E-Synergy

Local collaboration in Agriport

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Architectural Engineering

*inspired by a technique*

Nature = most sophisticated technique

↓

Sustainable energy
Disadvantage of sustainable energy

<table>
<thead>
<tr>
<th>Power source</th>
<th>Power Density [W/m²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>up to 4000</td>
</tr>
<tr>
<td>Natural gas</td>
<td>200 - 2000</td>
</tr>
<tr>
<td>Coal</td>
<td>100 - 1000</td>
</tr>
<tr>
<td>Solar (PV)</td>
<td>4 - 10</td>
</tr>
<tr>
<td>Wind</td>
<td>0.5 - 1.5</td>
</tr>
<tr>
<td>Biomass</td>
<td>0.5 - 0.6</td>
</tr>
</tbody>
</table>
Sustainable energy
closer to its user

“Truly a disadvantage?”
Energy infrastructure

*change of scale: macro*

Conventional energy infrastructure

*macro scale*

One way distribution
Energy infrastructure

development of scale: to micro

implementations

micro scale

Two way distribution

Less demand from macro system
Energy infrastructure

change of scale: to micro

further implementations

micro scale

Imbalance
Energy infrastructure

change of scale: meso is the answer

Small scale power plants (micro)
Implemented in a system (macro)
= a short term-based transition

We need to revolutionize the system:

meso scale

And eventually go for a worldwide grid
Energy infrastructure

change of scale: *meso is the answer*

centralised macro + decentralised micro = distributed meso

↓

collaboration
Energy infrastructure

*new spatial planning concept*
Energy infrastructure

*new spatial planning concept*

Agriport
Context: Agriport
Agriport

Agricultural cluster

Cluster of large scale food
- production
- processing
- logistics

business park

160 MW datacenter
Agriport energy analysis

energy exchange & CHP: current

CHP (3 – 4 MW capacity): 49% heat; 43% electricity
Agriport energy analysis

implementation geothermal

Currently providing 10 – 15 % of heat demand of greenhouses
Agriport energy analysis

implementation geothermal: future

Heat from geothermal source:
- $\text{CO}_2$ ?
- Electricity ?
Agriport energy analysis

*actual future situation*

- low temperature waste heat (30 – 40 °C)
- no energy exchange at all!
Agriport energy analysis

_datacenter: waste heat_

Waste heat from datacenter: 280 GWh (1 PJ annually) (25% capacity on average)

Reference project: 3500 MWh enough for 11,000m² aquaparc

Theoretically: 880,000m² (88 hectare) aquaparc in Agriport

Biggest indoor aquaparc is 'only' 66,000m²
Agriport energy analysis

*greenhouses: electricity*

Waste electricity from greenhouse next to datacenter: \[3800 \text{ MWh}\]

Average electricity use per household in NL: \[3500 \text{ kWh}\]

Waste is enough for 1000 households!

*But it’s not consistent*
Agriport energy analysis

*greenhouses: electricity*

Another problem: consistency
Agriport energy analysis

*meso solution*

- energy balance in own cluster
- exchange with other clusters
- use national/international energy shortages (wider scale)

Complement the energy exchange in the cluster
(not only using wastes)
Agriport energy analysis

energy & resource exchange

- using mainly waste heat
- using waste electricity
- provides clean surface water

Function:
Swimming pool
(& water treatment plant)
Program: Natural swimming pool
Agripool

*energy & resource exchange: incoming*

- **280,000 MWh**
- **3,800 MWh**
Agripool

energy & resource exchange: outgoing
Agripool

energy & resource exchange
Region scan

*is there a need for a swimming pool?*

absence of swimming association Medemblik:
*regional collaboration (April, 2014)*
Agripool

*water treatment*

Water treatment for the cluster Agriport

**Technique** = nature
Agripool

natural water treatment: sewage water
Agripool

natural water treatment: pool water

goal: chlorine free swimming pool
Agripool

*legislation vs. creativity*
Design: Agripool
Impression
Design principles

the different scales implemented

- **Micro scale**: aim on **self-sufficiency**
  
  *(self supporting roof)*

- **Macro scale**: **colossal** macro infrastructure
  
  *(exaggerated presence of construction)*

- **Meso scale**: **contribution** to the cluster
  
  *(transparency of facades)*
Design principles

context implemented

Materialization:
glass facade (greenhouses)

Shape:
rational & functional
(factories)
Design principles

**technique** implemented

**Sewage treatment:**
in greenhouse appendix

**Pool water treatment:**
outside but under construction
Agripool
Agripool
organization

- 50m pool
- Functional
- Recreational
- Visitor entrance
- Employee entrance
- Sewage treatment
Agripool

organization: middle part (ground floor)
Agripool

organization: middle part (1st floor)
Technical design
construction

1 basic principle:

- stability = helping construction (coöperation)
- self-supporting facade
- angled for sun protection and acoustics (coöperation)
Technical design

construction

basement needed for tension of construction (under pools)

room for installations
Technical design
installations
Technical design

installations: black water
Technical design

installations: heating water

waste heat datacenter (30 – 40 °C)

used for:
- swimming water
- underfloor heating
- ventilation
Technical design

installations: swimming water
Challenge the future

Technical design

installations: rainwater collection in basement

No connection to water infrastructure

greenroof buffers

70–90% in summer
50% in winter
Technical design

*installations: ventilation (BaOpt)*

conventional ventilation

BaOpt ventilation
Technical design

*BaOpt ventilation*

conventional solution:

*inspired by a technique called ‘nature’*

BaOpt solution:
Technical design

installations overview

BaOpt air inlet

swimming water

rainwater buffer

Internal swimming water
Rain water (re-usable grey water)
Ventilation