Defining Migration

As ideas form and migrate via individuals, society, and the environment, they become subject to external forces with various levels of power. These economic, social, political, ethical, and environmental forces become invested in seeing an idea fail or succeed. When contextualise within the energy transition, these powers are stakeholders that can adopt or discard new ideas surrounding the global energy transition , based on their associated desires.

Abstract

Within the European union, the transportation sector set a goal of 10% share of energy from renewable sources by 2020 (Eurostat 2020). The Netherlands has exceeded these targets by achieving over 12.5% in 2020. (Eurostat 2020). This was a 2.9% increase from 2019. (Eurostat, 2020) Already the Netherlands are close to the European goal of 14% by 2030 (EEA accessed 2021). Biomass is the leading source of this renewable energy, where it is converted into biodiesel of bioethanol.
Although biofuels were once seen as the solution to replace fossil fuels in the transportation industry, new research has revealed that external factors such as indirect land use change make co2 emissions from biofuel production comparable or even greater than diesel (T&E, 2016). Therefore, cleaner alternatives are required. Whilst there is no single perfect solution to climate positive energy generation, The Migration of Energy looks at the Netherland's transition away from conventional biofuels towards algae as an advanced biofuel. The argumentation is that these biofuels value natural capital, which is considered to be a more holistic metric or environmental, ecosystem and societal wellbeing (Costanza et al, 2014).

As the world moves into a territory of energy ambiguity, truly sustainable, simultaneous transitions from conventional to advanced biofuels as well as from valuing economic capital to valuing natural capital will require transparency and accountability across multiple sectors and scales. Contemporary research indicates that the public should be more active stakeholders within the transition because of their capacity for surveillance, and adoption of industry and government led programs.
Increasing public participation within the algae to energy industry can therefore lead Rotterdam towards achieving its circularity goals of resilient, self-sufficient energy by 2035. (Gladek et al, 2018)

Introduction

1.1 The Energy Transition

Energy can be defined as the physical capacity to do work. (Britannica accessed 2020), for or against accomplishing a goal (Berrett 2007, 28). The first law of thermodynamics is that energy can neither be created or destroyed. It can only be transferred from one form to another (Lumen accessed 2020). Therefore, even within the closed system of the earth, all forms of matter can be considered as energy in different states. (Berrett 2007, 27).
Therefore, The Migration of Energy looks at the evolution of man's ability to modify and manipulate states of matter for human need. The Dutch transportation sector is dominated by oil. (IEA, 2020) As one of the largest oil refining hubs in Europe, the port of Rotterdam played a big role in this process. However, increased pressure to switch away from fossil fuels has spurred a rise in biofuels. This industry has grown from 0.5% renewable to 12.5% renewable in 15 years. (EEA, accessed 2020) (Eurostat 2020).
Currently biomass makes up 60% of renewable energy in the Netherlands. (CBS, 2020). 30% of this is directed at the transportation industry (CBS, 2020). However, this paper investigates the true sustainability of the transportation sector in the production of biomass for liquid biofuels. It has been identifying that Indirect land use change is currently the greatest compromise to the efficiency of first- and second-generation biofuels. Algae as a third-generation biofuel has been identified as viable, sustainable option, largely because it is a significantly more efficient energy source in yield per kg than conventional fuels.
As the urgency of climate mitigation strategies increases, the values of the Netherlands and Rotterdam transitions from global trade dependence spurred on by 20th C ideology of GDP as the metric of success, towards circularity, resilience and self-sufficient energy and ecosystem conservation. These ambitions are outlined in municipal reports such as Circular Rotterdam 2018 and Energy Report: Transition towards sustainable energy 2016. These will become the basis for the literature review, situated within the contextual framework of effectively preserving ecosystem services and societal wellbeing through natural capital; the 'limited stocks of natural materials, land and ecosystems' (Kenniskaarten accessed 2021).

Furthermore, this paper explores the spatial solutions within Rotterdam that will enable public engagement and participation within the transition. The public are powerful yet undervalued stakeholders because their behaviour defines the everyday use and adoption of new energy strategies (Rip 2006, cited om Renn et al 2020) therefore combining energy research facilities with public engagement could enable places of energy generation to also become democratized public space. 'Sites were meaning is made' (Sanders 2009)

1.2 The problem of Biofuels

There are different qualities of biomass used to make biofuels. These are called generations. Four generations of biofuels range from least to most energy dense. The first generation is food biomass that comes from seeds and grains. E.g., corn, palm oil and rapeseed oil. These are used to make 'conventional' biofuels. Beyond that are second, third and fourth generation fuels known as 'advanced biofuels). The second-generation sources are non-food biofuels that come from the fibrous parts of plants such as wood, straw and food waste. Third generation biofuels come from crops that are even more energy dense. such as algae. Fourth generation biofuels are called solar fuels. Solar fuels are energy sources engineered to directly or indirectly convert sunlight into heat or hydrogen. As the need for global energy demand increases yet land availability, nutrients, water and sunlight remain the same, we need to look towards more efficient and effective ways of creating biofuels with the smallest impact.

Indirect land use change
Soy, wheat and corn are amongst the most common feedstocks used in the Netherlands, yet they are some of the least land efficient crops. As these conventional biofuels stem from land-based biomass they compete and replace land that would otherwise be biodiverse forestland ecosystems or used to grow agro-crops. Growing biofuel feedstocks therefore causes concerns over loss of biodiversity and conflicts in areas where the crops are grown. In most instances it still requires combustion like oil and gas therefore CO2 and GHGs are still emitted. It also requires the use of fertilizers; finite resources that becomes leached into the soil, whilst irrigation threatens water insecurity. When this lifecycle is factored in, ILUC can cause an average of '80% higher emissions than the fossil diesel it replaces.' (Transport & Environment, 2016)

2. Literature Review

This literature review conducted, identifies the existing regional and national strategies taking place in the Netherlands to improve sustainability within the energy sector. The literature highlights problem areas within the biofuel industry as well as progressive steps by private organisations to rectify and improve the systemic, lack of transparency within the sector. Further still the review highlights key players within the energy transition and the role of the public as active participants.

Circular Rotterdam, 2018 outlines that to be resilient against global volatility associated with unsustainable energy consumption, Rotterdam needs to be self-sufficient in water and energy. (Gladek et al, 2018, 36). Rotterdam will only consider itself circular once it consumes only ¼ of the total energy it consumed in 2015. (Gladek et al, 2018, 36). These goals are contrary to the fact that the Netherlands is the second largest producer of palm oil diesel in Europe. (Muzi, 2020). This comes from pressure to meet RED (Renewable Energy Directive) 'Green fuel targets' and has caused production, namely at the port of Rotterdam to increase by 7% in the last 5 years. (Muzi, 2019 CHECK). Palm oil has a large ILUC that are not currently factored into the sustainability rating of the fuel. (Grinsven et Kampman 2013, 45) even through its lifecycle produces 3x more c02 than diesel. (Transport & Environment 2016).

2.1 NGO & Public Participation

Transport & Environment is an apolitical non-profit organisation based in Brussels that amongst other things, works to reverse EU biofuel policies that have proven to be detrimental to environment and climate health. (T&E accessed 2021). The organisation campaigned against the mandated use of 14% food-based biofuels in the 2009, Renewable Energy Directive (RED) (T&E 2020, 2). In 2019 they won the campaign to end palm oil diesel in Europe and phase it out by 2023 (Bannon, 2019). Notably, over 650,000 Europeans signed a petition to terminate the use of crude palm oil as biodiesel. (Bannon, 2019). This indicates the power and potential of the public in actively shaping the energy transition through commitment to a shared cause.

2.2 Natural Capital

Alternative solutions that are in keeping with Rotterdam's ambitions for resilience and that don't have detrimental ecological impacts are required, yet these new energy industries in Rotterdam will greatly impact public life. Natural capital is 'the world's stocks of natural assets which include geology, soil, air, water and all living things ... From which humans receive a range of services known as Ecosystem Services'. (Natural Capital Forum accessed 2021) Valuing natural capital is a way of achieving 'the sustainable wellbeing of the whole system of humans and the rest of nature'. (Costanza 2020, 1) because human wellbeing cannot truly be achieved without the wellbeing of nature. (Constanza 2020, 1)

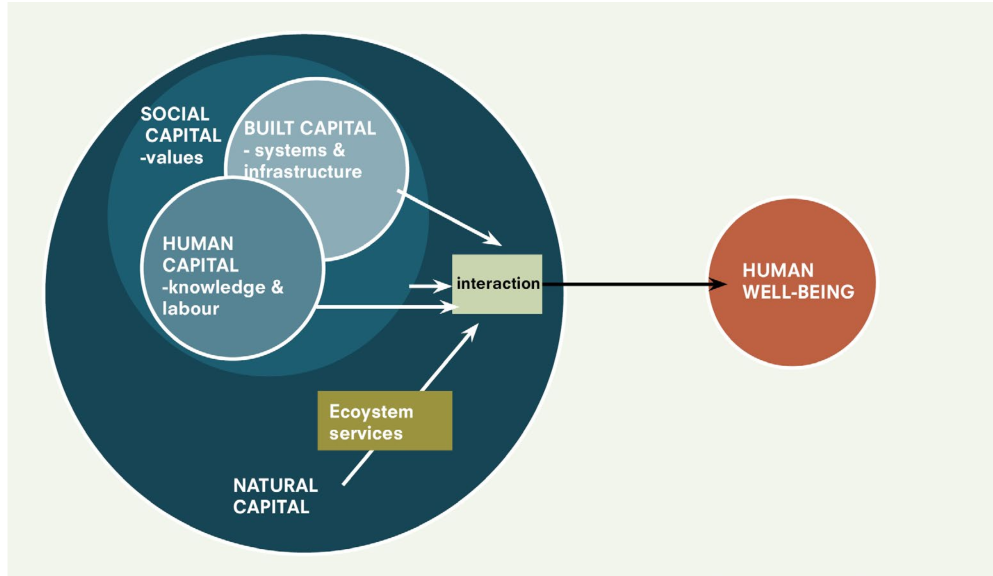


Figure 1. Natural Capital

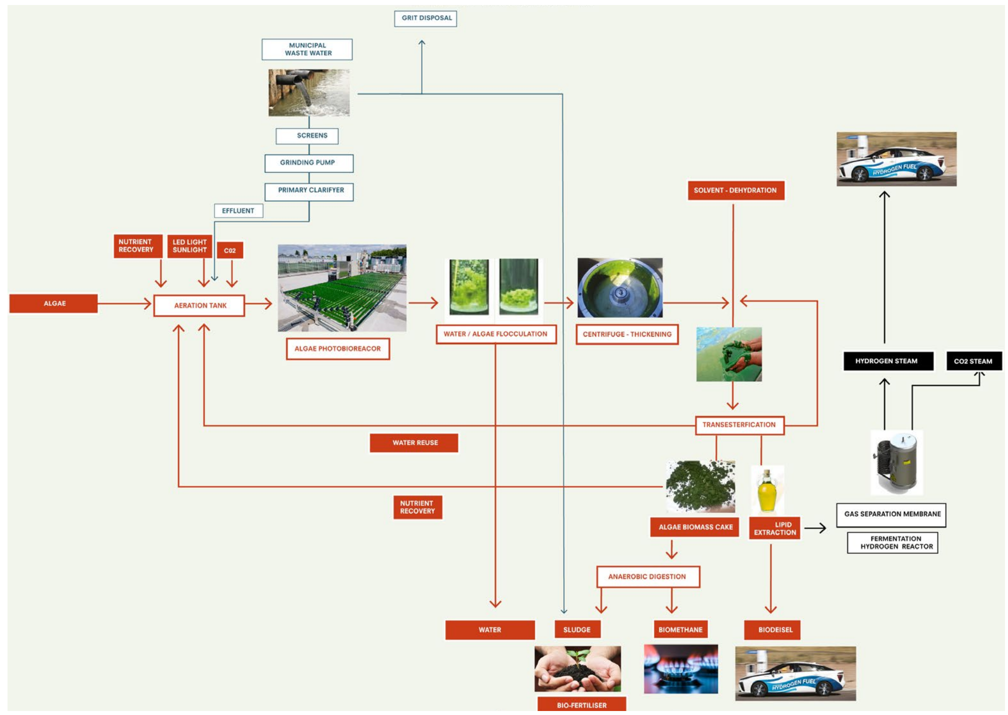


Figure 2. The Algae Cultivation Sequence.

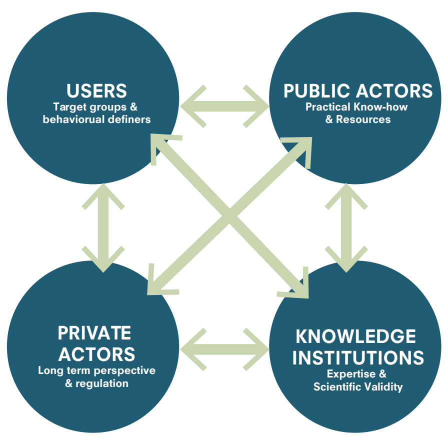
2.3 The Benfits of Algae

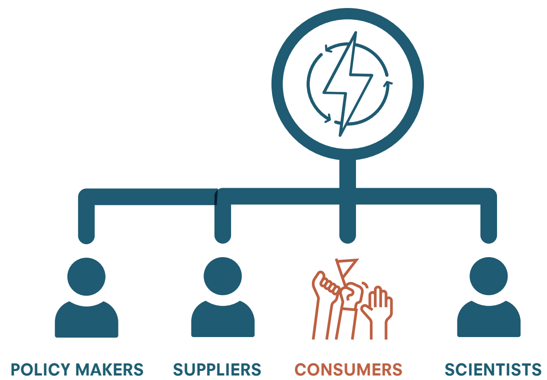
The barrier to expansion of a domestic biomass industry in the Netherlands is the sheer amount of land required. First- and second-generation biofuels have a comparably low energy density and consume more land surface than equivalent oil or gas. (Dobbelsteen cited in Tilly et al 2014, 76). Algae however, and algae to hydrogen in particular addresses the current challenges faced by land use change. Algae requires up to 132x less land area than soy or rapeseed. (Martinez-Guerra et Veera Gude 2016). Further still its required nutrients and water can be sourced from municipal wastewater and purified through membrane biological reactors in the first stage of the algae to energy process. These are nutrients such as phosphorus and nitrates that would otherwise be discharged into the sea and lost (Tilly et al 2014, 52).

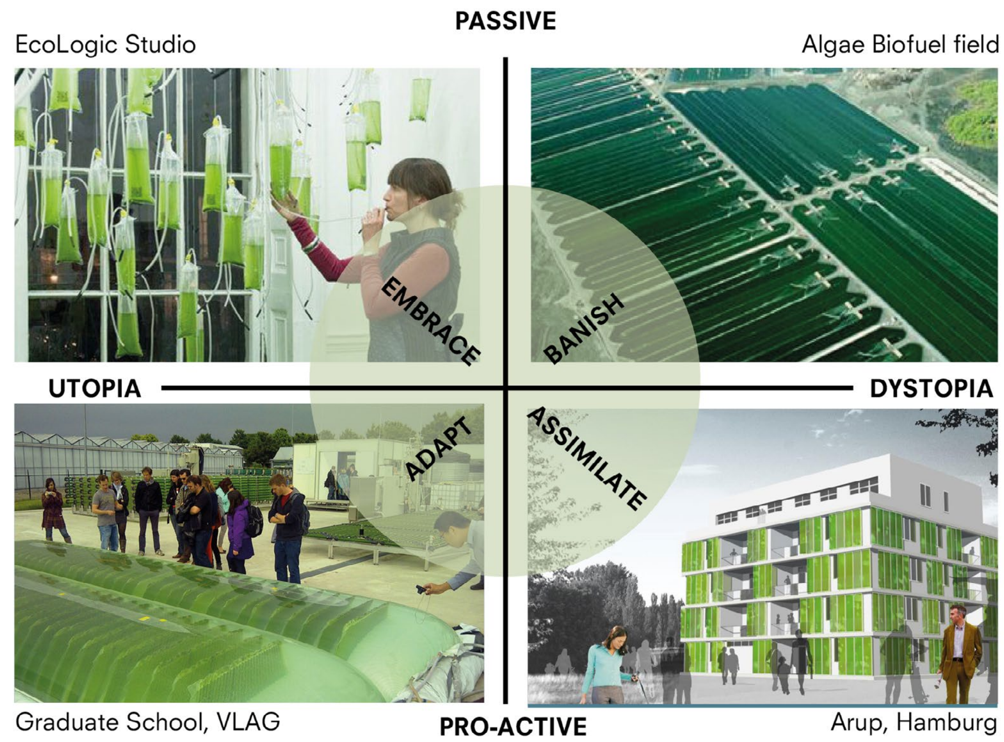
2.4 The Importance of participation

For the algae industry to grow, scientists must create awareness for the public and policy makers (Tiedje et Donohue 2008) Notably, as new technologies are developed, increased visibility and awareness by the public leads to better informed decision making. It also enables the public to hold policy makers and suppliers accountable. Therefore, increasing public education and fostering participation and community engagement should become priority for municipalities. (Zero Waste Cities 2020, 25). Further still, consumer perceptions of ecological value can be increased by integrating circular, transparent production chains & lifecycles into nominal/ normative, consumer decision making. (Bhasin, 2017).

In the Climate report, The Ministry of Economic Affairs of the Netherlands (EZK) addresses the feasibility of various energy transition strategies and describes pilot programs as the 'ideal way to test technological solutions before rolling them out at a large scale. (EZK, 2016, 48) These living laboratories are 'place-based research







Architecture & Identity. 'Representation of the four typology of 'monster treatment'. (Sijmons et al 2014. Modified by Author).

platforms' (MIT accessed 2020) that enable the multidisciplinary development of new technologies by bridging research with real world application. Such facilities can provide a bridge to entry for the public. They can also act as synthesisers between various stakeholders within the urban environment, bringing them together for faster implementation into society. (Steen & Van Vueren 2017, 4).

The way we generate and consume energy is the greatest threat to economic and social wellbeing that we currently face (Carbon Trust, 2013). In Urban Metabolism 2014, the municipality of Rotterdam and the IABR highlighted that there are psychological public health benefits to urban ecosystems (Tilly et al, 2014), 78) Highlighting that spatial design plays an integral role in creating the preconditions for spatial and metabolic systems to interrelate in practice. (Tilly et al 2014, 78)

These papers and reports outline the key problem areas within the transition. Namely the lack of transparency within the biofuel industry, lack of public awareness and poor political policies. Solutions however include living labs that can bring various stakeholders together, make energy systems visible and inspire public activism through day-to-day behavioural changes. This research indicates a three-step process. First, brining renewable energy closer to the consumer. The second step is creating familiarity through integration, whilst the third stage is adoption leading to behavioural change. The shortcoming of these articles, however, is the spatial characteristics in which these processes of education can begin.

2.5 Architecture and Identity

Public resistance to a new purely technical, power and research station in the city poses a real threat to the adoption of new and innovative technologies. This is due to the aestheticization of the western world view (Sijmons 2014, 497) whereby a prosperous, quality of life, 'enjoyment, leisure and time' afforded by cheap fossil fuels are the aspirations of western city dwellers. (Sijmons 2014, 498) In Rotterdam familiarity with the disassociation between the port and city will make the social acceptance of localised energy hubs in the city even more difficult. Significant changes are instinctively received negatively however, these fears can often be mitigated by inspiring the public with feelings of collective ownership, power decision-making influence as well as environmental gains. These instil a sense of pride and willingness to participate. Creating an identity link or making an existing link stronger is one way of instilling this willingness. (Trudel , 2016). Additionally, spatial assimilation and adaptation are the most effective strategies for social acceptance which enables a gradual adjustment to new 'monsters' (Sijmons 2014, 489) within the built environment. Therefore, 'the role of the architect is not to make buildings, but to make discourse about buildings, and to make buildings as a form of discourse. (Wigley 2005, cited in Jones 2011, 27) in order that they may understand and represent societal ideas and values. (Sanders, 2009)outdated housing and detachment of Rotterdam

3. Research Question

How can Rotterdam create an emblem for the Netherlands' biofuel energy transition, that fosters transparent communication between the energy sector and the public?

4. Methodology

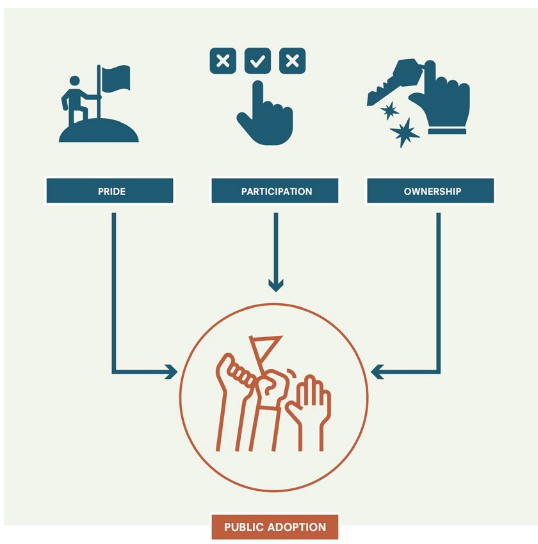
The key points within this research question are the transition, the emblem, and the engagement of the public. 'the physical form of this world is a direct manifestation of what is most valued in our culture' (Sim Van der Ryn, 1995) Therefore it's important to create an emblem to showcase Rotterdam's values and commitment to renewable energy.
The primary point of investigation is the programmatic capacity for an emblem to act as an educational tool for the public. After first proposing algae to hydrogen as the next appropriate step in the biomass transition, logical argumentation and case study comparisons were used to defend the Kuip as an appropriate building to house a living lab within the site of Feijenpoort, Rotterdam.

4.1 The Emblem

Collective identity is always a co-construction inherent to social shared practices and not outside them. (Jones 2011, 50). In this way, 'imagined communities' emerge out of 'horizontal comradeship'. This notion of being united in a common goal to 'defeat common enemies' (Jones 2011, 51) and moving together is one that can be identified clearly in football and can therefore potentially be directed at a new goal.

The Kuip is a municipal monument (OMA et LOLA 2019) located in Rotterdam South, yet close to the heart of Rotterdam. It is already an emblem of collective pride for football lovers. it is well located to connect European policy makers in Brussels and the Hague, as well as connect industry at the port of Rotterdam with scientists and academic institutions in and beyond the city. The Kuip is reaching the end of its life as a football stadium and concert venue because of the construction of the new Feyenoord City football stadium. This gives a good opportunity to put the site to good use and create another symbol for Rotterdam's future. Logically, its scale, proximity to the river as well as future development plans, spatial capacity, as well as symbolism makes it an appropriate site.

Through case study comparison as a praxeological research method, three research and conservation centres were identified. These informed the wider societal ambitions of this living lab as spaces of public pride, participation, and ownership. Further benchmarking was done with aquariums, community sport centres and research labs to identify the necessary spatial relations, hierarchy of spaces and programmatic flows. In conclusion a program with appropriate area allocations was developed based on this benchmarking exercise whilst actual spatial qualities and experiences was developed through a hybrid selection of each of the compared case studies.



Case-studies
1. has both the cleanest waste to energy plant in the world and tallest artificial climbing wall. This creates a sense of pride.

2. Biosphere 2 has a visible ecosystem that the public can engage with

3. The Montreal Olympic park has become a landmark embedded into the city long after the games. Its cultural value and sense of civic ownership has seen it transition from velodrome to biodome.

5. The existing challenge in Feijenoord

The district of Feijenoord, located in Rotterdam south, contains some of the most heavily deprived neighbourhoods in Rotterdam. Situated within Feijenoord is the site of Feijenpoort. This is a complex, heavily diverse neighbourhood, historically composed of port workers who settled during port expansions, the neighbourhoods now suffer from high unemployment, low income, low quality of life, outdated housing, and a detachment from Rotterdam's transition towards technology and innovation.

The ambition is to improve these aspects in an authentic way that bridges the social, physical economic and environmental wellbeing of Feijenpoort's inhabitants, with Rotterdam's' ambitious energy transition goals.

The Kuip Is located in De Veranda in the district of Oud-Ijsselmonde. Adjacent to the deprived neighbourhoods of Feijenoord. Overall, the area of Feijenoord has the lowest quality of life compared to the rest of Rotterdam. This is judged by security, social and physical indexes. (Wijkprofiel Rotterdam, 2020) Subjectively, residents in Bloemhof and Hillesluis in particular feel unsafe and unhappy with their physical environment as well as with the levels of participation within their neighbourhoods. (Wijkprofiel Rotterdam, 2020). At 20,000 euro per person per household, Feijenoord has the second lowest household income in Rotterdam (AlleCijfers, 2020). Research shows that these two qualities of neighborhood deprivation and income significantly influence mental health. However, urban public greenery can improve this, whilst also improving physical activity and creating social interaction (Kabisch 2019) . These are currently both statistically lacking in Feijenoord.

6. Conclusion

The aim of this investigation is to identify effective strategies to educate the consumer on the current problems with biofuels. By empowering the public to fully understand the holistic, environmental benefits of the algae harvesting process, they can support and drive the commercial availability of algae biofuel within the transportation industry as well as make better informed decisions over which fuels suppliers to support. These are decisions that would otherwise be based on convenience, price or familiarity. The ambition it that the stadium can pave the way for the adoption of algae to hydrogen as a clean fuel source whilst recreational aspects bring joy and pride to local inhabitants, thus increasing societal wellbeing.

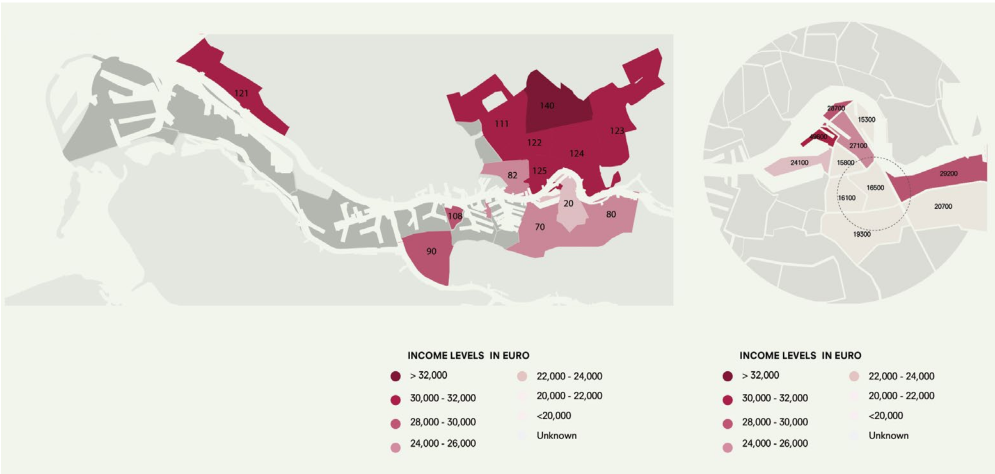


Figure 3. Lowest Incomes In Rotterdam, 2019.

Figure 4. Quality of Life Score in Rotterdam 2020.

This notion of serving infrastructural and social needs is what Bjarke Ingels terms hedonistic sustainability (Ingels, 2011) yet is routed in valuing natural capital.

These ambitions correlate with various SDG goals:

7. Affordable and clean energy
12, sustainable consumption and production
16.6 targets the effectiveness of institutions achieved through transparency and accountability.
16.7 aims for multi-level, responsive, inclusive participation between institutions. (SDGs, 2020)

Bibliography

About us. (n.d.). Transport & Environment. Retrieved 2021, from https://www.transportenvironment.org/about-us

Bannon, E. (2019, April). EU labels palm oil in diesel as unsustainable. Transport & Environment. https://www.transportenvironment.org/press/eu-labels-palm-oil-diesel-unsustainable

Berrett, B. H. (2007). Energy Abundance Now. Google Books. https://books.google.com.ng/

Bhasin, H. (2017, December 25). Understanding Consumerism & how it depends on level of involvement of customer. Marketing91. https://www.marketing91.com/consumerism/

Cappelle, H. (n.d.). EU28—Energy statistics. Retrieved 9 January 2021, from https://energy.at-site.be/eurostat/EU/EU28/

Decentralised energy: powering a sustainable future. (2013, January 21). Carbon Trust. https://www.carbontrust.com/news-and-events/insights/decentralised-energy-powering-a-sustainable-future

Defining Living Labs | MIT Sustainability. (n.d.). Retrieved 9 January 2021, from https://sustainability.mit.edu/defining-living-labs

DUHL, L. J. (1986). The healthy city: Its function and its future. Health Promotion International, 1(1), 55–60. https://doi.org/10.1093/heapro/1.1.55

Goal 16 | Department of Economic and Social Affairs. (n.d.). Retrieved 9 January 2021, from https://sdgs.un.org/goals/goal16

Energy | Definition, Types, & Examples | Britannica. (n.d.). Retrieved 9 January 2021, from https://www.britannica.com/science/energy

Energy Abundance Now. (n.d.). Energy Abundance Now.

Generations-of-biofuels-v1.3.pdf. (n.d.). Retrieved 9 January 2021, from
Energy Report Transition to sustainable energy. (2016). Rotterdam: Ministry of Economic Affairs and Climate Policy.
https://agsci.oregonstate.edu/sites/agsci.oregonstate.edu/files/bioenergy/generations-of-biofuels-v1.3.pdf

Golubiewski N. (2012). Is there a metabolism of an urban ecosystem? An ecological critique. Ambio, 41(7), 751–764. https://doi.org/10.1007/s13280-011-0232-7

González, A., Sandoval, H., Acosta, P., & Henao, F. (2016). On the Acceptance and Sustainability of Renewable Energy Projects—A Systems Thinking Perspective. Sustainability, 8, 1171. https://doi.org/10.3390/su8111171

IEA (2020), The Netherlands 2020, IEA, Paris https://www.iea.org/reports/the-netherlands-2020

J., Galle, N., & Dufourmont, J. (2018.). Circular rotterdam.

Kabisch N. (2019) The Influence of Socio-economic and Socio-demographic Factors in the Association Between Urban Green Space and Health. In: Marselle M., Stadler J., Korn H., Irvine K., Bonn A. (eds) Biodiversity and Health in the Face of Climate Change. Springer, Cham. https://doi-org.tudelft.idm.oclc.org/10.1007/978-3-030-02318-8_5

Klijn, O., Borsboom, J., & Looije, M. (2014). Urban Metabolism: Sustainable Development of Rotterdam (1147736908 863315718 N. Tilly, Ed.). Rotterdam: Municipality of Rotterdam.

Klimaat, M. van E. Z. en. (2016, January 1). Energy Report Transition to sustainable energy—Report—Government.nl [Rapport]. Ministerie van Algemene Zaken. https://www.government.nl/documents/reports/2016/01/01/energy-report-transition-to-sustainable-energy

Krijgsman, A., Koetsier, R., & Vliet, J. (1995). The Structural Design of the Gallery-Roof of the Feyenoord Stadium in Rotterdam. International Journal of Space Structures, 10(1), 65-73.

Martinez-Guerra, E., & Gnaneswar Gude, V. (2016). Energy aspects of microalgal biodiesel production. AIMS Energy, 4(2), 347–362. https://doi.org/10.3934/energy.2016.2.347

Mott, V. (n.d.). The Three Laws of Thermodynamics | Introduction to Chemistry. Lumen. https://courses.lumenlearning.com/introchem/chapter/the-three-laws-of-thermodynamics/

Muzi, N. (2019, June 26). Almost two-thirds of palm oil consumed in the EU is burned as energy - new data. Transport & Environment. https://www.transportenvironment.org/press/almost-two-thirds-palm-oil-consumed-eu-burned-energy-new-data

Muzi, N. (2020, July). 100 times more palm oil in EU diesel than in all Oreo cookies in the world. Transport & Environment. https://www.transportenvironment.org/press/100-times-more-palm-oil-eu-diesel-all-oreo-cookies-world

Natural Capital. (n.d.). Het Groene Brein. Retrieved 2021, from https://kenniskaarten.hetgroenebrein.nl/en/knowledge-map-natural-capital/definition-natural-capital/

Nelson, M., Finn, M., Wilson, C., Zabel, B., van Thillo, M., Hawes, P., & Fernandez, R. (1999). Bioregenerative recycling of wastewater in Biosphere 2 using a constructed wetland: 2-year results. Ecological Engineering, 13(1–4), 189–197. https://doi.org/10.1016/s0925-8574(98)00099-8

OMA & LOLA. (2019). Feyenoord City Masterplan 2019. https://www.feyenoord-city.nl/masterplan-feyenoord-city/

Press corner. (2012). European Commission - European Commission. https://ec.europa.eu/commission/presscorner/detail/en/MEMO_12_787

Rotterdam Is Building an Ingenious, Super-Green City Heating System – Next City. (n.d.). Retrieved 9 January 2021, from https://nextcity.org/daily/entry/rotterdam-is-building-an-ingenious-carbon-slashing-heating-system

Sijmons, D. (2014). Landscape and energy: Designing transition. Rotterdam: Nai010.

Solar Fuel. (n.d.). Wikipedia. Retrieved February 9, 2021, from https://en.wikipedia.org/wiki/Solar_fuel

Statistics Netherlands. (2020, June 2). Renewable energy consumption up by 16 percent. https://www.cbs.nl/en-gb/news/2020/22/renewable-energy-consumption-up-by-16-percent

Steen, K., & Van Bueren, E. (2017, June). Urban Living Labs: A Living Lab Way of Working. https://www.researchgate.net/publication/318109901_Urban_Living_Labs_A_Living_Lab_Way_of_Working

TEDxEastSalon - Bjarke Ingels - Hedonistic Sustainability. (2011, May 17). [Video]. YouTube. https://www.youtube.com/watch?v=ogXT_CI7KRU&t=375s

The Synergism Hypothesis: On the Concept of Synergy and It's Role in the Evolution of Complex Systems | Institute for the Study of Complex Systems. (n.d.). Retrieved 9 January 2021, from https://complexsystems.org/publications/the-synergism-hypothesis-on-the-concept-of-synergy-and-its-role-in-the-evolution-of-complex-systems/

Transport & Environment. (2020, January). REDII national implementation. https://www.transportenvironment.org/sites/te/files/publications/2020_01_REDII_general_implementation_briefing.docx_.pdf

Trudel, R. (2016, October 7). The Behavioral Economics of Recycling. Harvard Business Review. https://hbr.org/2016/10/the-behavioral-economics-of-recycling

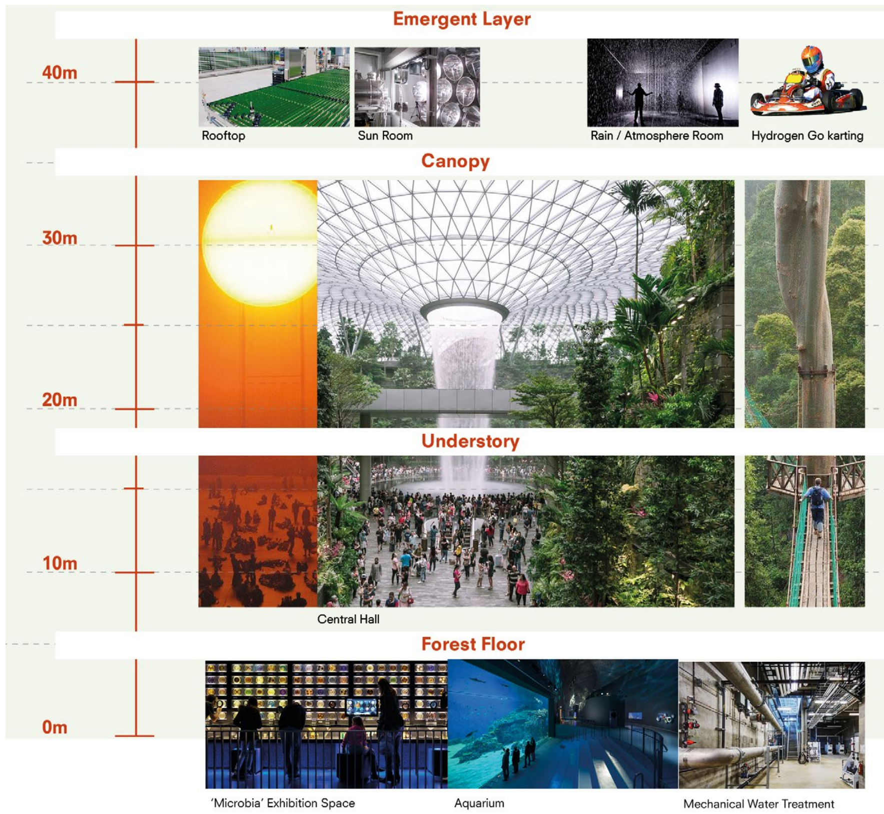
Renewable Energy Used in Transport Increasing. https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20201223-1. Accessed 9 Feb. 2021.

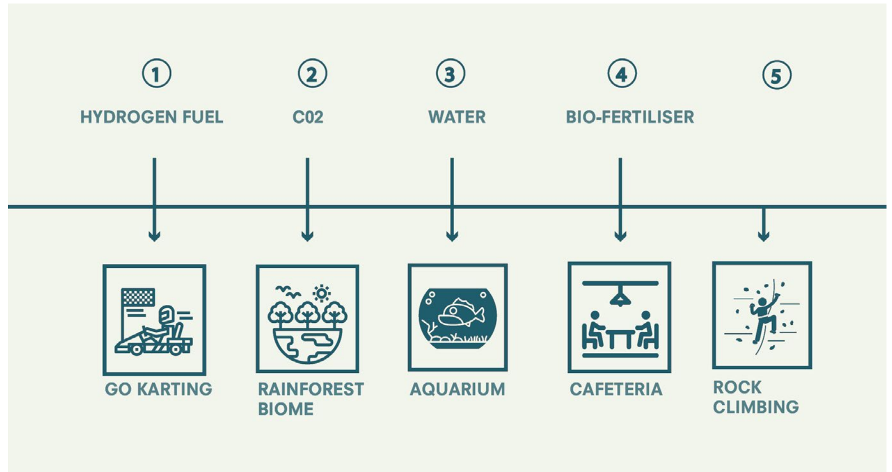
Ruimtelijkeplannen.Nl. https://www.ruimtelijkeplannen.nl/viewer/view. Accessed 9 Jan. 2021.

The Three Laws of Thermodynamics | Introduction to Chemistry. https://courses.lumenlearning.com/introchem/chapter/the-three-laws-of-thermodynamics/. Accessed 9 Feb. 2021.

Use of Renewable Energy for Transport in Europe — European Environment Agency. https://www.eea.europa.eu/data-and-maps/indicators/use-of-cleaner-and-alternative-fuels-2/assessment. Accessed 9 Feb. 2021.

What is natural capital? (n.d.). World Forum on Natural Capital. Retrieved 2021, from https://naturalcapitalforum.com/about/





Design brief

1.1Project Ambition

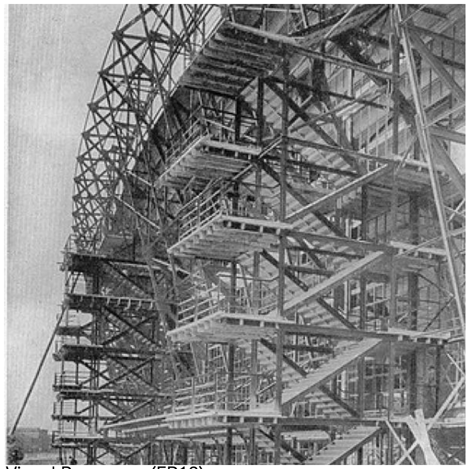
I propose the Kuip as a biofuel research and conservation center, able to turn algae and waste into energy through a visible experienced ecosystem which the public feels a sense of ownership over. The program is ultimately a living lab that merges leisure, education, and research in a space where the public can experience the benefits of natural capital.

1.2 Urban Ambition

The Kuip stadium is situated within the Veranda, along the east embankment of the Nieuwe Maas. Since 2016, OMA in collaboration with the municipality of Rotterdam as well as various other stakeholders, has worked to develop the Feyenoord City Masterplan. This will be a cosmopolitan, mixed use neighbourhood. The plans for this development have already been adopted by the Municipality's zoning Plan, (Ruimtelijkeplannen accessed 2020). Therefore, the Feyenoord City Masterplan has largely been accepted as the basis for the Kuip's local context within De Veranda and within the group masterplan. The residential ambition OMA proposes for the Kuip will not be adopted but replaced by the *Migration of Energy* strategy.

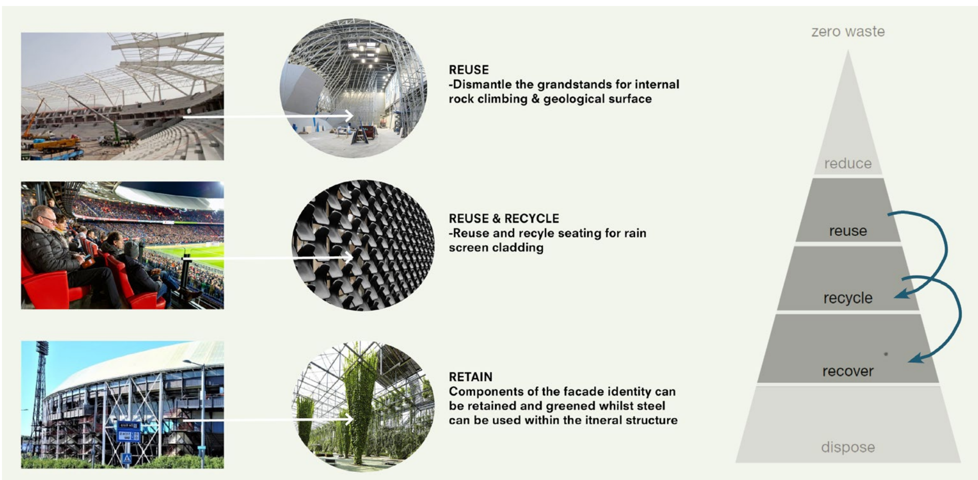
1.3 program / social ambition

The existing height of the building is 34m with a maximum height of 60m. This correlates with the stratification of the rainforest. Therefore, in considering the building as an ecosystem, I would like to consider different levels that reference ; the natural forest floor, understory, canopy, and emergent layer. It is important to Feyenoord City fans in particular to retain the atmosphere of the Kuip in terms of scale as well as facilitate the maximum height of trees. Therefore, the rainforest biome will be the central gathering space where all programs integrate.



Visual Presence. (FR12)

Iconic Structure (FR12)



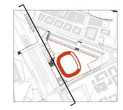
1.4 Construction Ambition

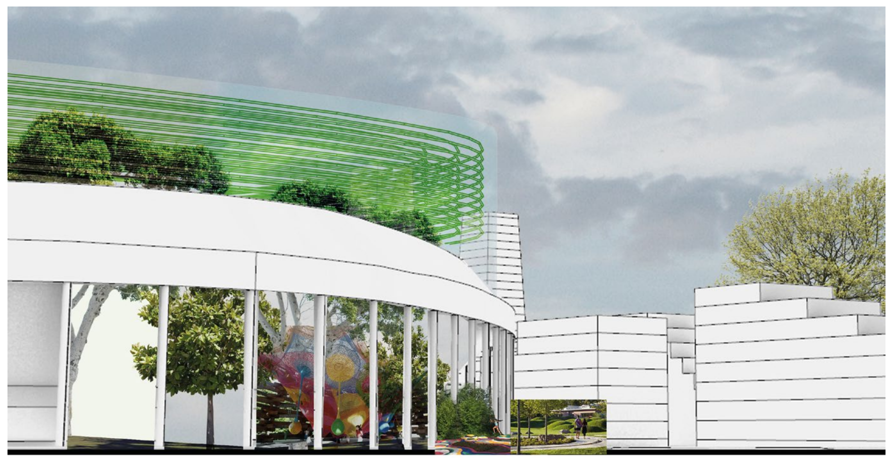
50 % of Raw Materials are consumed by construction and operation of the built environment in the Netherlands (Schuttelaar & Partners 2018) and 30 %of EU waste comes from construction (Arup, 2017). In line with this, I take an ecological design strategy. First reusing, then recovering then recycling. (Arup 2017). The ambition is to undertake a controlled dismantling of the structure. Particularly the grandstands which can be used to rebuild the internal rock-climbing wall and geological surface of the biomes. Seating can be reused and recycled for rain screen cladding. Components of the facade identity can be retained and greened whilst steel can be used within the internal structure. Where possible, building components will be sourced from recycled materials and dismantled materials recycled. In keeping with the industrial style of the stadium, buildings such as the Pompidou Centre, Paris is referenced for their articulated mechanical systems.

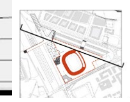
1.4 Site Location

As previously mentioned, The Kuip is a municipal monument of 'cultural-historical values'. (ruimtelijkeplannen.nl accessed 2020). According to visitor reviews, the main feature is its internal experience as well as the uniquely characterful, structure and façade. As a fairly low building within its context, more can be done to amplify the stadium. Particularly by creating a more articulated primary entrance. As visitors say this is currently 'confusing' to locate. (Google Maps Reviews, access 2020) It is important to have clear site lines and a visual presence from the station and proposed Center for the Arts. This can be achieved through raising the building height. A raised entrance also creates a physical buffer from train and road traffic whilst an external walkway makes the building part of the urban fabric. Oma's proposed residential blocks are in close physical proximity to the Kuip, therefore a transition zone into the building can soften the surrounding hard edges.

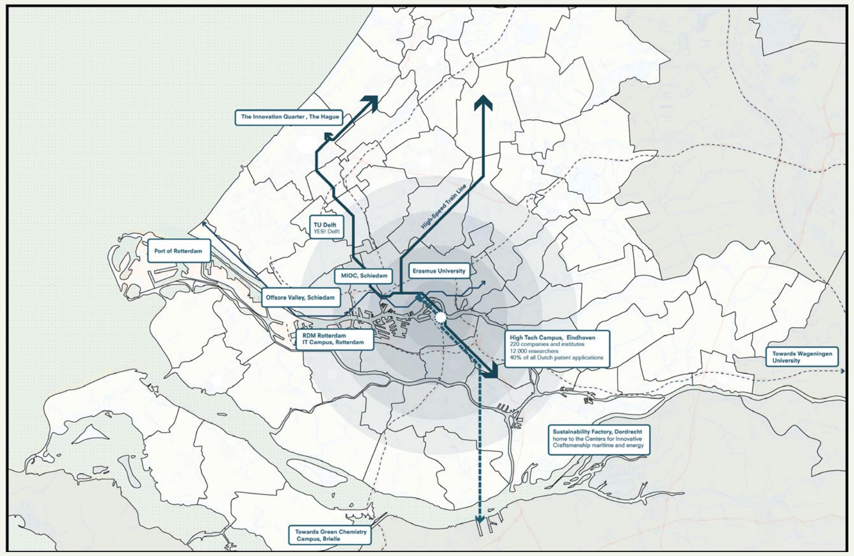
This newly articulated main entrance will be on the west of the site, thus accessible upon arrival from Feyenoord train station which we propose as a sprinter stop. This will also orientate the stadium towards the convergence zone and new football stadium along the strip. A secondary access along the site line of Puck van Heelstraat will make the site easily accessible to people coming by boat or bike along the east embankment. This can be accentuated by tuning the road into a wide, social boulevard. Particularly parallel to the train line and along Coen Moulijnweg, the building should have a striking visual presence. Whilst the North and East facades facing the residences of Kuip Park can be more understated.



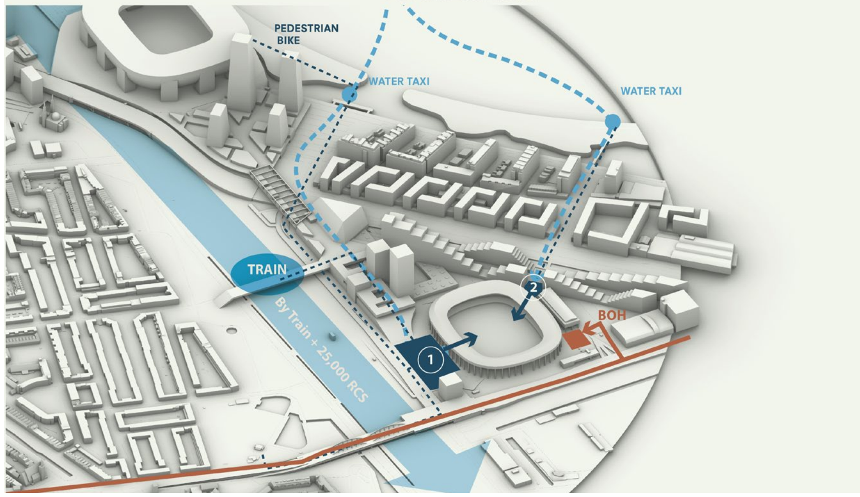




MRDH CAMPUS NETWORK



FUTURE MOBILITY



CULTURE & LEISURE LANDMARKS

1.5 Connection to research facitlities

The Urban ambition is to Connect the Kuip as a research centre to other such research institutions in the city. Physical accessibility by metro and bridge makes a connection to Erasmus University possible. This will enable the Integration of the Kuip into the Leiden Delft Erasmus Centre for Sustainability possible.

1.6 Client

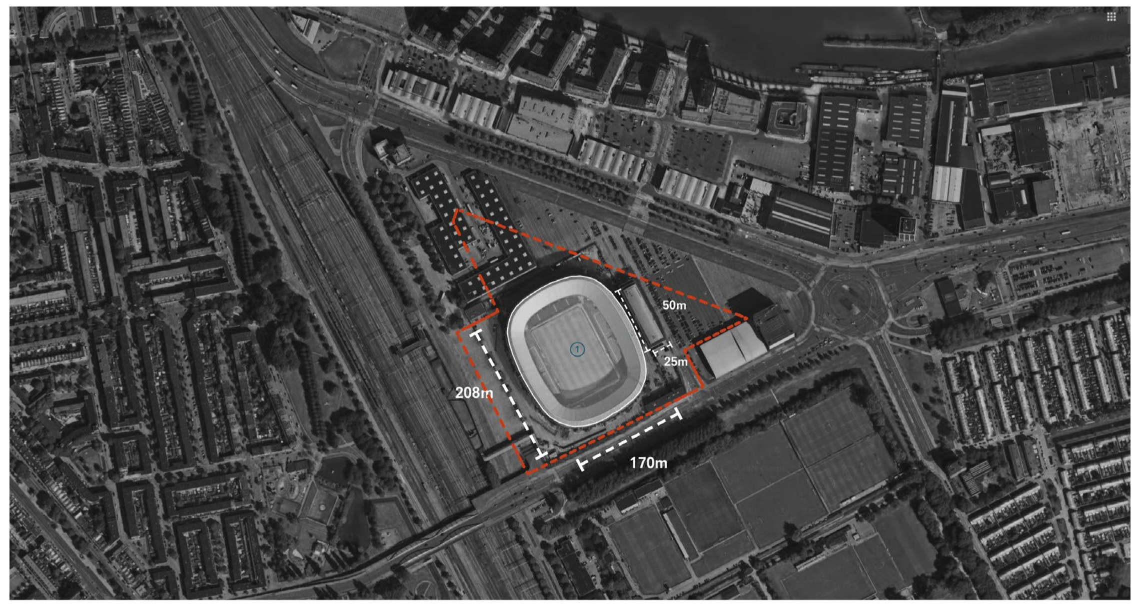
The funding for this research will primarily come from European co-financing schemes such as the EU Investment Fund, as well as private energy sector companies. The Dutch government however will invest based on the Advisory Council for Science, Technology, and Innovation. (EZK 2016, 47) Dialogues between local stakeholder such as sewage treatment facilities will also be important. (EZK 2016, 78). The Kuip is also near water pumping stations and outfall points along the Nieuwe Maas. Form these points, the living lab is able to capture nitrogen and phosphorus rich water for algae cultivation.

1.7 Current Situation

The Kuip has a 31,000sqm footprint within a 79,000sqm site area. The Kuip is on the west corner of an existing business park. It is near tram and train stations however, its surroundings are enclosed by large roads designed for car traffic and a trainline disconnecting Hillesluis from De Veranda.

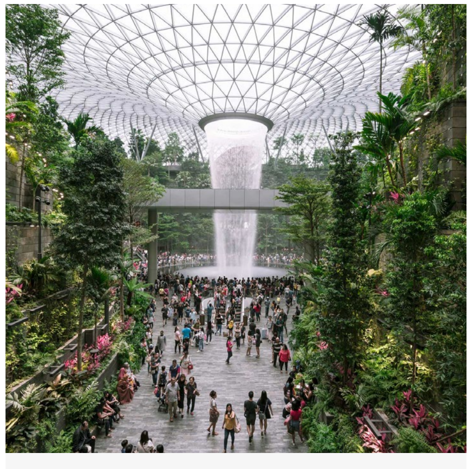
1.8 Public Accessibility

The OMA proposal adds new residential and commercial neighbourhood to the site, therefore more pedestrian friendly mobility networks as well as public transport connections are necessary. A new Feyenoord Stadium train station and water taxi stop will mean that West and East entrances become natural primary and secondary front-of-house entrances for the public. Whilst the south entrance becomes a back-of-house service entrance. On a local level, two pedestrian friendly bridges can connect old and new residential neighbourhoods. activating the monotonous fabric.



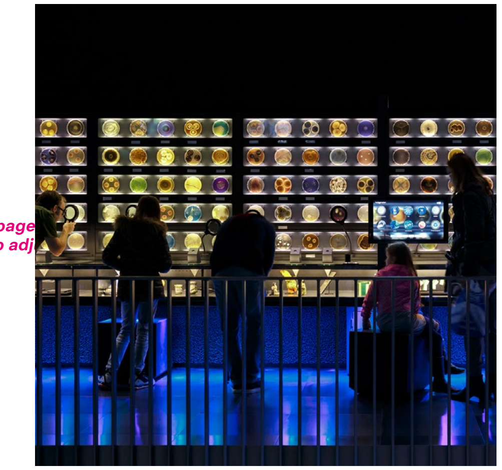
1. Plot Area: 79,000 sqm
2. Stadium Footprint : 31,000 sqm
3. Roof 15,000 sqm
4. Pitch 7140 sqm

Main Exhibition Hall - The Pomidou Center

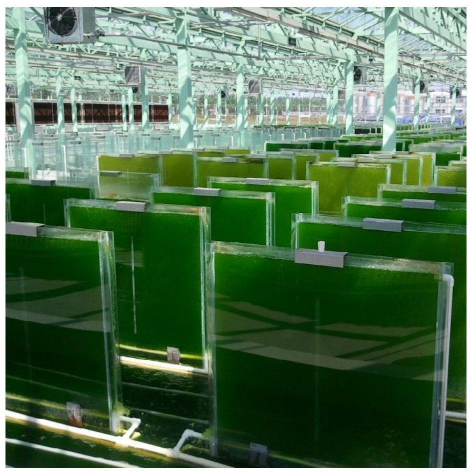


Central Hall - Singapore Changi Airport

Exhibition Space - The Biosphere Environment museum

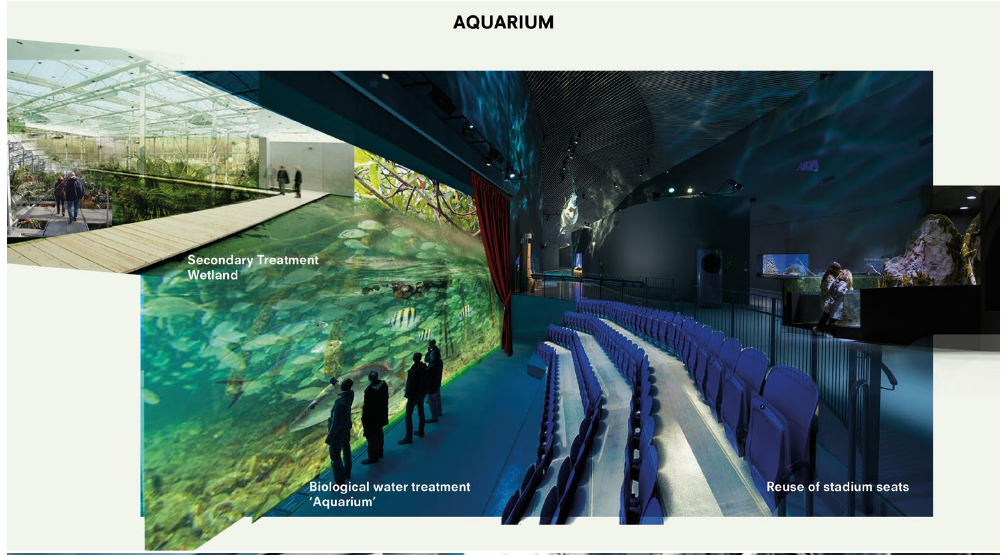


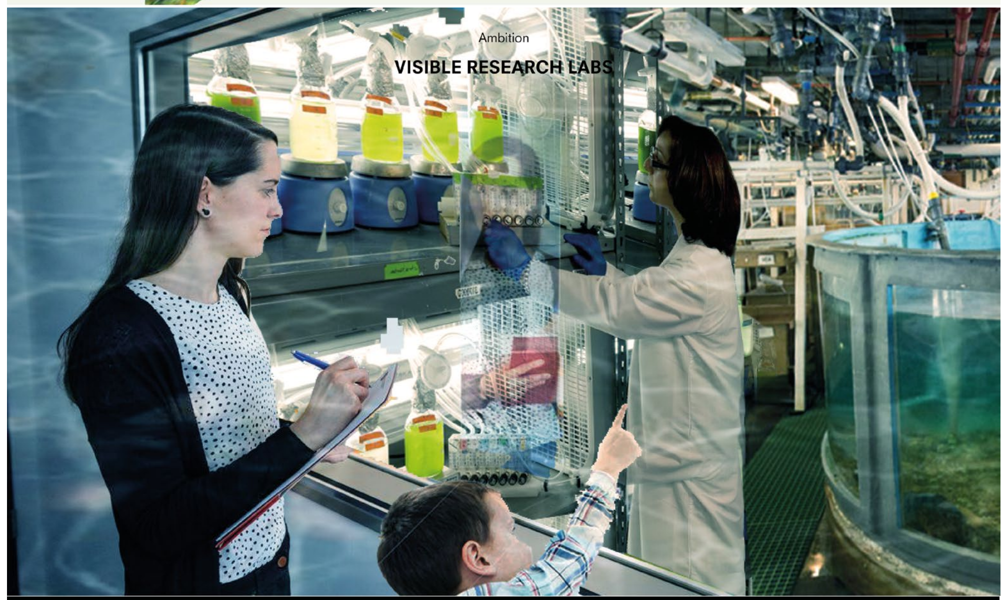
Exhibition Space - Microbia Museum

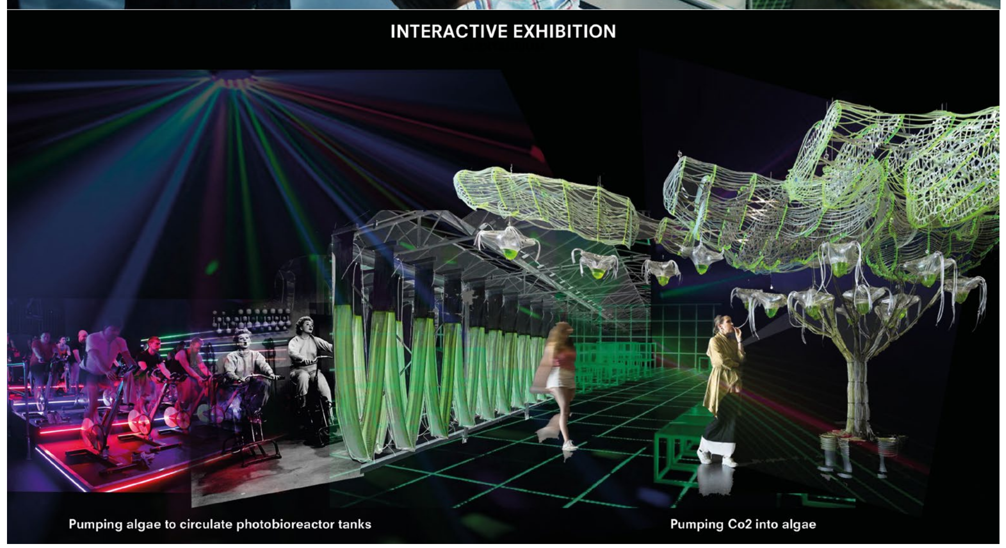


Rooftop - Algae PBR

Exhibition Space - EcoLogicStudio exhibition

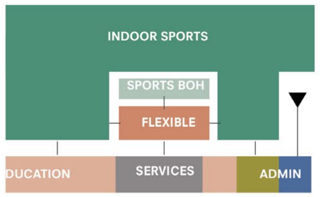


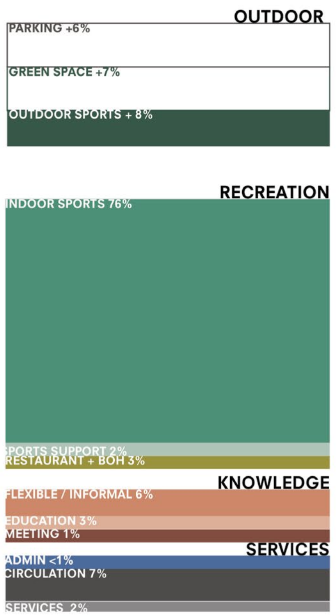




NGO COMMUNITY CENTER

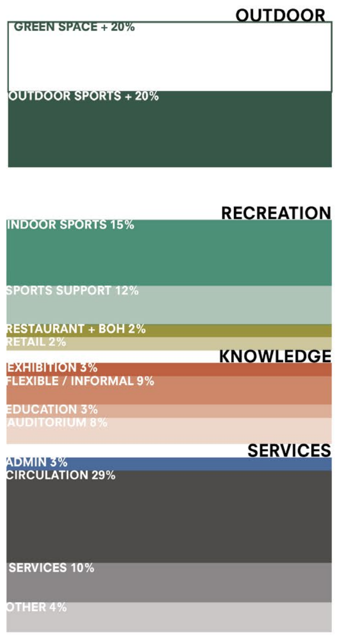
Name : GAME Streetmekka Viborg
Location : Birigui, Brazil
Architect : EFFEKT
Year : 2018
Programs: parkour, dance, DJ, basketball, bouldering, skate, fabrication workshops
Site Area:
Building Footprint: 3170sqm
FSI:





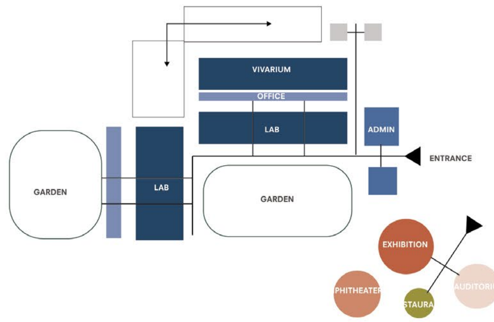
SESC COMMUNITY CENTER

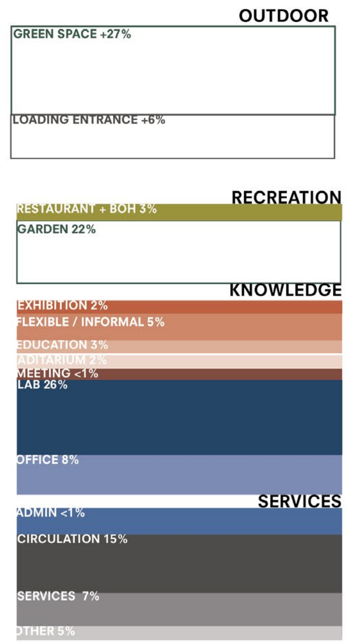
Name: Sesc Birigui
Location : Birigui, Brazil
Architect : Teuba Arquitetura e Urbanismo
Year : 2017
Programs: Community Center, Sports, library, receation, gym, auditunium
Site Area:
Building Footprint: 7418 sqm
FSI:



RESEARCH CENTER

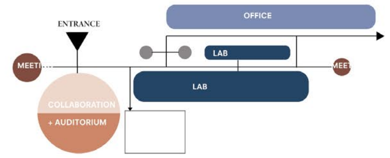
Name: Centre for the Unknown
Location : Lisboa, Portugal
Architect : Charles Correa Associ-ates
Year : 2010
Programs
Site Area
Building Footprint: 59,600 sqm
FSI:

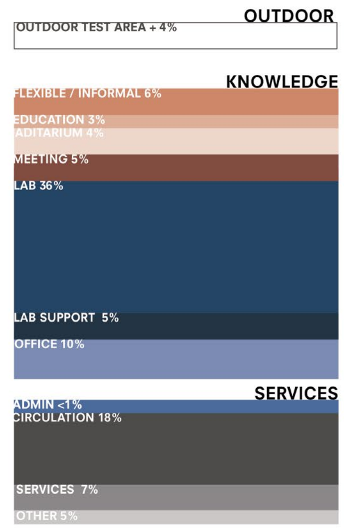


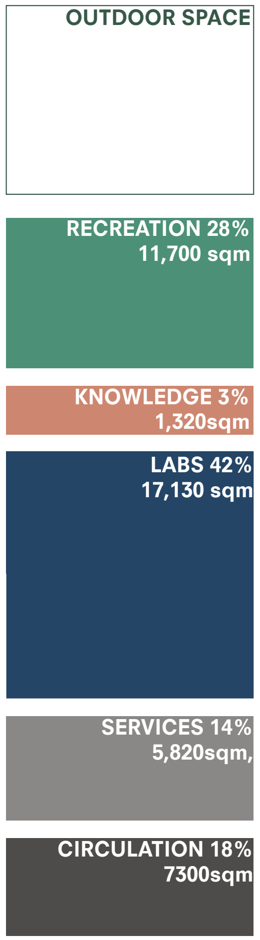


UNIVERSITY RESEARCH FACILITY

Name: PACCAR Environmental Technology Building (PETB)Location : Pullman, USA
Architect :LMN Architects
Year : 2017
Programs : University Researcg facility
Site Area
Building Footprint: 8920 sqm
FSI:







TOTAL : 40,560sqm

OUTDOOR SPACE

FOH

Hydrogen Go Karting Track	2415 m2
Courtyard, Main Entrance	5400 m2
Kuip Gardens / Playground	9,000 m2
Go Karting Support	200 m2

BOH 5000 sqm

Service Parking + loading bay
Disabled & Employee parking

RECREATION 11,700 sqm

FOH

Main Foyer	950 m2
Activity Box Office	130 m2
Admin / Information center	213 m2
Microbial Energy Exhibition Space	955 m2
Biomes	
- Rock Climbing Zone	250 m2
- Canopy Walkway	-
- Marsh Concept	560 m2
-Atmosphere concept room	280 m2
Ocean concept (salt water tank)	900 m2
River concept (Fresh water tank)	340 m2
Gift Shop	600 m2
Canteen	900 m2
Occasion Dining	500 m2
Cloakroom	110 m2
Kids Play / crèche	510 m2
Bar	200 m2

BOH

Public WC & Changing	715 m2
Kitchen	225 m2

KNOWLEDGE 11%

Classroom / Conference Rooms	240 m2
Research Reading Room	350 m2
Auditorium	600 m2
Backstage support + lighting	130 m2
wc	30 m2

LABS 31%

FOH 16,190 sqm

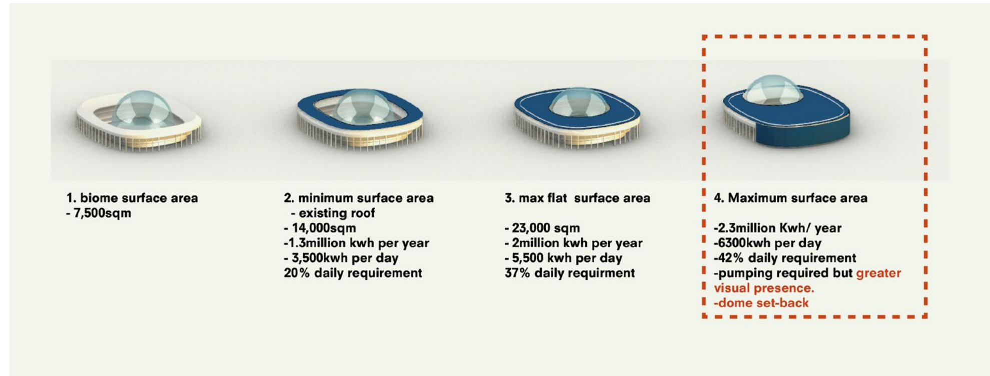
Algae Cultivation	14,000 m2
Waste water treatment	6000 m2
Algae water storage tank	100 m2
Meeting Rooms	240 m2
Office	230 m2
Admin	120 m2

BOH 904 sqm

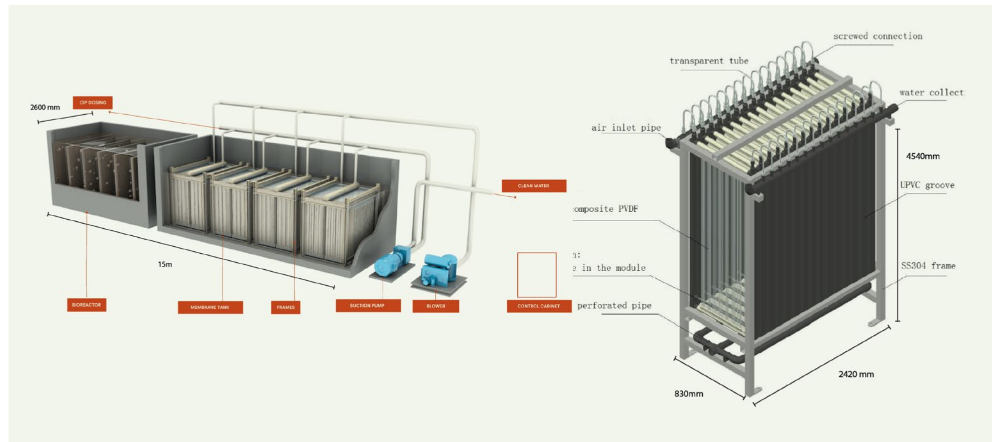
Soil Analysis Lab	216 m2
Microbiology Lab (Algae Cultivation Research)	216 m2
Water Analysis Lab	216 m2
Staff Room	200m2
Staff WC / Shower	60 m2

SERVICES 27%

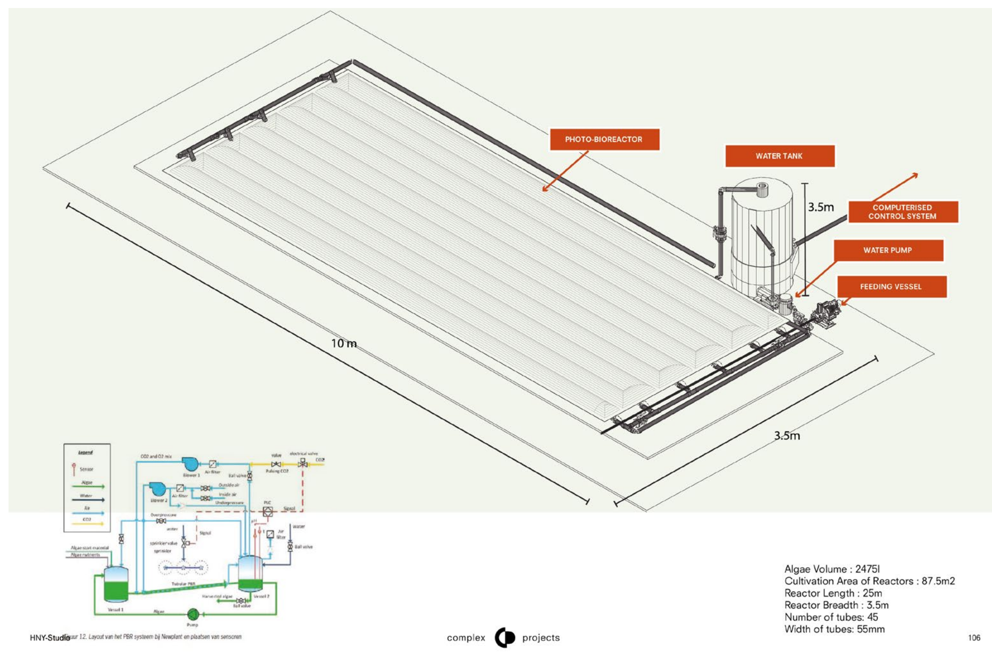
Water Mechanical Room	1200 m2
Algae Mechanical Room	2800 m2
ATES mechanical room	510 m2
Technical Room	550 m2
Data Center	450 m2
Co2 Storage	200 m2
Storage/ Service	200 m2



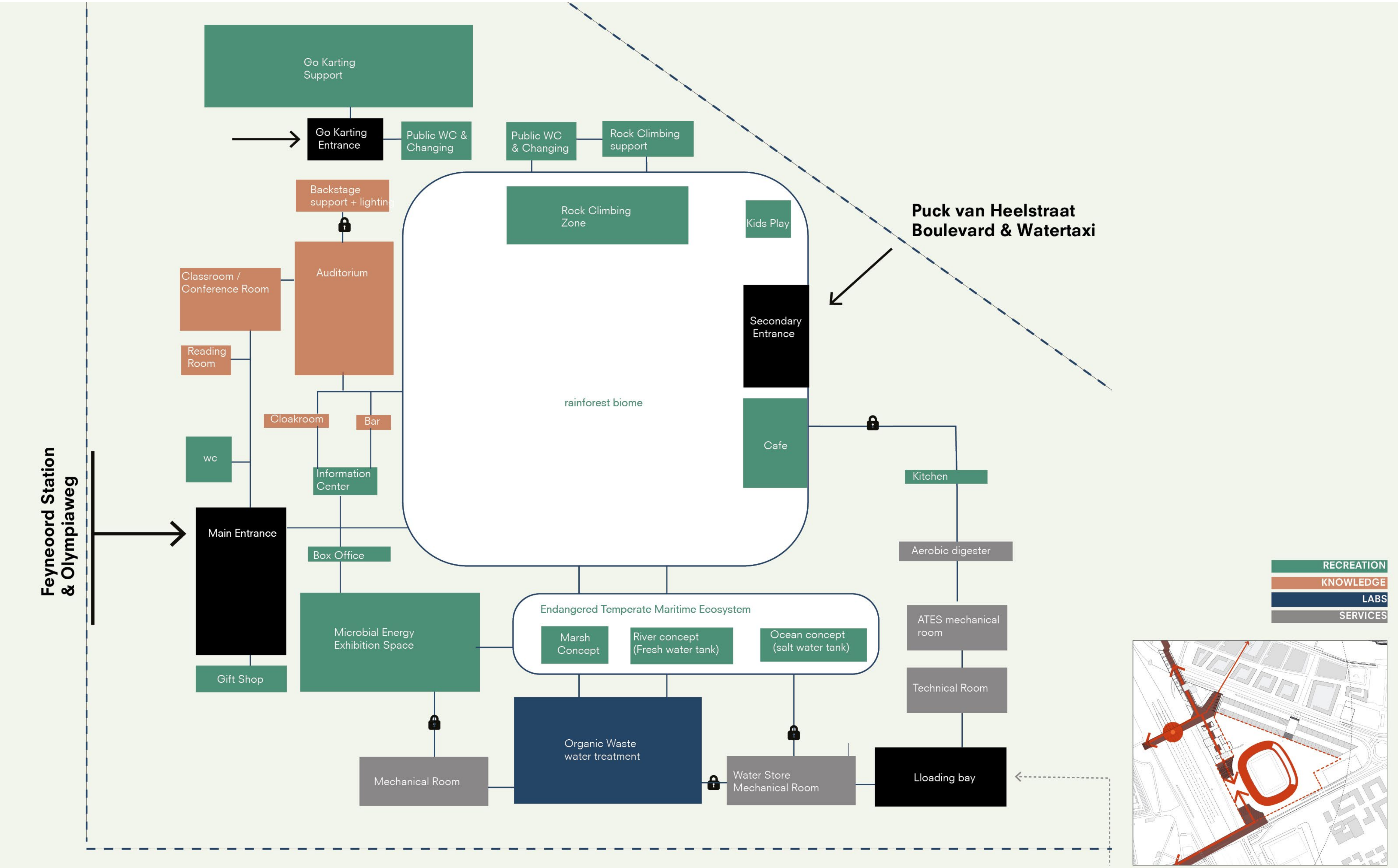
Algae Cultivation Surface Area.

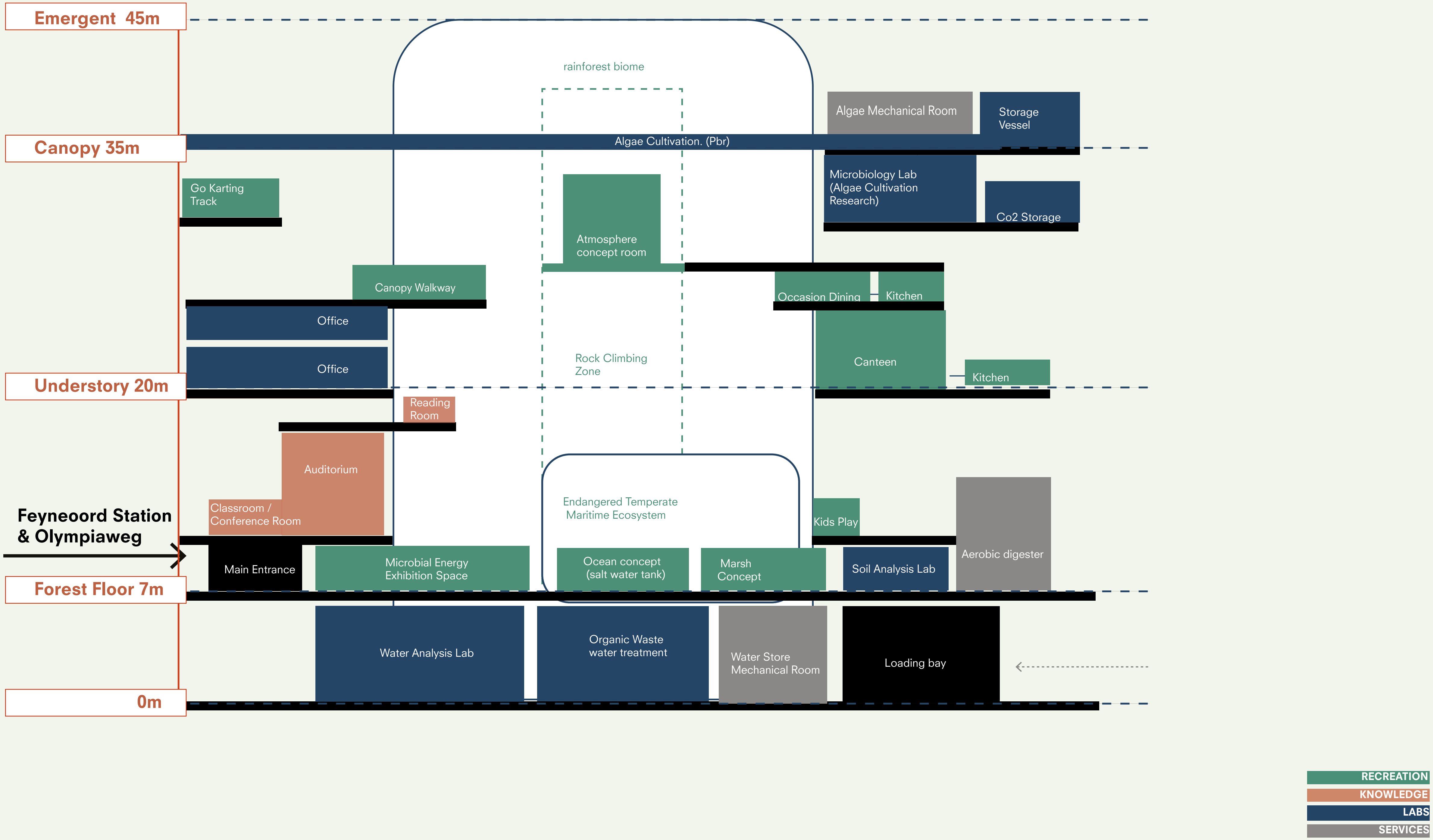


Membrane Biological Reactors for Water Treatment.



Algae Cultivation.


Go Karting Support
Go Karting Entrance
Public WC & Changing
Public WC & Changing
Rock Climbing support
Backstage support + lighting
Rock Climbing Zone
Kids Play
Puck van Heelstraat Boulevard & Watertaxi
Classroom / Conference Room
Auditorium
Reading Room
Secondary Entrance
rainforest biome
Cloakroom
Bar
wc
Information Center
Cafe
Kitchen
Feyneoord Station & Olympiaweg
Main Entrance
Box Office
Aerobic digester
Endangered Temperate Maritime Ecosystem
Microbial Energy Exhibition Space
Marsh Concept
River concept (Fresh water tank)
Ocean concept (salt water tank)
ATES mechanical room
Gift Shop
Technical Room
Organic Waste water treatment
Mechanical Room
Water Store Mechanical Room
Lloading bay
RECREATION
KNOWLEDGE
LABS
SERVICES



Emergent 45m
Canopy 35m
Understory 20m
Forest Floor 7m
0m
Feyneoord Station & Olympiaweg
rainforest biome
Algae Mechanical Room
Storage Vessel
Algae Cultivation. (Pbr)
Go Karting Track
Microbiology Lab (Algae Cultivation Research)
Co2 Storage
Atmosphere concept room
Canopy Walkway
Occasion Dining
Kitchen
Office
Office
Canteen
Kitchen
Rock Climbing Zone
Reading Room
Auditorium
Classroom / Conference Room
Endangered Temperate Maritime Ecosystem
Kids Play
Aerobic digester
Main Entrance
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