Towards energy autonomy, with environment oriented architecture
Problem | increasing energy demand
Problem | depleting natural resources
Problem | variable electricity production
Problem | non-integrated design
Objective
Starting points
Location | Nieuw-Haamstede
Program
Program

- Garage: 38m²
- Toilet: 2m²
- Bathroom: 8m²
- Large bedroom: 15m²
- Small bedroom: 12m² (3x)
- Living room: 20m²
- Dining room: 15m²
- Work space: 40m²
- Kitchen: 12m²

Visual connections:
- No visual connection outside
- Limited visual connection outside
- Visual connection outside
Design concept
Design concept | phases of energy neutral design

1. Passive design

2. Using waste streams

3. Active design: using sun, wind or water for producing energy
Design concept | passive design
Design concept | active design
Technical research | electricity consumption during one day
Technical research | solar energy

![Graph showing production and consumption of solar energy over weeks. The graph indicates periods of shortage and overproduction.]
Technical research | solar energy [year]

Solar irradiation on a surface [w/m²]

- **East**
- **South**
- **West**

Solar irradiation on a surface [w/m²] by direction:
- **North**
- **South**
- **East - West**
- **Horizontal**

Months:
- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November
- December
## Technical research | solar energy

<table>
<thead>
<tr>
<th>Position of PV cells</th>
<th>Horizontal</th>
<th>South 45°</th>
<th>South 90°</th>
<th>South-East</th>
<th>South-West 45°</th>
<th>East</th>
<th>East West 45°</th>
<th>East West 90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface PV cells (S 45°)</td>
<td>81 m²</td>
<td>68 m²</td>
<td>92 m²</td>
<td>72 m²</td>
<td>91 m²</td>
<td>128 m²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs PV system (€200/m²)</td>
<td>€ 16.200,-</td>
<td>€ 13.600,-</td>
<td>€ 18.400,-</td>
<td>€ 14.400,-</td>
<td>€ 18.200,-</td>
<td>€ 25.600,-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity consumption</td>
<td>40671 MJ</td>
<td>40671 MJ</td>
<td>40671 MJ</td>
<td>40671 MJ</td>
<td>40671 MJ</td>
<td>40671 MJ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity shortage winter months</td>
<td>13704 MJ</td>
<td>10886 MJ</td>
<td>8577 MJ</td>
<td>11562 MJ</td>
<td>13262 MJ</td>
<td>12673 MJ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overproduction summer months (to be stored)</td>
<td>16736 MJ</td>
<td>13183 MJ</td>
<td>10739 MJ</td>
<td>14010 MJ</td>
<td>16229 MJ</td>
<td>15534 MJ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount of batteries* (100kWh)</td>
<td>47</td>
<td>37</td>
<td>30</td>
<td>39</td>
<td>46</td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs batteries (€500/kWh)</td>
<td>€2.350.000,-</td>
<td>€1.850.000,-</td>
<td>€1.500.000,-</td>
<td>€1.950.000,-</td>
<td>€2.300.000,-</td>
<td>€2.200.000,-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks of electricity shortage</td>
<td>1-12</td>
<td>40-52</td>
<td>1-12</td>
<td>42-52</td>
<td>**1-10</td>
<td>43-52**</td>
<td>1-12</td>
<td>41-52</td>
</tr>
</tbody>
</table>
Design concept | phases of energy neutral design

Passive design

Using waste streams

Active design: using sun, wind or water for producing energy
✓ Combine dwellings into a small grid

✓ Solar energy: multiple orientations can match consumption and production during the day better: preferably S, SW and W orientation due to afternoon & evening consumption
Design concept | active design
Design concept | dwelling
Design concept | passive design
Design concept | integration in the context

• Different viewpoints

• Shape

• Materials & colors
Design | building shape
Design | building shape
Design | building shape
Design | building shape
Design | building shape
Design | building shape
Design | building shape
Design | building shape

40°

60°

45°
Design | section
deoel interieur overslag
- wooden roof construction
- glass facade
- shallow foundation
- timber frame construction
- reinforced concrete against ground pressure
Climate system | ventilation (natural)
Climate system | ventilation (mechanical)
Climate system | warm tapwater
Climate system | cold tapwater
Climate system | sewer system
Climate system | heating
Climate system | electricity
Climate system | roof plan

±11 m² PV slates per dwelling
132 m² in total = 27% of total consumption
Climate system | roof plan

300\(m^2\) solar collectors = 120% of total consumption

+ 128 \(m^2\) PV black panels
together with PV slates = 120% of total consumption

(428/680 \(m^2\) roof surface)
Climate system | roof plan
Climate system | roof plan