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The role of green energy as a filter in reviving the industrial spaces using the green microalgae technology as a landscape feature (Rainbow of the land) (A practical case study of industrial area, German)-Article Review

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ABSTRACT

This research is focused on a modern technique and offers a framework that maximizes the concept of the efficient landscape that focused on microalgae technology. Industrial areas have become a threat to most of the countries; particularly unused industrial areas represent a wide area. as a result, it has become a time bomb, so scientists and designers have gone to search for the most efficient ways of using green microalgae to solve this issue and combine it with the elements of landscape features where green microalgae can be grown within open ponds (Open Race Way Ponds) in the industrial areas to become a tool with two advantages: organic green fuel (Productive Landscape),also algae represents an aesthetic view through the various green color tones and movement of microalgae in its various colors drawing a rainbow on the ground and you will saw it on its natural green radiation at night (Natural Green (Nightscape)). All of this needs wastewater or salty water and carbon dioxide, solar radiation as inputs for algae breeding, i.e. waste transfer to useful urban potentials (Positive to Negative and thus the industrial spaces will be converted to human spaces and this represent the main objective for the research that radiate vitality day and night and become a source of oxygen, where algae produce 6 times the oxygen of trees. Through this research, a framework will be presented to use these strains in the spaces of industrial areas as a new approach in the landscape trends and theme.

Keywords: Green Energy - Microalgae Technology – living Building – Algal Fuel- Urban Waste Stream–Algae Bulb –Eco Pods – Algal landscape.

INTRODUCTION

This research reported most of the scientific research's in the world especially in the middle east in the field of sustainable landscape,the industrial areas did not mention using microalgae technology in the establishment of sustainable landscape for the industrial areas, but talked about the integration of solar panels, wind turbines, biogas and other elements of green energy, but most scientific research on marine algae is about how to extract bio- fuel from them but is not integrating it as a component of landscape elements although microalgae has a lot of applications such as bio fuel and food, waste treatment ,water purring, fertilizers ,cosmetics and so on .

This research will show a framework to find a relationship between the technology of microalgae and seaweed with landscape of the industrial spaces.

At present, the world faces many challenges that keep pace with the accelerated urban development resulting from population growth and the development of contemporary human life, especially in urban areas. The urban population increased from 14% of the population in 1900 to about 50% in 2000 and is expected to reach about 80% in the year 2100. As a result, the consumption of non-renewable energy continues to increase in order to achieve an environment suitable for human comfort, especially in the industrial areas, and of course the day will come when these sources will end or at least become difficult and expensive, in addition, the damage caused by the use of these

energies in urban development and its negative impact on the natural environment of the earth is increasing. Conventional energy sources were the reason for increasing rates of carbon dioxide, increase rates of diseases, immigration of human from their home or place to the industrial areas.

Green Energy Sources One of the most environmentally friendly alternatives that can be maximized as a substitute for traditional non-renewable energy is the reduction of damage to the Earth's environment due to the use of unconventional energy sources. urban development around the world consumes quite a few sources of the natural environment, so the designers and developers of the newly developed urbanization to the positive employment of renewable energy sources instead of conventional energy are inevitable in order to reduce the environmental damage resulting from the use of conventional energy and the infringement of the right of future generations Future Generations in energy sources and a clean, healthy environment for human life. This research discusses the necessity of reducing the dependence on traditional energy sources and especially reusing the industrial areas to provide the suitable physical environment for human comfort that meets the needs of his life through positive recruitment of renewable energies in sustainable industrial landscape in order to produce urban friendly for the natural environment mixed between factories and trees to become one hand that based on microalgae technology one of the recent technologies in the field of green energywhich contributes to preserving the environment of the earth healthy over generations (EPA, 2015).

The research also has document one of alternatives that can be a good solution for air pollution and waste stream (MicroalgaeTechnology) through the definitionof sustainable model for a design objective of creating an algae-powered urban system at the industrial spaces. The idea of algae-powered factories design derives from the concern about the increasing waste generation and energy consumption, waste water infactories as well as their impacts on the urban environment besides not using the industrial spaces. Integrated, decentralized and off-grid waste and energy managements are often discussed as a more efficient and eco-friendlyway than the traditional centralized and separations. In pursuing such an approach, algae technology shows great potential. First, it has high productivity of renewable energy (Biofuel). Algae are thought to be the highest photosynthetic efficient (PE) and can be harvested continuously. Second, the environmental impact of the growth of algae for use in biofuels is contended to be lesser than conventional crops such as soybeans. Third, the products available from microalgae can be used in multiple ways, such as biofuel and feed stock. Fourth, a typical algae cultivation system requires water, carbon, sunlight and nutrients (primarily nitrogen and phosphorous), which are contained in the urban waste stream and could be utilized after appropriate treatment.Fifth, using the microalgae ponds in the landscape elements such as using the lawn area but the differences in that algae- escape is dynamic result to changing colors in algae and growth.The algae cultivation system could be embedded in the industrial buildings and in their spaces where there is no use for them in any human activities. It helps construct new closed loops to form an algae-powered landscape system, in other words, a coupled algae- landscape system that could supply the algae system with local waste stream and carbon dioxide from the urbanindustrial environment and provide the productive landscape with the energy from the output of the algae cultivation and the green view for open race way ponds.

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Defining Green Energy

Energy that can be produced in a way that protects the natural environment, e.g. by using wind, water or the sun, biofuel comes from natural sources such as sunlight, wind, rain, tides, plants, algae and geothermal heat. These energy resources are renewable, that is, they are replenished naturally. Fossil fuels, in comparison, are a finite resource which takes millions of years to grow and will continue to diminish with use**.** Recently, plants and trees is used in producing green fuel such as algae breeding (Beatley, 2012).

Types of Green Energy

Green energy includes some types in different shapes as shown in Figure (1).

Algae in general

There are two main kinds of algae: microalgae and macroalgae. Macroalgae is better known as seaweeds and is not used for production of biofuel. Microalgae are used for biofuel production due to their high lipid content and fast growth rate.

Fig. 1. Types of green energy. Source: (Beatley, 2012).

A-Green Microalgae

Algae are single-celled micro-organisms that have photosynthetic ability. It has a fast growth rate. It is considered one of the oldest types of life on the earth. Fossil fuels are believed to be originated from algae in ancient times. The process of photosynthesis takes place in the presence of light to use carbon and water in the presence of sunlight energy and simple proportions of phosphates and nitrates from soil. With good growth conditions, algae doubled their growth within 24 hours. In addition, algae contain an oil content in excess of 50% of its bulk content in some types of algae, so this ratio has been used to produce fuel. Algae are very diverse and found almost everywhere on the planet. They play an important role in many ecosystems, including providing the foundation for the aquatic food chains supporting all fisheries in the oceans and inland, as well as producing oxygen and get rid of carbon dioxide (Vnnebregje, 2013).

B-Conditions for microalgae cultivation as landscape areas:

1- Light

It is for phototrophic algae the base source of energy, but light can also vary in intensity and wavelengths and these parameters can affect the success and failure of algae cultures (Tampier *et al*., 2009). There are two distinct points in light intensities that each phototrophic algae culture has. The first is at zero light intensity (night) in which algae don't grow at all (the compensation point). The second is at the presence of light. The growth rate of algae increases with increasing light intensities and the photosynthesis

increases until a point of maximum light absorption is attained and the algae become saturated and can't absorb more light (the light saturation point) if the light saturation point is exceeded (Tampier *et al*., 2009).

1- Temperature

Increase in temperature results in exponentially increased growth of algae until it reaches an optimum growth temperature. If the temperature exceeds this critical point, growth will decline. It is important to maintain a certain temperature level or have control over temperature. The optimal temperature for most microalgae to grow is between 20-30^{o}C, and stop growing with sustained temperatures below 5^{o}C and above 35 ^{o}C (Lavens and Sorgeloos, 1996).

3-Carbon Dioxide

The concentration of CO_2 in the air (0.033%) is the limitation for a quick algae growth if additional CO_2 is not supplied to feed the microalgae. For maximum growth rate, concentrated CO_2 supply is necessary. This can be captured from industrial exhaust gases or from soluble carbonates ($NaHCO_3$ and Na_2CO_3) (Chinnasamy *et al*., 2012).

4-Nutrients

Typical inorganic elements needed for algae to grow are phosphorus, nitrogen, potassium, sulfur and silicon (Chinnasamy *et al*., 2012; Tampier *et al*., 2009). The use of excessive nutrients has not shown any negative impact on the growth of algae. Typical trace metals as nutrition for algae are chelated salts of iron, zinc, cobalt, manganese, selenium and nickel (Tampier *et al*., 2009) .

5-Water

For photosynthesis approximately 0.75 liter of water is needed per kg of concentrated algae biomass (Wijffels and Barbosa, 2010). If the lipid content of the microalgae is 50%, then to produce 1 liter of biofuel about 1.5 liters of water is required. If we compare it to fuel crops, approximately 10000 liters of water are

needed for 1 liter of biofuel (Wijffels and Barbosa, 2010).

6-Stress Condition

Microalgae under stress conditions decrease the growth rate and the productivity. Stress conditions are nutrient deprivation, high light intensities, and very high concentrations of O_2, and very low PH (Hemming *et al*., 2012).When microalgae are non-stressed (comfortable conditions), it will store the lipids in the form of phospholipids.

C-Benefits of microalgae production farms:

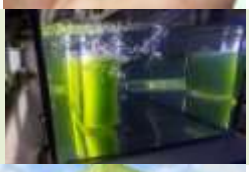
- Producing outputs for thermal energy production (biodiesel, methane, ethanol and hydrogen).
-Producing non-refractory products (food, fertilizers, animal feed and other chemicals.
- Green microalgae get rid of residues such as carbon dioxide, industrial wastewater and also waste from desalination plants.
-It has no effect on food production since they do not use farmland and can be grow in wastewater.
-The production of fatty materials exceeds the production of agricultural crops.
-After the stage of extracting oils from algae, it can be used as protein-rich feed and suitable for animals, poultry and fish feeding. It is also used in the manufacture of ethanol, methane, and organic fertilizers, due to the high ratio of positive amines to negative phosphate (N: P ratio), and the resulting residual burn is used to generate energy (thermal and electrical).
-Green algae are now being produced as a large-scale alternative to fuel in order to reduce production costs. Also, the production of chemical food and fuel from algae will be subject to many

improvements and developments necessary for it to have an appropriate economic and environmental return.

2. Uses of algae in the urban environment:

These were illustrated in Table (2).

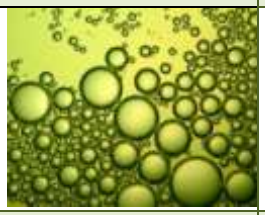
Table 2. Microalgae benefits

Applications	Figures	Uses in general
Filter (green lung)		**Perform an important photosynthetic activity, absorbing considerable amounts of carbon dioxide and producing oxygen**
Medical uses		**Can be processed for energy, cosmetic, pharmaceutical and nutraceutical markets.**
Biofuel		**Open up an incredible potential for new renewable energy resources, and hope for a greener future**
Integrated in the building environment		**It explains Cesare Griffa. "Building and architectural surfaces are an incredible resource of space".**
Green roof garden		**Urban façades and roofs represent billions of square meters that instead of being made of an inanimate material such as concrete.**
Fighter for climate warming		**It could become clever photosynthetic surfaces that respond to the current state of climate warming.**
Green technology for urban design		**Micro-algae could add to the green urban system that exists already, intensifying carbon dioxide fixation activity and acting as cladding for buildings, increasing their passive performance.**
Waterwaste treatment		**Algae pond systems are currently operated for municipal wastewater treatment. The essential function of the algae is to provide dissolved oxygen for the bacterial breakdown of the wastes**
Fertilizers		**Microalgae species were recommended to be used as bio-fertilizer as an alternative to mainstream synthetic fertilizers. This is because of the increased cost of chemical fertilizer that cause soil and water pollution. In comparison, microalgae are a cheap source of N, which does not cause pollution**

Source: The researchers based on the literature review and internet searches.

D. Types of algae: As shown in Table (3)

Table 3. Compare among algae types

	Macroalgae	Microalgae	Algae bloom	Maerl
Definition	They are large algae and they look like plants. They are multicellular as they contain many cells. They contain a "holdfast" which can be attached to sand, boats or rocks. They contain a "stipe" similar to a stem of plants. They contain "blades" similar to leaves of a plant and a collection of blades are called "fronds".	They are small floating organisms that contain one cell and so are called unicellular" organisms. The cell is surrounded by a cell wall. Microalgae can make their own energy and store their energy in the cell. Microalgae are different in their size, shape and color. They are very small in size.	Organisms that can severely lower oxygen levels in natural waters, killing marine life. Blooms can last from a few days to many months. After the bloom dies, the microbes which decompose the dead algae use up even more of the oxygen, which can kill fish.	It is another type of marine algae. It has a red color and forms a tough crust. Maerl is small in size and you could hold it in your hand. Unlike other macroalgae they are not attached by a holdfast but live on the sea bed with the sand
				
Size	12cm-2m(Seaweed)	Micron	-	-
Types	The two main types of microalgae are "Diatoms" and "Dinoflagellates".	-	-	-
Colors	The term includes some types of red, brown, and green algae	They can either appear blue-green, yellow, brown or orange.	-	-
Uses	Fertilizers and soil conditioners, fish and animal feed, biogas, integrated aquaculture, cosmetics	Fertilizers and soil conditioners, fish and animal feed, biogas, integrated aquaculture, cosmetics, building technology, biogreen fuel. Landscape Elements in open ponds	It is a result for the speed growth of algae so the under algae and aquaponics don,t see sun radiation then die , happens that the surface become governed by algae-	Used as a soil conditioner, it is dredged from the sea floor and crushed to a powder.

Source :(Aetrangere, 2012)

E. Using microalgae instead of trees in the industrial landscape design

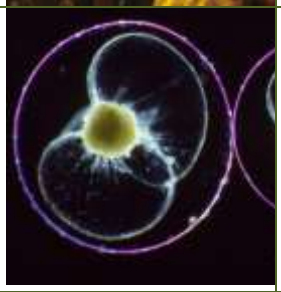
Microalgae have relatively high surface area-to-volume ratio, which let them absorb nutrients and carbon dioxide much faster than agricultural plants (Tampier *et al.*, 2009). They are responsible for 1/3 of the world's carbon fixation and produce at the same time for

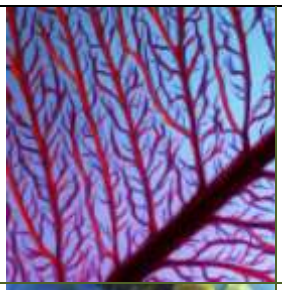
about 70% of the atmospheric oxygen (Chinnasamy *et al*., 2012).

In most cases, seaweed and microalgae species are considered to be a water planting with a very large capacity to absorb carbon dioxide, as studies have proven that they absorbs harmful gases 6 times faster than trees, in addition they do not need a soil for cultivation such as trees. Many designers and landscapers have devoted to creating and innovating landscape elements that depend on algae instead of trees as a species. A new landscape approach can be used in the industrial areas, given that it does not need fresh water or resources, but rather depends on the industrial waste (carbon dioxide - industrial wastewater) in addition to algae is a new form of living plants that can be used on the land as a type of dynamic green area that over whelmed with reproduction.

F. Types of color algae species that can use it as a landscape planting: As shown in Table (4)

Table 4. Algae species classifications in colors.

Types	Figure.	Abstract
1.Euglenid		They are one of the best-known groups of flagellates, which are excavate eukaryotes of the phylum Euglenophyta and their cell structure is typical of that group. They are commonly found in freshwater, especially when it is rich in organic materials, with a few marine and endosymbiotic members. Most euglenids are unicellular. Many euglenids have chloroplasts and produce their own food through photosynthesis, but others feed by phagocytosis, or strictly by diffusion.
2. Golden-brown algae and Diatoms		They called chrysophytes, chrysomonads, golden-brown algae or golden algae are a large group of algae, found mostly in freshwater. Golden algae is also commonly used to refer to a single species, *Prymnesium parvum*, which causes fish kills. The Chrysophyceae should not be confused with the Chrysophyta, which is a more ambiguous taxon.
3. Pyrrophyta (Fire Algae)		Fire algae are unicellular algae commonly found in oceans and in some fresh water sources that use flagella for motion. They are separated into two classes: dinoflagellates and cryptomonads. Dinoflagellates can cause a phenomenon known as a red tide, in which the ocean appears red due to their large abundance. Like some fungi, some species of Pyrrophyta are bioluminescent. During the night, they cause the ocean to appear to be aflame.
4. Chlorophyta (Green Algae)		Green algae mostly abide in freshwater environments, although a few species can be found in the ocean. Like fire algae, green algae also have cell walls made of cellulose, and some species have one or two flagella. Green algae contain chloroplasts and undergo photosynthesis. There are thousands of unicellular and multicellular species of these algae.

5. Rhodophyta (Red Algae)		Red algae are commonly found in tropical marine locations. Unlike other algae, these and centrioles. Red algae grow on solid surfaces including tropical reefs or attached to other algae. Their cell walls consist of cellulose and many different types of carbohydrates. These algae reproduce asexually by monospores (walled, spherical cells without flagella) that are carried by water currents until germination. Red algae also reproduce sexually and undergo alternation of generations. Red algae form a number of different seaweed types.
6. Paeophyta (Brown Algae)		Brown algae are among the largest species of algae, consisting of varieties of seaweed and kelp found in marine environments. These species have differentiated tissues, including an anchoring organ, air pockets for buoyancy, a stalk, photosynthetic organs, and reproductive tissues that produce spores and gametes. The life cycle of these protists involves alternation of generations.
7. Xanthophyta (Yellow-Green Algae)		Yellow-green algae are the least prolific species of algae, with only 450 to 650 species. They are unicellular organisms with cell walls made of cellulose and silica, and they contain one or two flagella for motion. Their chloroplasts lack a certain pigment, which causes them to appear lighter in color. They usually form in small colonies of only a few cells. Yellow-green algae typically live in freshwater, but can be found in salt water and wet soil environments.
8. Blue green Algae		Blue-green algae" describes a large and diverse group of simple, plant-like organisms found in salt water and some large fresh water lakes.Blue-green algae are used as a source of dietary protein, B-vitamins, and iron. They are also used for weight loss, attention deficit-hyperactivity disorder (ADHD), hay fever, diabetes, stress, fatigue, anxiety, depression, and premenstrual syndrome (PMS) and other women's health issues.
Source :(Chinnasamy et al., 2012).		

G. Benefits of using algae in the industrial spaces as a landscape element:

There is a mechanism to deal with the urban spaces for the industrial areas using micro-green algae technology as one of the landscape elements and it is the best way to decorate the unused industrial spaces and it is a good way to create a human activities space in which activities can be carried out in one of the periods that are not working in industrial time depending on the colored view of the livable dynamic algae The bred in open ponds, the mechanism is divided into two parts, the first part is production, i.e. green algae breeding in different ponds as shown in Table (5) in three types, each of which have disadvantages and advantages of these ponds, all of them share a common denominator: algae breeding and production the organic fuel from them, but the open race way ponds is the best for giving open view for seeing the green algae in the urban space as shown in Figure (3). But the others closed view is suitable for production fuel indoor and this falls under the name of productive landscape (Figs. 3-5), the other part is not production, but a breather and a direct aesthetic view by inserting green algae technology in the landscape elements such

as nightscape where algae radiate a natural green color resulting from the absorption of sunlight during the day and this radiation give a spectrum of color green or any other color according to the breed that is bred, as well as there are elements to form spaces such as pergolas.

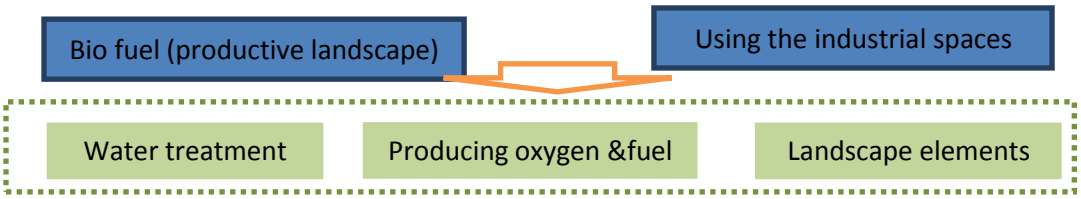


Fig. 3. Types of landscape based on algae and benefits. Source: the researcher

There is a mechanism to deal with the urban spaces for industrial areas using micro-green algae technology as one of the site coordination means and it is the best way to make unused industrial voids a good way to create a human vacuum in which activities can be carried out in one of the times that are not working in industrial time depending on the colored view of the moving algae. The bred in open ponds, the mechanism is divided into two parts, the first part is production, i.e. green algae breeding in different ponds as shown in Table (5) in three types, each of which have disadvantages and advantages of these ponds, all of them share a common denominator: algae breeding and production the organic fuel from them, but the open race way ponds is the best for giving open view for seeing the green algae in the urban space (Figs. 3 & 4).

Fig. 4. Cellana center for microalgae considered as a green area or landscape design Source**:** (Aetrangere, 2012a)

Fig. 5. algae capture CO2 in industrial areas. Source: (Aetrangere, 2012a)

Table 5**.** Various methods / system of algae cultivation and landscape uses. Source: (Acién, *et al.*, 2001)

System	Abstract	Figures.	Pros
1.Open raceway ponds	Open algae ponds are shallow artificial ponds used in algae breeding and cultivation, and are divided into several types: a rectangular grid, where each rectangle contains one channel in an oval shape, such as a car stream. From above, many ponds look like a maze. Each rectangle has a paddle wheel to make the water flow continuously around the circle and this is what makes the ponds active and mobile and gives vitality to the place by seeing this for people giving a kind of gesture to pay attention to it is this kind of ponds best in terms of use as a component of landscape		1-Easy to construct. 2-Least expensive 3-open view for landscape concept
2.Close photo bioreactor	The photosynthetic reactor itself is used to promote biological growth within fuel-producing plants by controlling environmental information including the ratio of focused light. The tubes are made of acrylic and are designed to contain light and dark periods to enhance the rate of growth in relation to the subject of this research. This type is not valid for the idea of creating a Landscape based on the landscape of algae.		1-More uniform temperature. 2-Better control of gas transfer. 3-Cultivation of algae is in controlled circumstances. 4-Reduced Fouling.
3.Closed water ponds	As a variation of the open pond system, the idea behind the closed pond is to close it off, to cover a pond or pool with a greenhouse. While this usually results in a smaller system, it does take care of many of the problems associated with an open system. It allows more species to be grown, it allows the species that are being grown to stay dominant		1-Allow better control of climate. 2-More protection. 3- lesser evaporative losses

1. The "Bio-digital" structure:

It is fluid filled with microalgae organisms pumped around an otherwise transparent shelter to produce dynamic shade used as a site furniture energy in the form of biomass, and an impressive amount of oxygen, while responding to the presence of visitors to produce interesting visual effects.When it's sunny, the microalgae naturally photosynthesize and grow, turning the fluid a deeper shade of green and providing extra shade when it's needed.The system responds to the presence of visitors – as people walk through each area of the canopy, they trigger electro valves that alter the speed at which the algae flows through the canopy (Slegers *et al.*, 2011).

Fig. 6. Bio-digital" structure Source (Slegers *et al.*, 2011)

2. These algae-powered pods:

The design of the structure is simply purifying the air (Fig. 7). It also uses semi-transparent Teflon membranes to reduce noise and visual stimulation – creating a quiet, isolated escape for tired visitors who want to relax and recharge. The algae fountain in the center consists of a series of photobioreactors filled with five cubic meters of water and algae. While the idea may seem strange at first, these pods could actually be the answer to the increasing problem of urban pollution and carbon emissions. The World Health Organization (WHO) predicts that by 2030, 60% of the world's population will live in big cities, and a recent study from WHO found that a staggering 92% of the human beings on the planet are already being exposed to unsafe levels of air pollution. That's a lot of people who could benefit from a quick daily dose of purified air.

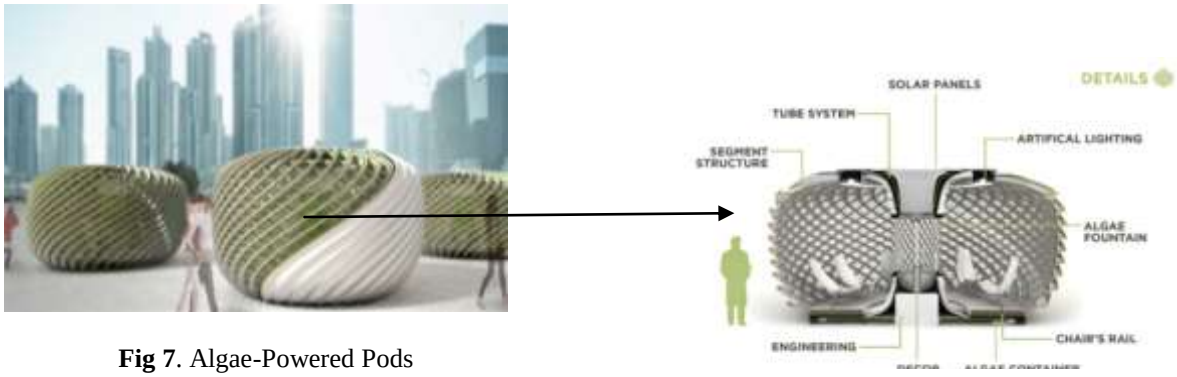


Fig 7. Algae-Powered Pods
Source: https://inhabitat.com/are-algae-powered-/oxygen-bars-on-the-horizon

These were designed for algae breeding in the industrial area as green areas or areas with diversified water plants, such as drawing a rainbow as shown in Figures (8, 9) resulting from the coloring of algae pools where different strains of microalgae can be used. With different solar radiation, algae give a variety of colors that give veneration and beauty to the place instead of trees beauty resulting from industrial waste. The algae take CO_2 from the environment, which is sucked into the chamber and circulated to the algae by a pump. According to the designer, the algae become saturated with CO_2 and form biomass that is pushed through underground tubes to a nearby filler station. The chamber inside the street lamp is refilled with more algae and water to start the process again (Fig. 10).

- Eco cars which run on biomass can fuel up at these filler stations, which essentially mean that clean energy cars will be fueled by smog-producing gasoline-powered ones. Although the concept seems a bit shaky, using biomass and existing pollution to power our world is an intriguing idea that definitely deserves exploration (John, 2009).

Fig. 8. Colored algae ponds as a planting composition in the landscape design approach
Source: (John, 2009)

Fig. 9.Various colors of microalgae ponds similar to rainbow can be proposed in the landscape design scheme. Source: John (2009)

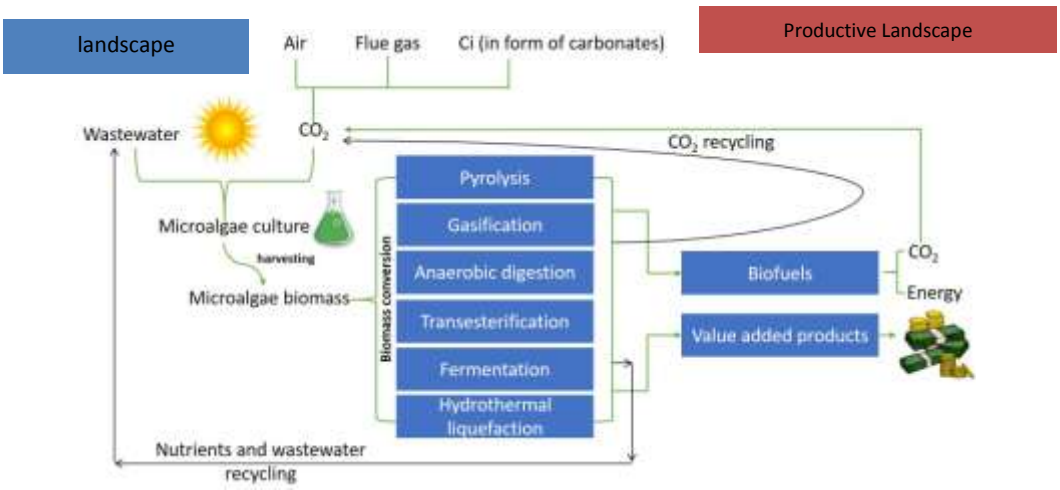


Fig. 10.The eco process in the industrial area based on algae technology (Productive landscape) Source: (Solar Gis)

Case Study: Algae- escape model, German (Industrial Landscape)
1. Example Landscape Scope

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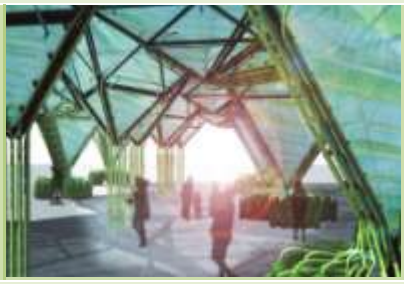
Project Title	**Landscape park based on algae technology (Algaescape)**

Fig.11. Algaescape Layout With Photobioreactor System For Algae Technology
Source :(http://landartgenerator.org/blagi/archives/3595).

Site	Münster, Germany
Team work	Artist Team: Tobias Anderson, Adam Pajonk
General Information	Submission to the 2014 Land Art Generator Initiative Copenhagen design competition
Project Overview	As industry becomes increasingly digital and mechanized, large swathes of industrial cities like St. Louis are struggling to generate reasonable solutions for abandoned manufacturing buildings and the residual pollution of soil and waterways. By adapting agricultural processes for the urban landscape, these problems can be solved through natural means. This project proposes a landscape of algal agriculture that has been adapted to integrate with the existing infrastructure of the site, allowing the polluted waters of the Mississippi River to be cleansed while providing a healthy source of algal nutrients for livestock feed.

Project Objectives	1-The installation provides a closed and efficient resource loop between the city, its infrastructure, and energy production. 2-Algaescape takes carbon dioxide and nutrient-rich wastewater and produces algae biomass and oxygen through photosynthesis. 3-It works like a filter for the city, cleaning the air and water. 4-The algae can be processed for food production, cosmetics, and for energy production in the form of either liquid fuel and/or gas. 5-The algaescape mesh is designed to be inhabited by visitors who can enjoy a variety of activities, such playing sports, viewing the cityscape, or walking off its edge to go for a swim. 6- Illuminated by energy efficient LED lights at night, algaescape will be visible from across the harbor. 7-Dynamic and living urban space zero carbon space.	 **Fig. 12. Simulation For Alga-escape Closed Loop System**  **Fig. 13. Algae urban canopy**
Energy Technologies	Microalgae bio-reactors (algae biogas production)	
General Considerations	1-Algeascape should be nearby artificial area as they will be a source of carbon dioxide and this suitable for breeding algae 2-Orientation in the direct of sun radiation. System temperature in the degree of 28-35 c degree Nearby water source **(Benemann, 2008).**.	
Design Concept	The team started by analyzing the process of energy production by algae. Out of this process we chose the part of the specific algae production, which requires the biggest amount of space, and transformed it into a both biomass producing and space providing form. The algae containing tubes which are used in typical algae reactors where replaced by flexible plastic sleeves and weaved to a textile. During the weaving process it is possible to imply different layers to the algae mesh, like a bearing structure and a supply and controlling system which is necessary for the algae growing. This textile is now able to form connect and affect spaces below and above it and is decisively aligned to the algae production. Mayor effects are a varying transparency depending on the algae population and an slightly inclined shape towards the south. The textile is like a shaped cloth which allows communication between both sides of it.	
	In the morning people come and visit algaescape in the morning you will meet some early bird jogger enjoying the first sunrays glimpsing through the woven algae structure. As a leisure activity you can jog around the track or use the landscape as your personal track with different height levels .	

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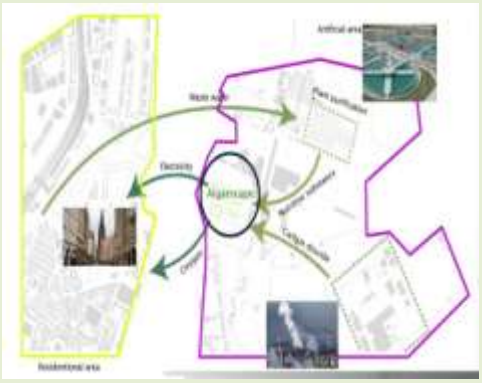
Scenarios of algaescape	At noon the algaescape gets more and more crowded with different groups of visitors. there are people who want to visit the algae space and learn about the biomass production, which is completly.The third possible group is here for lunchtime, just get a little snack from one of the container shops or enjoy your lunch at Amass, one of the best restaurants in the world. The algaescape provides a perfect location for the open air terasse	
	At nighttime the algaescape will be widely visible, on the one hand due to a great illumination by energy efficient leds and on the other hand due to large concerts that can be held on site. When there is a concert the algaescape structure can be used in different ways, the slope in the back can serve as a tribune and the hills as the roof structure for the stage.	
Environmental Impact	The algae preserves treated freshwater by only using seawater. It can adapt effectively to an urban context and continues to thrive in polluted waters, because of its development away from the ground. Unlike other biofuels, it does not require agricultural space for its production, preserving any pre-existing food production. It may even be possible to grow food under the algae's canopy. Algae further absorbs carbon dioxide, assisting in the fight against climate change. The algae's development is the equivalent of a growing forest. It is able to survive in extreme temperatures, for instance in the arctic regions.	

Evaluation of framework through the case study:
as shown in Table (6).

Table 6.Evaluation of framework through the case study

`Elements	Options for microalgae technology	Selections	Notes
Land use	Mixed		
	Typical		Industrial area
Microalgae Types	Macroalgae		
	Microalgae		In green color
Microalgae Cultivation System	Open Race way ponds		
	Closed water ponds		
Green energy	Consumption		
	Production		Produce biofuel
Inputs (needs)	Carbon Dioxide		From the surrounding factories
	Solar Radiation		Natural sun
	Water waste		From the urban community for the city and the industrial area

Source: The Researcher Based on (Algaewheel, 2011; Algomed, 2011)

4.2.3. Framework as a measure for using totally elements of microalgae technology in case study

This framework was derived from the theoretical study of microalgae technology applications in the urban areas, especially in the industrial areas. From this framework it was concluded that there are some elements that have been confirmed by case study and its application such as the system used to breed algae growth (close photo bioreactor) and the type used but not directly focus on the type of energy used, whether directly or indirectly in the form of fuel type and landscape approach that based on algae type economic cost so that will be put some of these elements in the final framework of the research to be guided by designers and experts when using this technology in the landscape of the industrial area.

5. Updated framework for using microalgae technology in the industrial areas as a landscape elements: The results are shown in Table (7).

Table 7. Framework for algaescape technology in the industrial spaces.

Types of landscape	Options for microalgae technology	Infrastructure Landscape	Productive Landscape	Vertical Landscape	Green Roof
Microalgae Types	Macroalgae	Not suitable	Not suitable	Not suitable	Not suitable
	Microalgae		Breeding it in open race way ponds	Use it in tubes shape in vertical position	
	Algae bloom	Not suitable	Not suitable	Not suitable	Not suitable
	Maerl				
Microalgae Cultivation System	Open Race way ponds	Use open race way in multi - shape it is suitable especially for wide open view for algae	Use open race way in multi - shape it is suitable especially for wide open view for algae	Not suitable	Not suitable
	Close photo bioreactor	Can use it in factories in labs indoor		Using in tube with system in vertical shape	Using in tube with system in horizontal shape
	Closed water ponds	Can use it such as green housing as an indoor view			
Algae colors	Composition	Mixed colors	Mixed colors	Green	Green
	Single Colors				
Green energy	Biofuel	Biofuel products	Biofuel products	Biofuel products	Biofuel products
	Direct Power	Can produce energy in direct method from interaction in algae breed	Indirect method in green fuel	Indirect method in green fuel	Indirect method in green fuel

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Inputs (needs)	Carbon Dioxide	CO_2 from air	CO_2 from air	Using tube system to absorb CO_2 from industries	CO_2 from air
	Solar Radiation	Natural sun	Natural &concentrated photovoltaic	Natural & concentrated photovoltaic	Natural sun
	Water waste	All types need those requirements			
	Organic Garbage				
Cost		low	medium	high	high

Source: The Researcher based on (Ahmad and Wyckoff, 2003)

Framework elements concluded from the theoretical studies

Updated elements concluded from studying case study

C

The most important results of research and readings on microalgae technology and its relationship to industrial spaces are that there are a set of requirements for the use of this technology and the advantages of its use, in addition to understanding the biological nature of these organisms, which contribute more to the understanding of requirements and to achieving the greatest number of advantages:

Microalgae technology is the creation of tools in the field of green energy, as it falls within the category of organic energy, that is, energy produced by plants and trees, and has a strong nature in terms of the speed of reproduction and the maximum production of oxygen and the fastest absorption of carbon dioxide gasit is considered a garbage bin and a global outlet and this makes us address the requirements of this technology, which includes the following:

- Solar radiation must be present, as it is an essential component of photosynthesis, just as other plants and trees are.
- These microalgae should be adopted and elevated near industrial areas, because they are fertile with carbon dioxide
- It is necessary to have organic materials, which are often plankton falling from ponds or from factory and waste materials.
- A source of water is not a requirement that it is fresh water, but rather salty water is represented by sea water, wastewater and water resulting from industrial drainage, therefore microalgae represent a natural purifier of water and at the same time there is organic plankton.

In addition to the requirements, there are technology benefits and advantages:

- Microalgae represent the lungs of industrial areas and are a source for many industries such as sustainable production of organic fuels, cosmetics, and fertilizers.
- Microalgae represent a lung and a filter for water and air, as they transform harmful industrial waste into urban benefits.

Mechanism for using microalgae in the industrial areas as a component of Landscape

- First, there are requirements as we mentioned above in addition to the existence of systems to raise them through research. A set of systems has been presented, but the best of them in terms of use as a component of the landscape is open ponds where microalgae can be seen in different colors such as the rainbow and this is what represents the softscape in addition to its movement which gives the vitality of the industrial vacuum

- For night activities, the vital nature of algae absorbs light and emits nighttime green radiation, which represents natural lighting that gives a kind of excitement and surprise to the viewers and gives the feeling of being in the forest.
- Technology can be combined with pergolas to make it have different functions, a product of fuel and seating, and a pollution canister (urban canopy).

In the end, research and the initial framework can be used as a good fertilized seed that can be developed by designers and experts and used to elevate and revitalize unused industrial spaces to become viable human spaces and become important in both directions, the first importance becomes spaces where producing biofuel and the other direction as vital spaces or parks that attract human activities (Demribas, 2011).

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استخدام الطاقة الخضراء كمنقي طبيعي لاعادة احياء الفراغات الصناعية المهدرة مستخدما تكنولوجيا الطحالب الخضراء الدقيقة كاحدي عناصر تنسيق الموقع (قوس قزح اليابس) (دراسة تطبيقية علي منطقة صناعية بالمانيا)

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المستخلص

يركز هذا البحث على تقنية حديثة من خلال إطارًا يوسع من استخدم عناصر الاندسكيب بشكل فعال مستعينا بتقنية الطحالب الدقيقة. أصبحت المناطق الصناعية تشكل تهديدًا لمعظم البلدان ؛ المناطق الصناعية غير المستخدمة بشكل خاص تمثل مساحات واسعة. نتيجة لذلك ، أصبحت قنبلة موقوتة ، لذلك قرر العلماء والمصممين البحث عن أكثر الطرق فعالية لاستخدام الطحالب الدقيقة الخضراء لحل هذه المشكلة ودمجها مع عناصر تنسيق الموقع الاندسكيب حيث يمكن تربية الطحالب الدقيقة الخضراء داخل برك مفتوحة (Open Race Way Ponds) في المناطق الصناعية لتصبح أداة ذات ميزتين: الوقود الأخضر العضوي (يمثل الاندسكيب المنتج) ، كما تمثل الطحالب منظرًا جماليًا من خلال درجات اللون الأخضر المختلفة وحركة الطحالب الدقيقة بألوانها المختلفة ترسم قوس قزح علي اليابس وسوف تراها على إشعاعها الأخضر الطبيعي في الليل .كل هذا يحتاج إلى مياه الصرف الصحي أو المياه المالحة وثاني أكسيد الكربون ، والإشعاع الشمسي كمدخلات لتكاثر الطحالب ، أي تحويل النفايات إلى إمكانيات عمرانية مفيدة (إيجابي إلى سلبي ، وبالتالي سيتم تحويل المساحات الصناعية إلى مساحات حيوية بشرية وهذا يمثل الهدف الرئيسي للبحث الذي يشع الحيوية ليلاً ونهارًا ويصبح مصدرًا للأكسجين ، حيث تنتج الطحالب 6 أضعاف أكسجين الأشجار ، ومن خلال هذا البحث سيتم تقديم إطار لاستخدام هذه السلالات فيالفراغات و المناطق الصناعية المهدرة كمنهج جديد في مدخلات ومفاهيم الاندسكيب.

الكلمات الدالة : الطاقة الخضراء – تكنولوجيا الطحالب الخضراء الدقيقة – المباني الحية- وقود المستخلص من الطحالب - المخلفات العمرانية- اضاءات مستخدمة بتقنية الطحالب الخضراء – تنسيق الموقع المبني علي استخدام الطحالب .