CAMP GREENSTEEL

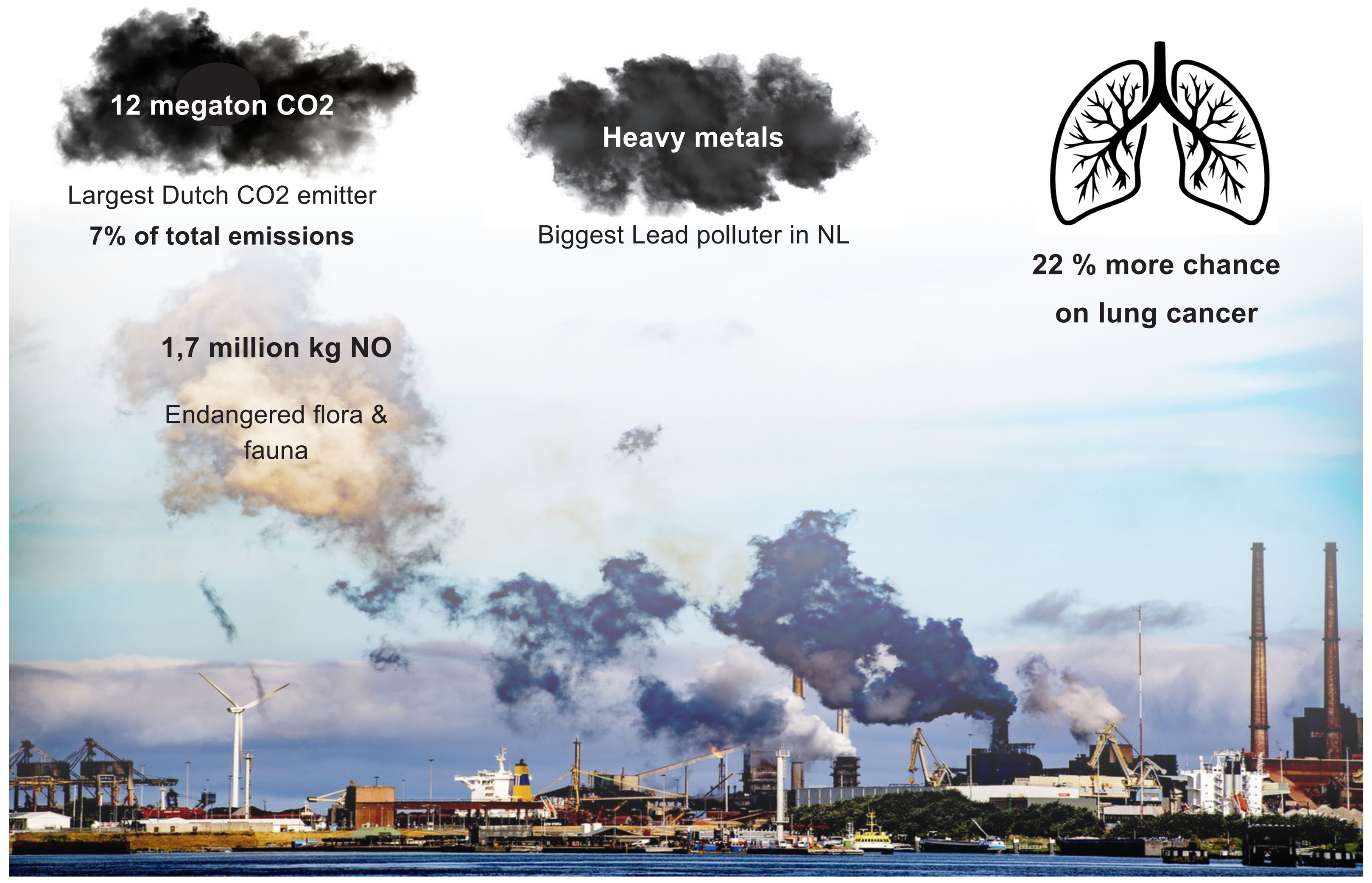
STEP 1: STOP TATA STEEL POLLUTION

Introduction

The strongly upcoming debate on pollution in the Netherlands caught my attention over the last years. Especially the pollution of nitrogen and carbon dioxide in the industrial sector. The debate surrounding the stricter regulations for farmers was in the news, but the air pollution of one steel producing factory in particular also received a lot of publicity.

Tata steel Ijmuiden is the largest industrial CO2 and lead emitter in the Netherlands. The companies heavy nitrogen emissions have major consequences for the biodiversity in the adjacent dune area. Because of the impact on the environment, dust & odour nuisance and the lack of clarity about the health consequences of that nuisance for humans, Tata Steel has become one of the most controversial companies in the Netherlands. The 'clean or stop' ruling of the Dutch House of Representatives from last September is a reality check for Tata Steel. The company only has a future in the Netherlands if action is taken now to stop the pollution.

Aerial view of Tata Steel terrain

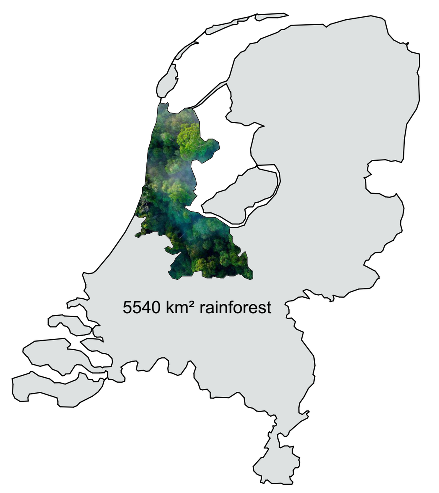


Tata Steel's Dutch production facilities produce 12 million tons of CO2 per year, and are therefore responsible for approximately 7 percent of the total CO2 emissions in the Netherlands. (RTL news, 2016) 1,7 million kilo's of nitrogen emissions also make them one of the biggest polluters in that field. (Bokkum, 2021) .

Tata Steel is the largest lead polluter in the Netherlands. The factory emits more lead into the air than all Dutch traffic combined, and was responsible for more than half of the total lead pollution of the entire country in 2016. This was mainly due to the graphite rains that descended on the surroundings at that time. (Noordhollands dagblad, 2019)

In 2020, unrest broke out after the GGD concluded that 22% more lung cancer occurs in the IJmond than elsewhere in the country. (Havermans, 2021) Environmental institute RIVM concluded in April 2021 that there is more particulate matter in the air in the Tata steel area and that there are more health complaints.

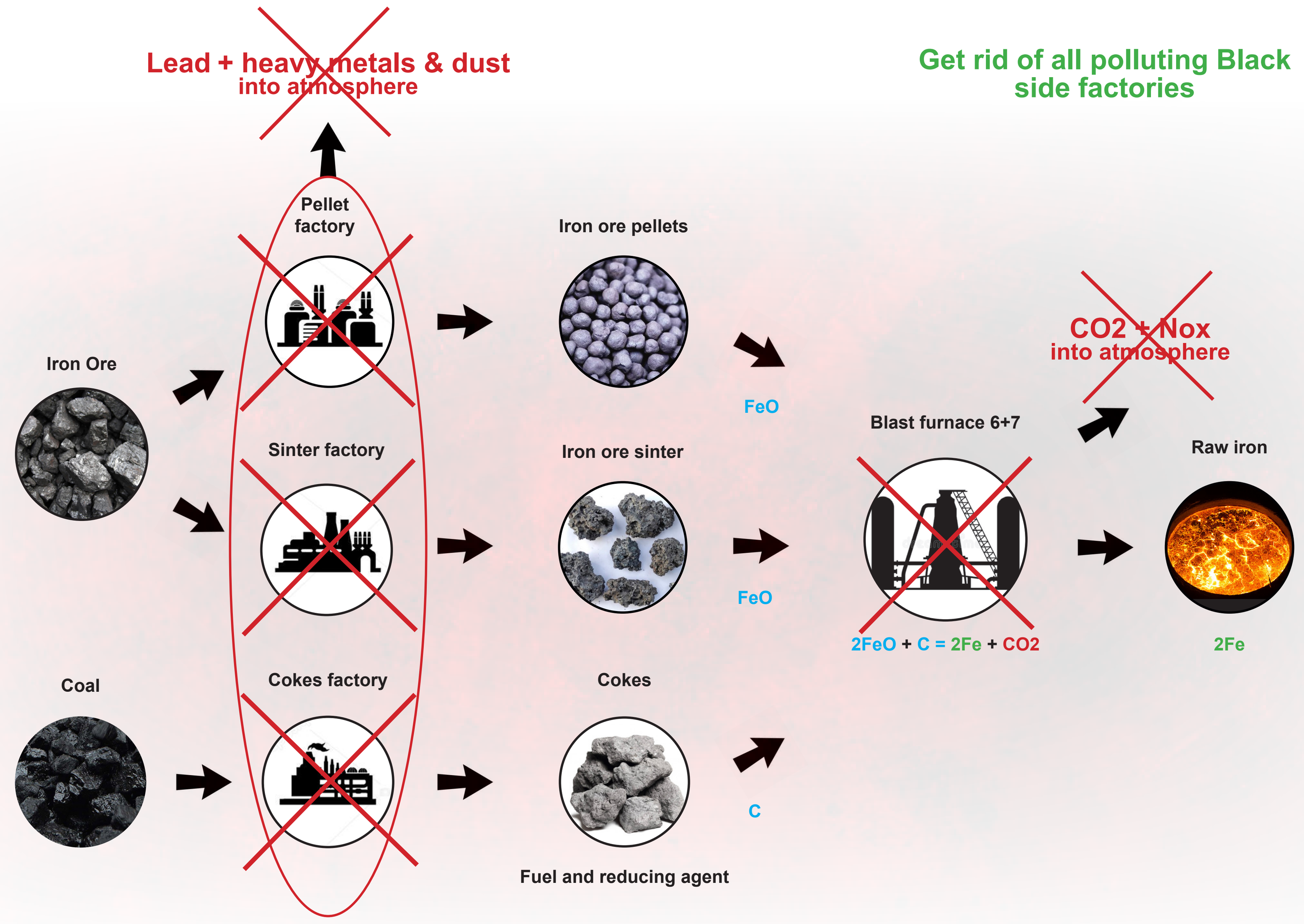
The CO2 emissions of the Netherlands is 166 megaton/ year.



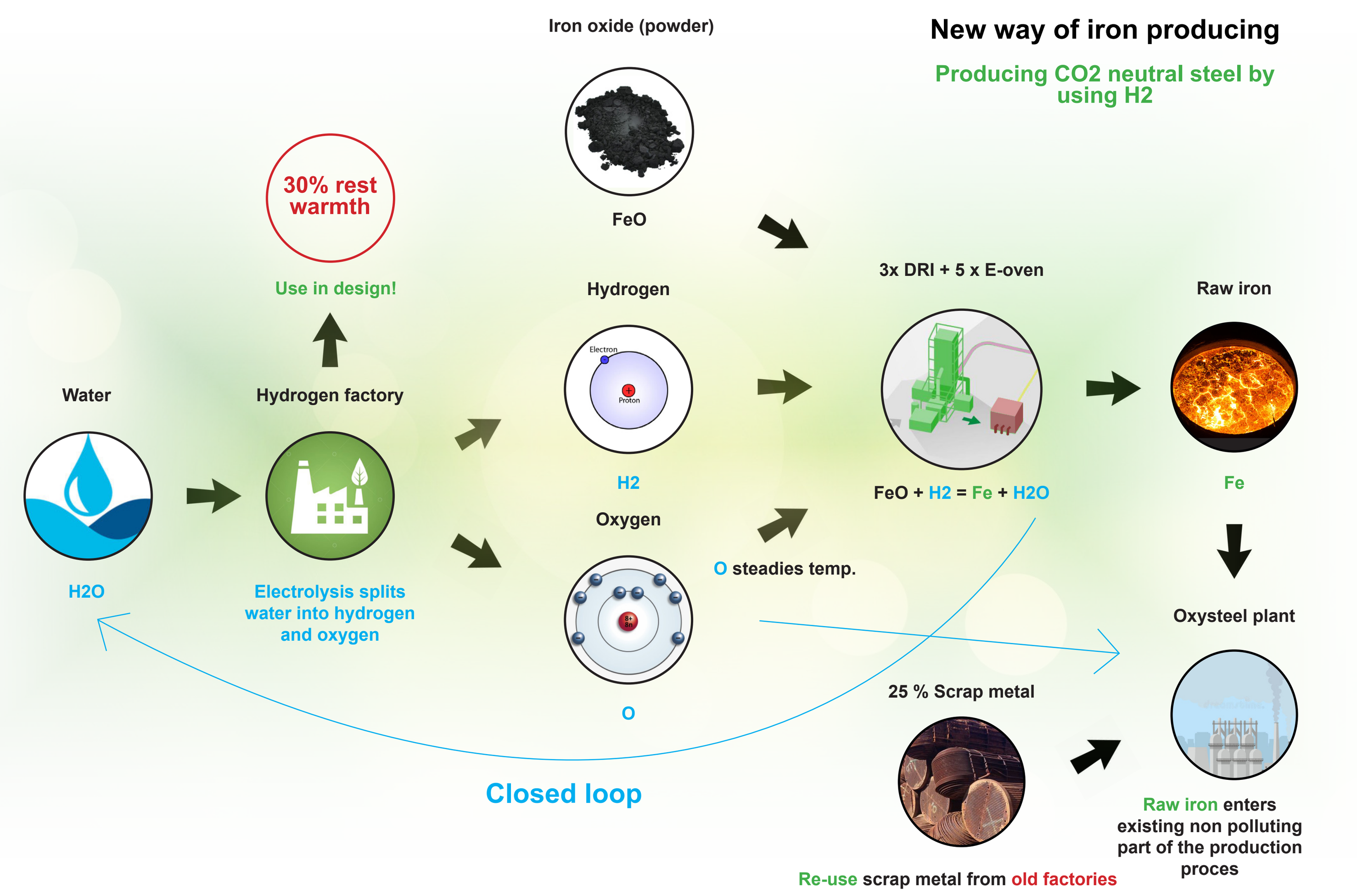
You need to plant a rainforest the size of the provinces Utrecht and Noord Holland to capture this much CO2 every year.

If we try to compensate the CO2 pollution of the Netherlands at the current pollution rate, the whole of the Netherlands will be a rainforest in 7,5 years.

Old way of iron producing



New way of iron producing



The Netherlands has set clear climate targets, in line with the signing of the Paris Accord, aiming to reduce CO2 emissions by 49% (compared to 1990) by 2030. Since tata's CO2 emissions account for 7% of national emissions, the company will have to start producing CO2 neutral steel.

Tata Steel has 300 million Euro at the ready to start investing in new factories that enable the production of CO2 neutral steel trough green hydrogen usage called DRI (Direct Reduced Iron). Green energy from offshore wind farms will enable the production of green hydrogen trough the electrolysis of water in the new hydrogen factory. The hydrogen will serve both as fuel and as a reduction agent instead of coal, making all the polluting 'black side' factories obsolete (see plan below and old production proces above).

The old way of iron producing uses pre-worked forms of coal and iron ore (made in the pellet-, sinter an cokes factories) to react with eachother in the blastfurnaces to create raw iron. The by-products of this reaction are carbon dioxide and nitrogen.

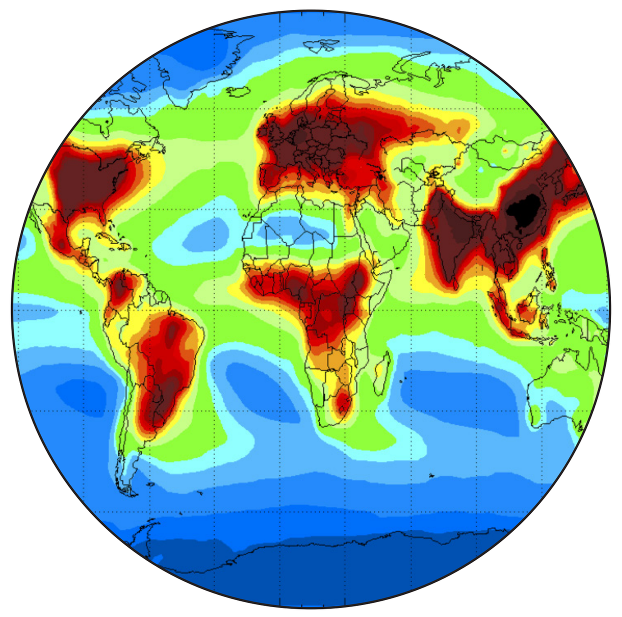
The new way of iron producing uses hydrogen and oxygen (products of the electrolysis of water) to react together with iron ore in the 3 new DRI-plants and 5 electric ovens to form raw iron. The by-product of this reaction is water, which can be used again to repeat the proces.

By using this new CO2 neutral way of steel producing, the old polluting factories can be demolsihed leaving opened up space on the industrial terrain for the development of the new factories of which I'm designing the hydrogen factory!

Course of action

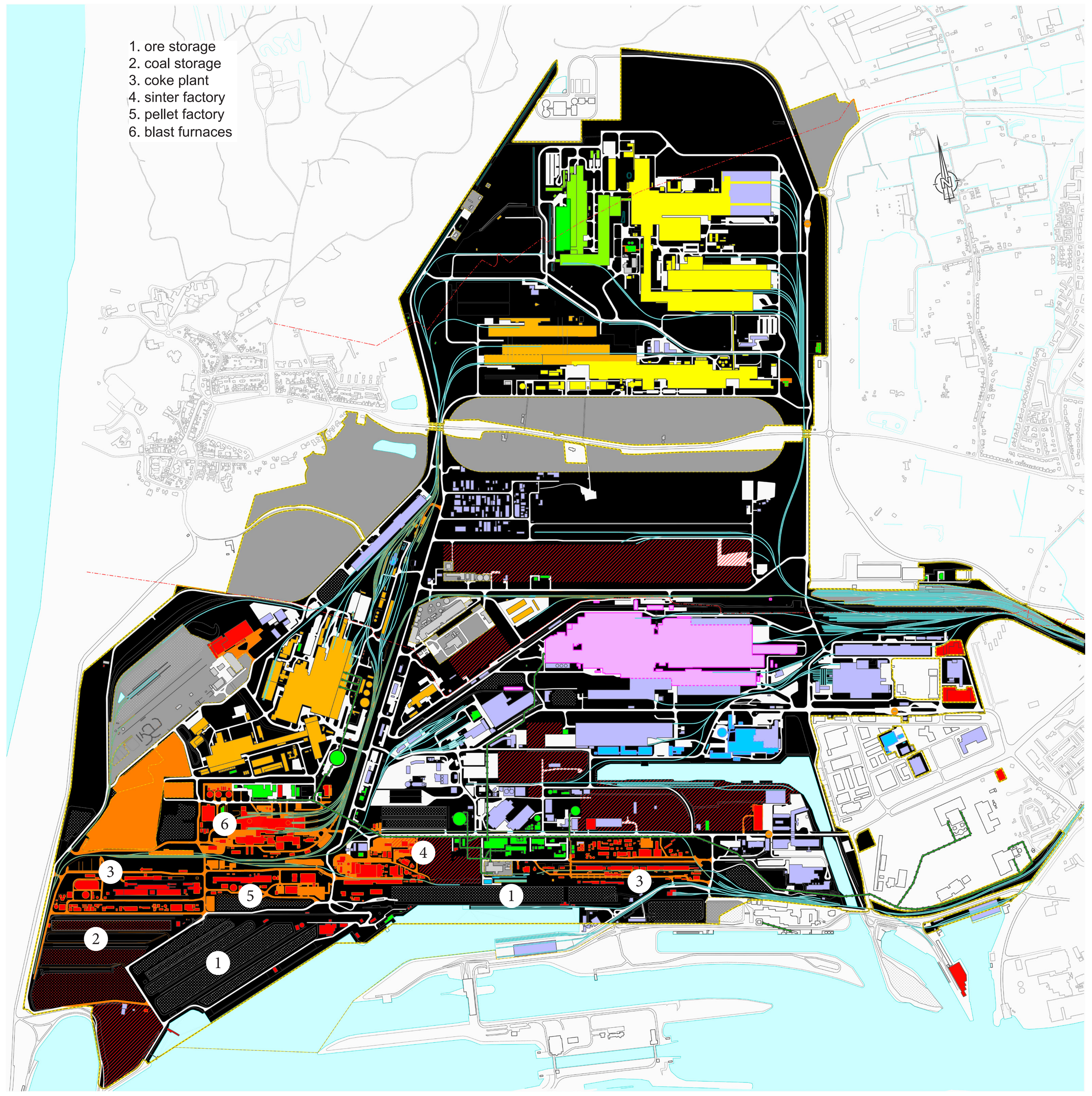
Tata Steel pollution = point source

Global nitrogen deposition & accidic rain = diffuse source



Tata steels pollution is part of a bigger problem: the global nitrogen deposition.
The nature around Tata Steel is extra polluted.

Course of action:
1) Stop Tata Steel pollution
2) Clean up Tata Steel pollution
3) Long term routine maintenance



Demolishable 'black side' factories and removeable asphalt

- Installations that can be demolished
- Roads & parking lots that become otiose
- Terrain under development
- Obsolete coal storage
- Property land (not in use by Tata Steel)
- Property land in use by Tata Steel

- Steel production
- Hot and cold strip rolling mill
- Coated products
- Services
- Steel packaging
- Research, Development & Technology
- Paint line
- Third parties
- Storage of raw materials

- Property boundary Tata Steel in IJmuiden
- Limit of use of Tata Steel in IJmuiden
- Municipal boundary

- Railway track
- Access to Tata Steel terrain

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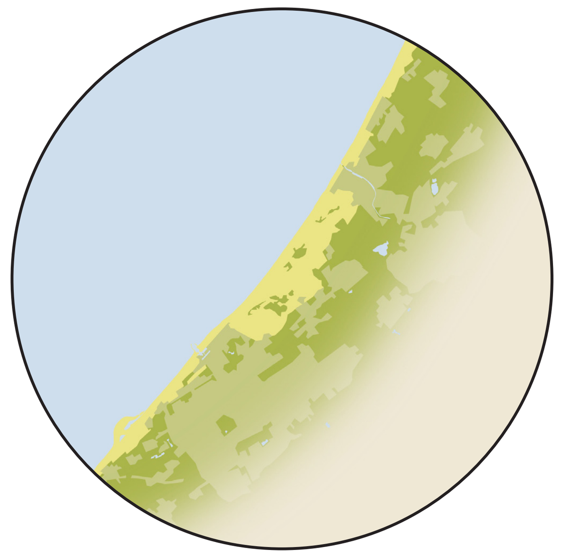
STEP 2: CLEAN UP TATA STEEL POLLUTION

Ecology (importance of the dune landscape)

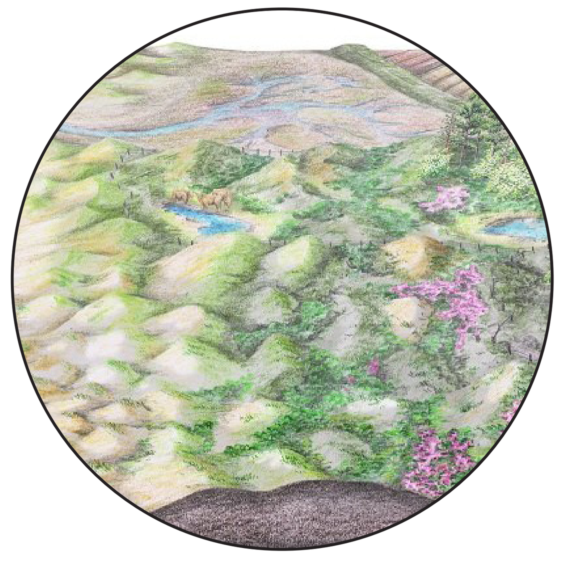
300 km long dune landscape
40.000 hectares



Patchwork of biotopes

up to 100 species/ m2

Richest ecological organ in NL



65-75% of all Dutch flora grow here

9% is specific to the dune landscape

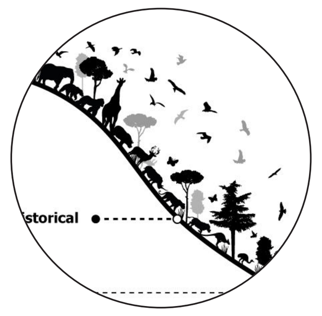
Original habitat of wild bees

>100 different species

flowers don't produce enough nectar due to pollution

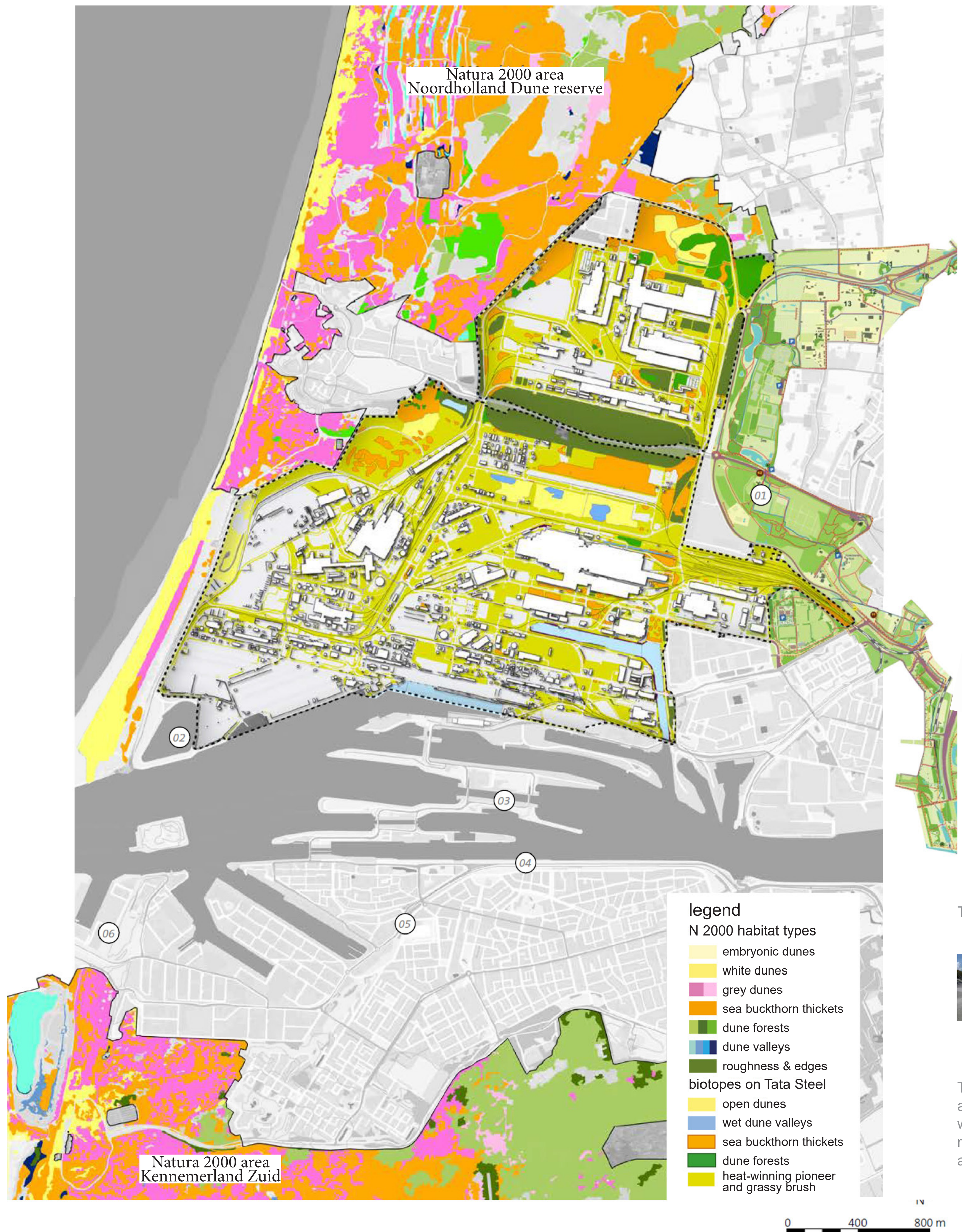
Nitrogen deposition
& accidification

Grass, scrubs, trees and sea buckthorn take over



Biodiversity decline

The 300 km long dune landscape of the Netherlands is our nations richest ecological organ. With almost 10% of national flora species specific to it, it also houses 65-75% of all Dutch flora species. This makes the dune landscape valuable and in many cases protected natura 2000 nature reserves (see picture below). Due to global nitrification and accidification we see nation wide biodiversity decline in our dune landscapes. Tata Steel is a heavy point source polluter of nitrogen, resulting in an even bigger local biodiversity decline of dune spcific flora and fauna species. Grass, scrubs, trees and sea buchthorn takes over from dune specific flora species because they are nitrogen and accid heavy soil loving species. Many naturally accuring plants are vanishing alltogether or dont produce anough nectar anymore to keep the dune specific fauna, like wild bees, alive. By cleaning and maintaining these grounds of nitrogen and accid we can reverse this biodiversity decline.



Bringing back original flora and fauna

The dune landscape is leading for a design with a gradient from primary dunes to dune forests.

The Tata Steel site now consists of biotopes that are uncommonly monotonous, disproportioned and distributed in comparison to the natura 2000 nature reserves surrounding it. My new design will bring back the natural balance which is so characteristic of the original dune landscape to restore the threatened flora and fauna by claining up and maintaining the grounds on the undustrial terrain (see diagram in upper right corner).

Use Tourism to improve ecology

Tourism

Motivation of conservation →

Taking people along in the change of the landscape

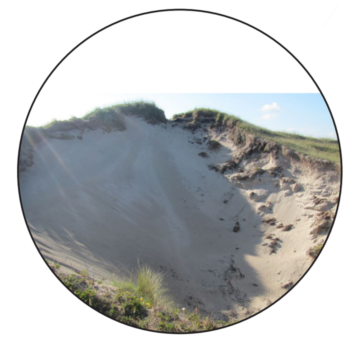
Give tour over Tata terrain by forrester

Employ local people & turn them into long term stakeholders

→ Use tourists to maintain the nature →

Teaching tourists about dune specific flora & fauna and let them pick exotics

Training people in battling nitrification and accidification of the ground on the newly designed industrial site to turn in back into the original dune landscape



Create drift pits

Creating annually rotating drift pits on the 5-10m high (new) dunes to be able to spread calcareous sand up to 500m to battle acidification of the grounds

New seedbank

Placement of annually harvested hay from Natura 2000 area Kennemerland South as a new seed bank on terrain from which the contaminated top layer (0.5 -1m) has been removed

Cleaning & maintaining the industrial grounds

Cleaning

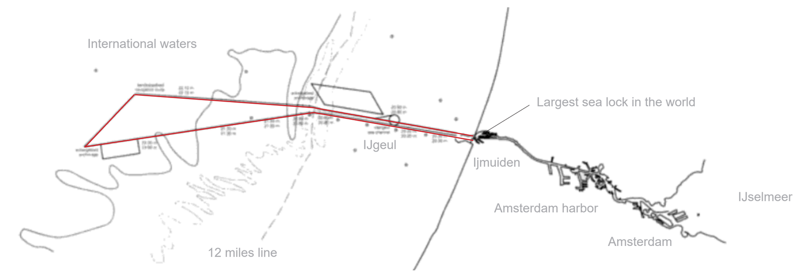
After demolishion of the old factories the contaminated top layer of the ground (0,5-1m) needs to be removed to reach the old firtile ground layers. New dunes can de formed with the 1,3 million m3 of anually dredged sand from the IJgeul & IJmuiden lock that follow the geomorphology of the old coal- and ironfields to create dune strips of 5-10m high with valleys inbetween. The top layer of these new dunes can be covered with sand from the digging of the energy pipeline deep in the North sea that has no PFAS (Poly- and perfluoroalkyl substances). This forms the perfect substrate for dune specific flore species to grow on!

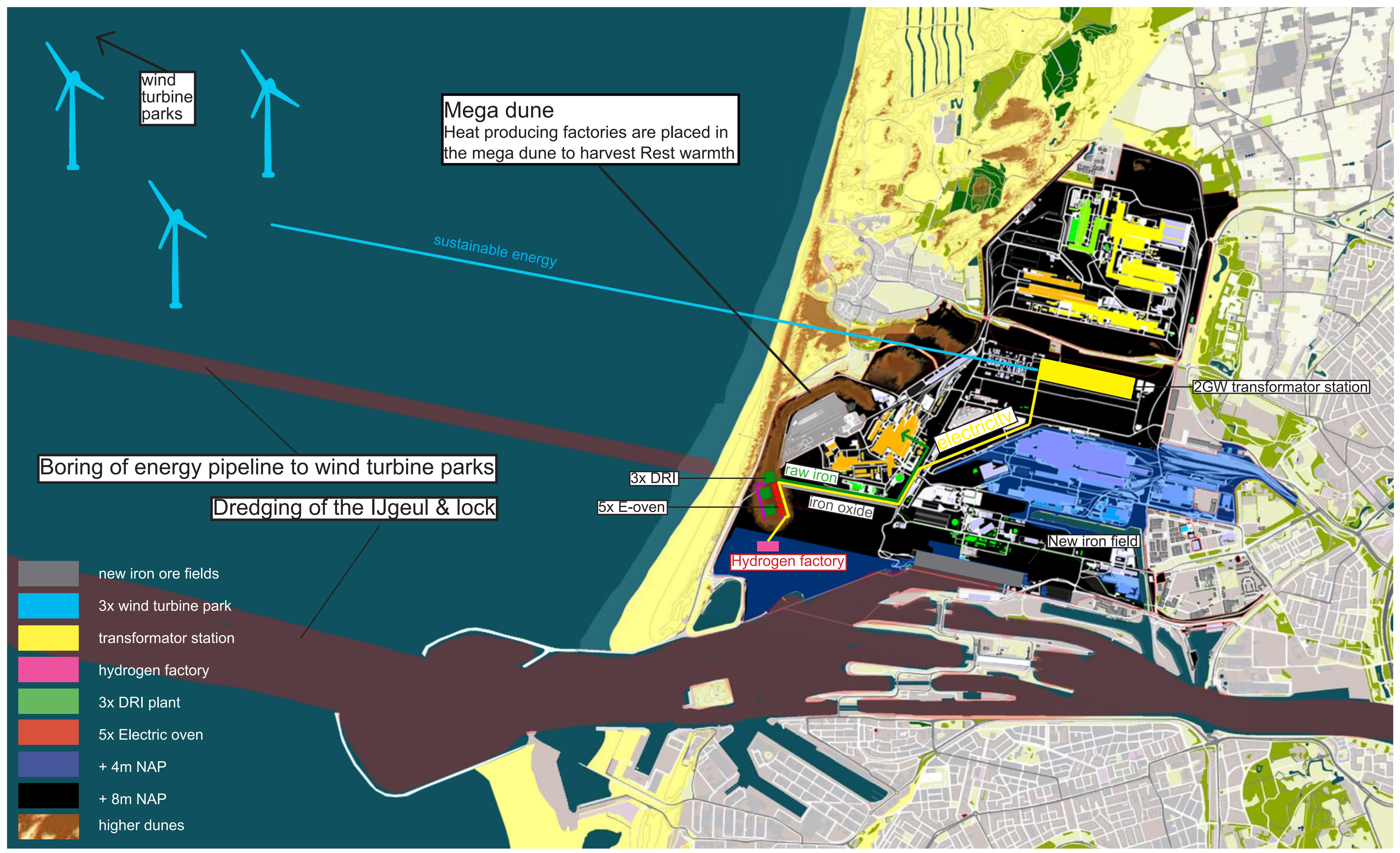
Maintaining & hypothesis

This perfect substrate needs to be maintained as long as the global nitrogen deposition and accidic rains are still going on. One of the main pillars of my design for the hydrogen factory is tourism, because I believe motivation of conservation starts with getting the public involved. I want Tata steel to become sustainable, non pollutive, eco friendly, entertaining, involving and educative by turning its opened up terrain into a campus and nature reserve for the public to experience the new sustainable ways of steel producing and the revived dune landscape. The public will help with battling the ongoing nitrification and accidification of the new grounds by creating anually rotating drift pits on the new dunes that spread calcerous sand, pick exotics and place new seedbanks (picture to the right).

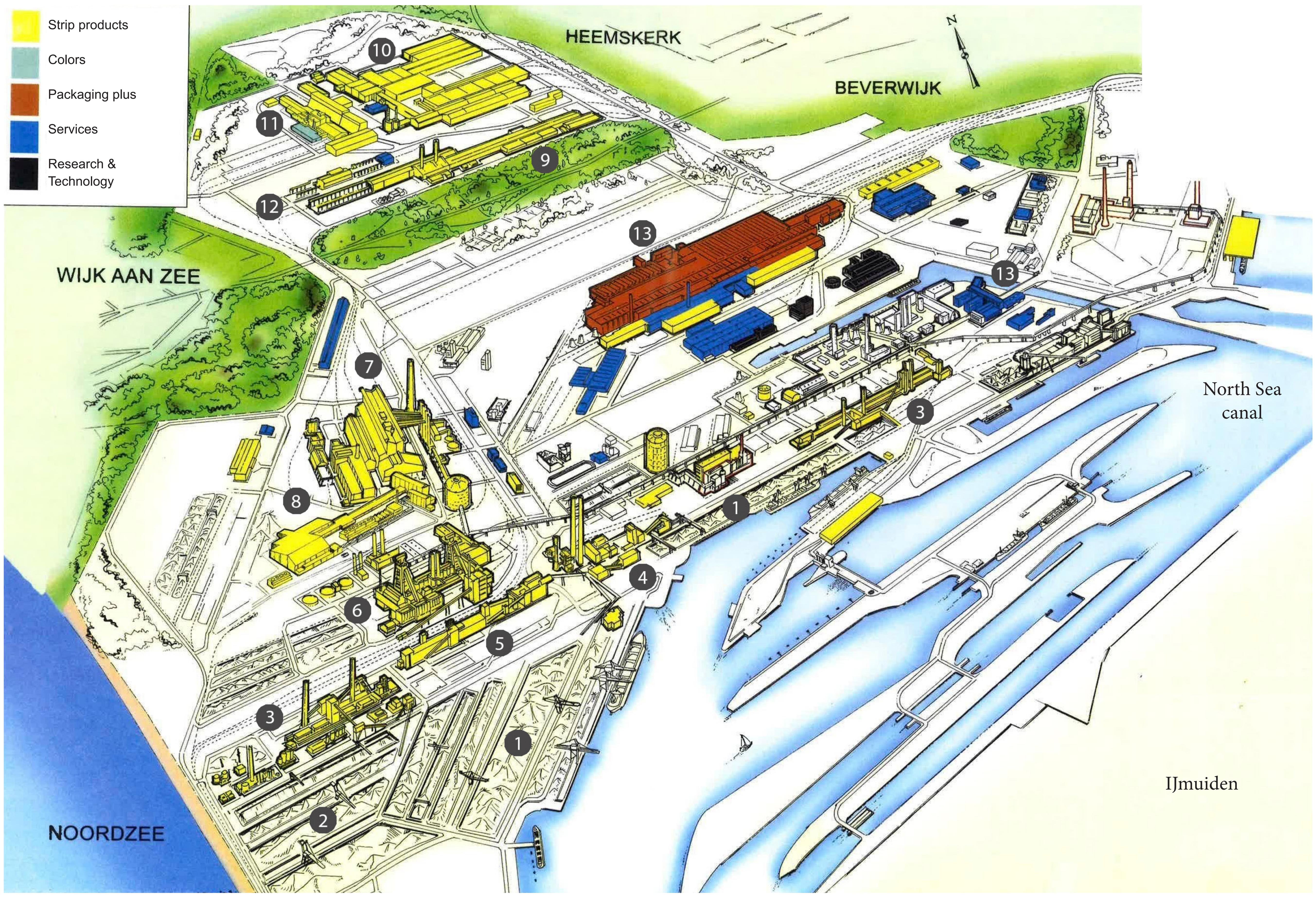
Using exces dredging sand

Where the digging of the North Sea Canal cuts through the landscape above sea level, the IJgeul cuts through it below sea level (see picture to the right). This fairway is just as long as the distance between Amsterdam and IJmuiden, which means that the North Sea Canal is actually twice as long. This channel is continuously dredged to prevent silting. Also the largest sea lock in the world is being build in the North sea canal at this moment. Dredging of this lock complex and the IJgeul produces 1,4 million m3 of excess dredge sand per year. Tata steel plans to build a mega dune of 45m high to block dust and sound nuissance to Wijk aan Zee. I will use the excess dredge sand to build this mega dune and place all new heat producing factories (DRI's and E-ovens) inside to harvest the residual heat. The rest of the excess dredging sands will be used to create new dunes – following the geo-mophology of the opened up terrain of the old coal- & iron fields for the new non polluting, nature inclusive design of the publicly accesible hydrogen factory.





Tata Steel industrial site

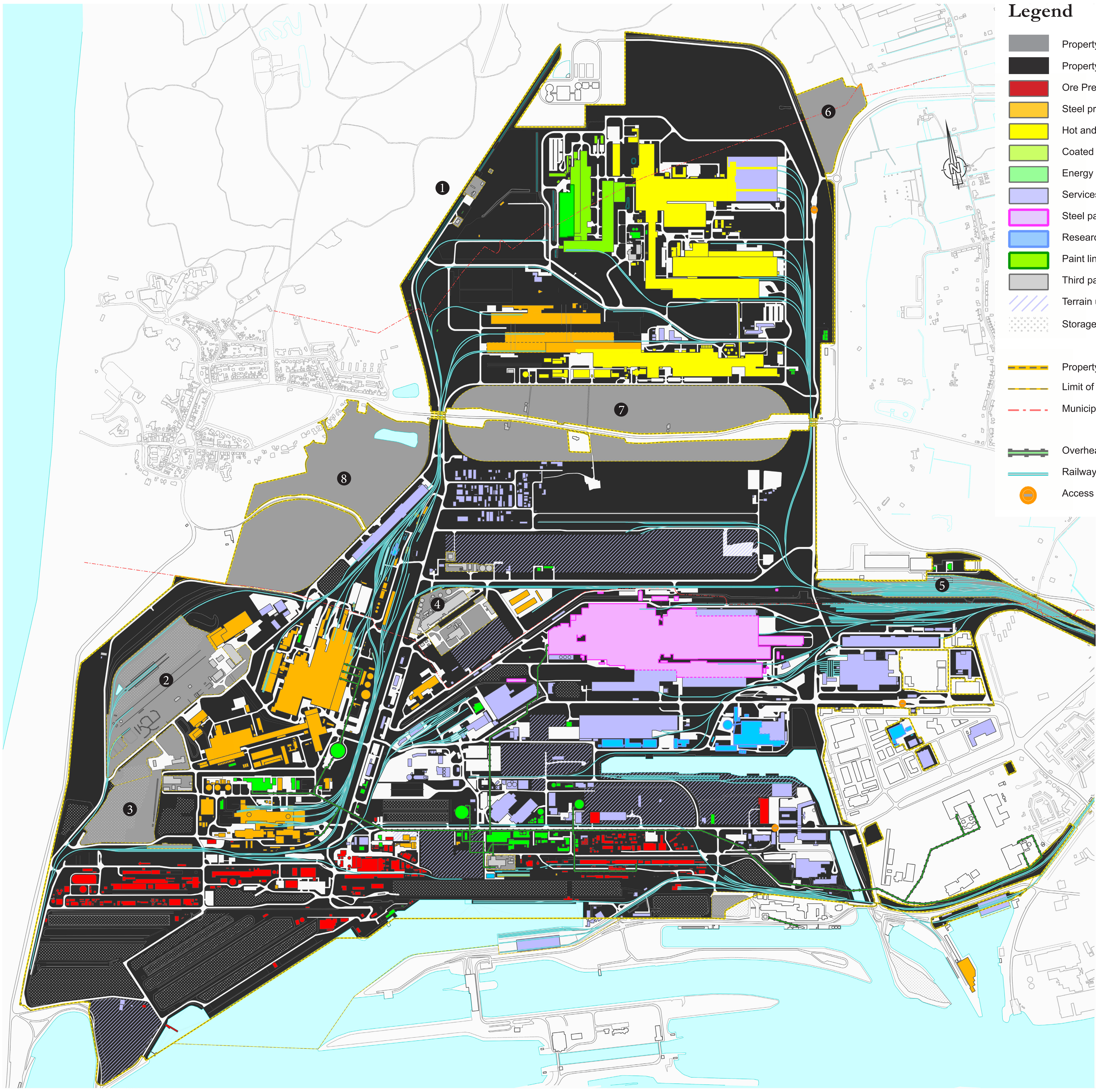


Legend

1. Ore storage
2. Coal storage
3. Coke plant
4. Sinter factory
5. Pellet factory
6. Blast furnaces
7. Oxygen steel mill
8. Casting roll installation
9. Hot strip rolling mill
10. Cold strip rolling mill
11. Galvanizing line
12. Paint line
13. Packaging
14. Headquarters

Product loop

Here we can see the current state of the Tata Steel industrial terrain. Coal and iron ore come in through the north sea channel at the bottom, ending up in the coal and iron ore fields. From here on the product makes a circular movement over the terrain to be transported out by train or ship again. First the coal and ore get pre-worked by the sinter, pellet and cokes factories before ending up in the blast furnaces. After this the raw iron gets worked into slabs of steel in the oxysteel plant. The steel gets rolled out in the rolling mills and/ or painted in the paint line, after which it ends up in the packaging centre. From here it gets transported out by train or ship.



Legend

- Property land (not in use by Tata Steel)
- Property land in use by Tata Steel
- Ore Preparation, Coke and Gas Plants
- Steel production
- Hot and cold strip rolling mill
- Coated products
- Energy company
- Services
- Steel packaging
- Research, Development & Technology
- Paint line
- Third parties
- Terrain under development
- Storage of raw materials

- Property boundary Tata Steel in IJmuiden
- Limit of use of Tata Steel in IJmuiden
- Municipal boundary

- Overhead Pipe
- Railway track
- Access to Tata Steel terrain

Land leased to other companies

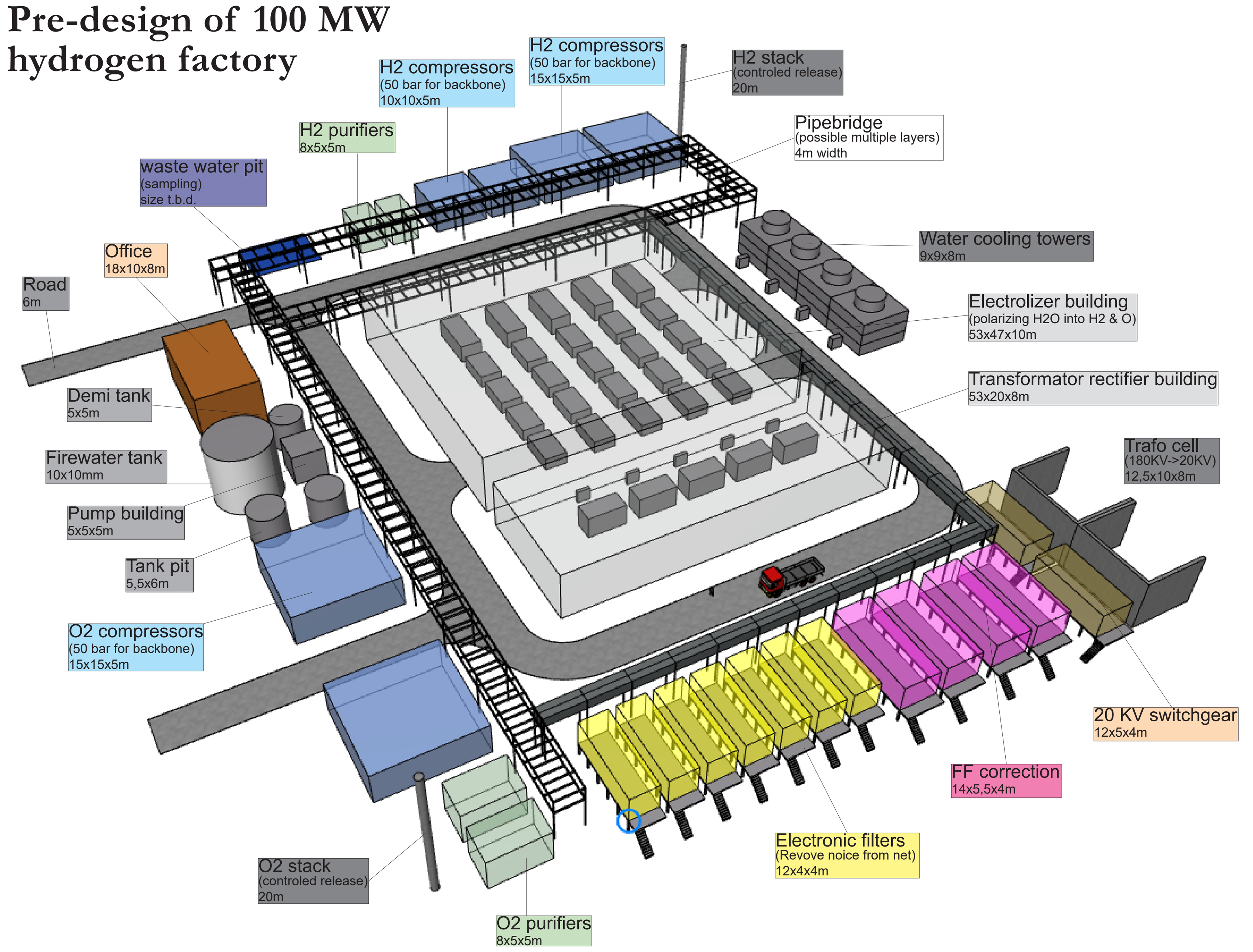
1. H2 verlading & opslag
2. Harsco Metals (slack processor)
3. Pelt & Hooikaas (secondary raw materials)
4. Lindegas (industrial gas company)
5. Train tracks

Green zones

6. Green area
7. Green strip
8. Green area

Hydrogen factory layout

Pre-design of 100 MW hydrogen factory



Building the largest hydrogen factory in the world

Going from 100MW to 500 MW

Tata Steel has made a preliminary design for a 100MW hydrogen factory (see picture on the left). The whole proces resolves around the electrolizer building in the middle where water gets polarized into hydrogen and oxigen. An industrial road with piperacks surrounds the main components for accesibilty and maintainance purposes. Other installation like transformators, compressors, purifiers, release stacks, electronic filters and watercooling towers can be found in the periphery.

Due to the high hydrogen demand for the future development plans Tata Steel will need a much bigger factory and plans to upgrade it to a 500MW factory (see picture below). this means the core gets multiplied by 5 and the periphery by 1,5.

Rest warmth destruction

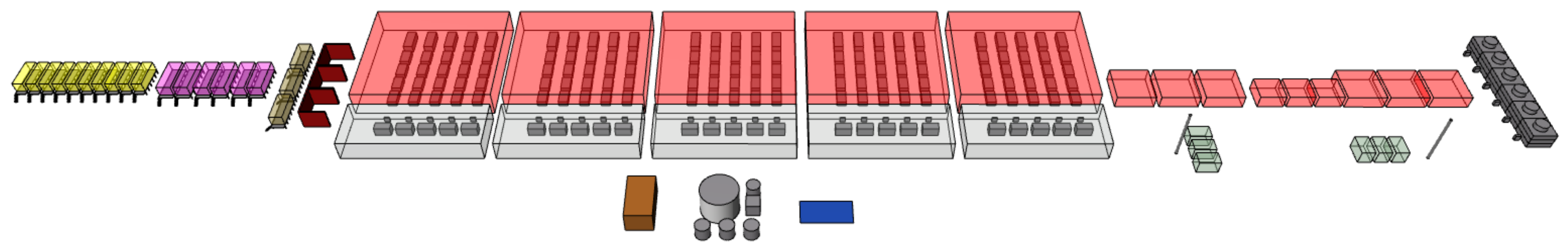
The trafo cells, the electrolizers and compressors produce an enormous amount of rest-warmth. One third ot the 500MW input transforms to rest-warmth. This is 167MW! One MW can provide 1000 households with electricity at the same time. Meaning the hydrogen factory could power 167.000 households, but it gets d**estoyed in cooling towers!**
Ofcourse my design is going to harvest this (picture below)!

Development plans

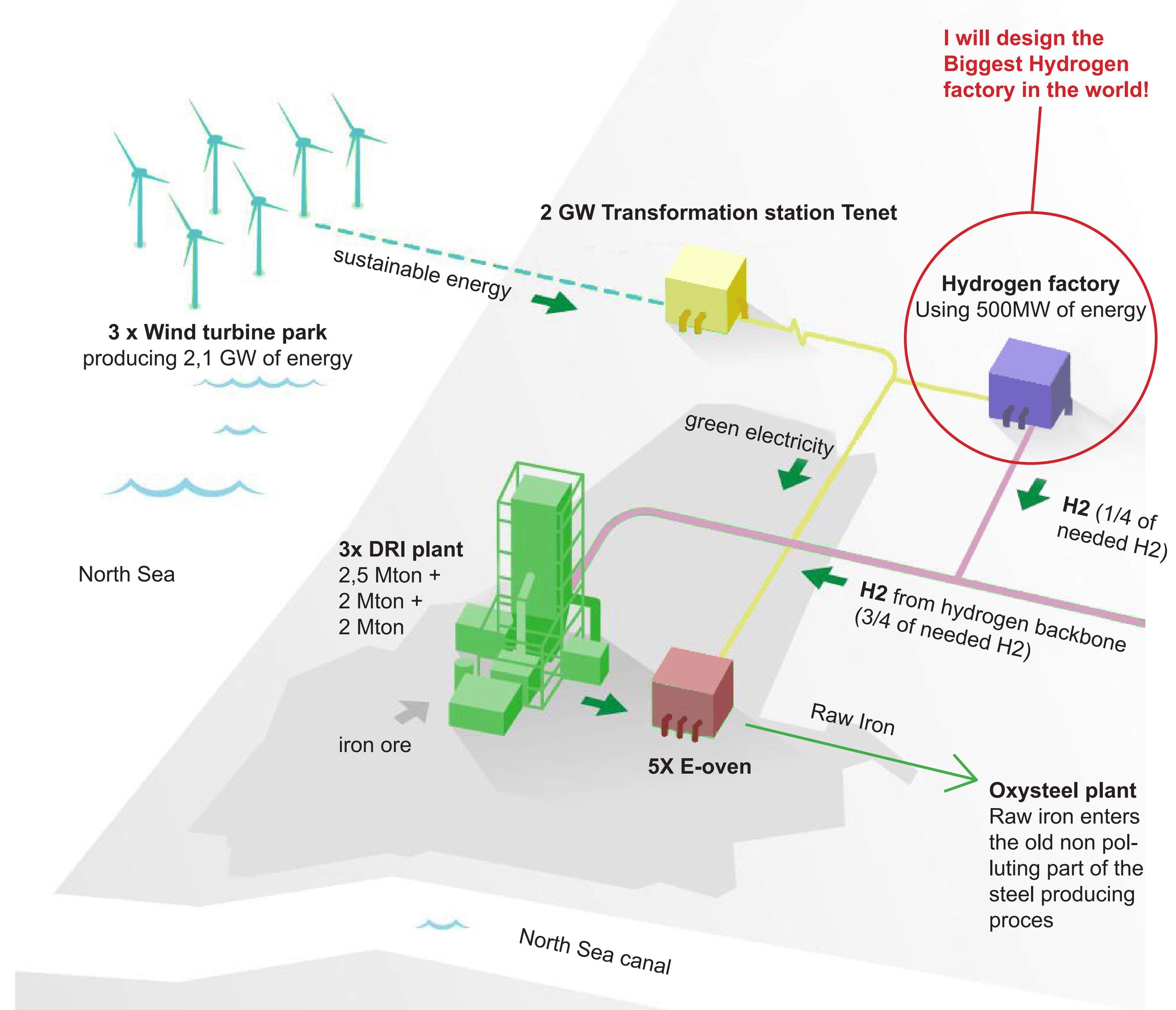
Tata Steels 12 million tons of anual CO2 emission is almost twice as much as the 700 million tons of steel they produce each year. In order to become a CO2 neutral steel producing company Tata Steel will have to replace the old blast furnaces with 3 Direct Reduced Iron plants (DRI's) and 5 Electric ovens that run on hydrogen in stead of coal. The byproduct of iron ore converstion to raw iron with hydrogen as the reducing agent is water instead of CO2 in the case of coal usage.

Three wind turbine parks will be build in the North sea that produce 2,1 GW of energy that will be made available in the new Tennet energy plant on site. A new hydrogen factory will be build that needs 500 MW of energy.
This will be the largest hydrogen factory in the world. There is 4 times as much energy available, meaning that the new DRI plants will be connected to an international hydrogen backbone. The old factories, that made up the black (polluting) side of the terrain, can be demolished. This means that the coal fields, the pellet & sinter plants and the cooksfactory will become absolete. This whole terrain can be used to build the new hydrogen factory (see picture below).

Rest warmth producing installations in 5000 MW factory



Future way of producing CO2 neutral steel



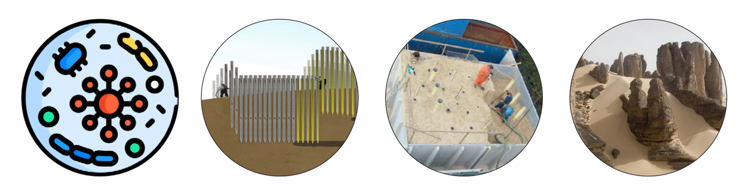
New design of the hydrogen factory

Using exces dredge sands

After demolishion of the old factories, I will use the excess dredge sand from the dredging of the IJgeul & lock of IJmuiden to turn the opened up space into a nature reserve and campus for the public to experience the future of green steel producing. The dredging sand will create strategically placed 5-10m high dunes with drifting pits on their S-W side that spray calcereous sands over the rest of the terrain to battle unwanted further nitrofication and accidification of the soil. These dunes will have man made sandstone cavities in their core in which the residual heat producing installations of the hydrogen factory are placed. This ensures that the new industrial installations give back space to nature in the form of heat harvesting, sand drifting dunes.

Biogrout technologies of TU Delft

SmartSoils technology applied on loose sand only take days to convert it into sandstone with an unconfined compressive strenght of up to 35 MPa where natural calcareous sandstones need thousands of years for its diagenesis.



bacteria | injecting | hardening | visual effect

To create this sandstone bacteria are injected into the sand, followed up by urea and calcium chloride. The bacteria produce carbonate ions from the urea in the soil. The calcium ions immediately bind with it to form the insoluble calcium carbonate or calcite, which cements sand grains together to form porous sand-lime brick.
The more often you rinse, the stronger the material becomes. Rinse twice for sand-lime brick, ten times for concrete strength up to 35MPa. Usually, the compressive strength of concrete varies from 17 MPa to 28 MPa. The whole proces only takes up a few months.

Residual heat harvesting

Unfortunately the 750 hectare industrial terrain is to big and the surrounding villages to small and far away to be heated by the rest warmth, but it can be used to heat up the local old Averijhaven to turn it into a spa! This will turn the industrial site into a touristic hotspot.

Touristic tour

A touristic tour will lead the visitor from the new touristic harbour (old coal harbour) through the publicly accesible factories and nature reserve to the spa. This will turn the old polluting factory site into a touristic hotspot with the new 'transparent' hydrogen factory as its throbbing heart. The hidden universe of the factory will be opened up to the public without disturbing its fabrication processes, so it remains fully operational. It will invite the visitor with open arms to show the new non polluting way of steel producing. This touristic impulse improves the ecological status of the site through guided participation in maintainance, creates motivation of conservation and improves the economic status of Tata Steels surroundings in the form of spin-off activities for locals. This will not only clean up Tata Steels terrain but also its name!

Plan exlained

A 7m wide industrial road makes sure all installations can be reached by trucks for maintainance. The piperack that lifts all connecting pipelines above the roads becomes a public walking path. It forms a network of publicly accesible walking paths through the dunes in which the residual heat harvesting takes place. The public looks down on the industrial processes through double glass floors without disurbing the processes. All non- heat producing installations will be placed in the open air along the roads/ public walking paths. The industrial site will be connected to the very popular recreational & kitesurf beaches on the west side.

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STEP 3: Long term maintainance

Residual heated Spa

Turn old harbour into a spa

The old Averijhaven

The old harbor was converted into a dredging depot in the mid-1980s to store contaminated dredged material from the North Sea Canal. Rijkswaterstaat is currently removing the 85,000 cubic meters of dredging material for permanent storage in the De slufter depot in Rotterdam.

I will use the 167 KW of rest-warmth from the hydrogen factory to heat up the dredged harbour to turn it into a spa for the public to enjoy.
A walking path on top of the pipe racks above the industrial roads will guide the public from the touristic harbour through the 'transparent' hydrogen factories in the new rest-warmth collecting dunes and revived dune landscape to the spa.

Spa facilities

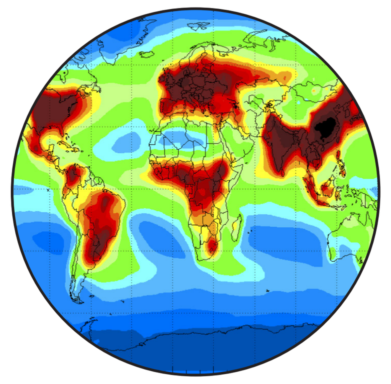
A restaurant & spa facilities will be created in sand stone cavities (picture above) made trough smartsoils technologies (see poster 3).

Local kitesurf beach

The beach next to Tata is largely classified as an activity beach for kite surfers. Rest-warmth will be used to heat up hot tubs on the beach to involge the many water sport enthusiast and recreational swimmers in the project.

The adjacent old coalfields are perfect terrain to create new dunes with drifts and wet dune valleys. The wet dune valley specific natterjack toad becomes the mascot of the thermal baths with its roar

Global nitrogen deposition



Within a few years after Tata Steel has become pollution free and the terrain has been cleaned, nitrogen will start to accumulate in the clean soil again due to the global nitrogen crisis and acid rain will acidify the dunes again.

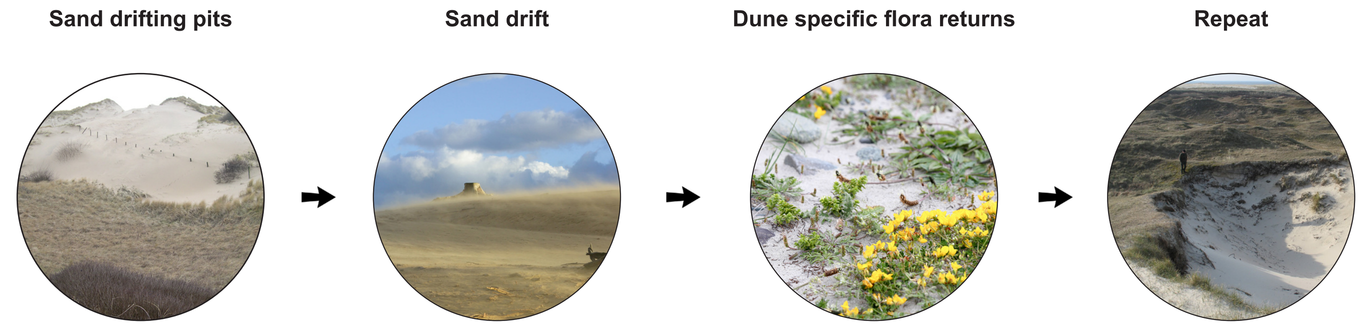
Nitrogen-loving plants take over

Nitrogen loving plants like grass, scrubs, trees and sea buckthorn will start to take over again from the dune specific species.

Long term maintainance

To make sure the ecological problems will not slowly return with the years, routine maintainance will need to take place.
A tour over the revived industrial terrain, led by a forrester, will involve and teach locals and tourists about the different revived biotopes, specific species and maintainance options. In this way the new nature inclusive hydrogen factory, together with the public and vollunteers, will work together to preserve the reclaimed nature and clean Tata Steels bad name.

Use Tourism to improve ecology

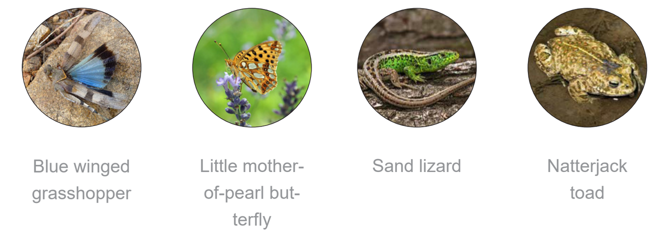


Sand drifting pits — Let tourists dig sand drifting pits on the S-W side of 5-10m high dunes before the storm season begins. The contaminated soil can be used under highways or to make sea barriers after washing.

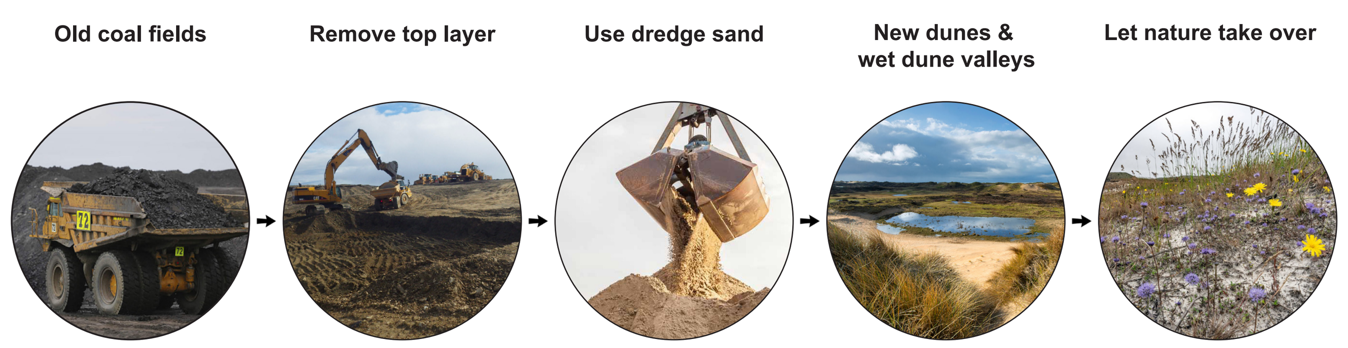
Sand drift — Sand pits spray chalky sand over the acidified grasslands behind the dunes up to 500m away

Dune specific flora returns — Within a year, these dust pits grow half closed with dune-specific species.

Repeat — Within a few years, the pits will be filled with dune-specific species. Repeating this process routinely ensures that all dune soil will be re-covered with original species and that all grassland behind receives calcareous sandy soil.



Reviving the open dunes & wet dune valleys



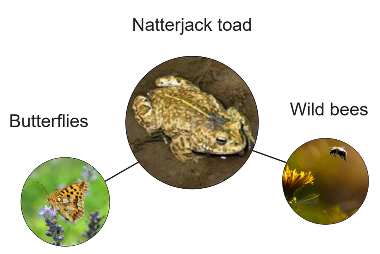
Old coal fields — Coal is out of use due to new hydrogen factory.

Remove top layer — Scrape away the top layer (0,5-1m) of contaminated ground from the old coalfields.

Use dredge sand — Bring in excess dredge sand (1,3 million m3/year) from the IJgeul & IJmuiden lock to cover the old coalfields with a subtrate layer.

New dunes & wet dune valleys — Use the geomorphology of the old coalfields to create dune strips of 5-10m high with valleys inbetween. Cover them with old clean sand from digging of energy pipeline deep in the North Sea (no PFAS, Poly- and perfluoroalkyl substances).

Let nature take over — The fertile clean subsoil ensures that dune specific species start to grow on the nitrogen-poor soil.



Target species

If we can create a suitable habitat of wet dune valleys for the natterjack toad to live in it automaticly goes well with many other types of plants, bees and butterflies

Reviving the dune grasslands

Black side factories — The higher grounds (+8m NAP) are the former 'black side' of the estate where the old polluting factories stood. This becomes vacant flat ground after demolishion. The old iron can be recycled in the new E-ovens (see poster 2).

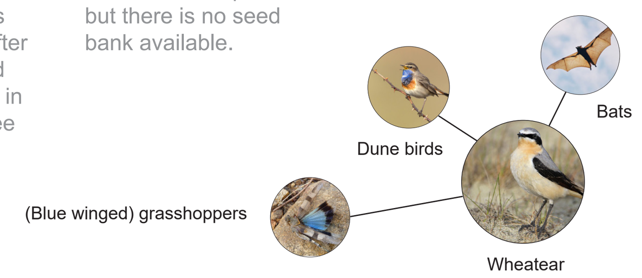
Removing old foundations — We find clean sand with old shell layers under the foundations. This is perfect drifting sand and has enormous potential, but there is no seed bank available.

Remove top layer — We scrape off the top 0,5-1m of contaminated soil from the other vacant ground.

Tourists place hay as new seedbank — Tourists place annually harvested hay from the adjacent Kennemerland South dune valleys to act as a new seed bank.

Flower fields & butterflies — The hay ensures that the flower seeds come up before the grass can and makes soil fungi return.
We mow only once a year instead of 15 times like Tata Steel does now. This creates a flowery area that attracts butterflies from South Kennemerland.

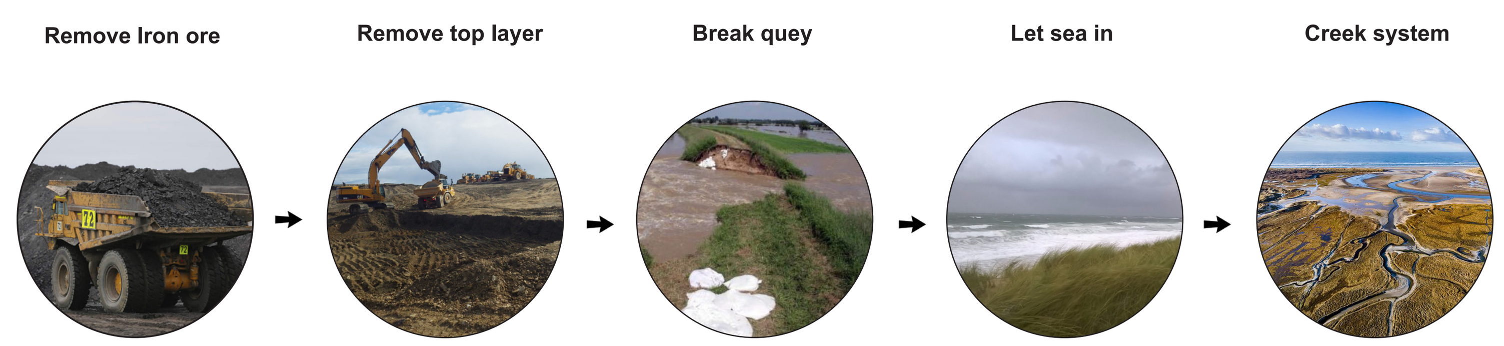
Calcereous drifting sand — The drifting pits made by the tourists spread calcareous sand up to 500m to battle acidification of the grassland. We let groups of tourists pick exotics from among the dune-specific species during information tours.



Target species

The wheatear raises almost no young because they ingest poisonous caterpillars.

Creation of a slufter



Remove Iron ore — Iron ore will be shipped to the new iron ore deposit (see poster 2).

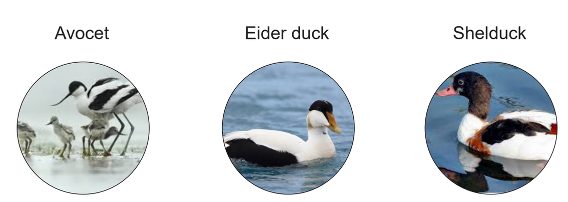
Remove top layer — Scrape away the top layer (0,5-1m) of contaminated ground from the old iron fields.

Break quey — Break through harbor quay to let seawater in.

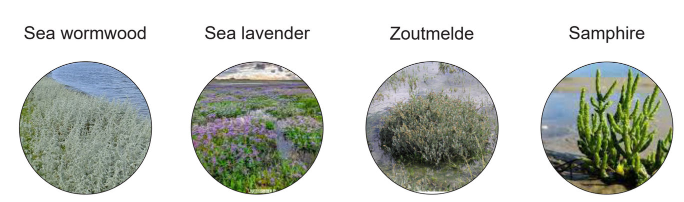
Let sea in — Under the influence of the tide and strong winds from sea, allow salt water to enter the tidal area through the gully.

Creek system — The old iron harbor becomes a creek system. The dunes receive a supply of fresh sand and nutrients.

Bird breeding area



Introducing new biotopes with salt tolerant plants



Building method: Man-made sandstone

Biogrout technology (TU-Delft)

Biogrout technology from the TU Delft will be used to turn the sand into man-made sandstone cavities inside of the dunes.

Natural calcareous sandstones need thousands of years for its diagenesis, but this new technology applied on loose sand only takes days to convert it into sandstone with an unconfined compressive strenght of up to 35 MPa (which is comparable to high strengt concrete).

Bacteria are injected into the sand, followed up by urea and calcium chloride. The bacteria produce carbonate ions from the urea in the soil that immediately bind with the calcium ions to form calcite, which cements sand grains together to form porous sand-lime brick.

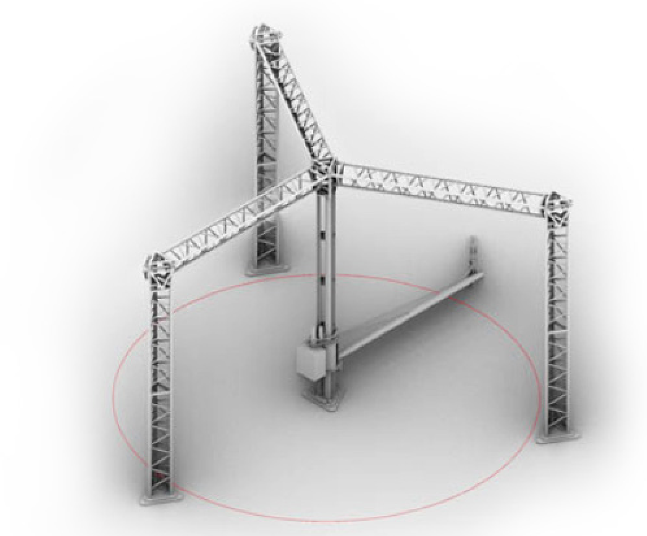
Necessities

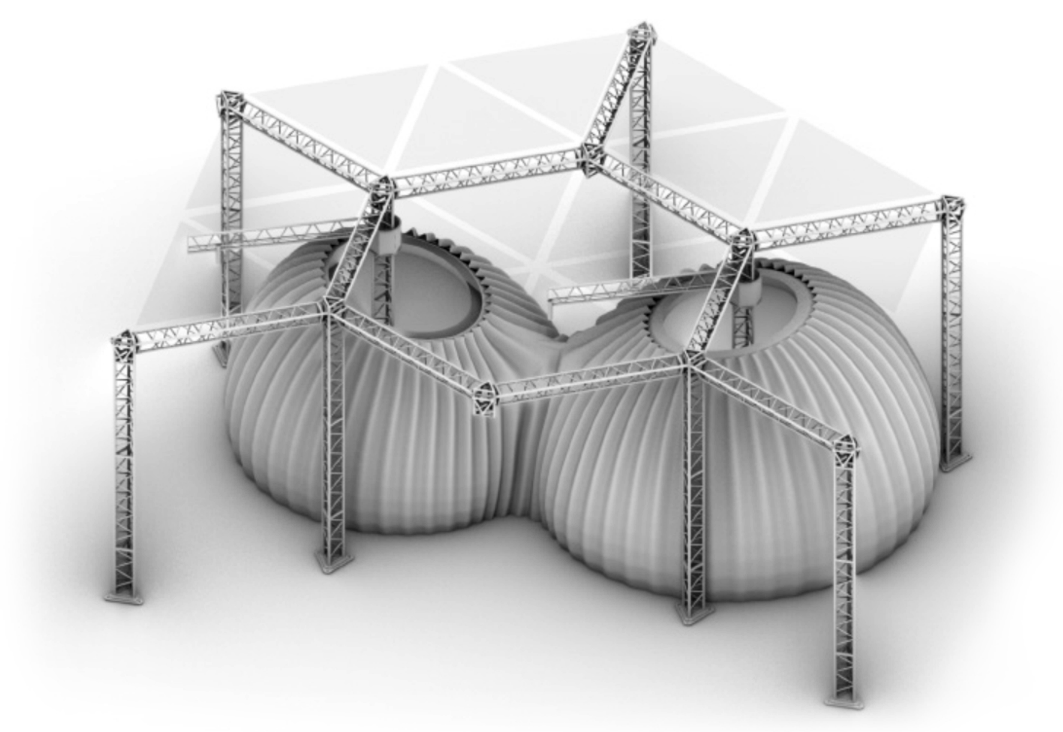
Bacillus Pasteurii
in liquid growth medium

Sand

Urea
organic compound (NH2)2CO a.k.a. carbamide

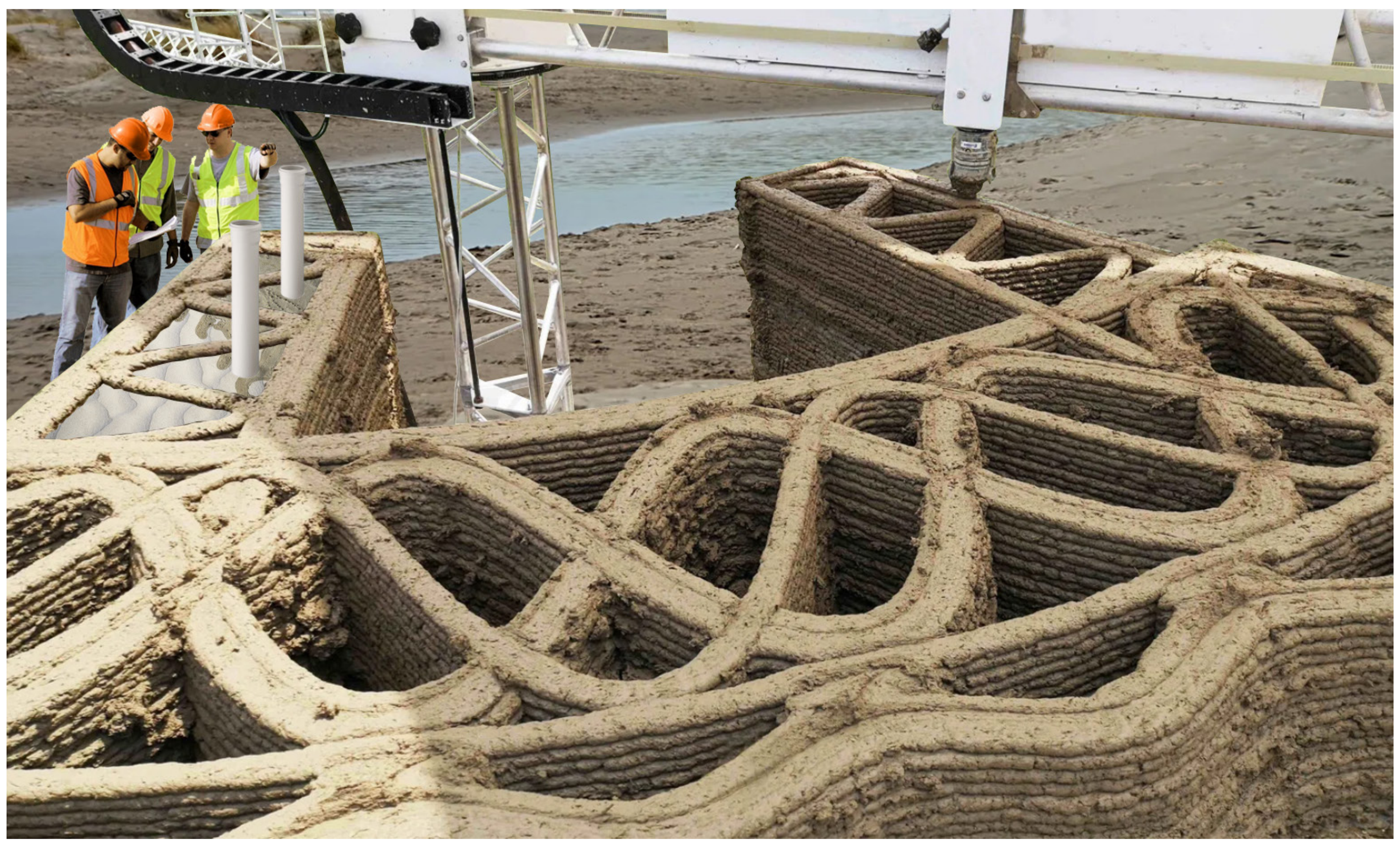
Calcium chloride
an ionic compound used as brine and in cement





3D printing method

To be able to withstand the outside pressure from the dune sand, the cavities are construction by 3D printing to form sandstone domes.



Wall build up

The build up will consist of small layers of sand that can be rinsed with urea and calcium chloride to reach the needed compressive strength. The cavities can be filled with sand manually, recieve extra rinsing or be equiped with the needed piping.

Natural lighting

Every room, depending on its function, has one or more 'lighting chimnies' that are strategically oriented to the required sun position to bring in natural light. This light moves around during the day and highlights the curvature of the 3D printed man-made sand stone dome walls, leaving visitors with the impression of being in an underground sand cathedral. This highlighted organic form language forms an interesting contrast with the rigid industrial steel structures.

End result

The result is an organicly looking naturally coloured horizontal layering of the dome walls that capture the light of the oculuses (sprouting like stone chimneys from the dunes to bring in natural lighting) beautifully.

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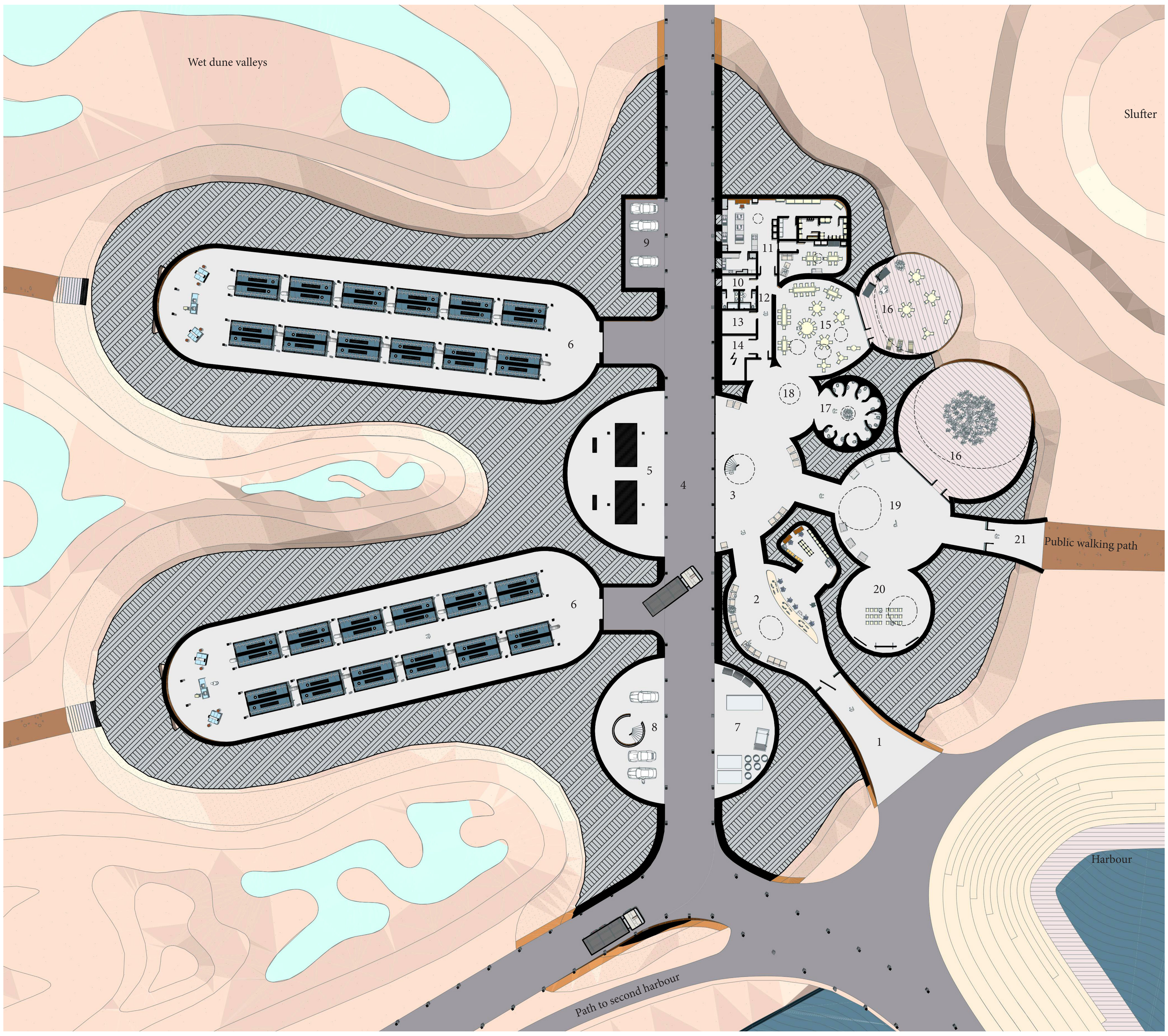
Plans Of harbour electrolizer



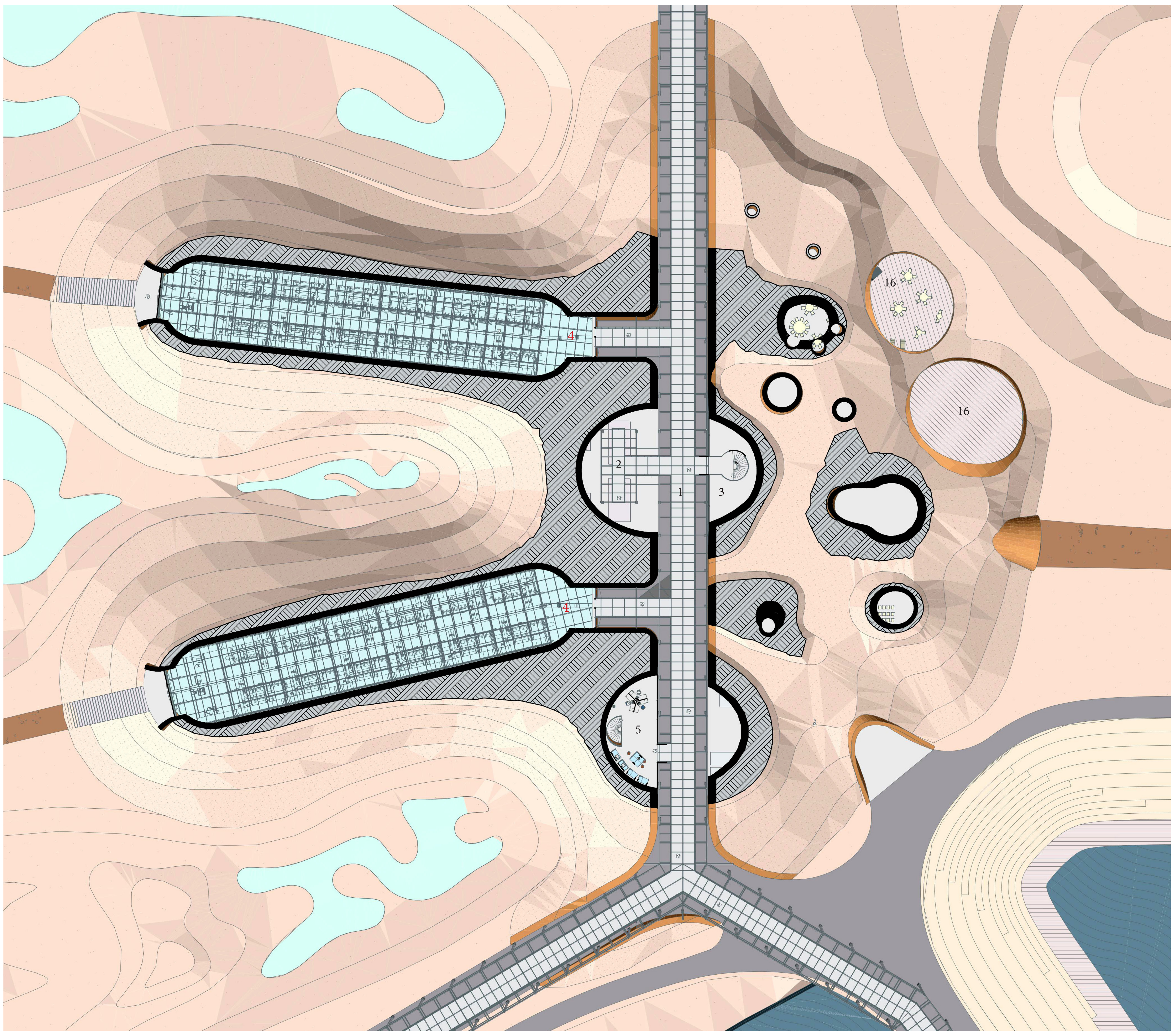
1. Main entrance
2. Lobby/ check in
3. Central hall with stairs to lifted public walking route & lookout
4. Industrial road (7m wide)
5. Transformator rectifiers (non heat producing)
6. Electrolizers (heat producing)
7. Storage
8. Parking employers office
9. Parking employers restaurant
10. Service entrance
11. Kitchen
12. Staff bathroom
13. Air conditioning facilities
14. Electrical
15. Restaurant
16. Outdoor terrace
17. Foyer
19. Gallery (exposition on green steel production)
20. Information centre
21. Secondary entrance (to walking path)

Touristic facilities

Every residual heat harvesting dune will be equiped with touristic facilieties. Here you can see the plans of the harbour electrolizer. This dune forms the start of the touristic tour through the nature reserve to the spa and popular recreational & kitesurf beaches. The public arives here by boat from the harbour of IJmuiden. This makes sure the direct polluted environment of Tata Steel receives a well deserved economical lift in the form of spin-off activities.

After climbing up the stairs from sea level to the 5m higher former coalfields, the visitors enter the dune through the main entrance. Here the choice needs to be made to climb the stairs in the main hall to reach the lookout point or enter the lifted walking path on the piperacks above the industrial roads that leads to the industrial residual heat harvesting rooms. Ofcourse there is also the choice to enjoy the other public facilities the harbour electrolizer has to offer. Information can be gathered on the new non polluting ways of iron producing in the gallery and a tour trough the revived nature reserve (guided by a forrester) leaves from the information centre. Ofcourse there is also the possibility to enjoy a cold beverage or meal in the restaurant or on the outside terraces overlooking the newly formed slufter.

Ground floorplan



1. Public walking path on piperacks
2. Lookout overseeing transformer rectifiers
3. Central hall with stairs to lifted public walking route & lookout
4. Publicly accesible part of electrolizer room
5. Office & water testing facility

Heat harvesting rooms

The electrolizer cells that split water into hydrogen and oxigen are placed inside the residual heat harvesting rooms (6 in ground floor plan). The publicly accesible part of these rooms can be reached by the walking path on the piperacks above the industrial roads. The visitor looks down on the industrial processes through a double glass floor that harvests warmed up air. Here the choice can be made to resume the tour on the lifted piperacks or venture down into the wett dune valleys through the walking paths.

First floor

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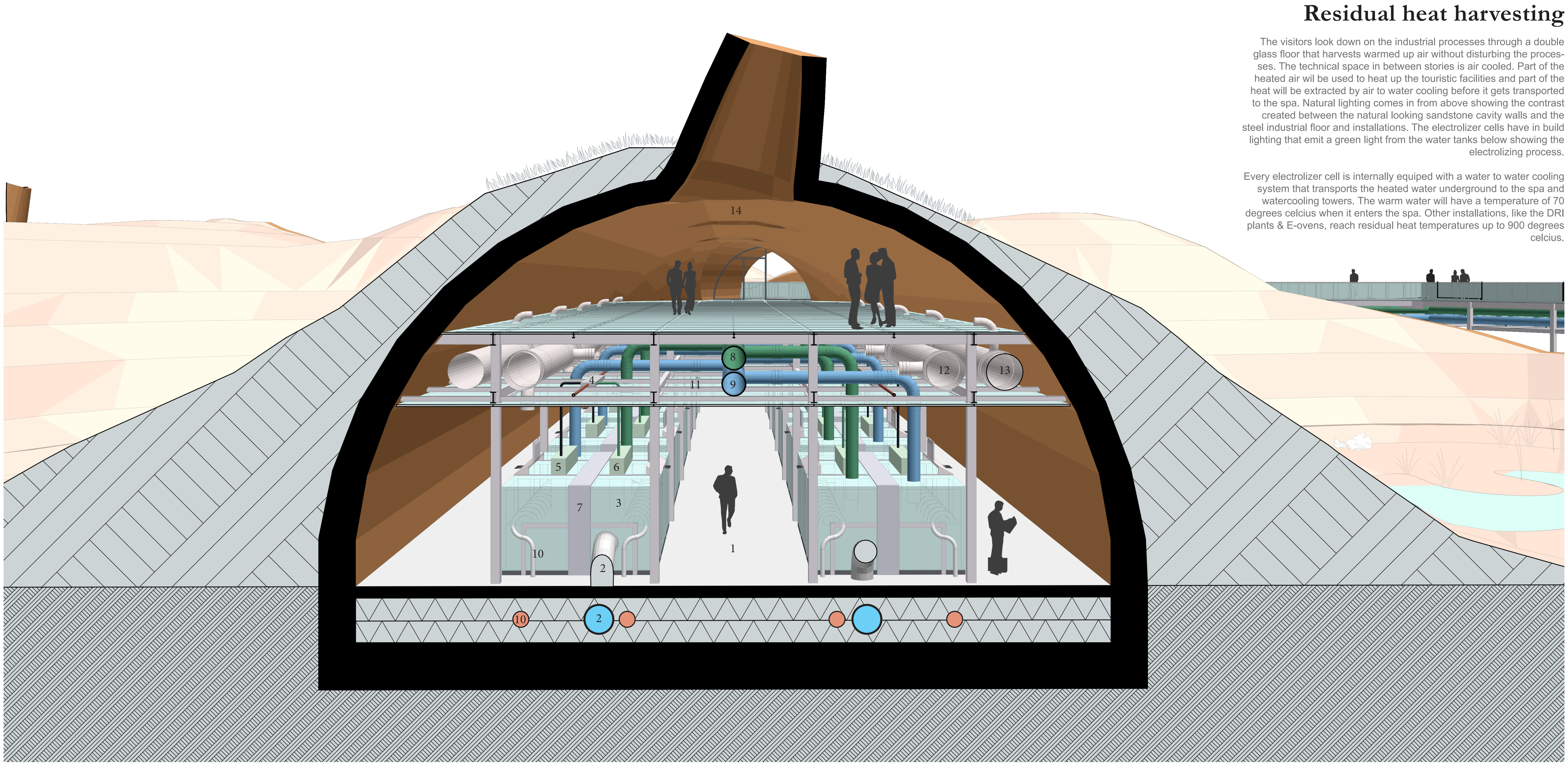
Hydrogen production in electrolizer dune

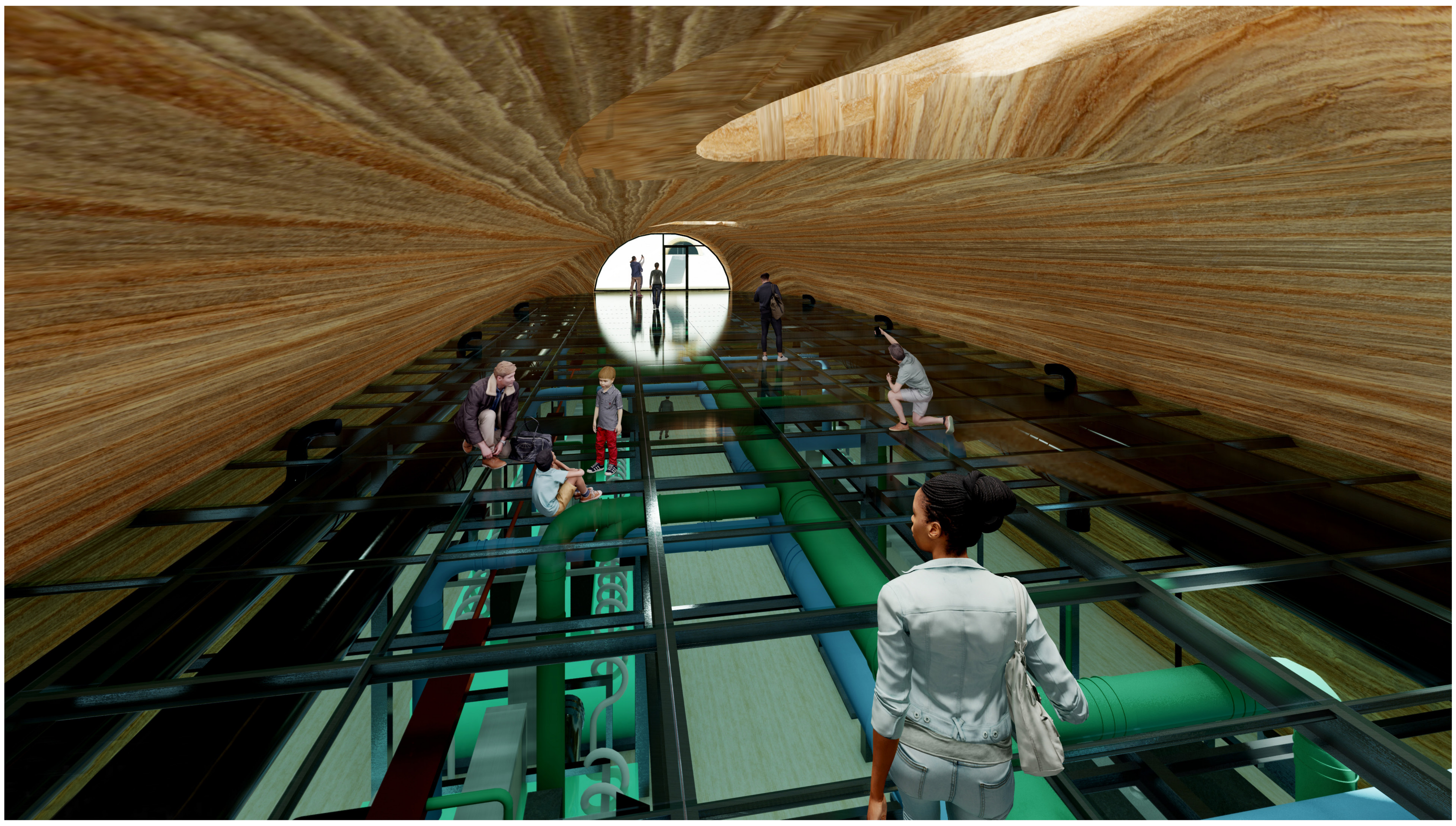


Section of electrolizer room

Residual heat harvesting

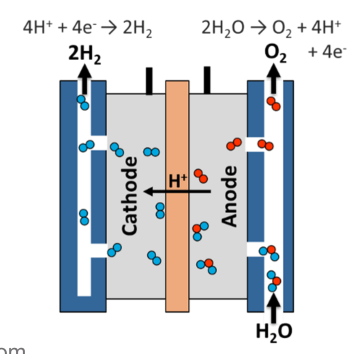
The visitors look down on the industrial processes through a double glass floor that harvests warmed up air without disturbing the processes. The technical space in between stories is air cooled. Part of the heated air wil be used to heat up the touristic facilities and part of the heat will be extracted by air to water cooling before it gets transported to the spa. Natural lighting comes in from above showing the contrast created between the natural looking sandstone cavity walls and the steel industrial floor and installations. The electrolizer cells have in build lighting that emit a green light from the water tanks below showing the electrolizing process.

Every electrolizer cell is internally equiped with a water to water cooling system that transports the heated water underground to the spa and watercooling towers. The warm water will have a temperature of 70 degrees celcius when it enters the spa. Other installations, like the DRI plants & E-ovens, reach residual heat temperatures up to 900 degrees celcius.



Publicly accesible viewing room

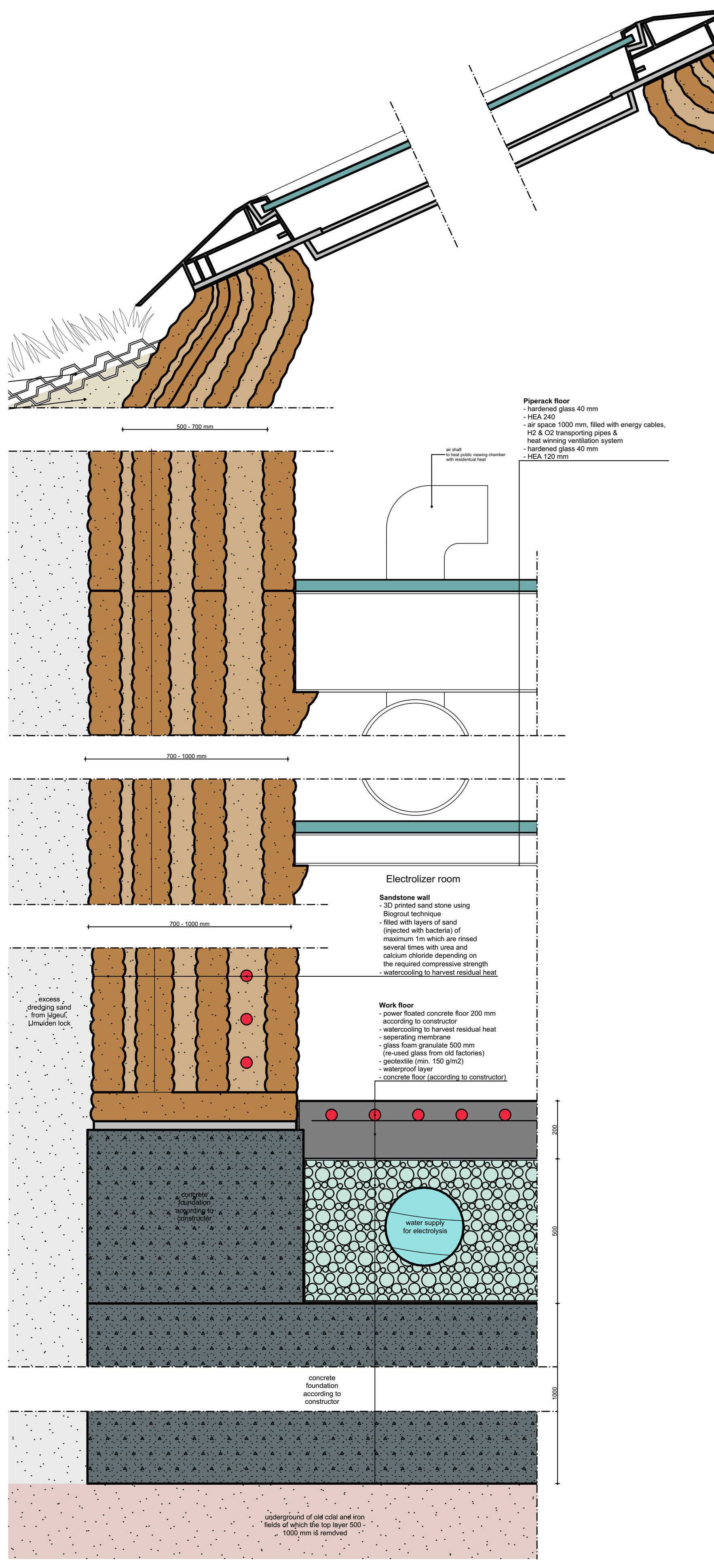
1. Electrolizer room
2. Water supply
3. Electrolizer cell
4. Power supply
5. Cathode
6. Anode
7. Electrolyte
8. Oxigen pipeline
9. Hydrogen pipeline
10. Water cooling
11. Technical space
12. Air extraction
13. Air distribution
14. Publicly accesible viewing room



Electrolisis

Electrolysis is the process of using electricity to split water into hydrogen and oxygen. Like fuel cells, electrolyzers consist of an anode and a cathode separated by an electrolyte. On the anode side oxigen is collected and on the cathode side hydrogen is collected.
10 electrolizing cells of 5 MW are placed in 1 harvesting room. This means that each one of the five 100 MW electrolizer dunes has 20 cells in total.

Workfloor of the electrolizer room



Walls & floor

The floors and walls of the electrolizer room are also equiped with watercooling. The width of the sandstone walls start at about 1m at the bottom, going down to about 500-700 cm at the oculus, depending on the height of the room. The foundation consists of a 1m thick slap of concrete, with a layer of recycled foam glass (from the demolished factories) on top, carying the water supply pipes, to be finished with a power floated concrete top layer supplying water cooling.

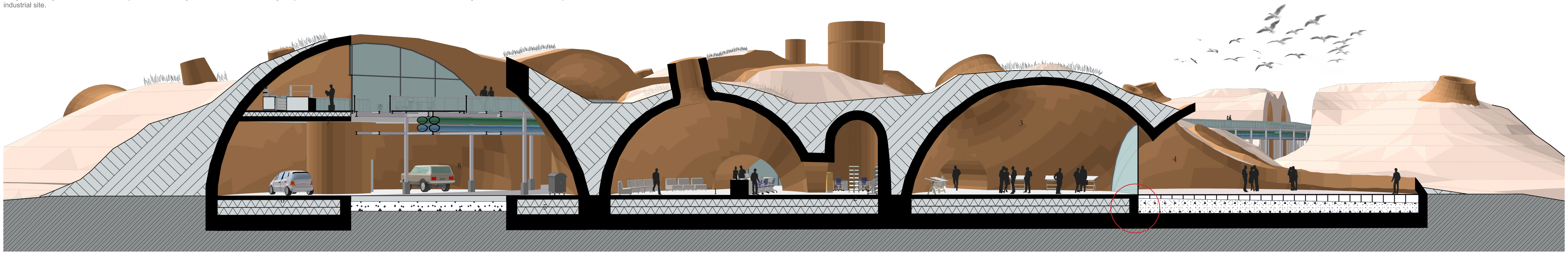
Section of harbour electrolizer dune

Piperack walking path

A 7m wide industrial road makes sure all installations are reachable by trucks for maintainance. The piperacks that lift all pipelines above the roads becomes a public walking path. It forms a network of walking paths through the dunes in which the residual heat harvesting takes place where the public can look down on the industrial processes through double glass floors. All non-heat producing installations will be placed in the open air along the roads/ public walking paths. The walking path leads the visitors from factory dune to factory dune, all the while crossing different dune biotopes to see and learn about. The steel piperack bridge makes rigid incisions in the factory dunes celebrating the contrast between the organicly formed dunes and Tata Steel factories seen in the background. A contrast that already facinates me on the current industrial site.

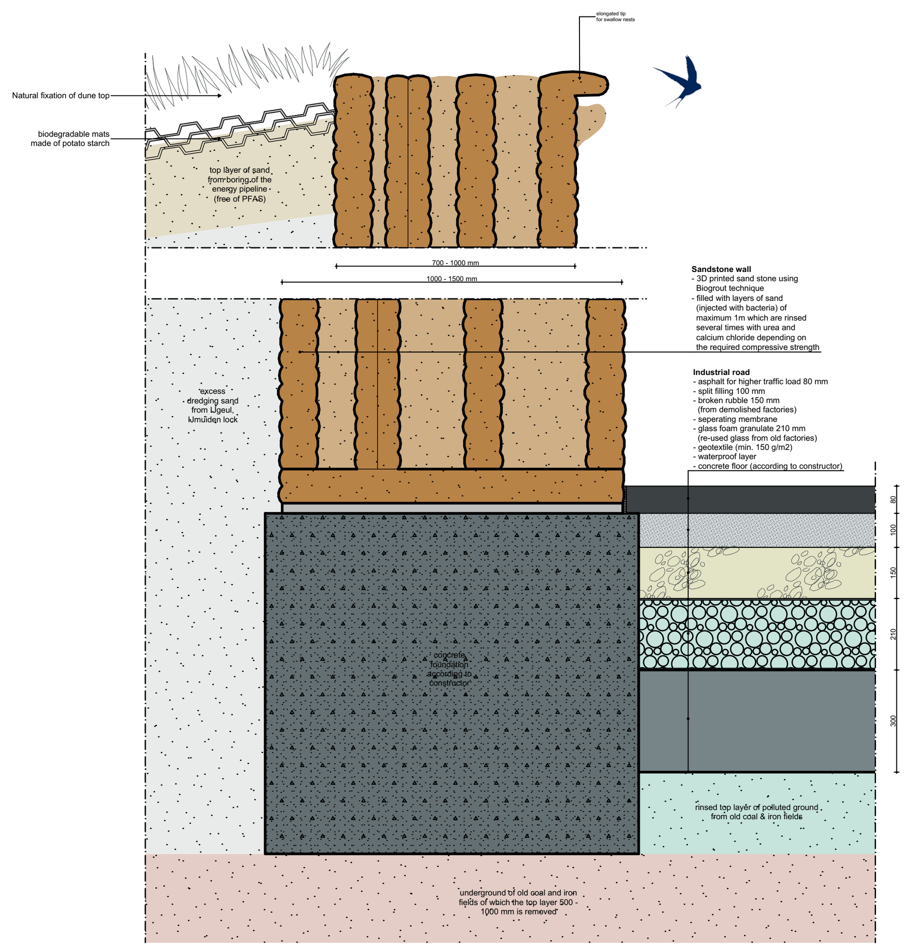
Gallery

Information on the new non polluting ways of steel producing can be found in the gallery that also holds an exhibition on the history of Tata Steel. If we zoom in on the gallery we can see the oculus of the dome bringing in natural lighting. Every room has its 'lightning chimney' strategically oriented to the required sun position depending on its room function. I wanted to construct the new factory with natural material to celebrate my fascination for the esthetics of the current Tata Steel site – with its convergence of regid steel factories and natural dunes – (like you can see in the background) and what to do that better with than the omnipresent sand? A tour trough the revived nature reserve, guided by a forrester, leaves from the adjacent information centre or outside terrace.



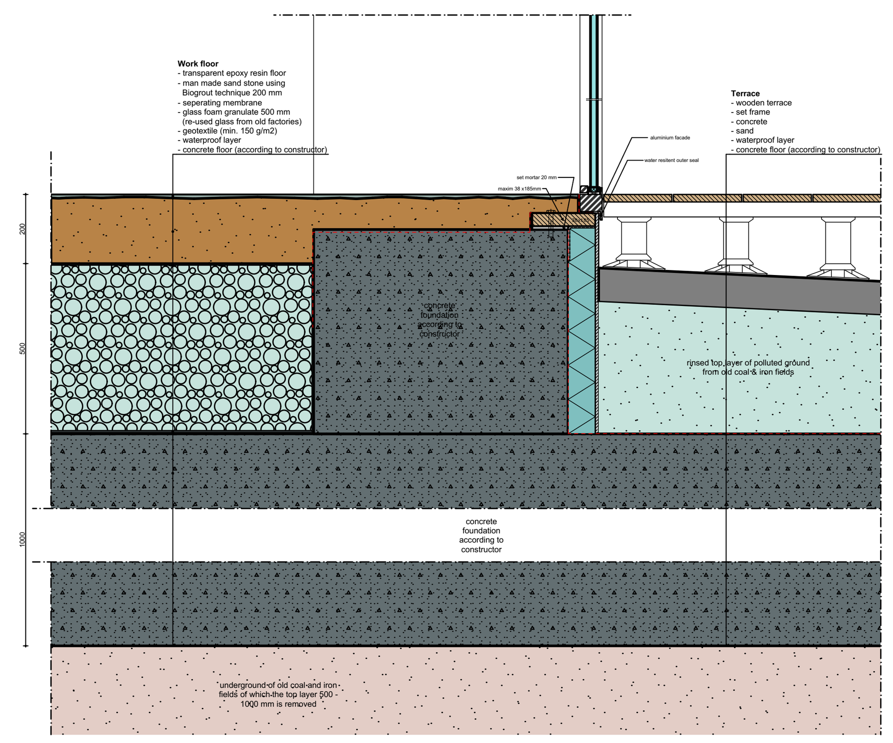
Section

1. Lobby/ check in
2. Storage/ small office
3. Gallery
4. Outdoor terrace
5. Storage
6. Parking employers office
7. Office & water testing facility
8. Public walking path on piperacks



Walls

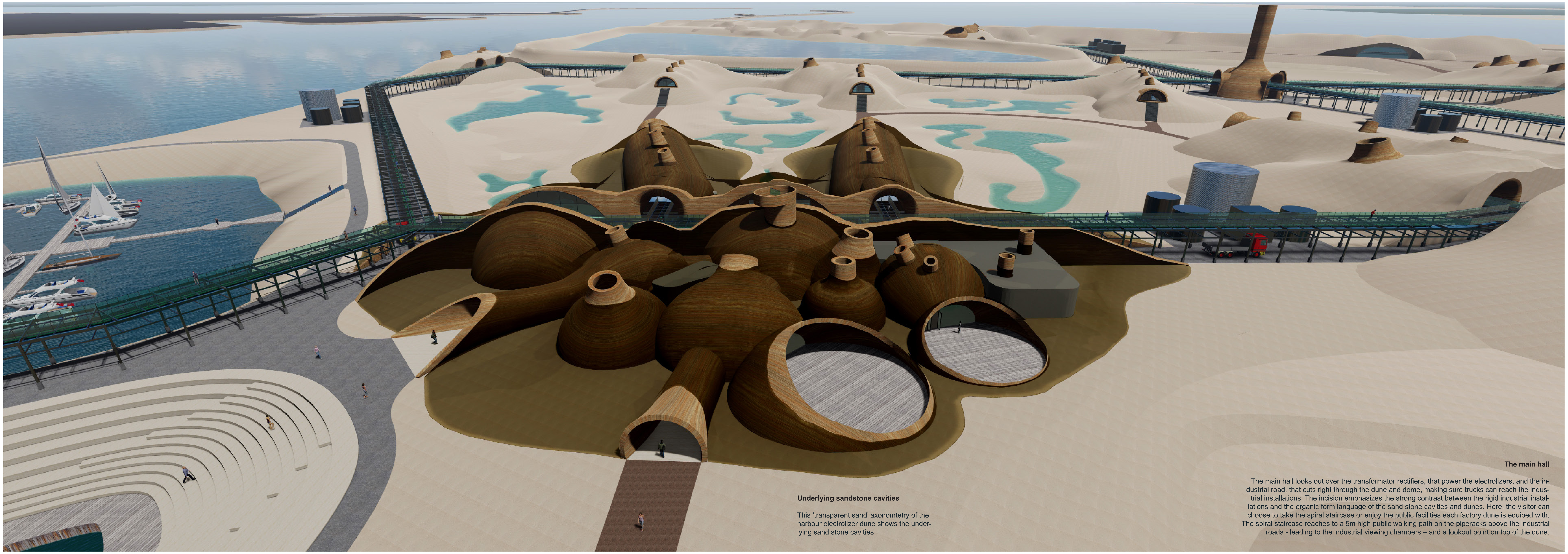
The walls next to the industrial road have a width of 1 to 1,5 meter at the bottom and 700cm- 1 meter at the top. Biodegradable mats of potato starch enable plant growth to fixate sand at the top of the dune next to the road gap. This top layer of sand comes from micro plastics free sand leayers in the north sea where it was harvested during the boring of the energy pipeline to the new wind turbine fields that will power the hydrogen factory. The sand used under the industrial road is the rinsed top layer from the old coal and iron ore fields. Above that a layer of rubble and glass foam (retrieved from the demolished factories) is provi-ded under the asphalt. A 3D printed elongated tip on the top of the wall enables swallow nest building . Swallows are an endangere bird species living in the excavations on the tata steel site.



Floors

These sandstone walls have a comparable build up to the walls of the electroli-zer room but there is a slight difference in the floor composition. I have replaced the power floated concrete finishing in the publicly accesible rooms for a layer of man-made sandstone that is leveled out with transparent epoxy resin to enlarge the feeling of being completely submerged in a sandstone cavity.

Axonometry of the harbour electrolizer



Transparent axonometry

Outside terraces

Outside terraces & restaurant overlooking the newly formed slufter

Main hall

Central hall with stairs to piperack walking path & lookout point (see text above)

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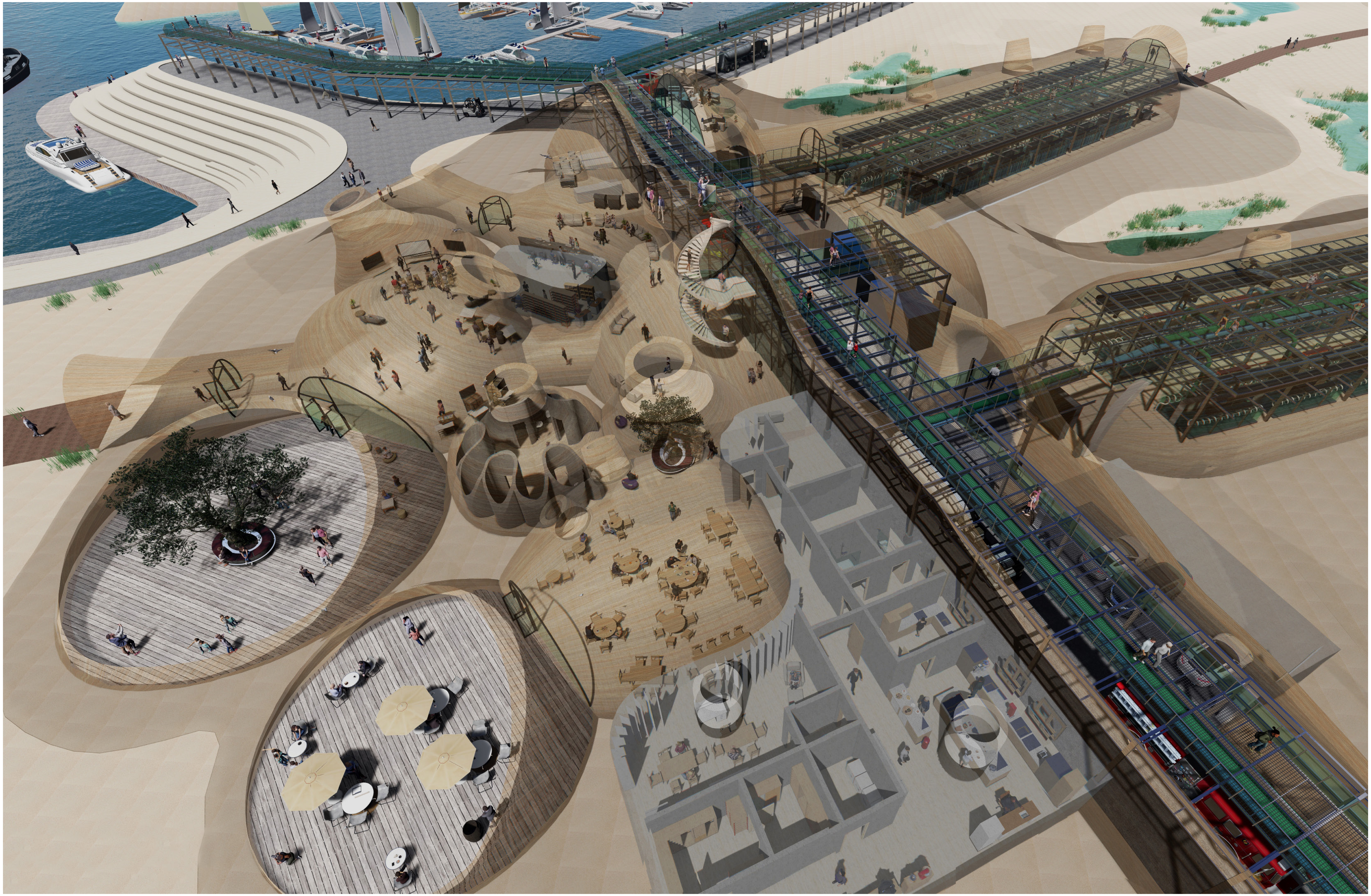
Transparant axonometry of harbour electrolizer



Harbour electrolizer

In this image the harbour electrolizer is shown in a transparant axonometry showing the harbour in the background. It is connected to the old coal harbour that has been transformed to a touristic harbour, bringing the public in through a high speed boatlift from amsterdam. Each ‘dune factory’ features industrial installations (in this case to the right of the industrial road) aswell as public facilities (seen on the left).

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