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Precedent studies

The precedent studies focused on the following premises:

- **John T Lyle Regenerative Centre as an example of passive design.**
- **Turbine Hall as an example of the heritage approach to design.**
- **Harmonia office building to demonstrate the building as an ecosystem**
- **Uptown Oil, a bio-diesel plant, as an example to aid in the understanding of the production process.**

Passive design

ID: John T Lyle Regenerative Centre.
Location: Pomona, CA, USA.
Design: John T. Lyle.
Client: California State Polytechnic University, Pomona.
User: Students and lectures.
Date: 1994.

The term “regenerative” describes processes that restore, renew or revitalize their own sources of energy and materials, creating sustainable systems that integrate the needs of society with the integrity of nature (Brown, 2010).

Purpose:
To advance the principles of environmentally sustainable living through education, research, demonstration and community outreach (Woo, 2010).

Aim:
To research and demonstrate a wide array of regenerative strategies; low-energy architecture, energy production technology, water treatment, organic agriculture, ecological restoration and sustainable community development.

Building systems aimed at energy efficiency:

- Minimize energy required for heating and cooling.
- Work with natural patterns of the sun as well as airflow.

Trellis structures on the southern side of the building support grape, chayote, or other deciduous vines (fig: 54 and 56). The shade from the vines limit direct sunlight from entering in summer, helping to keep the interior spaces from heating up. In winter the vines lose their leafs and the lower sun angles allow direct sunlight to penetrate into the interior spaces, passively warming the building.

The building is designed to control airflow to increase human comfort. Hot air is allowed to dissipate out of clearstory windows as cooler air enters the space from below (fig: 55).

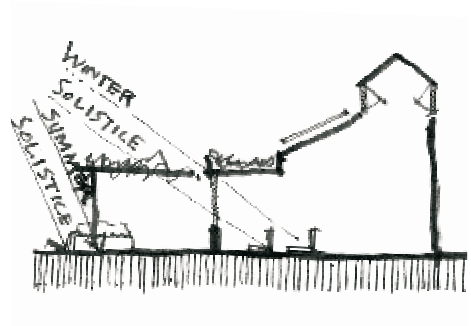

Figure 54. Trellis structure with vines to allow sun to enter the building in winter and limit it in summer: Woo, 2010.

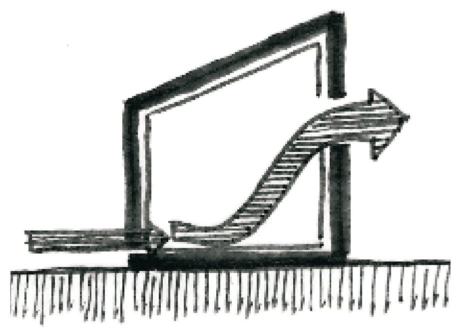

Figure 55. Hot air is allowed to dissipate out of clearstory windows as cooler air enters the space from below: Woo, 2010.

Building material

Building exteriors are finished with fast growing renewable cedar.

The centre continually explores alternative building materials, particulary materials that are waste products of our society. For example, the Centre constructed a strawbale incubator building which houses its bio-diesel operation. Straw is a wasteproduct of agricultural activity that is also an effective building material.

Energy systems

In designing an energy system, it is important to understand the needs of a community as well as their capacity to implement and maintain technology.

Solar energy

- The centre operates an Amenix Solar Concentrator Unit. This unit tracks the sun throughout the day, and is capable of generating up to 12.8kWh on a summer day (fig: 57).
- The centre also has a number of smaller fixed and tracking photovoltaic panels throughout the site.
- Another solar alternative at the centre is solar shingles.

Wind energy

The centre operates one windmill. Local conditions at the centre are not conducive to high wind generation, so the hybrid system generates only around 5.5kWh on windy days.

Bio-fuels

The centre actively conducts research into bio-fuels, particular bio-diesel, a substitute for petroleum based diesel fuel made from vegetable oil. The centre uses bio-diesel to power its machinery, and conducts numerous workshops and demonstrations of the refining process for the community.

Figure 56. John T Lyle Regenerative Centre: a trellis structure on the southern side of the building support deciduous vines, the shade from the vines blocks direct sun from entering in the summer, helping to keep the interior spaces from heating up: Woo, 2010.

Figure 57. John T Lyle Regenerative Centre: roof profile design to accommodate solar panels:Stine, 2000.

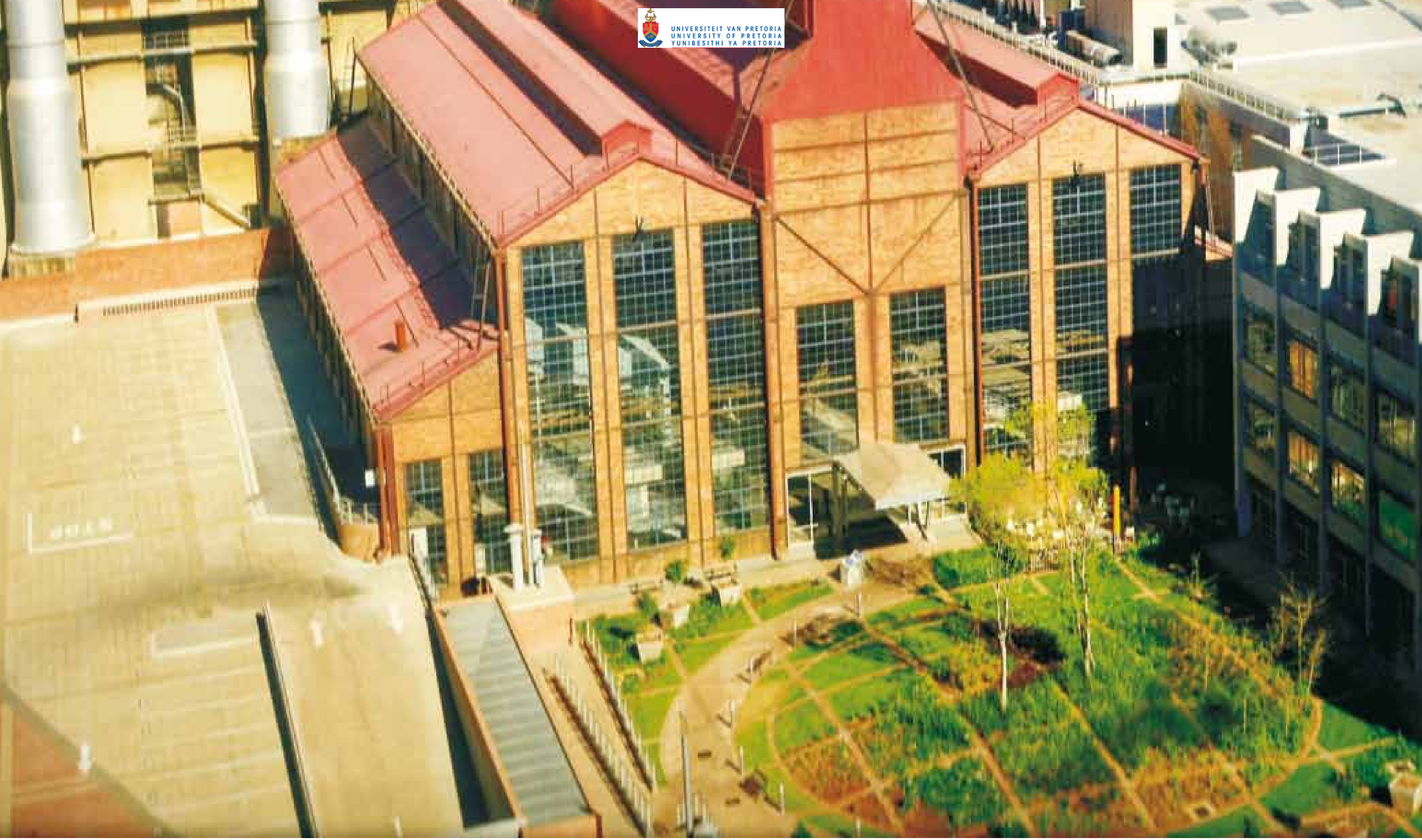

Figure 58. Turbine Hall, Jeppe Street, Johannesburg: The development stands as a example of modern architecture coupled with the conservation of an historic site and the seed for an urban renewal programme: Krige & Beswick 2001: 2.

Heritage

ID: Turbine Hall and South Boiler House.
Location: Jeppe Street, Newtown, Johannesburg, South Africa.
Design: TPSP Architects.
Client: AngloGold Ashanti/ Tiber Group.
User: Corporate office for AngloGold Ashanti.
Date: 1998-2003.

The origins:

After the First World War (1914-1918) came a surge of secondary industrialisation and with a huge demand for electrical power (Krige & Beswick, 2001: 18). After many delays, the first section of the Jeppe Street Power Station came into operation in September 1927, consisting of the North Boiler House, the Turbine Hall and three concrete cooling towers (Krige & Beswick, 2001: 25).

The Jeppe Street Power Station was the last and largest of three steam-driven power stations built in Newtown in the early twentieth century to supply electricity to Johannesburg. The Station could not keep up with the city's demand for electricity, and so, in 1934, the South Boiler House was build, and the Turbine Hall extended. However, demand still outstripped supply. In 1942 the newly-built Orlando Power Station was able to share the supply of electricity to Johannesburg, but by 1955 it too fell short in meeting demand.

During the 1950s, two more power stations were built. By 1958, the Jeppe Street Power Station was effectively operating as a substation and was decommissioned in 1961 (Krige & Beswick, 2001: 3).

The rebuild:
Aim: the Turbine Hall development (fig: 57) will stand as a world-class example of modern architecture coupled with the pragmatic conservation of an historic site and the seed crystal for an Urban Renewal Programme (Memorandum, annexure B: motivation letter from TPSP Architects in Krige & Beswick, 2001: 76). In terms of inner city rehabilitation, the Turbine Hall building was seen as a key reversing the decline in the western sector of Johannesburg (Krige & Beswick, 2001: 83).

Heritage:
The Heritage Impact Assessment (HIA) emphasises the positive impact of AngloGold Ashanti's decision to conserve two of the three buildings which make up the power station. If AngloGold Ashanti did not demolish the North Boiler House, the company might have been forced to build aboveground parking on adjacent land, in a building taller than Turbine Hall (fig: 57). This would have resulted in a building out of scale with the heritage building and therefore not appropriate from the aspect of heritage conservation (Krige & Beswick, 2001: 90).

The HIA case for the demolition of the North Boiler House states that:

> *If the viability of the site for development and that of Newtown are not to be compromised, then, despite what might appear to be a contradiction in terms of the demolition of the North Boiler House would best serve the interest of conservation in Newtown and economic survival (Prins, H in Krige & Beswick, 2001: 90).*

The BURRA charter (which provides guidance on the conservation of culturally-significant places) states that:

> *Demolition of significant fabric of a place is generally not acceptable. However, in some cases minor demolition may be appropriate as part of conservation. The possibility of removing the existing ground floor of the North Boiler House and the numerous supporting concrete columns would be a supportable action to take with a view to adaptive re-use of the building (Turbine Square Development, Heritage Impact Assessment in Krige & Beswick, 2001: 91).*

The heritage assessments took a holistic view in understanding the impact of the development on the urban fabric in the case of the Turbine Hall development.

Figure 59. Re-interpretation of a theme in Turbine Hall: the X-brace as structural and aesthetic device.The architecture is sympathetic to the existing architecture and urban fabric, preserving as far as possible the 'ethos' of the existing power station complex: Krige & Beswick, 2001: 24.

Figure 60. The original concrete hoppers in the demolished North Boiler House are commemorated as skylights in the central atrium of Turbine Hall: Krige & Beswick, 2001: 110.

Figure 61. Solar panels on the roof of the Turbine Hall and natural lighting through use of skylights: Krige & Beswick, 2001: 121.

Design phase of the Turbine Hall:
The fundamental concept behind the development was to create modern, functional office space for the tenant, preserving as far as possible the 'ethos' of the existing power station complex. This was achieved through the demolition of one of the existing structure to make space for the new building and the subterranean parking structure. These buildings then relate to the existing complex in a way that makes them spatially and functionally interdependent (Krige & Beswick, 2001: 98).

The architecture of the development is sympathetic to the existing architecture and urban fabric. The steel structures borrow freely from the ranking beams and connections evident in the existing engineered structure (fig: 58). The soaring spaces of both the existing and new architectures relates harmoniously to each other (fig: 59) (Krige & Beswick, 2001: 98).

Going green:
In terms of retaining the building, you would score a lot of points from adaptive re-use. A green building is not about what you see but what the building does. Energy strategies such as solar panels and allowing daylight into the building is an invisible part of the building (fig: 60); it is embedded in the building (Noir, E in Krige & Beswick, 2001: 120).

Conclusion:
The memory of the old buildings has been retained by many of the elements from the demolished sections that were saved and build into the new structures. Whilst new work was painted, the old was left as it was and every threshold or transition between old and new was emphasised with diagonal elements that makes a story of the building that is very legible and easy to understand (Fraser, N in Krige & Beswick, 2001: 134).

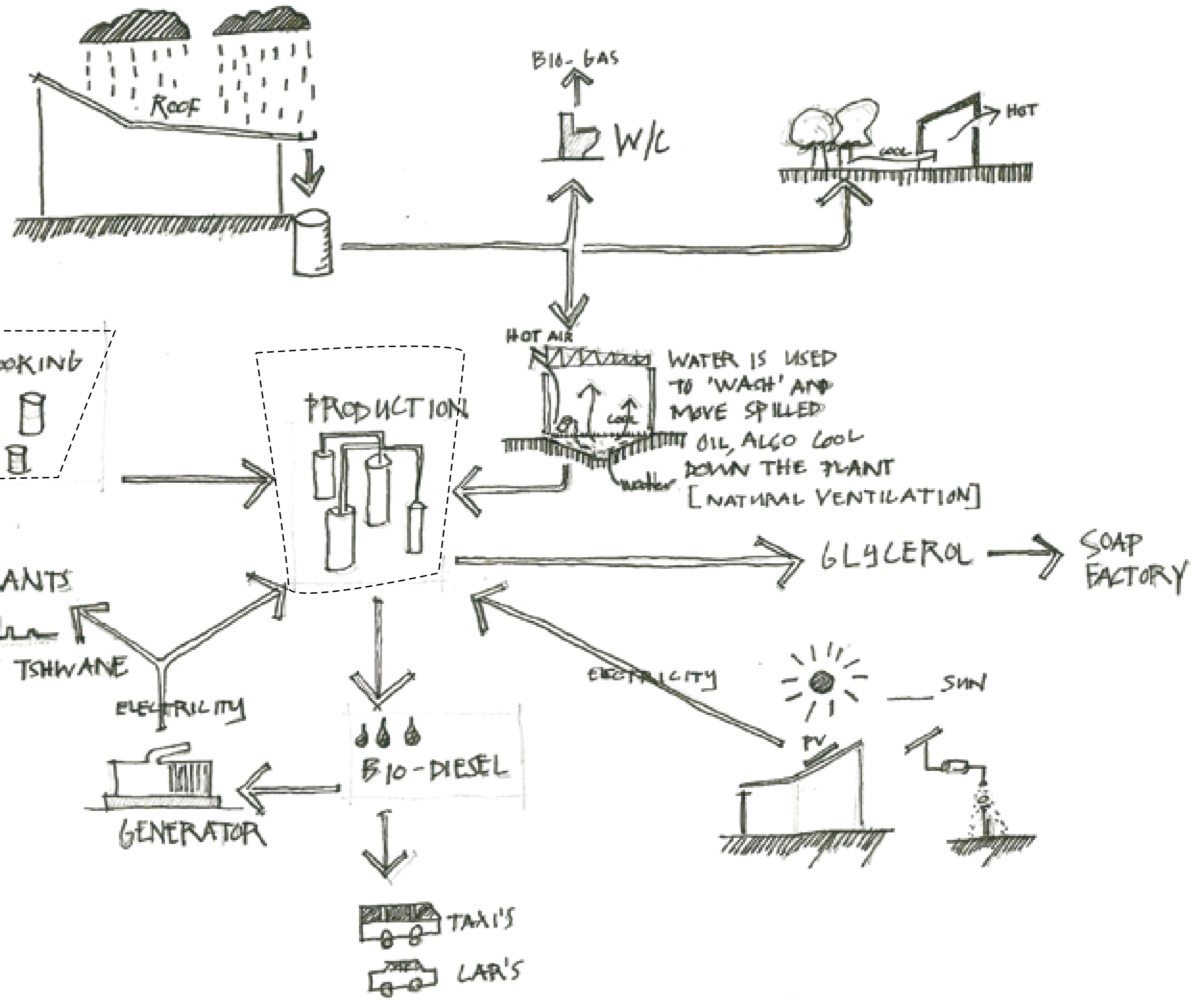

Figure 62. Pretoria West Bio-diesel Plant ecosystem: production process, rain water harvesting and solar energy. As inspired by the Harmonia Office building precedent study: Author 2010

Figure 63. Harmonia office building: Harmonia 57 by Triptyque, 2008.

Figure 64. Harmonia office building: the walls are thick and covered externally by a vegetation layer that serves as the skin of the structure: Harmonia 57 by Triptyque, 2008.

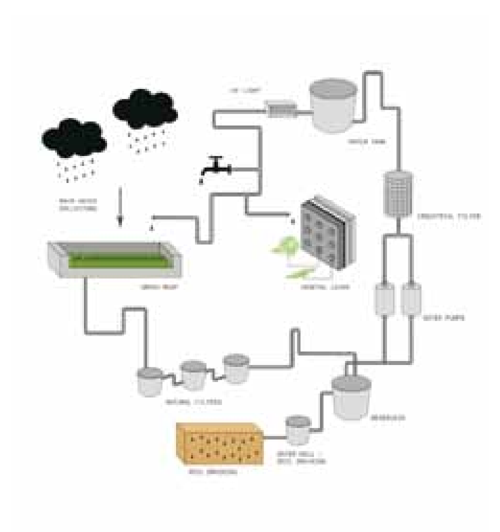

Figure 65. Harmonia office building: an ecosystem; where rain-and soil-water are drained, treated and re-used; a complex ecosystem is formed within the local: Harmonia 57 by Triptyque, 2008.

Ecosystem

ID: office building with a planted facade irrigated by a mist system. **Location:** Sao Paulo, Brazil. **Design**: Triptygue**. Site area:** 500 m^2 **. Constructed area:** 1060 m^2 .**Date:** 2008.

Purpose: Like a living body, the building breathes, sweats and modifies itself, transcending its inertia. The walls are thick and covered externally by a vegetation layer that serves as the skin of the structure (fig:63). This dense wall is made of an organic concrete that has pores, where several plant species grow, giving the facades a unique look (fig: 64) (Harmonia 57 by Triptyque, 2008).

In this great machine, where rain- and soilwaters are drained, treated and re-used, a complex ecosystem is formed within the local. This ecosystem is a multifunctional universe made-up of several interconnected machines (fig: 65).

Figure 62 shows how the Pretoria West Bio-diesel Plant will function as an ecosystem in the industrial production process

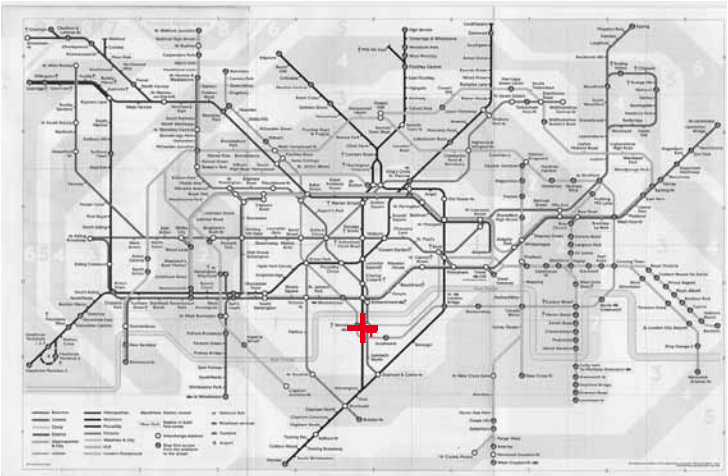

Figure 66. Map of London underground indicating the location of Uptown Oil Bio-diesel Plant: London Underground Station, 2010.

Production process

Uptown oil Bio-diesel Plant (London, UK)

The Up-Town Bio-diesel plant (fig: 68) is integrated into the urban fabric and is surrounded by housing and commercial activities (fig: 67).

The plant is located about a 5-minute walk from Waterloo Station in London (fig: 66). Due to its low-risk industrial activities this production process can easily be integrated into the urban fabric.

The company provides Bio-diesel to black cabs and to buildings to fuel their heating systems. Uptown oil supplies 45 000 litres of bio-diesel to accounting firm PriceWaterhouseCoopers' new premises in London, constituting a quarter of the premises fuel need (Uptown oil brochure, 2010).

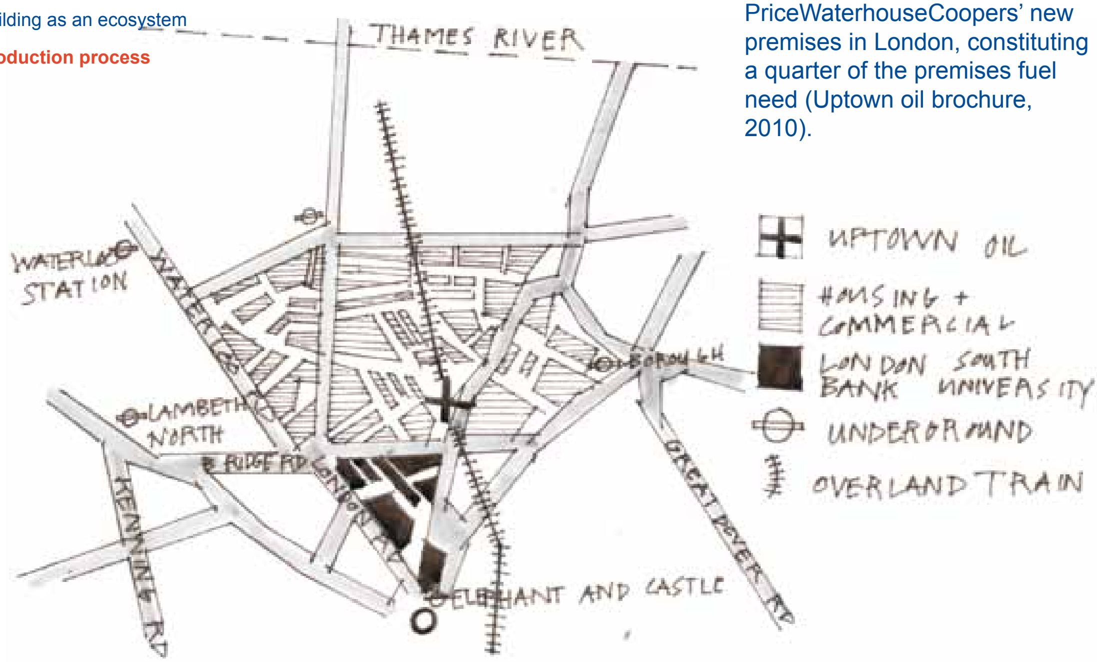

Figure 67. Uptown Oil Bio-diesel Plant in its urban context: Author, 2010.

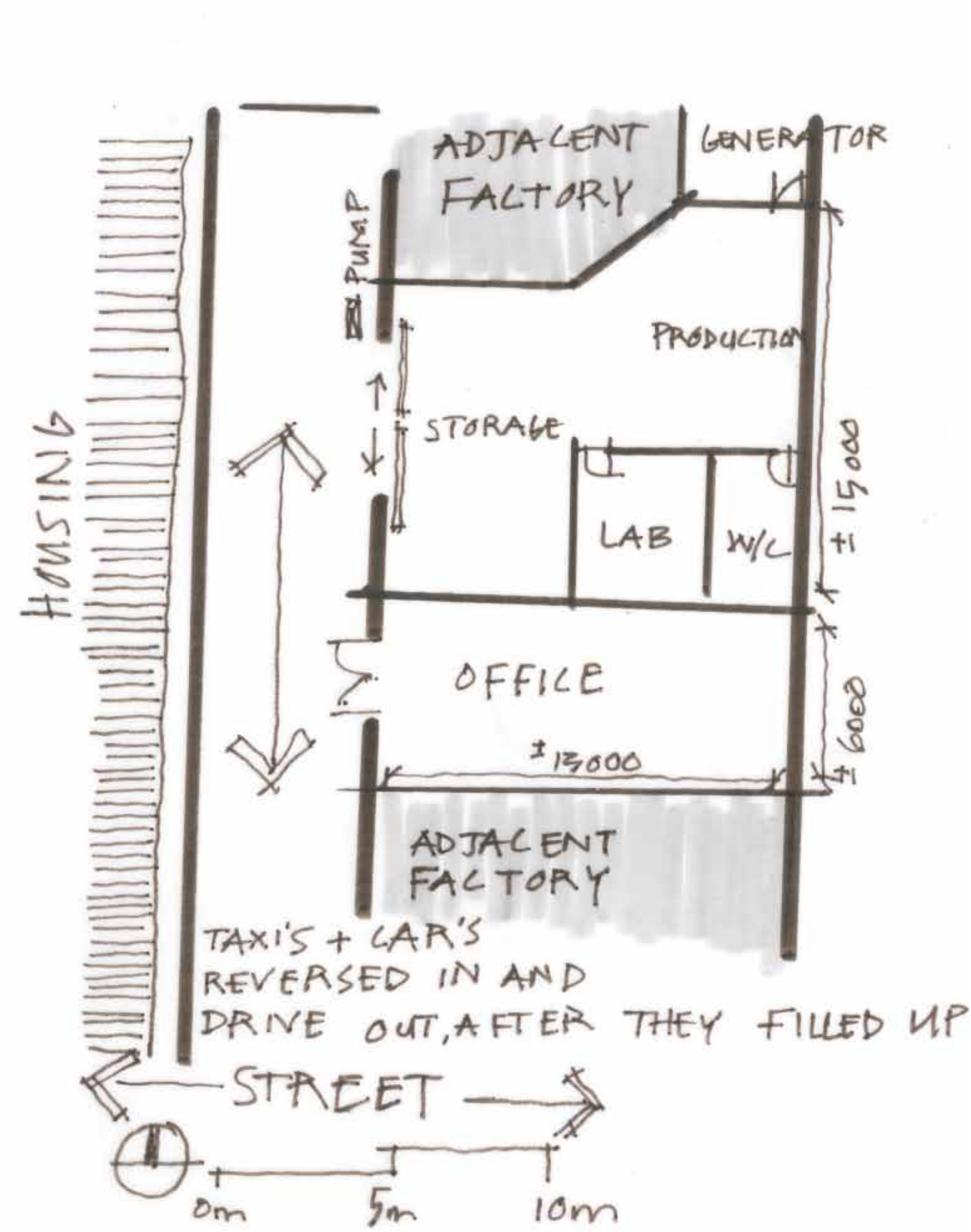

Figure 68. Uptown Oil Bio-diesel Plant plan: Author 2010.

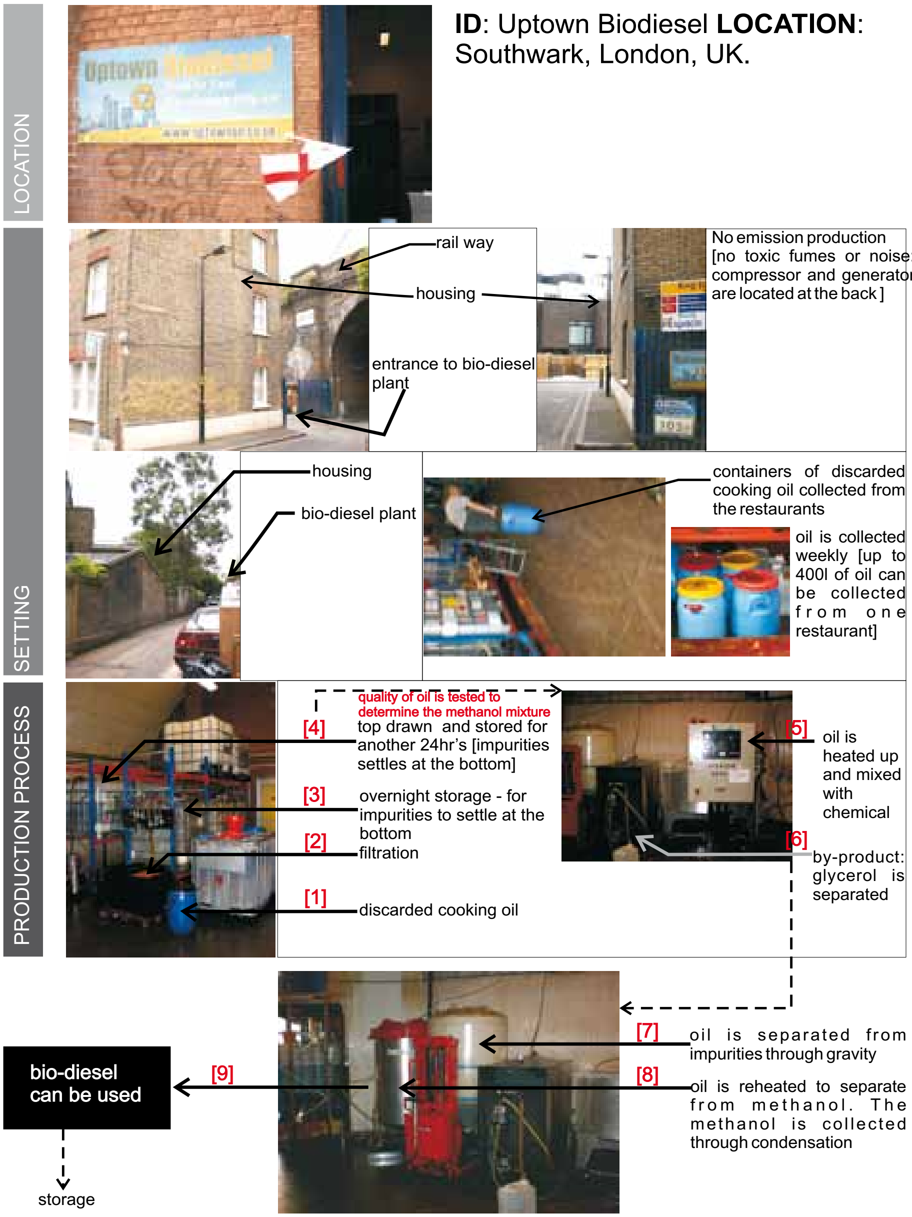

Figure 69. Diagram demonstrate the production process of bio-diesel at Uptown Oil, London, UK. Photographs by author (visited in June 2010).

Figure 70. Diagram showing the production process of bio-diesel at Uptown oil, London, UK. Photographs by author (visited in June 2010).

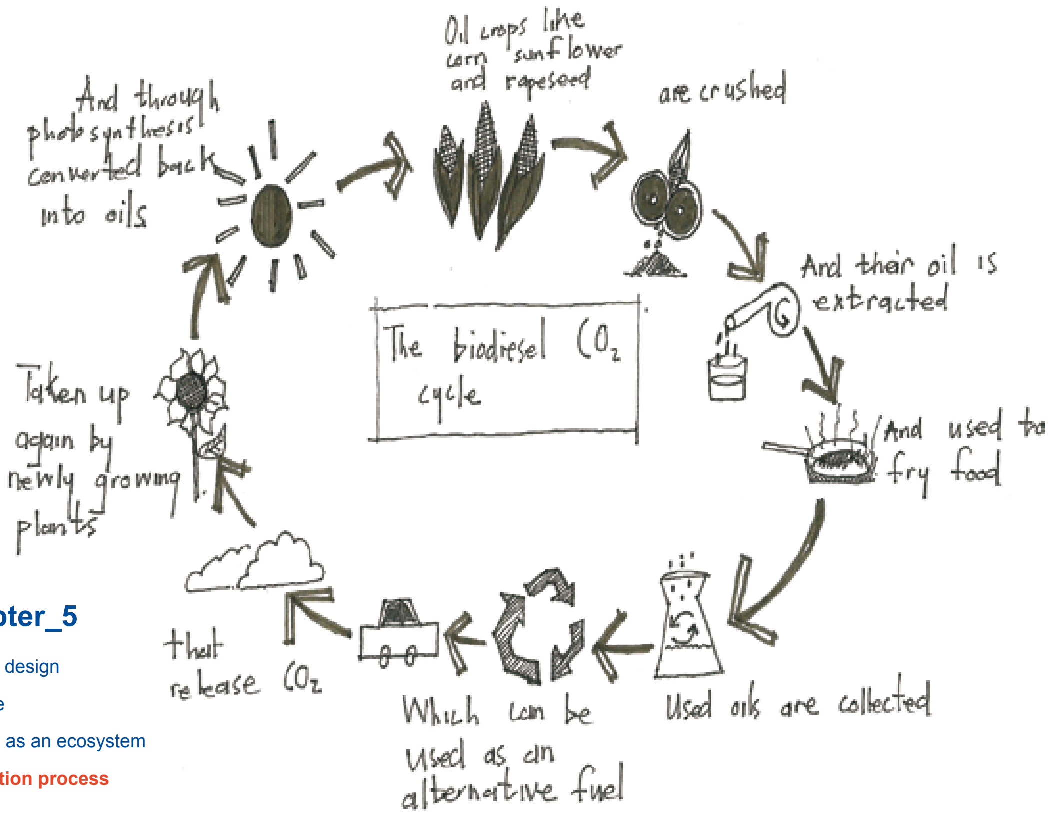

Figure 71. Bio-diesel CO_2 cycle showing how discarded cooking oil can be turned onto fuel: Uptown Oil brochure, 2010.

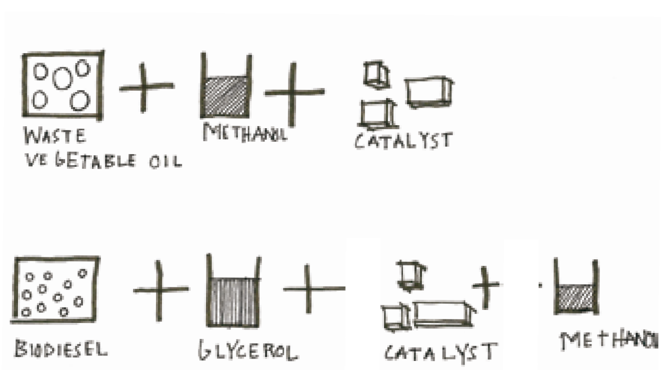

Figure 72. Bio-diesel components; showing that glycerol is a by product that can be used in another production process (for example in soap production) and methanol that are recycled, demonstrating that production can be cyclical: Bio-diesel production and quality, 2007.

Bio-diesel

The diesel engine was invented by Rudolf Diesel in 1894 and designed to run on peanut oil. He showed great foresight when he stated:

> *The use of vegetable oils for engine fuels may seem insignificant today but such oils may become, in the course of time, as important as petroleum and the coal-tar products of present time (Uptown Oil brochure, 2010).*

Bio-diesel is a fuel derived from a process known as transesterification; the process of converting one ester into another ester. An ester is a chemical combination of fatty acids attached to alcohol. Animal and vegetable fats, oils and bio-diesel are examples of ester.

Transesterification converts the vegetable oil ester into bio-diesel ester; it separates the larger glycerol molecules from the fatty acids in the vegetable oil. The methanol combines with the fatty acids, producing smaller methyl esters thus creating the more free-flowing bio-diesel.

Benefits of using bio-diesel

- Biodiesel is completely sustainable. It is carbon neutral in that it release the same amount of carbon dioxide into the atmosphere as it took out in the first place during the growth cycle (fig: 71).
- Biodiesel is 98% biodegradable within 21 days.
- Provides better lubricate resulting in a longer life for diesel engines.
- Provides Improved fuel economy – up to 8%.
- Around 20% cheaper than fossil fuel. (Bio-diesel production and quality, 2007)

How to make bio-diesel:

The process of producing biodiesel known as transesterification, involves adding methanol to vegetable oil. The process requires a catalyst to increase the rate of the chemical reaction between the methanol and the vegetable oil. The catalyst used in the creation of bio-diesel is an alkaline.

The basic process is as follows (fig: 72):

- Discarded vegetable oil is collected from the various sources;
- vegetable oil is mixed with the Methanol and the catalyst
- when the bio-diesel is created the catalyst and glycerol can be recovered;
- waste vegetable oil that have been heated several times will cause some of the fatty acids to bond with the glycerol and float freely in the oil; the amount of catalyst in the transesterification process is therefore increased to neutralise the acids and soap as an additional by-product is created.

In South Africa, about 360 million litres of wasted vegetable oil ends up in the wrong industry. Sometimes bleach such as Jik is added so that it looks like brand-new oil and is then sold in the rural areas. It also goes to the animal food industry as chicken and cow fodder, which then ends up back again on your own plate (The Bio-energy News Desk, 2009).