1 Design Principle 1: Entrepreneurship, equity and fair trade

The business development system for the property starts at the Business Place Information Centre, surrounded by a cluster of co-locating partners who provide both financial and non-financial business development services to small and micro-businesses. These providers are chosen carefully on the quality of their services, service-orientated approach, sustainability and contribution to the overall mission with common purpose.

The intention of the property developers is to create 'spaces' for entrepreneurs to implement new projects, and to assist existing businesses. For instance, the entire water system will be established by the EWSSCO. This will encompass purchasing water from the City, harvesting water from the roofs, selling and transporting the water to the houses and businesses, and operating and maintaining the on-site water / sewage treatment plants. This treatment plant will receive all the household and business effluent that is flushed or drained into the system, treat it, and re-deliver it to the cisterns of the houses, or the irrigation system on the agri-section. A local group will be trained to 'see' the global picture in terms of the product and service, maintain it and ensure quality delivery, as well as run the accounting system for this on-site business.

The inclusion of local Philippi CBOs and NGOs is crucial. Local organisations will be given the opportunity to re-locate onto the site, which will add depth and dimension to the assistance to entrepreneurs and communities already available.

Each Business Place operates within its own local reality. For instance, Business Place Johannesburg does not have an agricultural element due to its setting in the centre of the CBD and the clientele that requires services. In Philippi, two of the co-locating partners lend assistance to small farmers in the area, with strong linkages to the Eastern Cape. The focus, however, is on assisting small and micro business developers with linkages, ideas, finance, training and focused, co-ordinated technical assistance, whether it be for agricultural projects or mainstream commercial activities.

Beyond this national Business Place vision, Philippi has an extra task. As the property sits in the middle of an ocean of sprawling low-income settlements with a very weak economic base, the Business Place Information Centre and the entire SBRN aim to provide a kind of pulsating entrepreneurial economic environment that facilitates the build-up of skills, networks, access to knowledge and innovation that will contribute to the upliftment of the surrounding area. This approach to local economic development (LED) is very different to the subsidised so-called 'income-generating projects' that are commonly what local governments establish try to stimulate local economies. The BPP approach is to invest in entrepreneurial capacity at the most basic grassroots levels of society, and to provide actual on-site support services for these entrepreneurs.

4.2 Design Principle 2: Satisfying fundamental human needs and reducing inequalities

Crucial to the success of the project is that the envisaged infrastructure, buildings, sustainable building materials and resources, capital and so forth will be introduced and implemented in partnership with a specific group of households and businesses which will take ownership of every dimension of the project. It will be assumed that the designing and planning of these tangible aspects of the project will be integrated via a participatory process which will, in turn, foster ongoing, long-term entrepreneurial and (local) economic initiative and development.

The BPP project will achieve this integration of the designing, planning and social participation aspects of the process is through the adoption of the Human Scale Development approach and methodology which has as its aim the satisfaction of fundamental human needs. The Human Scale Development approach proceeds from the assumption that development is about people and not material objects, and that the purpose of LED is to serve the people, not for the people to serve the economy. To achieve this in practice, this approach argues that needs, satisfiers and economic goods are not the same. Needs are both material and non-material – needs are never hierarchical and fixed across cultures (as Maslow argued) but are always context-specific. Needs cannot be understood to exist in isolation, but should always be defined in an integrated way between the individual, the community and the environment. Needs are never completely satisfied – they are always poised in a creative tension between deprivation and potential and as such provide the human energy necessary for taking action and for mobilising in a certain direction. When looked at from this perspective, it becomes possible to see that food and shelter are not needs *per se*, but are rather satisfiers of the need for subsistence. Equally, education, study and investigation are satisfiers of the need for understanding and curative or preventative health systems can be seen as satisfiers of the need for protection. Food, shelter, education and health, therefore, are not basic needs; they are some of the satisfiers of deeper underlying human needs. Economic goods are the tangible

material products that are an important component of the range of satisfiers that are required for development to take place, but they are not the only components that count.

A development plan must acknowledge that the needs of the poor are not to be equated purely with material objects. Poor households also have non-material needs, the satisfaction of which implies, in turn, employing numerous real-life coping strategies. The result will look vastly different to a developmental plan which reduces the needs of the poor to economic goods only – e.g. the ‘basic needs’ approach. Developmental plans and interventions which follow this (materialistic) logic will tend to unilaterally impose ‘things’ onto the poor from the outside and exclude them from participating in social processes, affording them the opportunity to generate and articulate context-specific satisfiers of their fundamental needs.

The full matrix of fundamental human needs can be graphically represented and displayed as follows along two, existential (horizontal) and axiological (vertical), axes or dimensions:

	Being	Having	Doing	Interacting
Subsistence				
Protection				
Affection				
Understanding				
Participation				
Idleness				
Creation				
Identity				
Freedom				

The 36 ‘empty’ boxes in this illustration depict the reality that no satisfiers can be completed in the abstract by anyone other than the members of a specific community who, through a social process of participation and dialogue, will be afforded the opportunity to identify and express for *themselves* what forms of *being, having, doing* and *interacting* are considered to be absolutely necessary to satisfy *their* fundamental needs. The following example demonstrates the need for *understanding* and *protection* and their associated satisfiers.

	Being	Doing	Having	Interacting
Understanding	Inquisitive; inquiring; critical mind; astonishment; disciplined	experimenting; investigating; studying; educating; learning; analysing; meditating	literature; schools; educators; learning methodologies; libraries; computers	learning spaces; settings of formative interaction; workshops
Protection	feeling safe; belonging to a place; being part of a community; respect and acceptance; freedom for all religions	saving to build; borrowing to start a business; learning new skills; resolving conflict; building houses; living sustainably	an affordable house; adequate services; access to facilities; good roads	participating in decision-making; knowing and working with neighbours; being part of local associations and support networks

In Phase 2, the stakeholders and beneficiaries of the BPP project will be given the opportunity to participate in a series of facilitated workshops during which they will be asked to identify and articulate context-specific synergic satisfiers of their fundamental needs. As mentioned above, this means making sure that the individual *and* the community can fulfil their needs in harmony with ecosystems and in ways that respect the balance between individual and collective needs. The design principles will help facilitate this social dialogue. Participants will be encouraged to formulate satisfiers in accordance with these principles. This is where the practical confluence between design by principle and design via participation will take place. It is anticipated that, if conducted in this constructive and purposeful manner, this principled participatory process will not only succeed in producing ideas which may be critical to the success of the designing, planning and implementation of this project, but could also become the starting point for generating and mobilising the human energy necessary for long-term local economic and entrepreneurial initiatives and activities. This will lay the foundation for eradicating poverty and other historically-inherited inequalities.

4.3 Design Principle 3: Valuing authentic cultural diversity, community solidarity, child-centred activities and citizen participation

Valuing cultural diversity

The BPP concept will not only cater to the needs of the poor and disadvantaged, but also to professionals, students and those of middle and higher income brackets who recognise the value of living in a more sustainable way. Ensuring and maintaining a proper social mix, with the assistance of local community groups, is core to the BPP vision. Social mix refers to the fact that home owners, residents and commercial ventures will incorporate people from a wide range of socio-economic and cultural backgrounds. These might include: self-employed professionals, students, workers in all sectors, local government officials, police officers, mental health practitioners, teachers, nurses, informal sector traders, NGO project workers, farmers, and so forth.

Community solidarity and citizen participation

It is highly likely that a property owners' association and an associated code of conduct will need to be established which could help to define the way the community would like to live on a daily basis.

The POA could be responsible for ensuring that the community has the services it requires, such as water, refuse collection, sewerage treatment, gardens, grounds maintenance and so on. These services would be paid for from service charges and levies paid by the members of the association. This is a common institutional form across many settlements, including upper income and lower income areas.

The code of conduct could govern matters such as litter, the number of pets each owner is allowed, noise pollution, traffic control, building extensions, use of energy and water, use of common areas, planting of vegetation and food gardens, safety and security matters (especially for women and children), use of community spaces, conflict resolution, external appearance of buildings, procedures for managing community events (e.g. parties, marriages and funerals), behaviour of temporary residents (e.g. students), which would allow residents to participate in ideological and practical decisions within the eco-village context.

Community participation and issues like social justice, social welfare and meeting the needs of vulnerable groups are core to the BPP agenda. Value will be attached to social capital, social networks and improving quality of life.

It is envisaged that local community groups will set up a housing sub-committee, which will interface with the professional technical teams, and which will work with the emerging governance structure on housing development. These community groups will bring in housing professionals as appropriate, as well as knowledge and skills on creative housing finance. Community representatives will also sit in on professional team meetings. With spatial integration of low and high-income households, it becomes possible to create all sorts of environments that incorporate rather than exclude the urban poor.

The importance of child-centredness

Many of our previously disadvantaged South African children hold within themselves a 350-year heritage of colonialism, slavery, violence and apartheid. This legacy has led to massive exposure to social violence and sexual abuse in disadvantaged communities. Reported rape statistics – in particular, amongst girl children below the age of 10 years – is the highest in the world. Given this background, it is clear that unless children are placed at the centre of the development process, social integration will remain a chimera.

An approach that attempts to locate children *within* sustainable development has been adopted by the BPP. By encouraging the engagement of children via rich social connectivity, increasingly deep experiences with nature and ecology, and establishing a sense of place where, in practice, they will become a central part of a transformational process, these children will not only benefit themselves, but the lessons learned can then trickle through to the next generation.

The establishment of an on-site crèche has also been factored into the BPP conceptual framework. With the help of established ECD training programmes, a community-owned early learning centre can be established, with a proposed focus on healing, sustainability and ecological early learning. This can also evolve into an accredited ECD training programme for women from the local community

Child-centred development generously contributes to building a mixed, sustainable community in some of the following ways:

- From the day of birth, each child is *creating the adult to be* – a living vision of an emerging future that engenders in us awe, protection and a sense of 'beyond'.

- *Contextual learning*. Learning for sustainability means taking deeply into account the context that has helped form the child. This is to recognise the suffering and then to create a holding space where, in their own life journeys, the children may experience its opposite, i.e. trust, steadiness, constant confrontation of violent acts, immersion in nature's healing and build thus a set of possible generative alternatives to the old entrenched patterns from which they may choose.
- Locating the learning within *a sense of place*. In this context, as children step into their lives they will find the flow between the technicality of sustainable building, renewable energy, on-site waste treatment and the values in which they have been immersed, at least within this time and space.

4.4 Design principle 4: Be in transition to renewable energy alternatives and energy efficiency

Guiding principles of the proposed energy strategy

Every decision is an energy decision

All decisions have impacts in terms of energy. It is therefore useful for stakeholders to approach all decisions with this in mind and with an openness to find the most sustainable solution within the constraints of the situation.

Focus on the energy service and not the supply system(s)

Householders, business owners/operators, urban farmers and visitors to the BPP are essentially interested in the outcomes of the provision of energy services, namely light, heated water, hours of entertainment, etc. They may be interested in the quality of these energy services but generally not in the energy carrier (or fuel) itself. It is therefore appropriate to approach energy decisions on the basis of the benefits of the service and not the energy carrier or technology.

Practice good design to minimise negative impacts

The main impacts due to energy arise from two factors:

- The consumption of resources – such as coal, petroleum, water (for cooling power stations, etc.), biomass, etc.
- The production of emissions and other waste products – such as CO², ash, particulates, NO_x,⁷ etc.

The negative impacts due to energy can be minimised by:

- Minimising the need for energy inputs.
- Maximising the use of ambient (on-site) energy resources.
- Minimising the need to use/ procure off-site (or imported) energy services.

Adopt a mixed portfolio of energy service options

A mixed portfolio of energy service options provides a higher level of resilience – or energy security – in terms of dependence on the availability (or affordability) of any particular energy service supply option.

Increase the proportion of renewable energy service supply

The transition from an essentially unsustainable mix of energy service solutions to a more sustainable mix will occur as the overall proportion of renewable energy is increased. This transition will have the benefits of reduced financial, social and environmental costs – primarily through reductions in the extraction and conversion of fossil fuels and the associated waste management – and also a more diverse (and therefore resilient) energy portfolio.

Manage the utilisation and production of energy to optimise the system

The long term benefits of more sustainable energy services will accrue from continuous monitoring, evaluation and management of the needs of the stakeholders and the energy systems which seek to meet these needs.

⁷ NO_x is a generic term for the various nitrous oxides produced during combustion.

Information is power

All stakeholders are capable and probably willing to optimise the energy utilisation and energy supply if they are informed and able to see the impacts of their actions (or energy decisions). The ability of the stakeholders to respond in a positive manner requires that they are informed and experience the effects of their actions.

Location of the site and prevailing weather conditions

The property is located south of the Cape Town International Airport in the Western Cape Province of South Africa, at approximately 34°S and 18°E. The temperature regime on site is similar to that of the Cape Town area but with some local variation in terms of ambient temperatures, rainfall and prevailing wind regimes. Essentially, the site experiences hot and dry summer days with strong south-easterly winds, and cold and wet winter days with wind-driven rain from the opposite direction – north-westerly – at times gale force in strength. The temperature range is shown in Figure 3, with the diurnal variation relatively small, approximately 10°C.

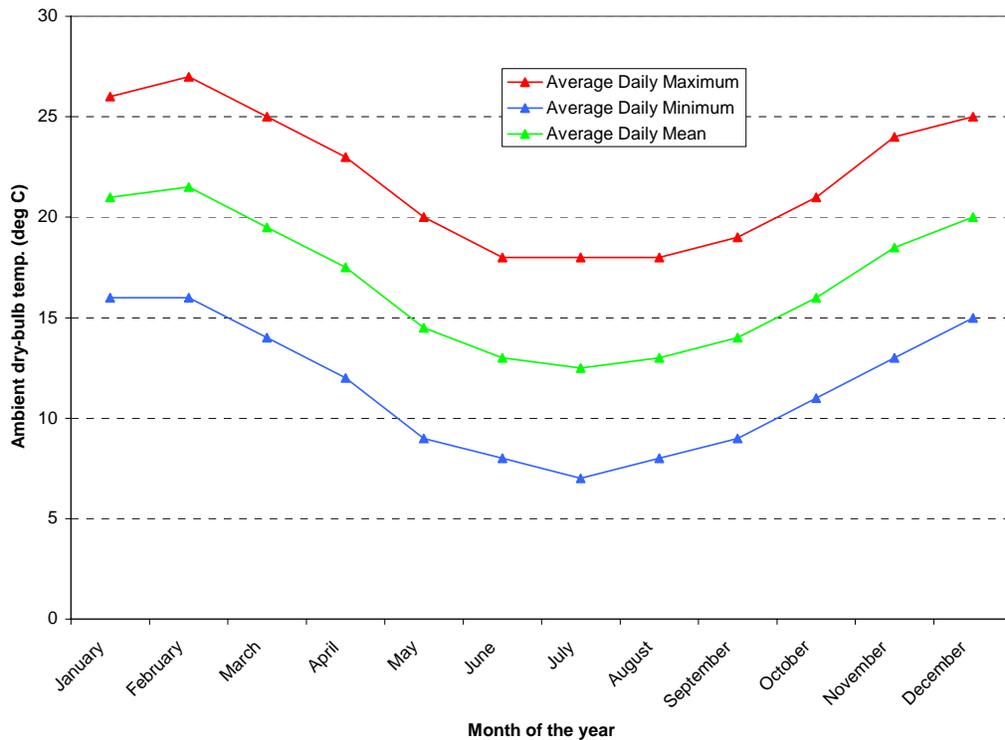


Figure 3: Temperature data for Cape Town (source: SA Weather Bureau)

Energy parameters

The entire project will have a residential population of 2 000 people, and a daily (living off-site) population of a further 1 000 people. It will consist of 350 houses using on average 150kWh per month, and a doubling of this figure from the business and trading zones. The figure for the houses includes four lights, fridge, radio/television and kettle. It makes the assumption that hot water needs are met through the installation of a 190l solar water heater serving five household members. The total consumption for the housing development plus an expanded Business Centre is calculated at 140 000 KWh per month or 4 700KWh per day. It is not proposed that the entire electrical needs are met through renewable technologies. Instead, the overall aim for Philippi is to use a demand-side management process coupled with a renewable energy generation system (supply-side management) that results in:

- a reduction in the consumption grid-supplied electricity by 60% per person per annum, measured against standard per capita data for Cape Town, and
- a 50% reduction in CO² emissions per person, measured against standard production data for carbon-based electrical production in South Africa.

To achieve these aims, energy efficiencies within the residences and other buildings will be achieved together with an increased use of renewable energy. The aim is to increase the renewable energy component to 25% of the total energy requirement for the site. The energy strategy can therefore be divided between demand-side management and supply-side design strategies.

Demand-side management is dealt with in the architectural report, and covers such features as:

- correct orientation of the buildings, in this case, north-facing and if necessary a westward orientation
- sunlight optimisation for internal daytime space lighting – use of roof skylights and reflective opportunities on the walls
- winter internal space heating by effective use of direct solar possibilities – for instance, a roof overhang that allows the low-incidence winter sun to penetrate the glass and reach the interior, whilst shading the glass from the high-incidence summer sun
- winter internal space heat retention using construction materials in the floor, walls, ceiling void and roof that have insulation properties and high thermal efficiencies – for instance, the use of hemp products have been cited as a possibility
- the use of low-energy-demand electrical lighting systems and home utilities
- the use of LPG for all cooking requirements, and as backup for water heating
- the reduction of the energy content of food consumption by providing access to locally grown and supplied food.
- passive (solar) energy systems such as trombe walls, ventilation through cavities of cavity walls on north side, larger windows on north side and smaller windows on south side.
- use of thermal capacity of soil under the foundation, e.g. inflow of fresh air via deep pipes (for winter and summer) – even possible to ventilate during the summer via a ventilator driven by 50 Watt PV panel, as an alternative to electrical air conditioning for offices, etc.

Supply side design strategies incorporate on-site power generation technologies such as:

- wind power
- solar water heating
- solar power generation
- biogas from household waste, black wastewater and organic sources
- biofuels.

Supply-side management strategy

Wind power

In a commissioned report on energy options for Philippi, Prof. Ryno Swanepoel of the University of Stellenbosch argues:

The use of wind power to generate electricity is only viable in regions that have sustained winds of speeds of between 15 and 45 km/h. The Philippi region does not have sustained winds of this nature with only about 30% of the time experiencing windy conditions. To be economically viable the system must be large with a tower in excess of 50 meters and rotor blade lengths of similar dimensions. Power output is typically in the MW range. Apart from being expensive there is also an environmental problem: the majority of people do not want these massive structures close to their homes. The use of wind power is thus not a viable option for Philippi.

Furthermore, the proximity to the flight path for Cape Town International Airport might also pose a problem.

The Agama Energy report on Philippi states:

No recorded wind energy data is available for the site. It is likely that there are very good wind regimes at hub heights of 50m or greater but these would need to be confirmed through monitoring. Consequently, the potential for wind generated electricity is not quantified.

Their report then goes on to state that it might be possible. As wind electricity generation has developed over the past two decades, it is now almost commercially viable at MW-scale investments. Wind electricity generation could be implemented at Philippi in two ways, namely as:

- on-site generation using multiple, smaller (10 kW) building-integrated turbines, and/or
- off-site generation using megawatt-scale turbines in a wind farm – probably in association with an independent power producer.

The costs of these two approaches differ due to the economies of scale which apply to wind energy technology. Typical capital expenditure (capex) ranges between R25 000/kW for a small (5–10kW) device generating 30–70kWh/day and R8 000/kW for MW-scale equipment generating 100kWh/day. The operation and maintenance costs are greater than for solar photovoltaic (PV) panels but depend on the scale of implementation.

Their recommendation is as follows:

- On-site wind electricity generation:
- Make provision for electrical distribution infrastructure to accept future on-site electricity generation.
 - Implement some pilot wind electricity generation – say 10 kW – for demonstration purposes.
 - Seek opportunities to fund investment in more capacity.
- Off-site wind electricity generation:
- Seek partnerships with third party independent power producers or TREC⁸ traders to procure increasing amounts of off-site wind electricity over time.

Notwithstanding the discrepancy between Agama's analysis of wind generation possibilities, and Prof. Ryno Swanepoel's conclusion, if the project goes ahead with wind generation, it would be a first for South Africa. There are no examples of grid-connected building-integrated wind turbines in South Africa yet. Technically, the project could integrate up to 1 000kW of building-integrated small turbine electricity generation capacity on-site on the roof of the BPP shed and on the silos. This may generate 3 000–6 000kWh per day. Given that 4 700kWh per day are required, Agama's figures make wind power technically viable. On-site generation capacity of 1 000kW would cost R8 million to install. If it generated 4 000kWh per day over 20 years, the cost would be 30c/kWh which is more than the current cost of electricity, but less than the 50c/kWh that it will cost Eskom to build a new coal fired power station. The alternative is to purchase wind power from an independent power producer for 20c/kWh. This is now technically and practically feasible and should be seriously considered as a viable option.

A wind monitoring programme over at least 12 months is recommended before deciding whether to implement a larger scale on-site wind programme.

Solar water heating

In South Africa, up to 50% of the electricity used in a home is for water heating. Solar water heating (SWH) deployed on an individual scale (i.e. one per roof) or via an on-site centralised bulk supply system will substantially reduce electrical demand for coal-fired electricity. This is the case without including the costs of externalities and other impacts. Solar water heating technologies are available locally. These are available in close-coupled or split systems for individual houses or as centralised systems. Conventional individual close-coupled SWH systems are proposed for the houses. The individual SWH systems would be 150litre/2.8m² direct-heating close-coupled SWH systems mounted on the roof of each house.

- Water heating: The project should implement individual close-coupled SWH systems with thermostatically-controlled LPG heating for auxiliary heating in winter. These systems should be sized for one 150 litre tank/2.8 m² per house.
- Auxiliary backup heating: A thermostatically-controlled instantaneous LPG heater rated at 13kW will provide auxiliary backup water heating. The LPG heater must be installed under cover and vented to exhaust the combustion fumes. It should be located adjacent to the bathroom and kitchen – in kitchen yard perhaps – together with the storage cylinders, i.e. 2 x 19kg with the automatic changeover valve.

⁸ Tradable renewable energy certificates.

Hot water plumbing: Care should be taken in the plumbing design to minimise the length of all hot water pipe runs to reduce the energy and water losses (and cost of copper pipes) associated with long pipe runs.

Provision for solar water heating should include a suitable portion, up to 4m², of roof area, preferably tilted at 25°. The orientation of the collectors of solar water heating systems should be essentially true north, although deviations of up to 15° east of north and 35° west of north have a minimal impact (CSIR).

Centralised systems could be investigated but these require metering of hot water and the institutional arrangements for energy service provision would need to be addressed first before this option becomes useful.

The provision of solar water heaters has an immediate impact on the cable grade required for the electrical reticulation. Engineering calculations show an approximately R1 million reduction in the capex for electrical connection and reticulation. This is primarily due the reduction in the ADMD⁹ from 2.5kVA to 1.5kVA per house unit as a consequence of non-electrical water heating and cooking. However, it does need to be offset against the higher costs of on-site energy infrastructure.

The financial implications of solar water heater offer a triple bonus

1. They reduce the infrastructural cabling costs by R1 million, as above.
2. The R7 000 will be added to the cost of the house, not the infrastructure. This means the cost of 350 systems @ R7 000 does not have to be amortised at project level.
3. Eskom's demand-side management programme offers a subsidy that could be accessed to discount the cost of the unit entirely. If not, a standard 150 litre electrical geyser costs R1 500. Further financing for R5 500 is therefore required per house. Amortised over the life of the 20 year bond, and taking the electrical savings into account, the financial benefits are enormous. Up to 50% of monthly electrical-spend in the household (approximately R100) can be put towards debt servicing or any other critical payment. Within 45 months, the system has paid for itself. With appropriately structured debt financing (e.g. a fixed interest rate of 9% over the term of the bond), this time span could even be reduced further.

Photovoltaic systems

PV systems are still a rapidly evolving technology with cost reductions still expected on the solar modules. Grid-connected solar PV systems have been implemented in Cape Town since the early 1990s. The most recent example is the 68kWp (Kilowatt Peak) system which is supplying approximately 350kWh/day on the new BP head office building at the V&A Waterfront. The guideline capex cost is R70 000/kWp or per 5kWh/day of electricity generation. These capex costs are directly proportional to the scale of the PV generator – there are no economies of scale. The equipment can last for over 20 years, depending on the quality of manufacture. The operational costs are insignificant.

GRID CONNECTED SYSTEM

A solar panel produces direct current (DC). In such a system, a house is wired and supplied with electricity from the utility in the conventional way. The power from the PV system passes through an inverter that transforms the DC power to 220V alternating current (AC) power, thus synchronising it with the Eskom grid. When the consumer uses power during the day, it is first drawn from the PV supply. If more power is required than can be delivered by the PV system, this extra power is obtained from the grid. When no power is used by the consumer, the power of the PV system is supplied to the grid. During the night consumers obtain their power from the grid. The ideal is to have a 'zero energy' house where the consumer does not use any net power from the grid.

STAND ALONE SYSTEM

In this system the energy obtained from PV during the day is stored in batteries. During the day the PV system charges the batteries and also supplies the demand. During the night the stored energy of the batteries is used. The energy stored in the batteries (DC) is transformed to 220V AC with an inverter. The system must be properly designed so that the consumer has sufficient power at all times. This system makes each house independent from external power. The house could, however, also be connected to a common grid.

⁹ After diversity maximum demand.

Lead-acid batteries (a modified version of the ordinary car battery) are at the moment the only viable technology to store electricity. They are not very efficient and are expensive. A typical 12V 90Ah battery costs around R600 and can only store about 1kWh energy. The efficiency of conversion is not perfect and depends on the current drawn. Most batteries need some maintenance. Batteries have a limited lifespan and having to replace them from time to time will add to the total cost. A stand-alone system is therefore not recommended.

A HYBRID SYSTEM

A diesel power generator can be installed as a central backup power source for the whole grid-connected community. The cost of a 2MW generator is around R2.5 million. The engine can be modified to run on bio-diesel or biogas. This will make the community independent of Eskom power. There may, however, be problems with noise and fuel storage.

SOLAR ROOF TILE OPTION

Solar roof tiles are at the cutting edge of innovation in the international and domestic solar PV market. Although durability and therefore 20 year warranties are not yet in place, large companies like General Electric and Sharp are supplying solar roof tiles commercially. The advantage of solar roof tiles is that the cost of the solar PV installation is partially covered by the costs that would be incurred in constructing the roof.

Assume a house with a north-facing roof of 7m x 4m is covered with solar roof tiles 40cm wide and 30cm high. Assume also that the efficiency of the tiles is 10%, i.e. 10% of the installed capacity. The total number of tiles that can be fitted is $16 \times 12 = 192$ tiles. The area of each tile is 0.12m^2 and the total exposed area is thus about 23m^2 . The power output for conditions in Philippi, using figures obtained from the nearby Airport Weather Station, can then be estimated as follows:

1. Total roof area: 23m^2
2. Worst case solar insolation: $4.5\text{kWh}/\text{m}^2/\text{day}$ (Cape Town)
3. Module (Tile) efficiency: 10%

The total electricity energy that can be obtained per day (worst case scenario) is:

$$E = 23\text{m}^2 \times 4.5\text{kWh}/\text{m}^2/\text{day} \times 10/100 (\%) = 10.3\text{kWh}/\text{house}/\text{day}$$

The maximum instantaneous power that can be delivered under 'standard conditions' ($1\text{kW}/\text{m}^2$) is

$$\begin{aligned} P_{\text{Max}} &= 23\text{m}^2 \times 1\text{kW}/\text{m}^2 \times 10/100 (\%) = 2.3\text{kW}/\text{house} \\ &= 800\text{kW for 350 houses} \end{aligned}$$

Given the above, and following international trends, the most viable option would be to connect the above system directly to the grid via, of course, an inverter. If the household also has a solar water heater, then the average daily energy requirement of the household could be 5–8kWh per day. The result is that a house with a solar roof could generate more energy than it consumes. If there was a feed-in tariff, Eskom could buy the electricity, thus generating an income for the households which could, in turn, be used to recover the costs of the roof.

The above quantities can be scaled up or down for the case of other exposed areas. The quantities are proportional to the efficiency of the modules. It represents the 'average worst case' conditions and, under favourable conditions (mid summer), up to 20% more energy may be available.

The battery storage system must further take into account that a situation may arise when there is no direct sunshine for several consecutive days. PV cells continue to operate from scattered ambient light under these conditions, but at a much lower output. A safe option is to design a storage system with three times the daily requirements (but this figure is debatable). This will then require 30 batteries with a capacity of 1kWh each.

The inverter should be able to handle the maximum power output with some spare capacity. For the above case an inverter with a capacity of 3kW seems appropriate.

COST OF A PV INSTALLATION

There is no running cost for PV, so only the initial capital cost must be considered. The cost of an installation can only be accurately specified if all the economic parameters are known, e.g. size of the installation, type of installation, cost of PV modules, cost of balance of system components, rand exchange rate, interest rate of loans, government subsidies etc.

A *rough estimate* of the cost can be obtained by considering the following cost estimates that are presently used in the international PV industry:

- The cost of PV modules should be less than US\$4 per watt.
- The cost of inverters is about US\$0.50 per watt.
- The cost of a complete installed grid connected system is about US\$6 per watt.
(This figure includes the inverter, control equipment, installation and labour.)

Given that the KW/p requirement is 2 300W for the above case, the total capital cost for a complete grid connected system for the above case is thus US\$6 x 2 300 = US\$13 800 ≈ R82 000. (Based on actual experiences in three different localities in South Africa, AGAMA estimates that the actual cost in the South African context is now around R65 000). If a storage system is part of the design, the cost of batteries must be included. For the above case, 30 batteries at a cost of about R600 each will add a further R18 000 to the cost, bringing the total cost to around R100 000 per house (or around R80 000 if Agama is correct). However, the use of battery systems will not be acceptable from a sustainable resource use perspective, which means grid-connected PV is the only option if PV is included.

This is prohibitively expensive. Cost reductions can only be achieved if the cited figure of US\$6 per watt can be significantly reduced through innovative local manufacturing of the solar roof tiles and employing less labour-intensive procedures. However, this figure needs to be reduced by the amount that would have been spent on constructing the roof with conventional tiles. The figure of US\$4 per watt for PV cells could drop significantly in the near future when the present shortage in the market is reduced through increased production, manufacturing costs decline through improved technology, roof cost benefits are included, and inverters are manufactured locally. Some estimates suggest that this could bring the costs down to as low as US\$1 per watt.

The average size of roof PV systems installed in First World communities is about 3.5kW. The above analysis was done on the assumption that the whole roof is covered with solar tiles leading to 10kWh being available per day. This figure is probably too large and a fraction of that amount may be necessary, depending on the specific requirements of the occupants of the house. This means that only a portion of the roof should need to be covered with solar roof tiles. The total cost will be reduced proportionately. Using solar cells with higher efficiencies will reduce the cost accordingly. The storage system (batteries) should be designed to supply short periods of large power demands (e.g. switching on the microwave oven) when the maximum capacity of the PV system is less than this demand.

As starting point for designing a PV system it must be determined what the average daily requirements of a typical household in kWh, given what they can afford and their lifestyle. The rest of the system can be designed to meet this specific requirement. The household members must ensure their lifestyle is such that their daily electricity requirements should not exceed the available quantity unless, of course, there is a feed-in tariff and it makes financial sense to sell energy into the grid.

The cost per kWh ('unit') for the consumer depends on the specifics. The subsidy (if applicable) must be subtracted from the net capital cost. The loan (at low interest rate) has to be paid back in monthly instalments over a long period. This monthly instalment divided by the total energy *generated* (kWh) per month will be his electricity cost per unit. The concept of 'electricity cost per unit' is not uniquely defined as in the case of a metered quantity purchased from a utility.

Storage technologies

FUEL CELLS

The electrolysis-fuel cell technology is the ideal storage technology for the future. The energy from the PV system is converted into hydrogen gas by means of electrolysis. The hydrogen is stored as a source of energy. The hydrogen is then converted into electricity (DC) when required by means of a fuel cell. This technology does not involve any carbon, has a high efficiency and a large amount of energy can be stored. The present PEM¹⁰ technology that is being developed for cars is prohibitively expensive for households. The phosphoric acid technology used in some industries operates at a high temperature and is also not suitable for households. The alkaline technology operating at room temperature is presently being researched and, if it becomes economically viable, it can be used instead of lead-acid batteries.

OTHER STORAGE TECHNOLOGIES

Energy derived from electric power can be stored in elevated water reservoirs, magnetic fields, spinning flywheels, chemical electrolytes, compressed air, etc. Most of these technologies are high-tech, expensive and are in the research

¹⁰ Proton exchange membrane.

and development stage. Compressed air is particularly attractive since very large amounts of energy can be stored and the technology is simple. The usual concept is to use the power obtained from PV to compress air in large underground cavities with turbines and release the air again through the turbines to generate electricity with a generator. However, the mass of compressed air presents a danger due to the large amounts of potential energy it contains. The air turbines are also quite noisy. The silos in Philippi could be considered for this purpose, but if something goes wrong there could be an ‘explosion’. Batteries and hydrogen electrolyser/fuel-cells seem to be the appropriate storage technology for Philippi.

Recommendation

- On-site building-integrated PV
- Make provision for electrical distribution infrastructure to accept future on-site electricity generation
 - Implement some pilot solar PV – say 5 kWp – for demonstration purposes
 - Seek opportunities to fund the investment of more capacity

Recommendation

Comments

Solar PV is attractive for very small, 0.2–1kWh/day, standalone applications which are not close to a grid connection or as a visible demonstration of a commitment to renewable energy. It will not be financially attractive for some time. The most likely opportunity will be to link its output to loads which coincide with the generation such as air-conditioning.

Technically, the BPP could integrate as much solar PV as it can afford on the roofs of the houses and even the roof of the shed (as a second choice). It is not recommended to consider investing in off-site solar PV generation.

Energy demand

For Philippi, calculations have been made using a figure of 200kWh/household/month. The lifestyles of communities can be categorised as high-income, medium-income, low-income and poor. The energy demands of these communities differ considerably. If it is assumed that the future community of the Philippi development is in the medium income category, then the typical present energy requirements for this group in Cape Town would approximately be as follows:

Electricity

Lighting	3.4kWh/day
Refrigeration	1.8kWh/day
Microwave cooking	1.8kWh/day
<i>Total</i>	<i>7.0kWh/day</i>

Heating

Cooking	3.0kWh/day
Space heating	2.0kWh/day
<i>Total</i>	<i>5.0kWh/day</i>

Hot water

<i>Total</i>	<i>12.0kWh/day</i>
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If hot water is supplied by a solar water heater, LPG is used for cooking and energy efficiencies are introduced, the total electricity requirement could be reduced to 7kWh/day.

Energy services approach

Experience shows that the predominant energy service needs are (in a rough order of magnitude of energy inputs) – space heating/cooling, water heating and food preparation (including refrigeration, cooking and cleaning). The former is highly variable and can have the greatest energy demands (for air conditioning and heaters) if the buildings are poorly

designed. The intensity of the latter are more a function of the use patterns of the households. Lower priority energy needs are for artificial lighting, appliances, water pumping and treatment, etc.

The key energy service needs are presented in Table 1. The approximate levels of service are indicated where these are applicable.

Table 1: Summary of energy services needs

	Residential	Commercial	The shed	Urban agriculture	Site
Space heating	18°C dry-bulb	20°C dry-bulb	20°C dry-bulb	n/a	n/a
Space cooling	28°C dry-bulb	26°C dry-bulb	26°C dry-bulb	n/a	n/a
Ventilation	Minimal	Toilets Extract hoods	Toilets Extract hoods	n/a	n/a
Cooking	Domestic Recreational braais Two cooked meals per day 1.2 MJ/meal	Catering	Catering	n/a	n/a
Hot water	Dishes Clothes 35l/person/day @ 45°C	Laundromat Catering Others? 5l/business/day @ 45°C	Catering Others? 5l/business/day @ 45°C	n/a	n/a
Refrigeration	80l/person @ 8– 10°C	Domestic Cold room(s)	Various Cold room(s)	n/a	n/a
Lighting	Indoor ambient Indoor task Outdoor ambient Outdoor security	Indoor ambient Indoor task Outdoor ambient Outdoor security	Indoor ambient Indoor task Outdoor ambient Outdoor security	Outdoor ambient Outdoor security	Paths Roads Signage Security
Entertainment	Television Hi fi Radio	Flat screens Public address systems	Flat screens Public address systems	n/a	n/a
Audiovisual	n/a	Data projector	Data projector Other?	n/a	n/a
IT	Personal Home business	SMME Commercial	Commercial	n/a	n/a
Office equipment	Home business	SMME Commercial	Commercial	n/a	n/a
Communications	Cell phone charging				
Potable water treatment	Rainwater	n/a	Rainwater		Filtration Sterilisation
Waste water treatment	On-site treatment	On-site treatment	On-site treatment	n/a	n/a
Signage	n/a	Indoor Outdoor	Indoor Outdoor	n/a	Outdoor
Water pumping	n/a	n/a	n/a	Irrigation	Irrigation
Transport	Local Metro	Local Metro	Local Metro	Local Metro	n/a
Agricultural equipment	n/a	n/a	n/a	Tiller	Lawn mower

These energy service needs are presented to stimulate the thinking of the design team for the next phase. The possibility of an energy services contract approach to manage the requirements recognised in the above table has the potential to

finance and manage these investments. So far, proposals for a dedicated energy services company have been received from two commercial entities.

The project's energy supply and management would be developed by the energy services company on behalf of The Business Place, and co-owned by a suitable third party, thus creating a small energy enterprise in Philippi that will service the ongoing development needs of the SBRN and even the immediate area outside the bounds of the property. This would mean feeding surplus energy into the grid for use in Philippi in general and for further on-sale to other customers such as the City of Cape Town.

Objectives of the electricity services company would be:

- *Supply of renewable energy using local renewable resources* – this approach will to a greater degree ensure security of supply to the greater housing and commercial development project.
- *Grid enhancement (stability and power quality) for Philippi* – developing a local power plant that will supplement the City of Cape Town grid power and that will enhance power quality and grid stability in the area. Such local supporting energy initiatives enhance power quality especially during times when energy supply becomes a problem.
- *Demonstrating commitment to renewable energy* – supporting the City's goal toward its renewable energy targets. If a small project is developed, this will mean Philippi will be able to boast higher levels of clean energy uptake, and it will strengthen the supply in the area.
- *Tourism* – many of the sites in South Africa (e.g. the Darling demonstration site wind farm) are accompanied by education centres and tourism information centres. However, these sites are often not located in key development nodes or areas where they are highly visible. Given Philippi's geographical position in the centre of a highly visible redevelopment node, this site would be ideal for the establishment of an 'energy education and information centre' that may be used for general education purposes around energy, development and the environment. Tourism benefits may also accrue if integrated with the local economic development strategy for the area.
- *Carbon trading opportunities* – The global emissions trading regime provides attractive opportunities that will further enhance the viability of a larger energy project providing that the structuring is completed effectively and the right partners are brought in. Such project partners would be enlisted in order to ensure that any potential carbon offset opportunities are secured.
- *Income to The Business Place Section 21 Company for its own community-development objectives* – The envisaged ESCO is proposed as a fully independent power producer that will meet local needs first, and then on-sell any surpluses (gas or electricity) to other customers or directly into the grid.

The ESCO will develop this project in partnership with The Business Place and the local municipality in a suitable structure. Such a structure will also accommodate local participation from third parties who may wish to secure a share in the energy entity.

The evolving institutional and regulatory context

The energy supply in Cape Town is in a state of flux and crisis. A Regional Electricity Distributor – called RED1 – has been established but the demand for electricity exceeds the limits of reserve required from available generation and transmission capacity. The breakdown, refuelling and vulnerability to grid instability of the Koeberg nuclear power station have demonstrated the capacity and security of supply crisis in the metropolitan area.

The City has drafted an Energy Strategy which elaborates on five energy visions which address access to energy, sustainability, efficiency, transport and economic competitiveness. It is clearly committed to more sustainable energy services and will be supportive of the BPP development. The City has two targets for renewable energy. These were announced in Bonn, Germany, in June 2004 and are: renewable energy to 10% of households with SWH by 2010; and 10% of the City's energy to come from renewable sources by 2020. The City has already developed some (limited) experience with renewables – including grid-connected electricity generation systems – and this is likely to be developed further in partnership with pioneering projects such as BPP. This mode of distributed (or embedded) generation has significant technical and financial benefits to the City/ RED1 and it is likely to find policy support at national level.

Grid electricity from Eskom or one of the REDs will be available on site and is mainly derived from coal (approximately 94%) and nuclear (4%). Table 2 presents the published environmental impacts per unit of electricity consumed, i.e. per kilowatt-hour (kWh).

Table 2: Resource and waste implications per unit of Eskom electricity

Water consumption	1.29l/kWh
Coal consumption	0.5kg/kWh
Ash produced	142g/kWh
Ash emitted	0.28g/kWh
SO ₂ emissions	8.22g/kWh
NO emissions, NOX	3.62g/kWh
CO ₂ emissions	0.9kg CO ₂ /kWh
Transmission and distribution losses	11%

The current retail price of electricity is 40–45c/kWh. Grid electricity has the immediate, short-term appeal of being very cheap, clean and convenient at the point of consumption and in terms of the conventions for energy service provision for urban and peri-urban settlements in South Africa, but these apparent advantages do not reflect the full costs of the service, specifically in terms of the social and environmental costs of the current coal-based electricity supply industry. The externalities of coal-based grid power are calculated at approximately 10c/kWh.¹¹ This implies a more realistic cost of in excess of 40–45c/kWh for electricity supplied from the current generation mix in South Africa. The trend towards more cost-reflective electricity tariffs is indicated by the approval of above-inflation tariff increases awarded to Eskom by the National Energy Regulator of South Africa since 2001. This trend is primarily driven by the need for capital investment in new generation capacity in South Africa.

Evolving new sources of grid electricity

Increasingly, Eskom and private developers are pursuing renewable energy systems for grid power. Examples include the Darling Wind Farm and the Bethlehem Hydro Project. In the medium term, this power will become available at a retail level as 'Green Power'. In the meantime, Green Power trading mechanisms such as renewable energy certificates allow customers to buy the benefits, or 'greenness', of renewable energy generation systems and claim the benefit against their environmental and social footprinting.

Bioenergy

The bioenergy resources on site derive from plants growing on site and organic material which is transported onto the site. It is available in the form of wood, recycled paper and / or biogas from an anaerobic digestion process. It is not commercially viable to grow fuel crops on site but some woodlot trees (or hemp) could be grown as wind breaks and harvested on a sustainable basis for braai wood or biomass. As indicated in the associated report on wastewater and energy, the nett energy available from 76 m³/day of biogas production from the blackwater on site is calculated as 80 kWh/day of electrical power.

Summary

Based on the information available at this feasibility stage of the project, the most likely scenario for more sustainable energy services at BPP is transition from:

- a mix of existing carbon-based utility and petroleum company energy carriers used and managed in well-designed buildings with energy efficient appliances
towards
- a mix of energy services which increasingly utilise renewable energy and energy efficiency systems and reduce the off-site energy inputs required.

This transition may also include a change in the provision of energy services from a utility approach towards an energy services contractor approach.

Table 3 gives an indication of the various scenarios and the financial implications of the final choice to be made. It is worth noting that as soon as one includes an element of PV or wind generation, the required investment increases

¹¹ Van Horen, C. 1996. *Counting the social costs: Electricity and externalities in South Africa*. Cape Town: Elan Press and University of Cape Town Press.

greatly. This is particularly the case when considering a PV installation. Careful consideration is required for the final energy provision solution for the project.

It is clear that, although the use of 100% renewable energy for electricity service needs may be attractive to minimise the dependence on external commercial electricity, it has high monthly cost implications (as a consequence of the high initial costs).¹² The additional cost of more sustainable electricity will, over time, reduce, and probably be reversed in the case of off-site wind power. A strategy which seeks to increase the proportion of more sustainable energy over time is recommended. In the meantime, it is recommended that some on-site renewable electricity generation be implemented to demonstrate the principle and the systems. This has the additional benefit of engaging in the renewable energy sector in a more active manner and developing experience in the operational aspects of embedded electricity generation.

The estimated budget allocations for the recommended additional costs for energy infrastructure are presented in Table 4.

¹² An example of the costs and financing implications is the replacement of the 6 000m² roof of the shed with solar PV roofing to generate electricity. The solar roof is estimated to cost R53 million and generate an annual average of 1 212kWh/day (or 36 869kWh/month) corresponding to 18% of the monthly consumption. These calculations are based on an annual average insolation of 5.3kWh/m²/day, a module efficiency of 0.127kWp/m² corresponding to an installed capacity of 762kWp, and an effective capacity derating of 70% due to the east/west orientation of the roof.

Table 3: Indicative monthly energy costs for different scenarios

Scenario	Description	Shed/ Commercial kVA	Household ADMD kVA	Max demand kVA	Electricity consumption kWh/month	LPG consumption kg/month	Electricity R/month	LPG R/month	Total R/month	Capital cost R
1	Business as usual – Eskom electricity	275	2.5	1 150	294 000	0	135 000	-	135 000	1 000 000
2	SWH + biogas + LPG + Eskom electricity	275	1.5	800	204 400	600	94 000	6 000	100 000	2 450 000
3	SWH + biogas + LPG + PV electricity	275	1.5	800	204 400	600	1 500 000	6 000	1 540 000	97 000 000
4	SWH + biogas + LPG + off-site wind electricity	275	1.5	800	204 400	600	112 000	6 000	118 000	13 000 000
5	SWH + biogas + LPG + on-site wind electricity	275	1.5	800	204 400	600	194 000	6 000	200 000	27 000 000

Table 4: Budget costs for energy infrastructure

Item no.	Energy service need	Technical description	Quantity	Unit costs (R)	Initial costs (R)	Operation and maintenance costs (R/annum)	Comments
1	Water heating	Solar water heaters	350	7 000	2 450 000	17 500	Could be supplied as part of LPG supply contract
		Instantaneous LPG water heaters	350	2 000	700 000	-	
2	On-site solar electricity	10kWp system	1	700 000	700 000	500	Could be as small as 1kWp
3	On-site wind electricity	10kWp system	1	250 000	250 000	1 000	Could be as small as 3kW

4.5 Design principle 5: Zero waste via re-use of all waste outputs as productive inputs

An operational contract and lease agreement has been signed with a local recycling group called Zanethemba. Having been in business for a year using their local backyards at home, they have established purchasing agreements with the large recycling firms in Cape Town (Mondi Paper, Consol Glass and others) who will be sending a five ton truck every day to collect their sorted material. For Zanethemba's raw material, they rely on dozens of 'street collectors' who deliver trolley and trailer-loads of household waste, semi-sorted, for cash payment on delivery measured by weight.

In addition, Zanethemba is conducting awareness campaigns throughout Gugulethu, Nyanga, Crossroads and Browns Farm, encouraging households to separate their waste at source, as well as clean their streets. This remarkably energetic organisation is low profile and has the potential to grow rapidly if the necessary support to build systems and business strategies is provided by the Business Place. There are no marketing brochures, no expensive consultants, no massive billboard campaigns, no seminars on how or why to separate household waste. They do not see Zanethemba as a business, but rather as a project that will result in a reduction in landfill loading, cleaner streets, and a healthier environment.

The organic waste received in amongst the hard recyclables will be turned into compost on site, with the group's plan to set up a 'compost business' to the side of their leased area. This of course will feed into the farming operation planned on site.

In addition, the members will place a night-time guard on the premises, and their mere presence on site during the day adds an element of security to the existing bush area where the houses will eventually be built. They have leased 1 000m² at the southern end of the steel structure for their operation.

The Zanethemba operation has satisfied an entire design criterion for the project on its own. In essence, it demonstrates the power of what is available in the local area, if it is given the opportunity to emerge. The Business Place (as landowners) signed the agreement with the project for a nominal rental, as it was more crucial to establish such a facility on site early on than secure a market-rate rental income stream for the property.

4.6 Design principle 6: Sustainable transport, with a major focus on public transport

The majority of residents in the area, the future home owners as well as those who will in future work on the BPP site but live elsewhere already use public transport. The development is located in the middle of a rich matrix of public rail, bus and taxi services. The key challenge will be to make sure that pedestrian connections to the existing public transport facilities are safe, accessible, clean and attractive. Investments in shelters, pedestrian crossings, and eventually integrated ticketing services may be appropriate. With the entrepreneurial opportunities to be built on site, as well as the Business Place encouraging and assisting the local population to build their own businesses, a 'walk to work and services' scenario will emerge. The SBRN development plans show wide boulevards and logical access routes to major services – to Lansdowne Road, the bus terminus (by allowing access through and to the Philippi Park suburb to the south) with good opportunities for the future residents to either be employed on site, run a business on site, or buy most of their household goods on site at the market or the local supermarket. Most importantly, because the development will not be a 'walled community', non-residents will not have to walk around the property to access major transport modes, so access to current public transport users will remain direct and on foot.

If every household has a car, the total consumption of fuel consumed in order to send out 350 cars from the site every working day, each car doing 20 000km per year, will be 700 000 litres per year. The best way to reduce dependence on fossil fuel consumption immediately would be to set up a plant which recycles used vegetable oil from fast food outlets into biodiesel on site. Producing 700 000 litres per year would require establishing two biodiesel plants at a cost of R70 000 each. Each of these plants can produce a minimum of 2 000 litres per day minimum, leaving an excess for one vehicle to use to collect the used vegetable oil. This option will be seriously considered.

4.7 Design principle 7: Sustainable construction materials and building methods

The architectural design for the housing units assumes the use of conventional building materials, including cement-block walls and galvanised sheeting for the roofing. However, this will change during the next planning phase because the aim must be to substantially reduce the embodied energy of the buildings, and in particular to reduce the cement content of the buildings. Materials should ideally:

- act as a permanent carbon sink
- have low embodied energy
- be locally available

- be low tech enough for local labour to construct the houses (high tech materials require specialised labour to install)
- be assimilated into the individual final building form in a way that causes minimal environmental impact
- be part of a total building design that has a low-carbon emission impact
- be long-lasting.

The authors of *The green building hand book*¹³ acknowledge that there are many different shades of ‘green’. The British Building Services Research and Information Association defines ‘sustainable construction’ as ‘the creation and responsible management of a healthy built environment based on resource efficient and ecological principles’. These principles are:

- minimising non-renewable resource consumption
- enhancing the natural environment
- eliminating or minimising the use of toxins, thus combining energy efficiency with the impact of materials on occupants.

Moving away from the philosophical approach for a moment, it is worthwhile considering the current standards in construction materials in low-income mass-housing developments in Cape Town, such as:

- walls of hollow cement block (140mm)
- cement binding between the blocks
- cement plaster over the bricks/blocks, or no plaster at all
- PVC¹⁴ paint coating (despite the fact that PVC has a known toxic impact)
- water supply using potable water, treated by and bought from the City at a high price, pumped to all outlet points in the house including cisterns, as well as garden taps for watering the lawns and flower beds
- effluent discharge is via a system that combines all grey and black water which is then transfer via a sewer line to the sewage treatment plant
- all energy requirements are met from grid electricity bought from the City.

A departure from these standard materials, even if it is a small departure, would signify a major shift from the norm in Cape Town. Generating a portion of the required electricity on site, treating the used water and recycling it to the gardens, and using a different type of brick (e.g. unfired) would already be a major change. Simply siting the housing estate within pedestrian reach of a productive, accessible agricultural area is a break from tradition. It is therefore not a difficult issue to productively challenge building practices and designs currently in use in Cape Town.

Selecting building materials

Whilst this document does not contain decisions on the final building materials to be used, a product analysis and materials specification process will be undertaken to drive these decisions. Table 5 outlines the factors that might be taken into account when deciding which building material to use at Philippi. The basics of the matrix are drawn from the *Green building handbook*, but the figures and criteria are not. The table is not exhaustive, but it indicates the type of investigation that will be conducted into many of the major components to be used in the building of the Philippi village. Local realities must be taken into account. For instance, whilst fired clay bricks may initially have a high environmental impact, there is a vibrant informal brick-recycling informal industry on the Cape Flats. The current building boom has brought with it tons of rubble from building sites, including discarded bricks. Informal traders chip off the cement plaster and binding, and stack their recycled bricks literally on the side of the road for sale to anyone with transport to take them away. Prices are generally 50% of a new brick. Therefore, whilst the textbooks may indicate a fired brick as highly undesirable as a building material, local conditions may make these a good building material in Philippi. Depending on supply, it is also possible that a sector of the houses will be built using recycled bricks, while another portion is constructed with hemp bricks.

¹³ Woolley, T, Kimmins, S, Harrison, R & Harrison, P. 1987. *Green building handbook: A guide to building products and their impact on the environment Volume 1*. London: E&FN Spon.

¹⁴ Polyvinyl chloride.

Table 5: Environmental impact of the production and use of different kinds of building materials

	Production									Use				
	Energy use	Resource depletion (biological)	Global warming	Ozone depletion	Toxics produced	Acid rain	Occupational health	Locally available	Carbon sink	Recycling/ reuse	Durability / maintenance	Health	Unskilled labour possible	Specialist labour required
Masonry														
Clay bricks, fired & new	4	3	5	2	2	3	4	Yes	No	Yes	Good	0	Yes	Yes
Clay bricks, fired and recycled	1	0	0	0	3	0	2	Yes	No	Yes	Good	0	Yes	Yes
Clay bricks, unfired	2	3	0	0	2	0	2	Yes	No	No	Good	0	Yes	Yes
Cement blocks	2	1	3	0	4	0	3	Yes	No	Yes	Good	1	Yes	Yes
Hemp bricks	0	-5	-5	0	-5	-5	0	No	Yes	Yes	Good	0	No	Yes
Composite boards														
Plywood	3	3	2	1	2	2	4	Yes	Yes	Yes	Poor	0	Yes	Yes
Chipboard	3	2	4	4	3	2	4	Yes	Yes	Yes	Poor	2	Yes	Yes
Fibre cement	4	1	3	0	4	2	2	Yes	No	No	Good	1	Yes	Yes
Melamine	4	0	4	2	4	3	3	Yes	No	No	Good	0	Yes	Yes
Roofing materials														
Clay tile	5	1	2	0	4	1	0	Yes	No	Yes	Good	0	Yes	Yes

	Production									Use				
	Energy use	Resource depletion (biological)	Global warming	Ozone depletion	Toxics produced	Acid rain	Occupational health	Locally available	Carbon sink	Recycling/ reuse	Durability / maintenance	Health	Unskilled labour possible	Specialist labour required
Natural slate	5	2	1	0	1	1	0	Yes	No	No	Good	0	Yes	Yes
Concrete tile	3	2	1	0	4	0	0	Yes	No	No	Good	0	Yes	Yes
Fibre cement tile	1	3	5	0	5	3	2	Yes	No	No	Good	1	Yes	Yes
Galvanised sheet metal	5	2	5	5	5	5	2	Yes	No	Yes	Good	1	Yes	Yes
Hemp tile	0	0	0	0	0	0	0	No	Yes	Yes	Good	0	No	Yes
Insulation														
Glass wool	2	1	0	0	3	2	4	Yes	No	Yes	Good	3	Yes	Yes
Hemp wool	2	0	0	0	0	0	0	No	Yes	Yes	Good	0	Yes	Yes
Polystyrene	5	2	0	0	5	4	0	Yes	No	No	Good	0	Yes	Yes

Key: 4 – Worst impact

3 – next biggest impact

2 – lesser impact

1 – smaller but significant impact

0 – No significant impact

Table 6 extracts the most important information from *The green building handbook* about choosing materials.

Table 6: Guide to choice of materials

Requirement	Best buy	Second choice	Avoid
Insulation	Wool, cellulose fibre, cork, strawboard, wood-wool	Foamed glass	
Masonry	Reclaimed bricks or stone with a pure lime mortar		
Plaster	Claytech	Lime mortar, natural gypsum	
Timber preservatives	No preservative	Water-based boron or zinc, copper and/or flouride compounds	
Paints	Linseed oil based containing plant pigments	Solvent-borne plant-based	Solvent borne synthetic
Rainwater storage	Cast iron	Glass reinforced polyester	
Carpets	Wool		Nylon
Underlay	Hessian/felt		Synthetic foams
Floor coverings	Linoleum, cork, stone, timber	Ceramic tile, latex tile	Vinyl, PVC
Fixings	Grippers/tacks		Solvent glues
Wire insulation	Rubber	Polyethylene, polypropylene, synthetic rubber	PVC
Flat roof membranes	Pitched roof!	EPDM ¹⁵ sheet or natural rubber if available	PVC, chlorinated polyethylene

This list is not exhaustive, but it provides a guide for the decisions that will need to be made. A notable omission is the environmentally friendly hemp-based materials that have become available. Discussions have been held with the French group European Fibre Technologies regarding building a portion of Philippi out of hemp-based products. The full product range is highly desirable and is considered in more detail here.

Hemp construction

Hemp has many advantages as a construction material but, in France, where it is a popular choice, only about 1 500 houses per year can be built from hemp-based products because the material is in such short supply. It is unlikely that the 350 housing units planned for Philippi could be built in a single construction phase using imported hemp from France. However, the National Organic Producers' Initiative (NOPI) has convinced South African farmers to begin to cultivate hemp as a crop. About 1 500ha of land will be planted to hemp in the coming year, and it is hoped that 15 000ha a year will be grown in the near future.

Cultivation

Hemp is a weed. It can be grown almost anywhere, from sandy soils to a sewage pond. It serves as a cover crop, a fallow crop and a wind-break between crops. It requires no chemical protection (herbicides, insecticides etc.), is fast growing (four months) and produces six times more biomass than a commercial timber plantation of the same area over the same period. Hemp also a nitrogen fixer that improves the nitrogen content of the soils. This means it is a massive carbon sink. The NOPI flagship initiative is called 'Grow your own home', a slogan which well describes the product's potential.

Hemp building materials

Through beneficiation processes, the plant can be made into bricks, insulation wool, underfloor insulation chips, roof tiles and floor tiles. The wool of the hemp fibre can be made into rolls for insulation in roofs, attics and wall cavities or into chips for pouring into crevices and cavities in partitions. Mixed with lime, it can be made into a binding material

¹⁵ Ethylene propylene diene monomer.

between the bricks, and a plastering and rendering product. Its oil can be used for leather treatment, skin products, or even taken internally as a rich source of Omega-3 oils. Hemp products were used for sails on sailing ships prior to the advent of synthetic materials, as a clothing fabric,¹⁶ and is still used to bind the paper of a tea bag together to stop the bag coming apart in the hot water.

Physical data

A hemp brick can be made to any specified dimension, and has a thermal conductivity of 0.04W/m.K, with a density of only 25–40kg/m³. The thermal qualities of a 37cm thick clay brick can be obtained from a hemp brick only 24cm thick. Heat conductivity is only 0.048W/m.K. If made into hemp concrete (with lime), the density is only 300–450kg/m³ with full vapour permanence and excellent acoustic properties. There are now over 300 000 hemp houses in France. Hemp-based materials will be seriously considered for use in at least part of the Philippi project.

4.8 Design Principle 8: Local and sustainable food

Land purchase

One of the driving forces behind BPP's purchase of land adjacent to the information centre was to set up an entrepreneurial assistance centre which would offer training and production assistance to small farmers. Then came the idea to develop a 'sustainable neighbourhood' on an unused portion of land. So it was that the 'training and demonstration farm' took shape as an integral part of a larger vision.



Skills training

Abalimi offers a three-tiered programme for stimulation of vegetable production. The elements of this programme are centred around:

- The selection of a group of existing small-scale farmers who are willing to attend further skills training in business as well as organic agricultural production and certification.
- The development of a vegetable collection system on the Cape Flats, making use of cellular text-message technology to collate the weekly information.
- The renovation of a building at The Business Place for the purposes of providing a packing shed through which the supply of produce will flow.

Abalimi's field staff have already completed a field-based programme to identify a core group of 15 vegetable gardening projects whose 80 participants are willing to undergo further training in various disciplines – crop planning and production, organic certification, basic finance and business skills. The basics of this training programme will be an

¹⁶ The Afrikaans word for shirt is 'hemp'.

intensive agri-planning and financial course known as the 'Agri-Planner', a course in organic certification and what it means to the producer, and a course in packing shed processes.

Vegetable collection, packaging and storage system

Abalimi has already set up a cellphone-based vegetable information system, and is planning to renovate part of a building at BPP and turn it into a packaging and storage facility. Field staff have distributed a cell phone number to which farmers send an SMS¹⁷ stating what product they have available for collection. One Abalimi employee has assumed the responsibility of checking messages every day. An SMS might read simply '20 cabbages'. The number from which it was sent will identify the farmer offering a crop for sale. All text messages from the farmers must be received by Friday 5pm. On Tuesday of the following week, the Abalimi vehicle will visit each of the gardeners who sent an SMS to collect the vegetables. The driver will have been trained to check quality, change the collection quantities as necessary (depending on produce quality), issue a collection note with the value of the produce, and move on to the next garden. Once the driver's round is complete, he or she will deliver to the central packing shed where the organic produce will be washed, bunched and boxed for sale. If necessary, the produce could be put into cold storage until it can be sold. Abalimi will transfer payment into producers' bank accounts. It will also send weekly text messages to producers advising them of current prices.

Choice of farming type

Once it was decided to push for vegetable production on the major portion of the land, the question was 'what form should the farm take?' The possibilities include:

1. Dividing the entire 5ha into 100m² plots, provided with water and rented at a nominal fee to local residents. This would provide 500 small plots for local residents walking distance to grow food, some of which might be for entry-level commercial purposes.
2. Large tunnels and hydroponic farming – a 'high tech' option that will require substantial investment.
3. Small tunnels – semi-intensive farming.
4. One large-scale extensive farming operation.
5. One large-scale intensive farming operation.
6. A combination of any of these.
7. Shadecloth farming.

There are obvious benefits or disadvantages to all choices but, for the purposes of this document, the shadecloth farming operation has been costed and analysed. It has a number of advantages.

1. The strong winds and hot sun in summer, and the gale-force winds and cold rain in winter means that a protective system for all-year production is required.
2. The shadecloth system offers protection from the worst of the elements, whilst allowing rain to penetrate.
3. The shadecloth method is not a solid barrier like the one used in a large plastic-clad tunnel system. The sheets used in tunnels are often shredded by the strong winter wind in the Cape, particularly when the plastic has become brittle.
4. Because it allows 60% UV¹⁸ penetration, it is suitable for most crops that are grown in the open air, including root crops.
5. Shadecloth systems are low-tech and have lower infrastructural set-up costs than tunnels. Most farmers who will be trained on the property will take up farming in a low-tech environment. Access to the level of credit required to develop a high-tech tunnel/hydroponic farm is simply not available to farmers starting out.
6. Training and production takes place in a reasonably comfortable environment, out of the wind and sun.
7. They offer a higher guarantee of a certain level of production.
8. They have lower maintenance costs for irrigation equipment. Pipes can be secured to the overhead structure, out of reach of implements and sources of damage.
9. They have lower evaporation potential, leading to water savings.
10. The potential for theft is reduced.

¹⁷ A text message sent to or from a cell phone (SMS stands for short message service).

¹⁸ Ultraviolet light.

11. There is greater control of crop pests, as long as the system is enclosed horizontally as well as vertically, i.e. the shadecloth extends to the ground on the sides.
12. Full organic production is possible with shadecloth.

The Department of Agriculture (a potential source of funding) and Dewcrisp Farms (a potential source of management expertise) both approve of the use of shadecloth.

Restraining forces

A number of restraining forces to receiving high quality, abundant vegetable produce on a consistent basis from small producers on the Cape Flats have been identified.

Lack of crop planning skills

Local farmers know how to grow crops, but lack the understanding of principles such as ‘sell before you plant’ and ‘respond to market demand’ (don’t simply respond to the current weather).

Lack of business skills

This is the most serious restraining force to production. Because few farmers keep records, they do not have the benefit of this self-measurement tool and therefore struggle to track progress. Inefficiencies cannot therefore be dealt with either at the production (tonnage) level or at the financial level.

Lack of belief in product value

Growers rarely experience the full power of market demand and daily price fluctuations, so they tend to sell to the surrounding population. Many farmers become discouraged by the lack of access to transport to markets and a lack of enthusiasm among neighbours to pay a fair price for high-quality organic produce. When conditions are bad, some farmers do not even bother to harvest what they have grown. This has led to city-based small-scale farming being seen as an unreliable income-generating vocation.

Geographical distance between growers

A farmer may have 50 cabbages to sell, but if her production plot is in Khayelitsha, the chances are she will put 10 of them at a time in a wheelbarrow and sell them door-to-door, or she may hope that a local resident will support her efforts. Dividing her time this way between marketing and production, besides other family pressures, negatively affects her ability to stay motivated and earn a consistent, reasonable income.

No information exchange between buyers and sellers

Currently, buyers and producers are not in contact with one another. For weekly vegetable production on geographically dispersed mini-farms to be economically viable, producers must be able to systematically communicate with buyers. Abilimi has already established the system described above.

Summary

Without specific farmer training, a viable information gathering system, a regular and reliable collection system and a central processing venue for produce, it is likely that the full potential of urban-based organic vegetable production from the Cape Flats will never be realised. No single element can function successfully without the others – the system must function as an integral whole. Training will not on its own guarantee a good outcome unless a distribution system is established. Offering a weekly collection system alone without an information-gathering system or crop planning and business skills training is likely to mean a half-empty truck visiting unproductive gardens on a haphazard basis. With Pick ‘n Pay’s backing and the field expertise of Abalimi, the city-based small-scale producer will be able to plant, tend the garden and access markets with greater confidence. The joint BPP/Abalimi project will play a vital role in the project, through on-the-ground training linked to agricultural ‘classroom’ training at The Business Place, managed by Dewcrisp and Abalimi.

Infrastructure cost estimates

Estimates for the infrastructure cost are provided in Table 7.

Table 7: Infrastructure cost estimates for the proposed Philippi farm

Item	Unit price	Year 1	Year 2	Year 3	Price per hectare	5ha price
Land clearing – remove/bury	R400 000	R400 000	0	0	R400 000	R2 000 000
Fencing @ R300m	R120,000	R120 000			R120 000	R540 000
Fertility improvement	R200/cubic m	R40 000	R30 000	R20 000	R90 000	R450 000
Machinery – mechanised soil tiller	R30,000	R60 000	0	0		R60,000
Hand tools & implements	R75 each x 40 per ha	R3 000	0	0	R3 000	R15 000
Hedgerows & windbreaks	R200 000 (R150/m including irrigation)	R200 000	0	0	0	R200 000
Field toilets (dry system)	R5 000	R10 000	0	0	R10 000	R50 000
Storage & offices (shipping containers)	R15 000	R60 000	0	0	R60 000	R300 000
Shadecloth & supporting structure	R500 000	R500 000			R50 ,000	R2 500 000
Seedling starter packs	R30/tray x 400 trays	R12 000	R13 000	R14 000	R39 000	R195 000
Wellpoints – 130mm + casings + housing	2 @ R20 000 ea	R40 000	0	0	R40 000	R200 000
Electrical reticulation to pumps + security lights	R40 000	R40 000	0	0	R40 000	R100 000
Irrigation system	R50 000	R50 000	0	0	R50 000	R250 000
					Total	R1 352 000
						R6 860 000

Notes:

1. Table 7 calculates the price for developing the 5ha as per the configuration on the ground at Philippi. With 4ha in a line, savings have been calculated based on common boundaries, whether for hedgerows or fences.
2. Allowance of 10% for inflation over the three years of set-up funding required.
3. Three years of fertility improvement required to stabilise the sandy soil to 3% organic content.

Production estimates

The figures provided in Table 8 are provisional and indicative. Average profitability per hectare after all inputs, labour and rent is estimated at R60 000 per year. A good weather-year will see the figures improve. One damaging storm could damage crops and infrastructure. Also, market demand and planting figures vary widely. Residents of the Cape Flats like cabbages which are the size of a football. The planting density for these cabbages is only 4/m². The Cape Town Fresh Produce Market sells smaller, sweeter cabbages that allow for a planting density of 9/m². Importantly, the same price can be obtained for both sizes, in both markets. In 2005, after four days of sunny weather during the tomato harvest, the price of a box of tomatoes hovered at R3.00. A few days later it rained and little picking was done in the Cape region. The price tripled. Anyone with tomatoes in cold storage at that time made a large profit.

Notes for Table 8:

For production estimates, the following factors have been considered:

1. An average 20% loss resulting from things like pest infestation, disease and land interference (roads, pathways etc. which may not have been incorporated into the planning) has been factored in.
2. The figures below are per hectare. There are an estimated 5ha available for crop production. 1ha will be used for small scale 'survivalist' farming 'for the pot' by the local community. The other 4ha will be divided into four production units, each with its own manager and team. The team will consist of students (for hands-on experiential learning), and paid labour drawn from the local population. The table therefore gives an annual production and profitability for the 1ha unit.
3. The table has not been complicated by amortising the capital costs in Table 7. Production costs ('input costs') have however been factored in on an average percentage basis. High-labour crops such as tomatoes have not been considered.
4. The table only reflects primary production. The farm itself could engage in value-adding to its crop, thereby increasing its feasibility. However, a small land loss would occur if this operation were to take place on the farm itself.
5. Input costs include all fertility applications (compost), seeds and seedlings, borehole water and rent at 20c/m² per month (R2 000 per month per hectare). Labour costs are subjective depending on how many people choose to work the hectare. However, a 20% loading onto the average input costs (excluding labour) has been added as a labour cost

Soil testing

Eight samples were extracted to a depth of 350mm. No horizons were visible during the sampling process, so the sample was a mix of layers throughout the profile. The soil tests confirm that there are no contamination problems and that the soils may be suitable for various kinds of farming practices.

Conclusion

The farm project will not generate a significant return on investment. There is, therefore, a very weak business case for including the farm project into the wider SBRN initiative. However, the agricultural space is required as an integral part of the project and provides a learning academy, employment, a working model for urban food production and it is also an important part of the aesthetic of the wider physical development. The options for funding the farm are therefore one of three, namely a government subsidy, grant funding from non-government funders, or internal cross-subsidisation by the other components of the SBRN.

Table 8: Farm production estimates

Crop	Average plants/ha	Days to maturity	Absolute minimum harvests per annum	Units harvested per annum after 20% loss	Selling unit	Average price per unit	Total farm turnover per annum	Input costs incl. labour + rent	Nett profit / (loss) per annum
Cabbages	40 000	100	3	96 000	Boxes of 10	R26	R249 600	80%	R50 000
Lettuce	100 000	80	3	240 000	Crate of 12	R15	R300 000	80%	R60 000
Spinach	300 000		2	480 000	10 leaves/bunch = 500g	R15/10 bunches	R720 000	70%	R140 000
Onions	600 000	270	1	480 000	10kg pocket @ 30 units/pocket	R20	R320 000	70%	R96 000
Beetroot	200 000	70	3	600 000	Bunch of 5 x 10 bunches	R26	R312 000	80%	R62 000
Carrots	2m	100	3	1.6m	Bunch of 8 x 10 bunches	R18	R360 000	80%	R72 000
Cauliflower	40 000	140	2	32 000	10 per box	R16	R51 200	70%	R15 000
Beans	100 000	85	3	45 000kg	8kg box	R30	R168 750	80%	R34 000
Butternut	10 000	90	3	90 000kg	10kg box	R10	R90 000	80%	R18 000

Notes: see previous page.

4.9 Design Principle 9: Sustainable water use and re-use of treated sewerage

The zero-waste approach that will be applied requires that all effluent is recycled back into the system for various purposes thus creating a closed-loop (except for evaporation, and groundwater leakage). Three broad alternative sanitation and water recycling systems were evaluated during the course of the conceptual design phase, i.e. activated suspended sludge, anaerobic digestion followed by an aerobic fixed medium reactor, and options involving land-based systems (e.g. constructed wetlands, biolytix systems, and helophyte filters).

Sanitation infrastructure (technical specifications)

The preliminary design was based on the estimates and assumptions shown in Table 9. The flow rate is based on typical values for such developments. Organic and nutrient loads are based mostly on European and American studies. South African research data is lacking in this regard.

Table 9: Assumptions for the preliminary design of waste flow rate, nutrient loads and organic loads (based on chemical oxygen demand (COD) measurement)

	Flow rate (l/p.d)	Nitrogen gN/p.d	Phosphate gP/p.d	Organic gCOD/p.d
Residents' toilet water	40	13.0	1.8	84
Residents' grey water	70	2.0	0.7	56
Dailies'* toilet water	25	5.2	0.7	34
Dailies' grey water	20	0.8	0.3	22

*'Dailies' are people who visit or work on the site.

Activated sludge processes

These convert organic material in wastewater (COD) to active micro-organisms and CO₂, through mechanical aeration. The amount of CO₂ produced is inversely proportional to the amount of waste sludge produced. Waste sludge has to be removed continuously and can be further digested for biogas production, or alternatively composted. The CO₂ output (and the mechanical energy input) are higher than the other two systems which have been considered here, but very low in comparison to other societal activities. Advanced biological systems can remove nutrients (N and P) to very low concentrations. A drawback of these systems is that a reasonably good understanding of the activated sludge flocs is required for operation and maintenance. The sludge age needs to be controlled to prevent washout of certain organisms (at a low age) and failure of the clarifier (sludge-effluent separation) (at a high age).

The elements of this system are:

- screening where inorganic matter is removed
- a clarifier where phase separation (sedimentation) takes place
- a holding reservoir
- disinfection with chlorine
- piping to houses for filling toilet cisterns
- the system can also be operated as a batch reactor, which could very well be included in some of the existing silos on site.

Land-based systems

These include techniques such as pond systems (anaerobic-facultative-maturation) and engineered or artificial wetlands. These systems are also called 'natural' treatment, mostly because aeration is not mechanical and relies on natural gas exchange. This is also the reason for the large area required by land-based systems. Engineered wetlands have the added advantage that plants take part in the treatment process (some nitrification and denitrification in summer) and removal of heavy metals and hydrocarbons through absorption. Effluent quality from land-based systems is not as good as that which is the output of a well-operated activated sludge plant.

Anaerobic-aerobic system

This system was developed on a Council for Scientific and Industrial Research concept. A main feature of this option is separation of toilet water and other waters (grey water). Two reasons are cited for this decision:

- Toilet water contains the majority of the nutrients (Table 9), which should be recycled to the urban agriculture. Toilet flush water should also be free of nutrients to prevent growth of algae or other organisms in the collection tanks and delivery lines. Keeping toilet water separate from all other water is the simplest way of achieving this.
- Toilet water is treated in an un-mechanised anaerobic digester, which relies on hydraulic residence time for treatment. A lower flow rate (i.e. without grey water) would increase the retention time for any given reactor size, or alternatively allow for smaller reactor sizes.
- Effluent from the anaerobic reactor can be treated in a trickling filter (or biolytic filter) to remove soluble and other effluent organic material aerobically (similar to the grey water treatment), to nitrify ammonium in effluent, to enable later denitrification (to be pursued in the detail design phase).

The elements of this system are:

- screening where inorganic matter is removed
- a biodigester where anaerobic treatment takes place which produces usable methane gas
- a trickling filter where aerobic treatment takes place
- a clarifier where phase separation (sedimentation) takes place
- a holding reservoir
- disinfection with ultra-violet radiation.
- Irrigation.

Table 10: Comparison of the three sanitation and wastewater treatment options

	Activated sludge	Land-based	Anaerobic-Aerobic
Energy demand	4 – 5 W/p (excluding biogas)	0	0.6–1.0W/p (excluding biogas)
Land use	<0.1m ² /p	1 - 3 m ² /p	0.2m ² /p
Effluent quality	Very good (nutrient removal)	Varying	Good (no nutrient removal)
Maintenance requirement	Mechanical and electrical, with specialised biochemistry	Basic	Mostly mechanical and electrical

Based on these indicators, and in cognisance of the project objectives, the anaerobic digestion - aerobic biofilm system seems to be a good starting point for detailed design in the following phase.

In summary, the preferred option generated by the technical team was as follows:

- separate black and grey water sewage outflows from the various households and facilities
- the grey water will be treated aerobically to remove organic solids
- the treated grey water will be re-used for flushing toilets (which means it then joins the black water circuit after being flushed through the toilet system)
- the black water is then transported to the anaerobic digestion (AD) system (which will be configured as a biogas digester to capture the biogas for re-use to generate energy)
- after going through the AD (biogas digester) the sewage then goes through an aerobic treatment system for removal of slowly biodegradable organics not removed in AD – the most robust aerobic system is a trickling filter or (if there is sufficient oxygen left in the effluent) possibly a biolytic filter (with the final choice determined by further investigation and analysis)
- the treated black water is used in agriculture, after going through a UV filter to remove the pathogens.

Figure 4 is a conceptual representation of the entire system and Figure 5 shows more detail. Figure 6 shows the design of the biogas digester. The recommendation is the use of a fixed-dome digester which is non-heated and sited below ground level. The terrain does not lend itself to gravity flow throughout, and hence there will be a need to pump the supernatant from the digester up some 5m for inflow to the (aerobic) trickling filters. The fixed dome design is in use for decentralised waste water treatment throughout the world.

Cheaper alternatives that require a lower level of skill to maintain will be investigated, in particular the system that has been constructed at the Lynedoch EcoVillage which uses a biolytic filter plus a UV filter to treat black water flows to generate irrigation quality water; and a vertically integrated wetland plus a dam to treat black water to the quality suitable for re-use for flushing a toilet.

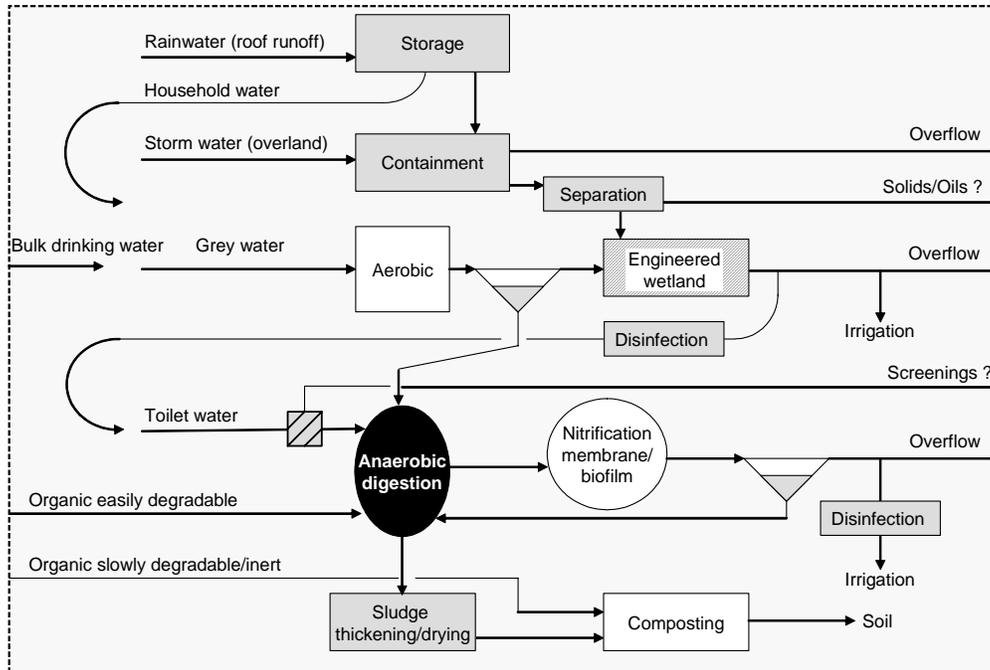


Figure 4: Conceptual representation of the proposed sanitation and wastewater treatment system

Drinking water

Though there is an existing borehole on the site, test results indicate that the water is only suitable for irrigation and will therefore be pumped out of boreholes to the storage reservoirs for this use. Drinking water import from the municipal supply for domestic purposes, without any form of recycling, is estimated at 275m³/day, assuming 2 000 residents with 1 000 dailies. However, with grey water recycling, the import of drinking water can be reduced to 170m³/day. A manual volume control plan to arrest distribution losses, possibly based on a monthly maintenance contract, should be further investigated to minimise actual drinking water importing. Residents should be encouraged to shower rather than bath, and water saving devices should be fitted to all taps.

Water recycling

The water used in homes will be collected and biologically treated in order to make it suitable for re-use in an irrigation application. If the activated sludge system is used, there will only be one drain pipe, mixing black and grey water. If the land-based and anaerobic-aerobic systems are used, the collection of water will be by way of separate pipes: one for grey water (all except toilet water) and one for black water (toilet water), as described below. At this point both options remain open, and this will be decided during the more detailed design phase.

Treated grey water would be stored in an existing silo after UV radiation (grey water contains pathogens which are not all killed in the aerobic trickling filter). This treatment ensures that organisms are killed before entering the silo, which could form a living environment. Water leaving the silo (toilet flush water) may need to be disinfected with chlorine to maintain a residual chlorine concentration in the delivery network. Water leaving the silo would be well clarified, because solids settle and are removed at the bottom of the silo.

Rainwater collection and use

Rain in the Western Cape is probably too seasonal to rely on for ongoing everyday services. For example, the maximum potential of roof runoff from new houses and the shed relates to around a month of irrigation water (11 000m² x 550mm/annum = 6 050m³/annum = 200m³/day x 30 days). The current choice of roof material (galvanised steel) has to be examined in the detailed design phase, since zinc leaches off galvanised surfaces and leads to heavy metal toxicity. Rainwater runoff (from galvanised roofs) could probably be used for landscape irrigation (i.e. other than crops).

WATER TREATMENT & RECYCLING

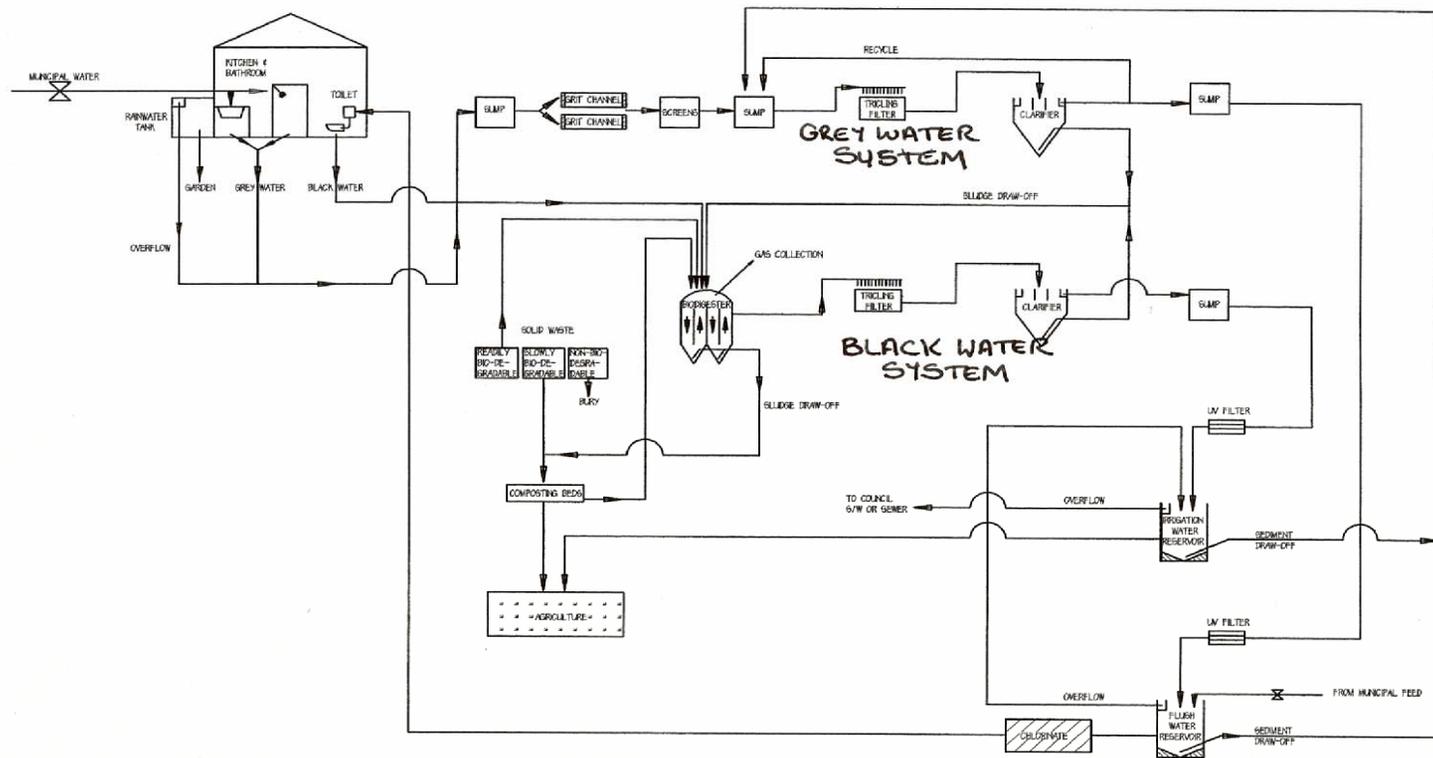


Figure 5: Proposed sanitation and wastewater treatment system

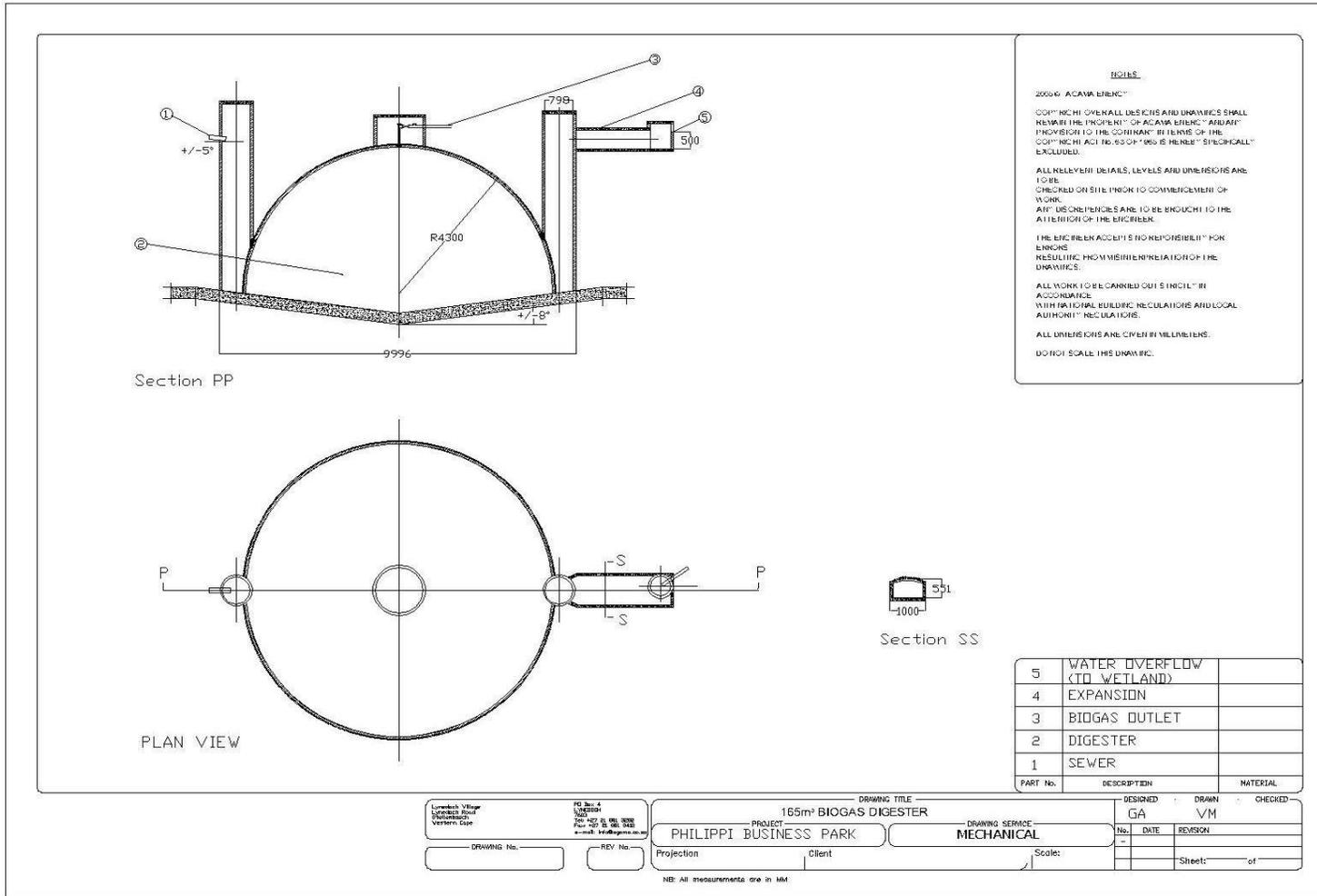


Figure 6: Design of proposed biogas digester

The capture of rainwater is by its very nature rather fickle and hence a source of water which must be 'polished' by a storage system. This will entail utilising the existing silos on site as storage reservoirs. It must be noted that these silos would have been designed as granular product silos and are therefore not water-retaining. In order to make use of them to store water, they will have to be lined with a waterproof membrane. They have been checked for structural integrity and found to be suitable in this regard.

Storm water (overland runoff)

The main aim of urban drainage is to prevent flooding. While houses should be protected in all but the worst storms, the degree to which certain areas would be allowed to flood still needs to be decided. However, the following basic approach should be adopted: it should recharge the groundwater (depending on soil type, but this should be feasible); and it should offer some environmental protection.

The design of the storm-water system must take into account the concept that as much storm-water should be kept on site. Safety and property protection issues must also be considered. In this latter context, there are two eventualities that must be designed for: minor flood and major floods.

Minor floods

Minor floods are defined as occurrences which have a return period of one every two years. In practice this means that the inlet catch-pits and storm-water gulleys, pipes, rainwater channels, etc. must cope with such run-off without overflowing. The water caught up in the minor flood system will be routed to a collection sump from where it will be pumped to reservoirs for use as irrigation water. Because the site is very flat, various sumps may be required if the depth of the stormwater piping system is not to be excessive.

Major floods

Major floods are those which exceed the once-every-two-year occurrence level and can therefore be expected to overload the piped storm-water system. Roads and pathways can be shaped to act as storm-water conduits, taking floodwater away from houses and other buildings.

The water flowing overland should ideally be routed to a detention pond from where the water is allowed to drain to the minor flood collection sumps at a rate which the system can cope with, or to drain into the soil to replenish the aquifer.

Composting

The inputs to a composting system are slow-degradable or inert organic material from gardens, landscaping and agriculture and sludge from the anaerobic-aerobic treatment system. If compost exceeds the local requirements, it could be sold and therefore become an economic asset to the community.

Operation and maintenance of the sanitation and water system

A suitable contractual option could be an on-site energy and water services company with contract-based operation and management that looks after electricity, some solid waste, water and sanitation.

Economic assessment

The added value of grey water recycling, local nutrient recycling and biogas production would make anaerobic-aerobic treatment an attractive choice. However, since financial value (or market price) of these goods and services is often not equal to the sustained economic value, the final choice could be a combination of the three options. The case at least needs to be made on savings as follows:

- Water demand reduction: $105\text{m}^3/\text{day} @ \text{R}4/\text{m}^3 = \text{R}420/\text{day}$ (this is about R150 000/year).
- Sanitation levy waived by council: 2 500 people @ R150/person.year = R375 000 per year.
- Fertiliser substituted: 1 200kg N; 800kg K; 1 200kg P = a saving of R5 000 per year. (Note: The cost of fertiliser replacement is based on the production costs, from international prices.)

4.10 Design Principle 10: Enhancing biodiversity and the preservation of natural habitats

Site degradation and history

The relationships between the commercial, residential, agricultural and ecological aspects of the Philippi site are symbiotic. The site has been ecologically degraded by commerce and industry over the years, with the resultant

deterioration of natural vegetation. This project will attempt to recover land that has been under-conserved, to regenerate natural habitats and vegetation, and to establish an organic farm for localised food production. In short, development on the site will reverse the eco-system degradation that has taken place to date thus demonstrating that socio-economic development and eco-system sustainability can be mutually reinforcing.

Philippi is located within the Cape Floristic Kingdom, a global urban biodiversity ‘hotspot’ which is one of only six floral kingdoms in the world. The Cape Floristic Kingdom is one of the richest, with a high proportion of endemic and endangered species. The Cape Flats (where Philippi is located), is an area that to date has suffered from extensive land degradation due to massive urban sprawl, soil pollution, groundwater pollution, and eco-system degradation caused by the influx of alien plants (such as the Australian Port Jackson tree), bird, insect and animal species.

Biodiversity and development

During the period 1988–2002, urban development in Cape Town has significantly increased to an average of 1 232ha of land developed each year. This figure is almost double the 1977–1988 averages, and reflects the tremendous development boom that Cape Town is experiencing. If this development is not managed correctly, it could lead to severe environmental and social consequences, which may include the loss of large areas of agricultural land, and land which has high potential with regard to biodiversity. Bearing this in mind, the BPP vision has incorporated tracts of land for the purpose of creating open and green spaces, an organic farm, and land on which indigenous plant species can be grown, in order to enhance biodiversity, recover natural habitats, and create jobs. Waste products from the human settlement will be used to enhance the soil, and to create jobs in waste management and composting.

Biodiversity and job creation

Given the commercial orientation of The Business Place Philippi, the establishment of on-site biodiversity-related enterprises is one of many business concepts currently being explored. Commercial ventures based on biodiversity help to educate participants, create jobs, offer an incentive to ‘exploit’ biodiversity, and may increase the value the city places on biodiversity assets.

Planting trees, and other types of ‘greening’ projects add social value and assist with climate change and emissions reduction as well. Green spaces have been termed the ‘lungs of a city’. These spaces play a significant role in keeping the air clean and processing environmental waste products. Green spaces can be open spaces, such as parks, green corridors, gardens, etc. Open spaces are areas in which people living in the city can find a place for recreation and relaxation, as well as the enjoyment of natural beauty. Access to green spaces is a vital part of promoting a sense of community well-being, and the BPP has incorporated many such green spaces into its project plan.

Some highlights of Cape Town’s biodiversity

First a few salient facts:

- South Africa has the second highest number of plant extinctions in the world.
- 70% of the Cape Floral Kingdom’s 9 600 plant species are not found anywhere else on earth.
- The Cape Flats has the highest concentration of threatened plants per area of remaining vegetation in the world.
- The Cape Flats support more than 1 466 plant species on 1 874km² of land, 76 of which are endemic and 131 Red Data species.

Although the BPP site is thoroughly degraded, it is still possible to start an urban design by assuming that the integrity of the site’s eco-systems should be used as the point of departure for the proposed urban development. In other words, instead of fitting green spaces into the urban system (which is what ‘greening’ means today), sustainable urban design should be about fitting urban systems into eco-systems. On a degraded site, the focus should be both in mutual reinforcement of each other.

4.11 Design Principle 11: Health, well-being and soulfulness

Area health issues

The proposed architectural designs for the Philippi site ensure that households will have a significantly improved living environment, with resultant health benefits. By utilising renewable and energy efficient technologies, proper orientation and insulation, residents will not need to rely on paraffin and coal for heating and cooking. Sustainable, on-site waste management systems will reduce the negative health impacts of sanitation practices in the area which have included the

use of bucket toilets and open exposure to wastes generated in high-density environments. The result of proposed improvements in lifestyle will be to reduce the incidence of diseases, such as hepatitis, shigella dysentery, cholera, and tuberculosis and other respiratory problems. The debt burden of households will be reduced by the provision of affordable on-site services.

Crowded, poorly ventilated conditions in informal settlements, as well as the high density of these settlements, increases the likelihood of transmission of tuberculosis from one person to another, and increases the suffering of those living with HIV/Aids by exposing them to other diseases.

The prevalence of HIV/Aids in Cape Town has been increasing steadily over the years, with the 2003 rate estimated to be 13.1%. The highest rate of prevalence of HIV/Aids and tuberculosis is on the Cape Flats. These high ratios of illness place a burden on the already overstressed health system. This has far-reaching social and economic consequences for the city, as the number of child-headed households (households headed by Aids orphans) increases, and a large number of the economically active part of the population is unable to work due to illness.

The ability to purchase locally-grown, high-quality fresh produce will have positive health impacts. This is often not an option for many lower-income households, due to the high cost of packaging, transport, storage etc. which pushes market prices up. At Philippi, the direct supply of organic foods will offer residents better produce at reduced cost, with the resultant positive affects on physical and mental health.

Community well-being

The residents of Philippi are burdened by anxiety about the increasing incidence of crime. In 2004, there were 74 murders per 100 000 population per year in Cape Town, and an average of 135 rapes per year reported per 100 000 people in the city. The incidence of serious crime is probably higher than official statistics suggest. The social and psychological effects of crime include increased levels of fear, suspicion, stress, aggression and despair.

The BPP site is surrounded by high-density suburbs – about 250 000 people. The layout of the Philippi eco-village has taken into account the need for safe spaces for women and children, the need for proper lighting in public and open spaces, and the need for community support. Community involvement will be a key success factor in making the site safe. The property is well represented in the wider local community through four main contact bases:

- Abalimi – an NGO with strong local support amongst urban farmers, and one of the founding members of the BPP.
- Community Connections – an existing tenant in the Information Centre cluster, working on capacity building in the CBO sector.
- The Community Organisations Resource Centre – the support organisation for FEDUP, a coalition of community representative groups with strong lobbying powers.
- CESVI – an Italian-based NGO that has purchased adjacent land and will be constructing a house of refuge for abused women. (CESVI is part of COURC.)
- The Philippi Economic Development Initiative (PEDI), a networking group with the sole purpose of attracting investment into the immediate area.

It is envisaged that the Philippi EcoVillage will be a working example of a socially mixed, ecologically designed urban system, with the goal of becoming financially and economically sustainable. It will be developed as a commercially viable venture from the start, without dependence for ongoing viability on external grant funding.

The Philippi EcoVillage will provide a safe space where South Africans from all backgrounds can live in peace with each other and in harmony with nature. It is envisaged that it will be a place where people can come and share in the life of the community while they work, learn, think, worship within their own spiritual context, create, and contribute to the making of a better world. It must, in other words, be a place where all life is celebrated and beauty in all its forms treasured for this and future generations.

4.12 Design Principle 12: Democratic and effective governance

Although the developmental vision articulated in this document envisages a wide range of economic activities to drive the local economy, this will not be centrally controlled and structured. Instead, each initiative will be a stand-alone entity with its own governance structure and financial responsibilities. Like the developer of a shopping mall, the developers of the Philippi SBRN will provide a space that has an overall purpose. Those who enter and use the space as residents, businesses or CBOs will be responsible for their own financial viability. If they fail to meet their financial and other obligations, they will have to leave.

At the moment, the owner and developer is a Section 21 Company called The Business Place Philippi. This structure will establish a new company structure, currently referred to as Devco, that will facilitate the development process, with a development rights contract with BPP. Eventually, the following is envisaged:

- After completion of the physical developments, eventual governance of the area will be taken over by a property owners' association that will be a Section 21 Company with a comprehensive memorandum and articles of association that defines every property owner as a member who must, in turn, abide by an agreed code of conduct.
- Service delivery via an energy and water services company that operates in accordance with agreed efficiency criteria;
- A wide range of partnerships that will govern common facilities, such as the 'farmer-to-fork Market', public spaces, etc.

5 Detailed development framework

5.1 Urban design and architectural vision of BPP spaces

This section will outline the design and vision of the BPP as illustrated in the architectural drawings.

Housing

The residential component will comprise:

1. 120 x 56m² double storey houses that will each cost R101 864 and sell at R328 000.
2. 88 x 32m² houses that will each cost R20 576 and sell at R60 000.
3. 88 x flats (varied between 30–50m²) that will cost on average R24 322 and sell at R105 000.
4. 54 x 47m² houses that will each cost R37 293 and sell at R184 000.

Urban agriculture

The urban agriculture component will comprise three types of arable, agricultural land at three distinct scales of use, these being:

1. House gardens which range from 40–70m² in extent
2. Agricultural allotments which comprise sub-divisible areas of 100 m² for each cluster of 30 houses.
3. Commercial agricultural lands of a combined area of 35 000 m² for use by the wider community under the supervision of appointed commercial farming enterprises.

Existing buildings, excluding shed and silos

The existing factory and office building is to be remodeled to create a campus of loosely connected buildings which will accommodate offices, The Business Place and ancillary accommodation, a conference centre and meeting venue, a greenhouse and packing shed, rentable commercial office accommodation and a set of outdoor spaces which will be employed to connect the various and disparate buildings together into a cohesive whole.

Existing shed and silos

The existing shed encloses a volume of approximately 180 000 m³. The intention is to enclose the shed, use the roof which occupies an area of 6 000m² to collect solar energy and stormwater and to use the vertical sides to support hydroponic agriculture whilst at the same time to act as a means to modify the external climate to achieve comfort within the building.



Figure 7: The existing shed and silos

Internally, using mezzanines, the volume will be divided into planes to accommodate a variety of activities – a sports centre and running track on one level, a working arts and crafts factory village, a conference facility and a farmers' market. The upper levels will house spaces for cultural and commercial activities. Already, one part of the structure has been rented out to a local recycling group.

This stack of silos has unique earning potential as advertising space – a sponsored community mural has been suggested, with various advertisers keen to get involved. This advertising could earn the project up to R500 000 per year. However, city bureaucracy has meant that such an improvement is illegal on the grounds that it detracts from the beauty of Table Mountain, even though this is barely visible in the distance. For the interior, water storage during the dry months for the agricultural area is a possibility, as are apartments.

5.2 Design principles for a sustainable housing neighbourhood

Social and economic principles for sustainable communities

a) Mixed use – the proposal seeks to dissolve the strict land-use segregation which is a legacy from modern planning doctrine which has rendered South African cities unworkable and unsustainable. To this end the architects attempted to achieve a broad a mix of uses appropriate to the site and its location. Ideally the site will offer the householders access to housing, work, recreation and the social and cultural opportunities that are needed to sustain a healthy, fulfilled and sustainable urban lifestyle.

b) Housing as a form of income-generation – the design of the houses seeks to capitalise on the opportunity to transform the houses from merely shelter to income producing opportunities. The houses have been consequently designed to be as flexible as possible – this has been achieved by fulfilling the principle of 'loose-fit', namely that the interiors of the houses are designed as shells which can be arranged internally in a variety of different ways. Opportunities for the houses to be expanded have been created by offering the opportunity to the household to either add onto the existing structures or to build a free-standing structure in the garden space adjacent to the house.

c) Housing as capital investment – all houses are intended to be sold. Housing represents the single biggest investment that most people make in their lifetimes. It represents a potentially huge capital investment and the proposal seeks to ensure through the placement and the design of both the houses and the public spaces to ensure that the houses can be owned by the householders and can be sold over time in the market place to other families.

Physical design principles for sustainable housing

a) Appropriate house types – all houses are treated as terrace houses in which common walls are shared between houses. This ensures that the envelope of the house is of such a nature as to reduce external wall areas to the minimum exposure whilst at the same time ensuring maximum exposure to north sun when required and ensuring decent cross ventilation to all rooms for comfort and health.

b) Correct orientation – all houses face north to capture the sun in winter and exclude the sun in summer. Roof overhangs of 1 200mm on the north-facing elevations ensure that the summer sun is excluded and the winter sun is allowed to penetrate the interiors.

c) Cross ventilation – all houses comprise single-banked rooms to ensure that opening windows can be placed on at least two walls of each room to ensure adequate cross ventilation.

d) Sustainable material choices – recycled materials will be used where possible. Also the different edges of the houses facing different directions will be treated differently in response to the climatic demands placed on the vertical faces of the houses facing these different orientations. For example the north elevations comprise cavity-wall block construction since the winter rain is driven from the north-west direction. The south elevations are generally built from well-insulated lightweight corrugated sheeting since this side requires no treatment from rain but only from the dry hot south-easterly winds in summer.

e) Sustainable trade-offs – trade-offs are required since the range of opportunity is limited by cost. To this end appropriate and sustainable trade-offs have been made. The roofs are well insulated with properly constructed ceilings. This cost is entirely justified since it not only ensures comfort and health but also lessens the energy inputs needed to heat and cool these spaces during the winter and summer months. Similarly, the decision to build all north- and west-facing walls out of cavity wall block construction is a considered and appropriate trade-off since this will ensure that the walls remain waterproof internally and will exclude heat gain through mass and air insulation. This in turn ensures health and comfort and lessens reliance on external energy inputs to the house. However, a thick adobe or hemp block might provide a cheaper alternative that is thermally equally effective.

d) Grouped services – all services to the houses are grouped and shared across boundaries where possible. This achieves an efficiency of services which contributes to low maintenance costs which enhances sustainability.

e) Appropriate roof design – the roof is considered to be the most important external building element. Great care has been taken in ensuring that the roofs are properly designed to ensure that they are waterproof, properly insulated and face north at the correct angle to permit maximum use to be made of the roof to support solar energy collectors. Similarly roof over-hangs have been carefully designed to provide relief from the sun in the summer months.

f) Rain water harvesting – all houses capture rainwater via gutters which run into rainwater tanks.

5.3 Design strategy¹⁹

Urban design proposal

The site to the east of the large existing shed has been divided into four main zones running from north to south. Starting from the east side of the site are family homes arranged in terraces with north facing gardens. To the west of these houses is a pedestrian way which is flanked on the west side by the communal allotments. To the west of the allotments is a public pedestrian walkway which runs the full length of the site and provides a through-way connection to the wider community. This walkway is flanked on both sides by housing and commercial/community/NGO office spaces. This walkway is controlled and is closed to the public at night-time for security purposes. It is accessible to service vehicles during prescribed times during the daytime only.

To the west of the through-way are the larger commercial agricultural lands which are in turn flanked by the large shed on the west. These four broad stripes are linked to each other by a series of transverse walkways that run from east to west.

Vehicular access is limited to a road along the east boundary which provides off street parking for 50% of the homes. Public parking is provided on the west side of the large shed as well as at the north end of the site adjacent to the large shed.

These four broad stripes represent a number of important ideas. Firstly they represent a gradation of scale with regard to the agricultural lands – moving from the east they represent firstly the garden as a field of production, then the allotment as a place of communal production and finally the agricultural field which represents the largest scale which carries a commercial responsibility for it to be productive.

The through-way running from east to west represents a line of negotiation and interaction which holds the possibility of bringing together these three stripes of production into the fourth zone which can be described as a zone of exchange.

To the west of the shed is the main public entrance to the site and this is flanked by a group of approximately 50 houses which offer the opportunity to create a work/live community of people who in turn would be closely linked to the large shed and the campus of buildings to the west of the shed.

Housing design

The houses have been designed to meet a wide variety of individual and family needs. Contrary to current national housing policy which is based on ‘one size fits all’, we have proposed a socially more sustainable approach in which the widest possible range of housing options is developed. Implicit in the proposal is the notion of choice. This rejects the simplistic idea that all housing is family housing and that the nuclear family predominates in our cities. Current research on communities living in shack settlements next to the N2 highway in Cape Town contradicts this ‘standard’ strongly and suggests there is a much more finely nuanced housing market in which the single person and the single parent family predominates. The proposed housing mix seeks to strongly reflect this reality.

To underpin this idea the housing units are treated as shells in which the only spaces that are clearly defined are the service spaces. The other spaces are left undetermined and the engagement of the householder is invited in determining how this space should be sub-divided, if at all. This flexibility offers a number of advantages which include the engagement of the householder in shaping their own space as well as affording the highest degree of flexibility that is realistically possible.

Larger homes are associated with outdoor private garden spaces since it is anticipated that these houses will be occupied by families with children.

¹⁹ This section should be read in conjunction with the relevant drawings (not included in this document)

Housing technology

The materials selected are ubiquitous to the Cape Flats and Philippi. The view is that an engagement with the everyday systems of construction and material use will achieve a form of economic and social sustainability with regard to ease of construction and availability of materials. Also the view is presented that the materials used in the shack settlements for construction probably represent the most resourceful and efficient and sustainable approach to house construction found anywhere in the city. The construction is well understood, the materials are readily available and in many cases are recycled to great effect.

The materials envisaged include cement blocks for north, east and west walls. Insulated corrugated sheeting is used for all south walls. Roofs will comprise insulated corrugated sheeting. Waterproof paint will be applied to both inside and outside surfaces. Internal floor finishes will comprise tinted power-floated screeds or hand finished tinted floor screeds. The construction system that is envisaged is easily known and within the competence of local contractors.

There are many opportunities to set up local enterprises to manufacture blocks, doors windows etc. We believe that this is to be supported but needs to be carefully underpinned by training programmes and careful project management and supervision. This component will add costs to the contract price but should be part of the project at all costs since the capacity building potential in these small businesses can easily be sustained beyond the life of this project and well into the future if properly managed.

6 Financial model and strategy

For the moment the project can be conceptualised as comprising five components, namely:

1. The energy, water, waste, road and stormwater infrastructure which will cost R28 million to construct.
2. The property which has been valued at R12 million.
3. An integrated mixed-use commercial and community area located within a cluster of renovated and new buildings which will cost R55 750 000 to construct (including a 55% contribution to the property value and to the total infrastructure cost), of which R2.2 million has already been raised and spent on existing renovated buildings.
4. An intensive commercial agricultural area (5ha) which will cost R4 million to establish (excluding a 5% contribution to the property value and infrastructure cost) and will include an organic demonstration and training farm.
5. A residential area comprising 350 housing units that will cost R78 million (including a 45% contribution to the property value and the total infrastructure cost), including a 500m long pedestrian boulevard, bounded by shops and bazaars of various descriptions, with live-above, work-below accommodation

The total construction cost (which includes escalation) is estimated to be R138 133 553. All costs (excluding the establishment of the agricultural area) were calculated by quantity surveyors CP de Leeuw, one of the largest and most respected quantity surveying firms in South Africa. All costings of buildings were done using the square metre method, and engineering drawings were used to calculate the infrastructure costs. The costings have been done on the assumption that conventional construction techniques and designs will be used. This means that any innovations that are introduced to ensure alignment to the Design Principles described in Section 1.2 must not exceed these costings for a conventional design. The financing of social or technological innovations where required have been justified against long-term savings and/or annuity returns, or offset against the saving of levies and charges payable to public authorities (e.g. bulk infrastructure connection fees).

The total requirement for the integrated mixed-use area plus the farm is R59 750 000. If the grant funding already acquired plus pledged funding for the Abalimi facilities is deducted, this results in a total net capital requirement of R57 550 000. This includes a 55% contribution to total infrastructure costs and the property value. Based on existing rentals per square metre, conservative estimates for newly created floor space, and a subsidised return from the farm, a rental return of 9.12% will be generated (excluding escalations). This means that a capital loan with a redemption period of ten years at a 9% fixed interest rate might be financially viable. This, however, excludes overhead costs.

In summary, the project is looking for relatively long-term debt financing at a fixed interest rate of 9% for the integrated mixed-use area plus the farm. The total requirement is R57 550 000 against a rental income. This effectively means the farm is heavily subsidised.

As far as the residential and boulevard area is concerned, the total capital requirement is R78 million, which includes a 45% contribution to infrastructure and the property value. The total selling price is just over this amount, but this includes a R6.6 million return on the land cost. The simplest model for this would be a conventional freehold title sale. To fund this, a three-year working capital facility will be required at a fixed or variable interest rate. However, there are numerous options that could be considered for a portion or even the entire development, including the following:

1. A social housing component with an annuity income that covered the costs of a long-term capital loan.
2. A 'people's housing process' approach to acquire 'institutional subsidies' via a housing association which, in turn, acts as a non-profit developer in partnership with beneficiaries who build the houses themselves under supervision and monitoring by the housing association. This effectively means the housing association remains the owner of the properties until they are paid off in full or in part.
3. Selling off the land to one or more private and/or non-profit developers who develop and on-sell/rent the housing stock at their own risk to the buyers – this is the lowest risk, minimal management input and therefore potentially minimum return option.
4. A variation on Option 3 would be to finance the infrastructure, and then sell off to for- and/or non-profit developers, with a higher return (probably the land price of R6.6 million).
5. Another option would be to treat the residential housing component and the boulevard in completely different ways, such as selling off the residential development to developers, but retaining the boulevard and developing it against an annuity income rather than a once-off capital sale.

There are numerous ways of packaging the development of the integrated mixed-use area and the residential and boulevard area, including treating them as an integrated whole that could be developed totally by a professional for- or non-profit developer. This latter option might create opportunities for equity partners. However, in general debt may turn out to be cheaper than an equity-based arrangement if the equity partner is a traditional for-profit investor. However, a non-traditional equity partner who is prepared to accept a 10% return on capital may turn out to be the best option. An optimal result may stem from a mix of debt and equity.

As far as the energy, water and sanitation system and ongoing services are concerned, the most viable option may well be to create from the start an energy and water and sanitation services company. The EWSSCO could enter into a so-called BOO (build-own-operate) contract with the Devco to design, finance, own and operate the infrastructure. This means that the end-users (residential and non-residential owners, plus the farm) would not own the infrastructure, but they would instead purchase an integrated set of 'services' from the EWSSCO. This is a contemporary trend worldwide because it creates the conditions for high levels of efficiency and removes the end-user from operational risks if new sustainability technologies are introduced. In practice, this would mean entering into a partnership with a EWSSCO that would design, building and operate the water supply services (municipal supply and recycled water), sanitation service (mainly treatment and re-use including composting and biogas generation), and energy service (including purchase of electricity and onward sale to end-users, plus sale of renewable energy via various installations within the built structures such as solar water heaters or solar roofs, or major shared installations on or off-site). The advantage of a EWSSCO is that it is financially incentivised to promote efficient resource use and reduce dependence on the purchase of externally derived water and electricity supplies which are increasing in price at rates that are much higher than inflation. Over a 10–20 year period, the EWSSCO will make it possible for residents within the Philippi development to live more sustainably at a much lower monthly cost because they will not be as dependent on externally supplied energy and water and externally treated sewage as the average consumption neighbourhood. The EWSSCO model might also have a favourable short-term impact on purchase prices for the buyers.

Given that the single biggest expenditure will be on the renovation of the steel shed structure, and given that a huge proportion of the infrastructure cost for the total site has been allocated to this project, it follows that a detailed feasibility analysis will be required to make sure the right partners are secured to co-develop this facility. The most likely and viable option would be a consortium of co-investors. Although the financial model included here has assumed that the Devco raises the funding and finances this against a rental income, this could change substantially depending on the nature of the consortium that comes together to co-develop the steel structure.

Appendix A: Partners of The Business Place Philippi and their value-based contributions

Central to The Business Place philosophy is its partnerships with local corporations, government, NGOs and CBOs. Here resides the relevant knowledge and networks in the local area, and the varied nature of each entity will result in a multi-faceted offering of products, services, networks and resources. The parties below have each made a valuable contribution to the project so far.

a) Investec

Three years of financial contributions including:

- donation of the purchase price of the land (valued at R12 million)
- funding of all start-up costs and salaries (R2 million)
- donation of the Business Place Information Centre network package
- management of the property *pro bono* by Investec Property Management.

b) British American Tobacco

- Grant funding of R4.2 million towards building renovations and core costs of the Business Place Information Centre.
- Promotion and publicity support through access to its communications resource in order to build the profile of The Business Place locally and internationally.
- Legal advice and support.

c) Abalimi Bezekhaya

- Raising grant funding of R1.2 million towards building renovations and service support.
- Resource support and training to local emerging farmers.

d) The Sustainability Institute

- Raising grant funding of R500 000 towards professional design fees for the sustainable neighbourhood development of the property.
- Providing a venue for research and access to a model organic farm.
- Offering its international contact base to the Business Place database.
- Using its networks to enhance the mission and operations of the BPP and Business Place Information Centre.

Funding of the Business Place Information Centre and hub

Funding was required to refurbish the first two crucial buildings on site in order to launch the The Business Place Information Centre. For this, British American Tobacco donated R4.2 million, of which R1.6 million was used in renovations, and the remainder has been set aside as operational funding for Centre. Phase 1 is now complete. Operational expenses of the Centre are budgeted at R1.2 million for 2006 and 2007.