REPLANT THE SEED

FILLING THE EXCISTING GAPS IN AGRICULTURE DEVELOPMENT BY INTEGRATING A RESPONSIBLE ACHITECTURAL SOLUTION

Architecture forms a social and ecological system for the increasing vacancy within the agricultural sector around the Loonse & Drunense dunes, wherby it frames the collective balance between increasing recreational pressure and large-scale sustainability of the area.

By expanding the field of architectural design into programmatic studies, the project aims to claim **an renewed circular agricultural system** as part of the architectural and industrial object.

This results in a new experience of the agricultural business where the renewed circular agricultural system defines space and function which forms the **architectural transformation** that combine industrial activities with opportunities for visitors to become part of this new form of agriculture.

LOCATION

The transformation is a response to the new policy of the municipalities around the Loonse and Drunense dunes, which have stated that the recreational pressure of the area must be absorbed by the surrounding shell. It is also important that intensive livestock farming in this area makes way for sustainable, ecological solutions that contribute to improving the quality of the landscape. This is done to prevent small agricultural businesses from leaving the area and be replaced by mass industry.

Due to the objectives, it has been determined that the area around the Loonse & Drunense dunes does no longer offers space for intensive livestock farming. It will also have to absorb the recreational pressure from the heart of the Loonse & Drunense dunes. This forces farmers to switch to an organic, sustainable way of farming, whereby the transformation of their farm business forms a cohesion between the environment, the recreational opportunities and the financial business model.

Land:	75 hectares
Dairy cows:	100 pieces
Young stock:	70 pieces (spread over several locations)

CONTEXT

A medium-sized dairy farm will be transformed with a renewed circular system that makes it possible to create a self-sufficient business model within the current contours of the existing situation. The farm that has been selected for this, is located in the shell of the Loonse and Drunense dunes and is directly attached to the sub-area 'The Brand'. By studying the current agricultural system of the farm, it is obvious to conclude that many expensive raw materials must be bought to keep the business running. This indicates the need to adapt the current system.

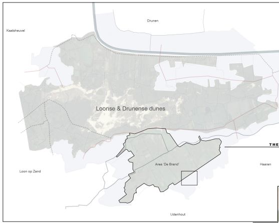
The current farm has about 75 hectares of land and has a typical farm typology, in which the farmhouse is located parallel to the street with the barns at the back of the yard. These various buildings each date from a different year of construction, which makes them clearly distinguishable in materialization and building methods.

CIRCULAR SYSTEM

The integration of a renewed circular system within the existing organisation and typology of the farm leads to a transformation of spaces and function. This renewed circular system shows itself to the public and invites visitors to become an active part of the system.

To make the current agricultural system circular, substitute elements need to be added. These serve as a replacement for the production of animal feed. New products like insects, duck grown and algae are added within the production process. The same applies to plants such as sorgum, hennep and lupine which are planted in the fields to ensure that the necessary raw materials are available on site. Innovative production processes like aquaponics and vertical agriculture are also being added, which leads to the increase of diversity in end products.

This extension of the production process will respond to the constant change of demand for vegetable products. A biogas installation ensures that manure and residual products can be processed into heat, electricity, hot water and biogas. This can be used to supply the new system, but can also be returned to the supply network. This circular system provides all the necessities to provide an average of 40 households with heat, electricity, hot water and gas every year.


Drunen
Kaatsheuvel
Loonse & Drunense dunes
Area 'De Brand'
Loon op Zand
Haaren
Udenhout

THE SHELL

LOONSE & DRUNENSE DUNES

MAIN EXPERTS

Agricultural business:	P. Teurlings (farmer)

P. Teurlings is the owner of the dairy farm and is an important link in the evaluation of the current production process. He knows exactly what he needs to run his business and is therefore essential for this architectural transformation.

Circular system:	Mieke Peijnenburg van Rooy - ABZ Dierenvoeding

Together with Mieke Peijnenburg van Rooy, it was determined how the circular cylces could be closed. Within this system, the animals are central because they work as a catalyst to provide the biogas installation with residual products.

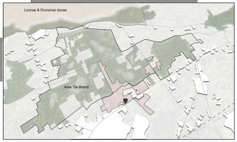
Loonse & Drunense dunes:	Chris-Jan Peijnenburg (resident Udenhout)

To obtain information about the area around the Loonse & Drunense dunes, contact was made with Chris-Jan Peijnenburg. He is familiar with the history, problems and the agricultural sector in the area. As a result, contact has been made with P. Teurlings.

Stable construction:	Mario Welvaarts / Ralf Theelen - Slaats Asten BV

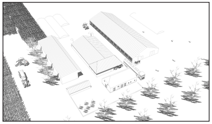
To gain insight into the relevant context, it was decided to contact Slaats Asten BV. This collaboration has resulted that the project being provided with more technical aspects. This also determined the current construction value of the farm.

AREA THE BRAND

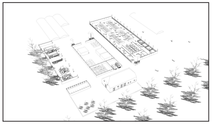

Loonse & Drunense dunes
Area 'De Brand'

AREA DE BRAND

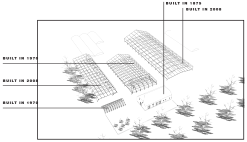
■ FARM P. TEURLINGS
▨ HECTARE P. TEURLINGS



EXISITING FARM



AGRICULTURAL ACTIVITIES


BUILT IN 1875
BUILT IN 2008
BUILT IN 1970
BUILT IN 2008
BUILT IN 1970

CONSTRUCTION

CURRENT SITUATION FARM

BIOGAS INSTALLATION

DIGESTATE

In addition to biogas, the anaerobic digester produces digestate as an endproduct. Digestate is an high-value fertilizer that can be used for land application. Using a separator, the solid digestate can also be used as bedding for cattle.

PRE-STORAGE TANK

Collection tank for dairy manure as well as food waste. All incoming food waste must be pasteurized before entering the anaerobic digester.

BIOGAS UPGRADING UNIT

Removes the moisture and carbondioxide from the biogas, resulting in biomethane gas.

ANAEROBIC DIGESTER

The anaerobic digester is the heart of the system. In the absence of oxygen, bacteria from the manure breaks down the organic matter and converts it to biogas. This process is very similar to what happens inside a cows stomach. The digester is continuously stirred using submersible mixers in the anaerobic digester.

PROCESS HOT WATER

Hot water generated by the generator is captured and used to provide heat to the digester. In additon, hot water is used on the farm to reduce the amount of fossil fuel purchase for heating and process demands.

PROCESS HEAT

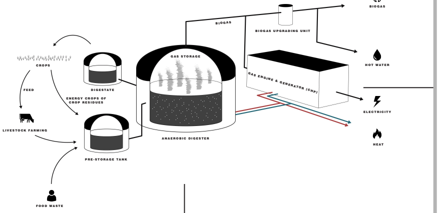
Heats the fermenter and is fed into the local heat supply network.

HEAT AND POWER UNIT (CHP)

In the gas engine & generator, the biogas is incinerated to produce electricity and heat.

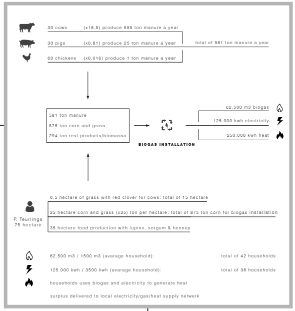
GAS STORAGE

The resulting biogas is stored above the digestate in a floating gas membrane.


BIOGAS
BIOGAS UPGRADING UNIT
BIOGAS
GAS STORAGE
GAS ENGINE & GENERATOR (CHP)
HOT WATER
ELECTRICITY
HEAT
CROPS
FEED
DIGESTATE
ENERGY CROPS OF CROP RESIDUES
LIVESTOCK FARMING
ANAEROBIC DIGESTER
PRE-STORAGE TANK
FOOD WASTE

> *"It does not matter how many cows a farmer has, since the amount of milk per worker determines what is left under the line"*
>
> **P. TEURLINGS**

By increasing the range of products and involving participants in the production process, it is possible for the farmer to establish a profitable, sustainable business system. The current number of cows on the farm will be reduced and replaced by the addition of chickens and pigs. The manure from these animals can be used for the biogas installation, which ensures that rest products become a essential element to close the cycles.



30 cows (x18,5) produce 555 ton manure a year

30 pigs (x0,81) produce 25 ton manure a year

60 chickens (x0,016) produce 1 ton manure a year

total of 581 ton manure a year

581 ton manure

875 ton corn and grass

294 ton rest products/biomassa

BIOGAS INSTALLATION

62.500 m3 biogas

125.000 kwh electricity

250.000 kwh heat

P. Teurlings
75 hectare

0,5 hectare of grass with red clover for cows: total of 15 hectare

25 hectare corn and grass (x35) ton per hectare: total of 875 ton corn for biogas installation

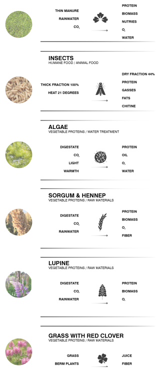
35 hectare food production with lupine, sorgum & hennep

62.500 m3 / 1500 m3 (avarage household):	total of 42 households
125.000 kwh / 3500 kwh (avarage household):	total of 36 households

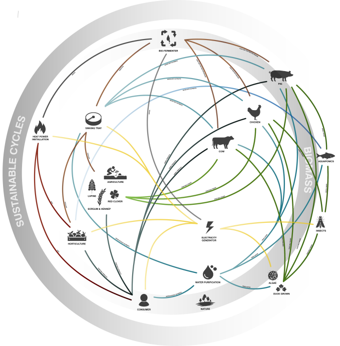
households uses biogas and electricity to generate heat

surplus delivered to local electricity/gas/heat supply netwerk

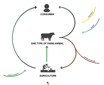
INVESTMENT:	**200.000 EURO**
SAVING:	**20.000 EURO PER YEAR**


THIN MANURE
RAINWATER
CO_2
PROTEIN
BIOMASS
NUTRIES
O_2
WATER
INSECTS
HUMANE FOOD / ANIMAL FOOD
THICK FRACTION 100%
HEAT 21 DEGREES
DRY FRACTION 44%
PROTEIN
GASSES
FATS
CHITINE
ALGAE
VEGETABLE PROTEINS / WATER TREATMENT
DIGESTATE
CO_2
LIGHT
WARMTH
PROTEIN
OIL
O_2
WATER
SORGUM & HENNEP
VEGETABLE PROTEINS / RAW MATERIALS
DIGESTATE
CO_2
RAINWATER
PROTEIN
BIOMASS
O_2
FIBER
LUPINE
VEGETABLE PROTEINS / RAW MATERIALS
DIGESTATE
CO_2
RAINWATER
PROTEIN
BIOMASS
O_2
GRASS WITH RED CLOVER
VEGETABLE PROTEINS / RAW MATERIALS
GRASS
BERM PLANTS
JUICE
FIBER

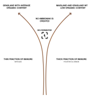
ADDITIONAL ELEMENTS


SUSTAINABLE CYCLES
BIOMASS
BIO-FERMENTER
PIG
CHICKEN
COW
AQUAPONICS
INSECTS
ELECTRICITY GENERATOR
ALGAE
DUCK GROWN
WATER PURIFICATION
NATURE
CONSUMER
HORTICULTURE
HEAT POWER INSTALLATION
SINKING TRAY
AGRICULTURE
LUPINE
RED CLOVER
SORGUM & HENNEP

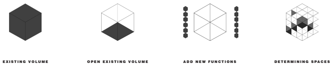
CIRCULAR SYSTEM


CONSUMER
ONE TYPE OF FARM ANIMAL
AGRICULTURE

CURRENT FARM SYSTEM


GRASLAND WITH AVERAGE ORGANIC CONTENT
MAISLAND AND GRASLAND WT LOW ORGANIC CONTENT
NO AMMONIAK IS CREATED
BIO-FERMENTER
THIN FRACTION OF MANURE
THICK FRACTION OF MANURE

SEPARATED MANURE TO PREVENT AMMONIA


EXISTING VOLUME
OPEN EXISTING VOLUME
ADD NEW FUNCTIONS
DETERMINING SPACES

DESIGN DEVELOPMENT

FUNCTIONS

Integrating this renewed system leads to a different approach to the agricultural typology. The renewed typology is distinguished by transparent spaces and functions that are created to make the production process visible. These spaces are connected by certain routing and sightlines, so that the visitor will go through every step of the process.

The **routing** is essential to experience the circular system. As a result, the route starts with the first elements within the cycles such as the growth of algae and duck grown. These phases are visible within the new buildings and are closed with clear **sightlines** towards the fields. The sightlines automatically guide you through the process, which are also reinforced by the variance of open and semi-closed facades. This allows you to experience the small-scale and large-scale components that are needed to complete the cycles. Because these fields change crops every year, the experience will be different at every moment you will visit the farm. The route leads to the green courtyard where you become part of this circular system by tasting some local products from the shop that is placed in the space where the cows used to live before the orginal barns were built.

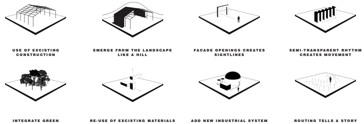
The routing shows that the farm becomes a **social** and **educational** experience in which the visitor can contribute.

Because several new production processes are being added to the system, more people will be needed to implement them. Where modern farms choose to keep employees or visitors away from the company, this system requires that they are literally **integrated** into the updated plan.

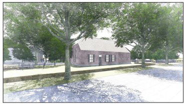
The new program includes accommodations so that visitors have the opportunity to spend the night on the farm. The accommodations for overnight stays are located at the courtyard. These accommodations will hardly be inhabited during the day as the people will help on the farm. As a result, the accommodations are quite hidden behind the facade for privacy, but still give guests the opportunity to enjoy the inner green garden.

It was decided not to transform the traditional farmhouse so that it differs from the street. The main road that is located next to the farm is characterized by traditional longitudinal façade farms that are parallel to the street. By conserving the local products from the shop, the visitor becomes automatically part of the cycles.

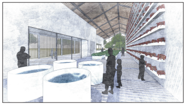
This new prgram hardly changed the appearance of the traditional farmhouse, so there is still an identical **contrast** between the renovated stables and the old traditional farmhouse.


USE OF EXCISTING CONSTRUCTION
EMERGE FROM THE LANDSCAPE LIKE A HILL
FACADE OPENINGS CREATES SIGHTLINES
SEMI-TRANSPARENT RHYTHM CREATES MOVEMENT
INTEGRATE GREEN
RE-USE OF EXCISTING MATERIALS
ADD NEW INDUSTRIAL SYSTEM
ROUTING TELLS A STORY

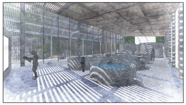
DESIGN ELEMENTS



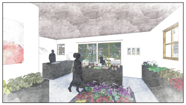
HISTORICAL FACADE IS PRESERVED



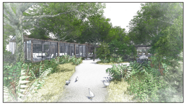
INNOVATING FARMING METHODS



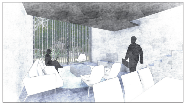
INTERACTIVE PRODUCTION PROCESS



NEW BUSINESS MODEL

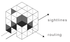


INTEGRATE RECREATION & GREEN



ACCOMODATIONS

PROGRAM

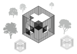

sightlines
routing

CONNECTING SPACES

MERGING SPACES

EMPHASIZE THE ORIGINAL SHAPE

APPLY AN SEMI-TRANSPARENT FACADE

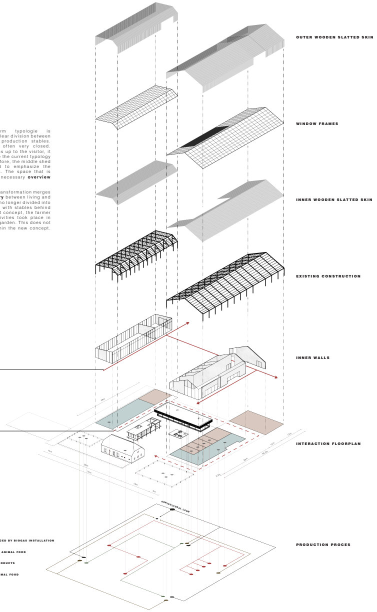


ADDING REQUIRED NEW VOLUMES AND GREENERY

TRANSPARENCY

The current farm typologie is characterized by a clear division between the farm and the production stables. These stables are often very closed. Since the farm opens up to the visitor, it is important to make the current typology more **spatial**. Therefore, the middle shed will be demolished to emphasize the other two buildings. The space that is created provides a necessary **overview** of the yard.

For the farmer, the transformation merges the current **boundary** between living and working. The plot is no longer divided into a typical farmhouse with stables behind it. Within the current concept, the farmer families leisure activities took place in or around the front garden. This does not have to change within the new concept.


OUTER WOODEN SLATTED SKIN
WINDOW FRAMES
INNER WOODEN SLATTED SKIN
EXISTING CONSTRUCTION
INNER WALLS
INTERACTION FLOORPLAN
PRODUCTION PROCES
sightlines
routing

🟦 **OPEN FOR PUBLIC**

🟫 **CLOSED FOR PUBLIC**

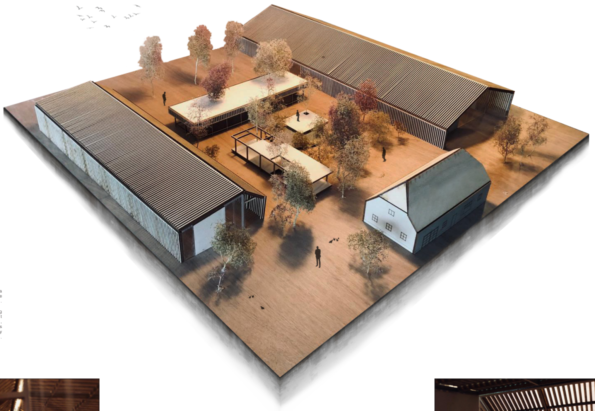
🟥 **HEAT/ELECTRICITY PRODUCED BY BIOGAS INSTALLATION**

🟩 **ADDITIVES PRODUCED FOR ANIMAL FOOD**

🟫 **MANURE AND RESIDUAL PRODUCTS**

⬛ **CROPS PRODUCED FOR ANIMAL FOOD**

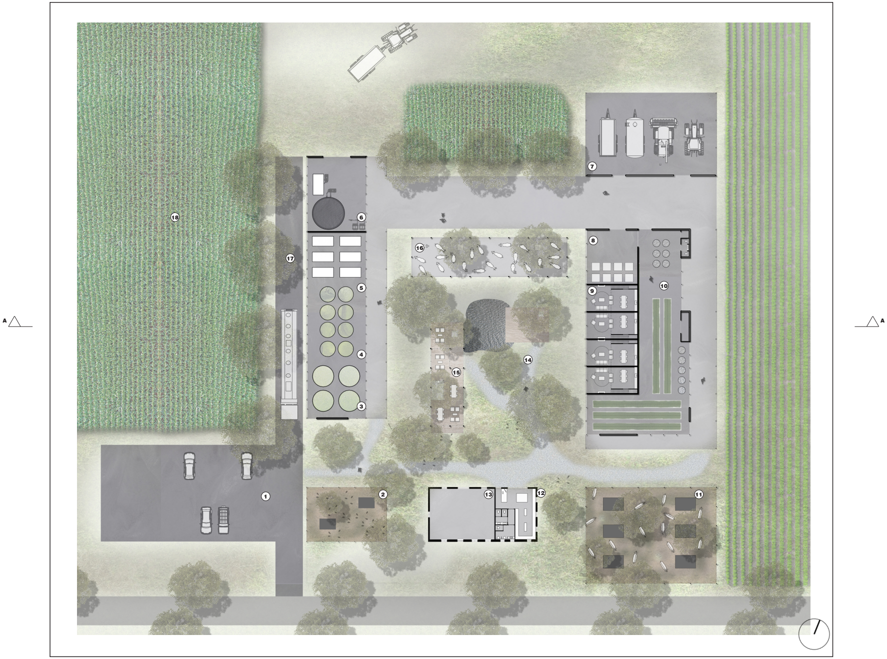
EXPLODED VIEW



MAQUETTE

By converting the architectural transformation into a presentable model, it becomes clear what the influence of architecture has on the experience of the farm.

The design has taken a clear position by interweaving itself with the environment. By applying transparent architecture and the spatial interpretation of the design, a coherence of functions has been created that invites people to enter the farm. This cohesion is enhanced by the minimal, monotome choices in materials and colors.


A
A
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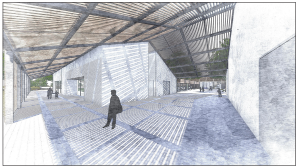
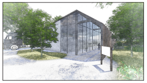
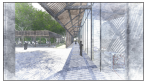
FLOORPLAN

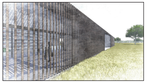
1:100

1. PARKING
2. CHICKENS
3. DUCK GROWN
4. ALGUE
5. INSECTS
6. BIOGAS INSTALLATION
7. MACHINES
8. STORAGE
9. ACCOMODATION
10. HORTICULTURE / AQUAPONICS
11. PIGS
12. LOCAL SHOP
13. FARMERS RESIDENCE
14. INNER GREEN
15. PAVILION / MULTIFUNCTIONAL SPACE
16. COW PAVILION
17. TRANSPORTATION
18. CROPS









RED CEDAR WOOD

PLASTER WHITE

GREY PAVEMENT

BLACK STEEL

Materials and detailing play an important role in the architectural image. The materials that mainly come back in the design, can be found on the existing farm. Examples of these are old pavement and construction beams of the previous barn. The walls are finished with a white outer plaster, so that the inner walls form a **monotonous contrast** with the outer, red cedar wooden shell.

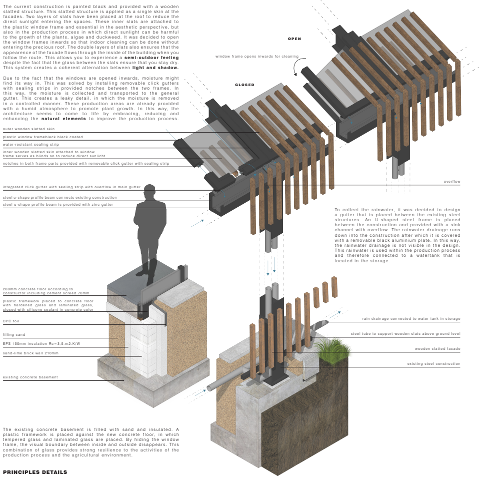
In addition, the existing steel columns and beams are painted black to increase the identity of the construction. This creates an interplay of dark and light colours that together form a contrast with the deviating, natural appearance of the wood.

MATERIALS

DETAILLING

The current construction is painted black and provided with a wooden slatted structure. This slatted structure is applied as a single skin at the facades. Two layers of slats have been placed at the roof to reduce the direct sunlight entering the spaces. These inner slats are attached to the plastic window frame and essential in the aesthetic perspective, but also in the production process in which direct sunlight can be harmful to the growth of the plants, algae and duckweed. It was decided to open the window frames inwards so that indoor cleaning can be done without entering the precious roof. The double layers of slats also ensures that the appearence of the facade flows through the inside of the building when you follow the route. This allows you to experience a **semi-outdoor feeling** despite the fact that the glass between the slats ensure that you stay dry. This system creates a coherent alternation between **light and shadow.**

Due to the fact that the windows are opened inwards, moisture might find its way in. This was solved by installing removable click gutters with sealing strips in provided notches between the two frames. In this way, the moisture is collected and transported to the general gutter. This creates a leaky detail, in which the moisture is removed in a controlled manner. These production areas are already provided with a humid atmosphere to promote plant growth. In this way, the architecture seems to come to life by embracing, reducing and enhancing the **natural elements** to improve the production process.


OPEN
window frame opens inwards for cleaning
CLOSED
outer wooden slatted skin
plastic window frameblack black coated
water-resistant sealing strip
inner wooden slatted skin attached to window frame serves as blinds so to reduce direct sunlicht
notches in both frame parts provided with removable click gutter with sealing strip
integrated click gutter with sealing strip with overflow in main gutter
steel u-shape profile beam connects existing construction
steel u-shape profile beam is provided with zinc gutter
overflow
200mm concrete floor according to constructor including cement screed 70mm
plastic framework placed to concrete floor with hardened glass and laminated glass, closed with silicone sealant in concrete color
DPC foil
filling sand
EPS 150mm insulation Rc=3,5.m2.K/W
sand-lime brick wall 210mm
existing concrete basement
rain drainage connected to water tank in storage
steel tube to support wooden slats above ground level
wooden slatted facade
existing steel construction

To collect the rainwater, it was decided to design a gutter that is placed between the existing steel structures. An U-shaped steel frame is placed between the construction and provided with a sink channel with overflow. The rainwater drainage runs down into the construction after which it is covered with a removable black aluminium plate. In this way, the rainwater drainage is not visible in the design. This rainwater is used within the production process and therefore connected to a watertank that is located in the storage.

The existing concrete basement is filled with sand and insulated. A plastic framework is placed against the new concrete floor, in which tempered glass and laminated glass are placed. By hiding the window frame, the visual boundary between inside and outside disappears. This combination of glass provides strong resilience to the activities of the production process and the agricultural environment.

PRINCIPLES DETAILS

DESIGN

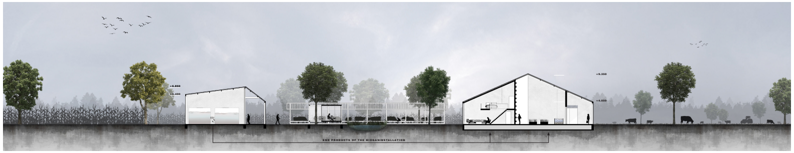
The current construction of the stables are retained within this transformation. This construction is completely covered with a **rhythm** of wooden slats that ensures a **semi-transparent** facade. In this way, distinction is no longer made in a wall-to-roof structure, as a result of which the new building appears to **emerge** from the landscape like a hill. The facade is not interrupted by various elements, so that the facade retains a monotonous appearance. The facade ensures that the production process starts to move in a contemporary way. This happens because the rhythm of the wooden slats provides a visual **movement** when you pass the buildings.

The inner volumes within this new outer skin are pushed back to emphasize the shape of the building. These sightlines define the spaces and also ensure that façade openings are created that remove the boundary between the routing and the agricultural landscape. This creates an interesting indoor/outdoor space that will be experienced as semi-open or semi-closed.

PROCESS TRANSPORTATION

It is important as a visitor to experience the activities on the farm up close. As a result, the choice was made to transport the various products from one building to another. Another aspect of the cycles is the transportation from supplies of products to the farm. By means of the transparent walls behind the slatted facade, it is possible to experience this process when a truck comes to load and unload.

In order to affect this slatted structure as little as possible, it was decided to run the pipework underground. The machines are part of the circular system and therefore visible in production areas. These machines will have an above-ground supply that is visible to the visitor. The underground disposal of end products such as electricity and biogas goes underground to the designated locations.


+6.850
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+4.050
END PRODUCTS OF THE BIOGASINSTALLATION

1:100
SECTION A-A

RODPLANT

ROYAL FERN

TWO-STYLE HAWTHORN

ARNICA

DOUBLE LEAVES

WOOD ANEMONE

WILD MILLET GRASS

FOREST HORSETAIL

YELLOW DEAD-NETTLE

RUGGED FIELD PIPING

SOLOMON'S ORDINARY STAMP

GREAT WALL

GOLDEN BUTTERCUP

WHITE WOOD SORREL

THREE-GRAIN WALL

FLORA

INNER GARDEN

The green inner garden offers places for visitors to relax and consume the purchased local product. This is equipped with a transparent multifunctional pavilion that merges into the renewed area. Lectures, workshops and meetings can be given here. The other new building volume that is attached to this green inner garden is the cow pavilion. This cow pavilion provides space for approximately 30 dairy cows that are milked on-site by means of a mobile milking machine. These dairy cows walk on a renewed floor system that can separate the hard and wet manure before it goes to the biogas installation. In this way, ammonia is not produced.

These new building volumes in the heart of the yard are lower and different in shape, compared to the large stables which creates a more enclosed feeling from the inner green garden. In this way, the volume of the characteristic stables is preserved, giving you the feeling that you are entering a framed courtyard. To enhance this feeling, it was decided to raise the pavilion and to provide it with a rational wooden construction which merge with the reintegrated green planting in the garden. The same applies to the cow pavilion, where it also seeks the link with the other buildings in the form of the wooden slats. The cow pavilion forms the visual connection between the two large buildings, enhancing the routing.

FLORA & FAUNA

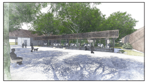
Because the courtyard is the focal point of the renewed concept, all activities have moved to the edge of the farm. This makes it possible to create an oasis of green where it is important to strengthen the link to 'De Brand'.

Wood is used primarily for this transformation. The area 'De Brand' characterized over the years because of the wood extraction. The area mainly consisted alder trees, but this was replaced by oak trees around 1950 due to the increasing demand for building materials.

To strengthen the **connection** to the nature reserve, it has been decided to bring this alder tree back within the new concept. Alder wood is not a material that can be built with, so it has been chosen to reflect this in the planting of the courtyard. This also applies to a number of native flowers and plants that are characteristic of the area.

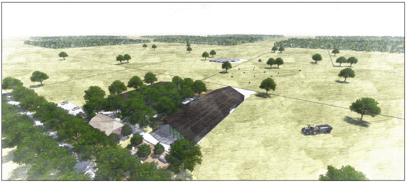
By bringing the natural area within the renewed concept, there is a good chance that fauna will also nettle here. In this way it is not only the architectural transformation, but also the planting that reduces the boundary between the farm and the rural area. This shows that a polluted production process can be changed in an area that is open to humans, plants and animals.

PAVILION / MULTIFUNCTIONAL SPACE



COW PAVILION

IMPRESSIONS



OVERVIEW AGRICULTURAL BUSINESS

FUTURE PERSPECTIVE

This project speaks for itself through a renewed way of agriculture that comes together in a contemporary architecture. It links itself to the environment and ensures that a sustainable revenue model is created for the farmer. It hereby gives a response to the increasing, polluted mass industry within the agricultural sector, which literally seems to distance itself from its surrounding.

Because this new concept is based on an architectural transformation, it is possible to apply this within any existing agricultural company. In this way, the entire agricultural sector will literally become interwoven with the landscape and responds to the demand for sustainable climate solutions by making innovative ways of farming visible.

Max Peijnenburg

Graduation Project

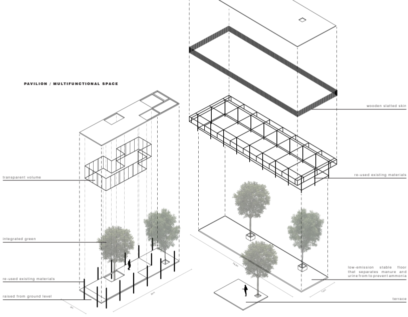
Master of Architecture + Urbanism Fontys Tilburg

18.06.2020

mentor extern:	Dingeman Deijs - Dingeman Deijs Architects
mentor academy:	Jan Willem van Kuilenberg / Pieter Feenstra

RE-USE OF MATERIALS

As many materials as possible are reused within the circular process. This also applies to the wood construction in which the two pavilions are built. Despite the poor status of the current barns on the farm dating back to 1970, it is possible to use enough old construction beams and columns to shape the pavilions.


COW PAVILION
PAVILION / MULTIFUNCTIONAL SPACE
transparent volume
integrated green
re-used existing materials
raised from ground level
wooden slatted skin
re-used existing materials
low-emission stable floor that separates manure and urine from to prevent ammonia
terrace

EXPLODED VIEW