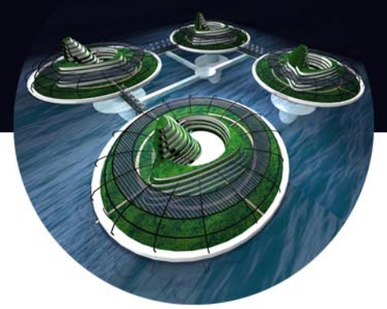
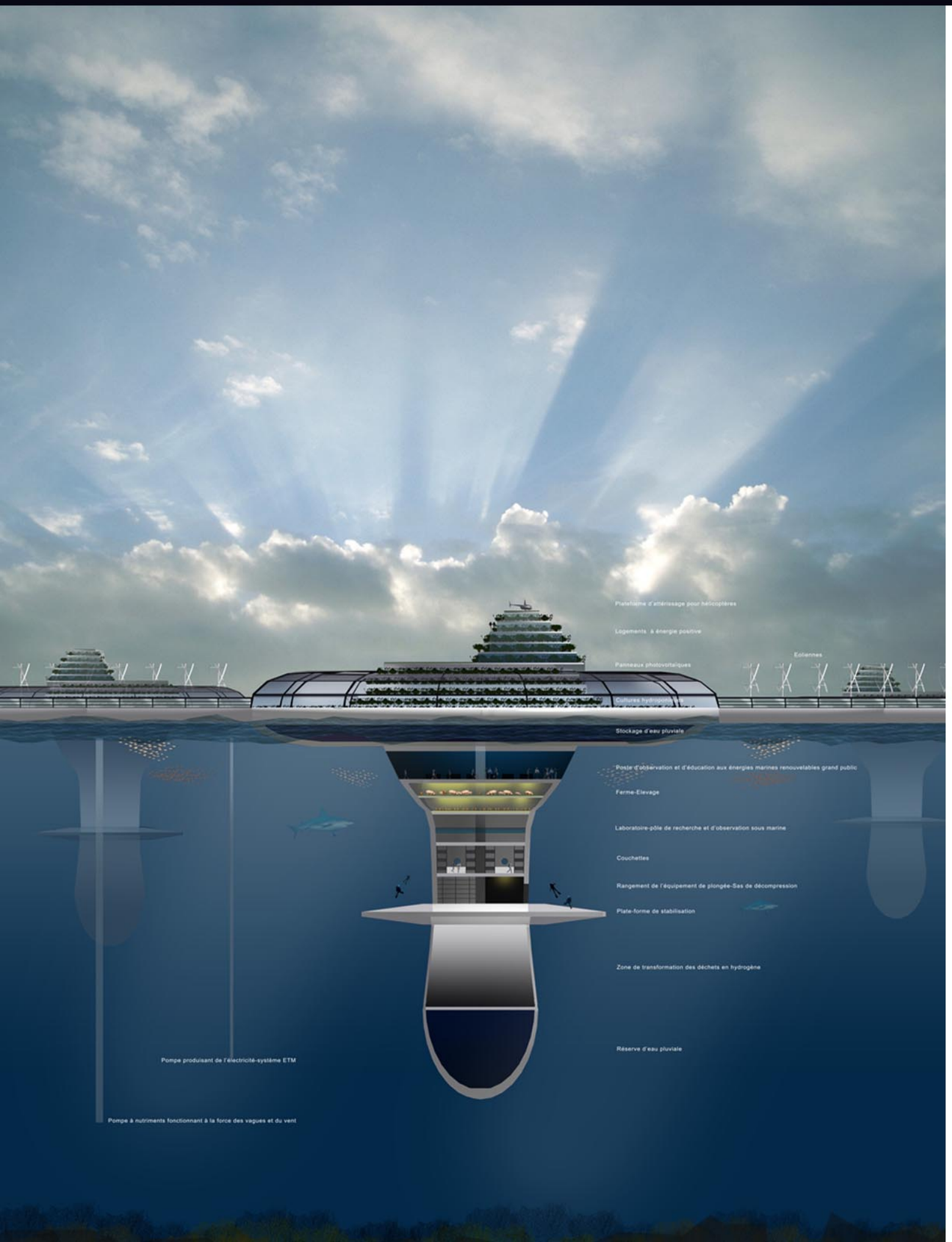
Enercité





Introduction
Les réfugiés climatiques: une question d'actualité soulevant des enjeux de taille

1/ Une ville à énergie positive sur l'eau

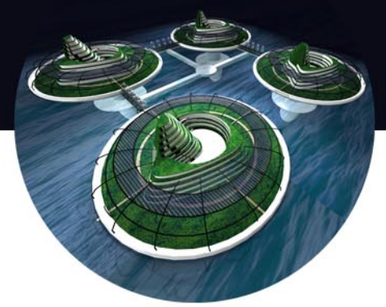
Des avancées techniques pour maximiser les rendements et minimiser les impacts sur la planète

Une architecture contemporaine plaçant le bien-être et l'échange et la culture au coeur de la problématique

2/ Préserver la nature et en tirer le meilleur parti

Construire avec un matériau innovant respectueux de l'environnement

Protéger l'écosystème et le mettre en valeur



2/ Préserver la nature et en tirer le meilleur parti

Construire avec un matériau innovant

Building a refugee camp will require a large amount of construction material. While it is unavoidable that a large amount of the materials will have to originate either from terrestrial sources and mining we would like to use techniques that disturb the environment as little as possible. One method we want to consider is to use natural reef building organisms and in particular oysters to organically grow structures. Oysters are filter feeding organisms and therefore ideally suited to feed on the increased primary productive created with the artificial upwelling. They also grow rapidly (in the juvenile stage 1mm per day) which should make it possible to grow structures within a acceptable time frame. We envision 3 potential methods for construction using clams.

1. The first potential method is by building a frame for the entire structure to be constructed using oysters. Oyster spat (juvenile clams) from a nursery can then be added to various strategic places to start construction. Once the structure has become sufficiently covered and structurally strong any gaps can be closed using a cement mixture made from ground down clams and limestone released from fast growing corals such as those from the pocillopora family. Once the structure is water proof the water on the inside can be pumped out so that it becomes buoyant and then can be used for its intended purpose.

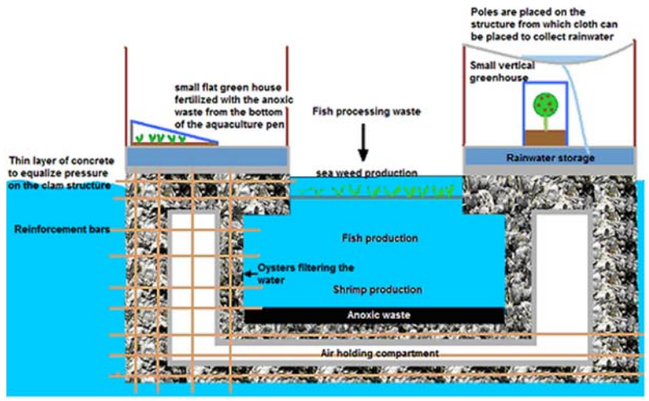
2. The second method would design structures into different building blocks which can be grown and then when they are sufficiently grown connected and made into 1 large structure. Generic building blocks could also be created for projects that are designed at a later period.

3. The last method would use suspended ropes on which oysters are grown. Then once the oysters have fully formed the ropes are pulled around a frame or form to grow together and form the final structure.

One issue to be resolved is that once the structures are completed the oysters will have to be killed so that they no longer take up algae and zooplankton which is feed for the herring. Methods to kill the clams can be include exposing them to air for a sufficiently long time or natural biocides.

Alternative uses for the Oyster Structures

While oysters are a potential building material they are already proven natural filters capable of cleaning large amounts of water from organic pollution. Using this characteristic we see two additional uses, as a natural filter for use in aquaculture and as a natural filter to clean up areas affected by large scale organic pollution.



Maintaining water quality

In aquaculture one main problem is maintaining clean water quality. Uneaten food and animal waste products result in poorer water quality rich in bacteria, ammonia, nitrite, viruses and other potential threats to successful aquaculture production. By using oysters as natural filters we should be able to reduce this organic pollution thereby protecting the natural environment as well as improving production. For example a polyculture aquaculture basin can consist of an enclosure built with oysters. The oysters create the basin and maintain water quality. The fish and shrimp in the enclosure can be fed using herring and fish processing waste. The bacteria that feed off excess food can be eaten by the oysters.

Cleaning up excess organic pollution

Many ocean areas are being affected by excessive organic pollution resulting in large areas suffering from oxygen depletion. This is in turn means that the area cannot support most types of marine life. The largest marine deadzone is in the Gulf of Mexico but they can be found around the world. By creating huge oyster farms around these dead zones it might be possible to reduce the amount of nutrient pollution, construct structures to use for the refugee camp, for harbors and coastal protection projects, for aquaculture, or to create artificial reefs. It is however essential to prevent the use of species that can turn into invasive pest species such as the Japanese oyster in Europe.

Intensive Aquaculture and agriculture

Using seaweed, kelp, herring and the waste from fish processing as feed and fertilizer we can use intensive aquaculture and agriculture techniques to provide additional and different types of food to the inhabitants of our refugee camp. Intensive aquaculture can be used to grow species such as salmon, tuna (if the life cycle can be closed) and other species using herring and fish processing waste processed into feed pellets or directly. Seaweed and possibly kelp can be used to feed herbivorous fish species such as those from the siganid family and echinoderms such as sea urchins. Agriculture can be done in greenhouses using fish waste, kelp and seaweed as fertilizers. This prevents a reliance on petroleum based fertilizer and is therefore more sustainable than most current forms of agriculture.

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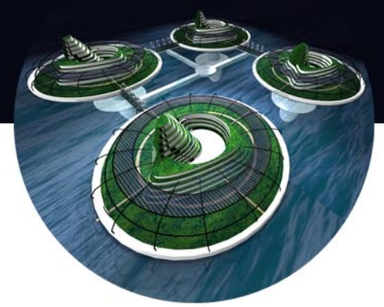

Protéger l'écosystème et le mettre en valeur

Creating a Connection with nature

While we can write about the many technologies and technical solutions that can be used to create a more sustainable society one of the most important if not the most important thing that needs to change is the mindset. To achieve this it is our intention to create an environment at the refugee camp that creates a connection between the people and the planet. To achieve this we intend to create artificial ecosystems of various terrestrial and marine habitats as well as have various science projects in which people can work.

Artificial Terrestrial Environments

Our design provides the opportunity to allocate certain areas to create parks that individuals can use for recreation. However since space is scarce we intend to have these parks fulfill a double function of providing recreation as well as food. To do this we intend to create a tropical and a temperate park. The parks will be temperature regulated using heat exchange mechanisms in contact with the ocean surface water and deep sea water. They will first be crafted into an area with interesting relief, water areas and walking and sitting areas. They will be planted largely with trees and plants that provide fruits, nuts or construction materials such as mango, banana, cashew, coconut, orange, apple, plum and other trees. Plants such as bamboo, rattan, sunflower, aloe vera, strawberry, mint and others will also be used. Of course there will also be other nonfunctional plants to create the landscape but it is the intention to make it functional as well as recreational park. It will almost be a polyculture plantation.

Artificial Marine Environments

Marine environments are some of the most beautiful environments in the world yet few people have or take the opportunity to see their beauty. Two artificial environments we would like to create are a coral reef and a kelp forest.

The Coral reef

The coral reef shapes will first be sculpted from dead oyster colonies. Then the fast growing corals such as those from the acropora, pocillopora, montipora families will be added. Potentially slower corals will also be added. One method might be by sculpting the shape of a long living coral then a small long living coral is fragmented into different pieces which are placed at certain distances to each other so that they can grow towards each other on the sculpture using encrusting methods. This might be a method to rapidly grow larger colonies. The techniques learned from growing a coral reef can then be used to restore coral reefs around the world which suffer from various anthropogenic impacts.

The Kelp forest

Kelp forests are another beautiful marine habitat. To create a beautiful kelp habitat we first sculpt a rocky shore. The rocky shore includes tide pools which will fill with water due to an artificial tide. People can walk on paths through the tide pool area to observe anemones, sea stars, small fish, crabs and possible octopus. In the deeper end there is extensive kelp forest with orange garibaldi fish, small horn sharks, bat rays and groupers. People will be able to snorkel and dive in the park or look inside from an inside glass tunnel.

How to use the artificial upwelling zone

Once the artificial upwelling zone has been created it will have to be applied to produce food, building materials and possibly energy. We can apply both extensive and intensive aquaculture methods. Our strategy would rely on a combination of both.

Extensive aquaculture

By creating a natural upwelling area a large amount of nutrients will become available at the surface where they can be consumed by seaweed and kelp as well as algae which can then be consumed by zooplankton and then by planktivorous fish and filter feeding molluscs such as sardines and herring. As a fast reproducing and growing species the sardines will form a part of the staple diet of the inhabitants of our refugee camp as well as a major export product. The sardines and/or herring will be free swimming in the area and can be caught using pelagic trawling. It is expected that the herring will remain in the area due to an abundance of food. There are however 3 issues that will have to be resolved.

Balancing the Ecosystem

With artificial upwelling we will have created a new ecosystem in which a balance between the various organisms will have to be found. Having too many zooplankton can cause the algae population to crash while too many herring can cause the zooplankton population to crash. To prevent this there are two options, 1 is bottom up control in which the amount of upwelling is increased by creating more upwelling pumps and 2 top down control by harvesting herring at the optimal level. Without such strategies it could be possible that fish populations crash potentially resulting in food shortages. By monitoring various variables such as nutrient concentrations, fish/zooplankton/algae population sizes, catch rates it should be possible to maintain a steady production.

Fish Reproduction

Another challenge will be fish reproduction. Sardines and herring spawn in shallow coastal zones where they lay eggs in dense mats on various substrate. There the eggs develop into larvae which can then be spread over large areas. Since our refugee camp will be located on the open ocean there will be no coastline for the fish to lay their eggs. To solve this there can be two strategies.
The first strategy is to use natural reproduction by creating artificial environments with shallow substrate and good conditions for the fish to lay their eggs and choosing a location for the camp with currents that will not sweep away all larvae. The second option is to manage the reproduction in special laboratories. Fish can be induced to spawn using hormones or the eggs and sperm can be harvested by manual means. The eggs and larvae can then be raised in laboratory conditions till they are of sufficient size to be released. Natural reproduction however is preferred above more artificial means of reproduction because this requires less labor and fewer resources.

Natural Predation

Another issue that will have to be resolved will be how to minimize natural predation. Large schools of pelagic fish will undoubtedly attract predators such as sharks, cetaceans, sea birds, tuna, cephalopods and a range of other potential predators. To deal with this various strategies will have to be developed, however we consider it essential that these strategies do not involve the killing of these animals. Appropriate strategies might involve structural barriers, acoustic devices, underwater structures that scare away predators such as large fake sharks (like an underwater scare crow), electrical fields, offensive odors and other innovative strategies. Finally it will have to be accepted that there will be predation losses due to natural predators.

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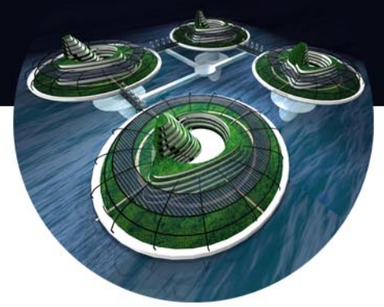


Introduction

«Oui, mes amis, dit Cyrus Smith, je crois qu'un jour l'eau servira de carburant, que l'hydrogène et l'oxygène qui la constituent, utilisés seuls ou ensemble, fourniront une source inépuisable d'énergie et de lumière, d'une intensité dont le charbon n'est pas capable, et que lorsque les ressources en charbon seront épuisées, nous nous chaufferons grâce à l'eau. L'eau sera le charbon du futur.»
L'île mystérieuse (1874), Jules Verne

Le dérèglement climatique n'est plus contesté, plus contestable. Pour employer les mots des climatologues, nous constatons une augmentation moyenne des températures terrestres de 0.6°C en un siècle. Les activités humaines en sont largement responsables. Les transports, l'industrie, le chauffage et la climatisation des bâtiments, l'agriculture etc. émettent des quantités énormes de gaz à effet de serre dans l'atmosphère, provoquant un confinement de l'énergie solaire à la surface de la planète. Conséquences : une élévation de température, mais aussi bien d'autres dérèglements déjà perceptibles, imminents ou probables- bouleversement du régime des précipitations, augmentation de la fréquence et de la violence des événements climatiques (tempêtes, pluies, canicules etc.) migration des habitats naturels, élévation du niveau de la mer etc.

Récemment, le tremblement de terre en Haïti, le séisme au Japon, la disparition de Lohacara, petite île du Delta du Gange, dûe à la montée du niveau des océans ou encore la désertification dans l'ouest sahélien poussant des populations entières à migrer, provoquant des conflits entre populations locales et migrants nous exhortent à songer sérieusement à des solutions permettant aux populations touchées par ces catastrophes climatiques de vivre dans des situations convenables.

La ministre de l'Écologie, du Développement durable, des Transports et du Logement, Nathalie Kosciuzco-Morizet, s'interroge sur le statut des réfugiés climatiques :
« Le futur traité de l'après-Kyoto prendra-t-il en compte la question du statut juridique des migrants environnementaux ? Ou bien devra t- on trouver des solutions au cas par cas, selon les régions ? Cette question essentielle n'est aujourd'hui envisagée que dans le seul volet « adaptation au changement climatique » des négociations dites « post-2012 ». Une évidence s'impose : ce cadre est trop étroit pour un problème de cette taille. »
Nous proposons d'étudier un système de ville flottante à énergie positive accueillant les migrants environnementaux, leur donnant des conditions de vie décentes, les éduquant aux principes fondamentaux du développement durable et utilisant les dernières recherches techniques, technologiques et agricoles permettant de fournir l'énergie suffisante et d'exporter le surplus vers les continents qui en nécessitent l'apport.

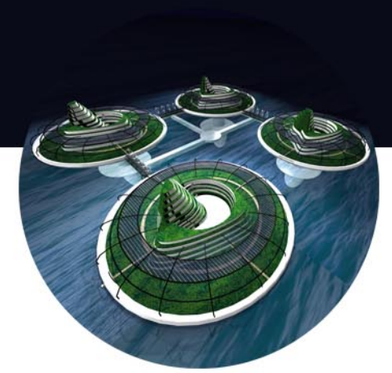
Au milieu du XIXe siècle, Jules Verne avait déjà présenti les potentialités de l'eau qu'il appelait le « charbon du futur ». Aujourd'hui, les chercheurs ont commencé à imaginer des systèmes permettant de fournir de l'énergie à l'échelle d'une ville.

Les villes flottantes imaginées ici tirent partie de leur situation originale sur l'eau en exploitant toutes les potentialités du site :
la force du vent et des vagues pour créer de l'electricité avec des éoliennes dernière génération et des tubes pompant naturellement l'eau froide localisée au fond de l'océan , la force des vagues pour faire remonter en surface les ressources non utilisées en nutriments au fond de l'océan, afin d'alimenter et de regénérer la population de poissons, ce qui permet à la population de se nourrir en partie.
La récupération des eaux de pluie permet d'alimenter un système de cultures hydroponiques suffisant à nourrir l'ensemble des habitants d'une cellule. Si la production dépasse les besoins, le surplus est acheminé vers les continents qui nécessitent ces denrées à l'aide de bateaux propulsés par de l'hydrogène fabriqué par la transformation des déchets générés par les habitants de la cellule.

Enfin, parce que la vie n'est pas exclusivement une question de survie, les réfugiés bénéficient d'un espace de vie convivial, créé autour d'une place centrale permettant de se retrouver et d'échanger, de se promener dans les boutiques ou de boire un café, d'aller chercher ses enfants à l'école, de se cultiver avec la présence de bibliothèques et aussi d'admirer les fonds marins tout en s'instruisant sur les dernières technologies dont les recherches sont effectuées en permanence sur place par les chercheurs installés là pendant la durée souhaitée et nécessaires à leurs travaux.
Les habitants, installés dans des appartements naturellement éclairés et ensoleillés intégrant les dernières normes bioclimatiques, aux toitures végétalisées, bénéficient d'une vue panoramique spectaculaire sur l'Océan, les arbres fruitiers situés sur leur balcon absorbant le CO2 de l'air, les protégeant du soleil et leur fournissant la quantité de fruits et légumes nécessaires.

En effet, lorsque l'on a la chance de repenser une ville depuis son début, on peut rêver d'intégrer l'ensemble des dernières découvertes permettant d'exploiter la nature en la respectant et de faire vivre une population de manière heureuse et responsable.

Enercité

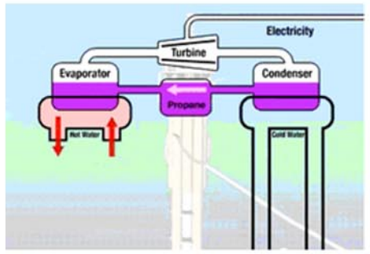


1/ Le choix d'une ville à énergie positive sur l'eau

Des avancées techniques pour maximiser les rendements et minimiser les impacts sur la planète

Sustainable Energy

A modern society not only requires food but also large amounts of energy. To supply these energy needs we want to use only sustainable resources and resources with minimal polluting effects. The obvious choices for energy sources are solar, wind and wave power. Still this might be insufficient and therefore we also want to make use of the Ocean Thermal Energy Conversion technique (OTEC). OTEC uses the difference between the warm surface water and cold deep water to drive a turbine. The warm surface water is used convert a liquid with a low boiling point such as propane into gas this then drives a turbine after which it is returned to a liquid state by the cold of the deep water. This method should produce continuous renewable electricity to power our refugee camp. This might then require building such a plant outside of the aquaculture area.



Hydroponics/Aeroponics

To grow terrestrial crops such as salads, tomatoes, cucumbers, strawberries and more we intend to use both hydroponics and aeroponics. In hydroponics the plant roots are suspended in liquid from which they are fed their essential nutrients. In aeroponics the roots are suspended in the air and the roots and lower stem are sprayed with a fine mist containing the essential nutrients. Both techniques are very useful to achieve high levels of production with low inputs of water and energy and efficient use of nutrients when compared to other forms of agriculture. An advantage of aeroponics is that it allows for easier cloning of plants than tradition agriculture and hydroponic aquaculture. This is important since food production will be centered around the needs of the refugees whose population will vary depending on the worldwide need for refugee shelter. Therefore it should be possible to rapidly increase and decrease food production to maximize the effectiveness of resources used.

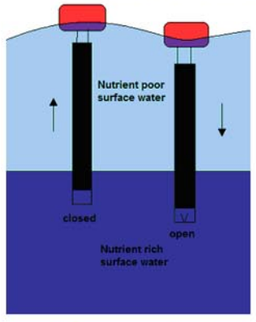
Wind turbine

Photovoltaic panels

Feeding and Building our refugee camp

Establishing a refugee and maintaining a refugee camp on the open ocean requires a large amount of building material and food. Our mission is to have this camp be as self reliant and environmentally sustainable as possible. Therefore it is necessary to think of techniques and strategies to make this possible. While harvesting seafood could be a method of providing food it is clear that the seas are rapidly becoming depleted due to overfishing and habitat destruction.

Therefore we want to apply another strategy that can deliver both food and construction material. To achieve this we intend to create an artificial upwelling zone that enriches the ocean surface with nutrients to increase productivity and thereby increases the amount of food and other organic materials that can be harvested from the ocean. Natural upwelling already provides some of the most productive fisheries in the world such as off the sardine fisheries off the coast of Chile and highly productive fisheries off the coast of West Africa.



Creating an artificial upwelling zone

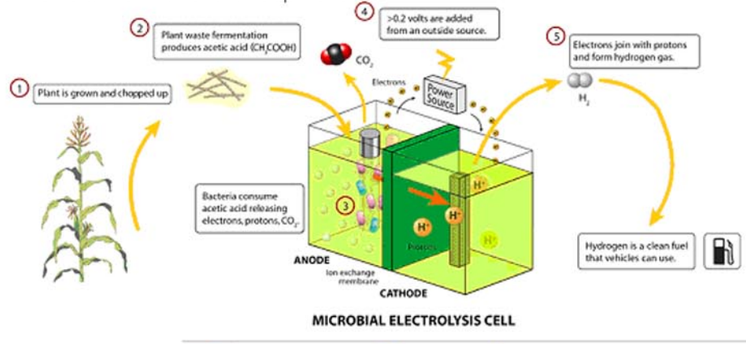
Natural upwelling zones occur where cold nutrient rich water comes up from the deep to the surface. This happens because the water is pushed up by large landmasses. Our artificial upwelling zone will however be created using wave powered pumps. The pumps will consist of long tubes suspended by floats at the surface of the water. At the bottom of each pump there is a valve which opens when the float moves down and the deep water pushes the valve open. When the pump moves up the water in the pump pushes down the valve to close it. The deep water is then pulled up to the surface. This method has been researched by the university of Hawaii as a method to remove CO2 from the environment.

Une architecture contemporaine plaçant le bien-être et l'échange au coeur de la problématique

Alors que l'on a l'impression que les architectes et constructeurs d'aujourd'hui se chamaillent le mérite de construire la plus haute tour du monde, nous avons décidé d'axer notre réflexion architecturale sur le bien-être de l'usager et la rationalité constructive.
Pour cela, nous nous sommes inspirés de constructions traditionnelles aztèques qui, loin des préoccupations d'aujourd'hui plaçaient le sacré au coeur de leurs constructions.
Ainsi, l'échelle de notre projet vise à ce que l'homme qui y vit ne s'y sente pas écrasé mais enveloppé, protégé. A cela s'ajoutent les problématiques de commodité liées aux usges d'aujourd'hui, induisant la forme circulaire des cellules (on pense aux récoltes des cultures hydroponiques).
Une «plaza» centrale permet aux usagers de se retrouver, d'échanger mais aussi se divertir : effectivement, lorsque l'on est loin de sa patrie, il est nécessaire de se changer les idées! L'accent est également mis sur la culture (bibliothèques, écoles) et la science:un laboratoire accueille des chercheurs à l'année et le grand public est invité à découvrir les dernières actualités scientifiques liées au monde de la mer.
De plus, le bien-être du migrant climatique est servi puisqu'il évolue dans un environnement sain, intégrant les dernières normes bioclimatiques. L'habitat a été pensé de manière à ce que les usagers bénéficient d'une vue sur l'Océan et le paysage qui les entoure grace à de grandes baies vitrées laissant entrer la lumière tout en étant protégé grâce aux plantes situées sur les balcons et les toits.

Powering ships and airplanes using hydrogen

Powering ships and airplanes will require an efficient transportable fuel source. One source of fuel could be biofuels however this will still result in various forms or air pollution. Therefore we chose hydrogen as our main form of energy storage which is also created from organic material although these processes are still being perfected. One method we find promising is the Microbial Electrolysis cell. Organic Material can come in the form of algae, seaweed or kelp grown using nutrients pumped up by the nutrient pumps, from polyculture aquaculture farms, from our terrestrial crops and from sewage waste. The outside source of energy can come from one of our renewable energy plants. In the Microbial electrolysis cell microbes consume acetic acid and generate protons and CO2. The H2 is captured and can be used as gas while the CO2 can be released, used as a source for carbon in algae cultures to improve growth, or it could possibly be stored somewhere so that it is permanently removed from the atmosphere



MICROBIAL ELECTROLYSIS CELL

The hydrogen can be used to power ships and airplanes using it either as a traditional fuel in which the hydrogen is burnt in a combustion engine or in a fuel cell where it is combined with Oxygen to generate electricity.

Intitulé du projet : Enercité

Nom de l'auteur ou des auteurs : Camille Benoit -- Bastiaan Vermonden

Fondation Jacques Rougerie - Génération Espace Mer - Institut de France
Prix de la Fondation Jacques Rougerie - Génération Espace Mer - Institut de France "architecture, design et technologie de la mer"