1 ppp is not equal: its resources, that people have to live in balance with. And money to facilitate that. So we focus on resources.

2 Its not about improving a bad scoring benchmark, but about the distance to an ideal future situation.

And that’s about working in closed cycles, or a flow constancy, below carrying capacity, or within potential exergy.

3 No weighing factors....

4 No end of pipe but input and flow.
Land as limiting factor - 'in time'

Island Earth

“Island” Limburg

Limburg krimpt al honderden jaren!

Alleen hoefden we daar tot nu toe niets mee te doen…
(to be verified:) If a system, whether defined as a building, city or the earth as a whole, consumes more thermodynamic “quality” as being converted and stored from radiation, somewhere depletion takes place and quality in the system as a whole decreases. (Within limits of balancing the original situation)
If a system, whether defined as a building, city or the earth as a whole, consumes more thermodynamic “quality” as being converted and stored from radiation, somewhere depletion takes place and quality in the system as a whole decreases. (Within limits of balancing the original situation)
radiation source

Energy food materials

Wind PV collector biomass
- Electricity
- heat

Crops sediments living
- Wood
- lime

Gravity

stocks

heat

stocks

Embodied Land/space

source

conversions

qualities
Ijburg house

mining and depleting non-renewables 57% embodied loss

growing renewables 43%
Embodied Land = 18.33 m²

0.08 m² Operational Energy
0.06 m² Embodied Energy
Embodied Land:

The land in time needed to convert solar radiation into useful resources, 
In principle via the best known technology, 
ie energy is recalculated to m2 PV panels, 
and materials:
Production renewable fraction: yields in \textbf{kg/ha-year}

<table>
<thead>
<tr>
<th>Material</th>
<th>Yield (kg/ha-year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>flax fibres (vlas) for insulation material</td>
<td>2.000</td>
</tr>
<tr>
<td>flax shives for particle board / flax board</td>
<td>3.000</td>
</tr>
<tr>
<td>flax linseed for linoleum</td>
<td>1.500</td>
</tr>
<tr>
<td>straw</td>
<td>4.000</td>
</tr>
<tr>
<td>roof reed (dry)</td>
<td>6.500</td>
</tr>
<tr>
<td>sheep wool</td>
<td>29</td>
</tr>
<tr>
<td>hemp</td>
<td>3.500</td>
</tr>
<tr>
<td>wood</td>
<td>10.800</td>
</tr>
<tr>
<td>bamboo</td>
<td>36.000</td>
</tr>
<tr>
<td>cork</td>
<td>125</td>
</tr>
<tr>
<td>shells</td>
<td>245</td>
</tr>
<tr>
<td>loam</td>
<td>1.000</td>
</tr>
<tr>
<td>sand</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Yields vary greatly depending on various factors e.g. location, climate, what part of the biomass is counted as yield, dry/fresh material, quality selection, harvest method, use of fertilisers/chemicals, etc.

Refine database in further research
Maxergy

Indicator: Embodied Land

Primary impact

Secondary impact

Material

Energy

Water

Product

Material

Recycled material

Direct

Indirect

Operation

Total Embodied Land
Show xls tool
Winning design for Building 4 District of Tomorrow

**Embodied Land:**
- EL for 82% **renewable materials:** ~ 800 m2-year/m2-useful area
- EL for **Embodied energy** all materials: ~ 10 m2-year/m2 ua
- EL for **Operational energy** (0-energy house): ~ 0.5 m2-year/m2 ua

- After ~ 20 years OE equals EE. After ~ 1600 years EL materials.
- (related to PV potential/ incl storage)
<table>
<thead>
<tr>
<th>floor</th>
<th>renewable</th>
<th>normalised</th>
<th>design</th>
<th>Building as normalised</th>
<th>operational</th>
<th>0-Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>ton</td>
<td>m²</td>
<td>%</td>
<td>kg/m²</td>
<td>EL total m²/year (ha)</td>
<td>ha/m² ha/m² fl</td>
<td>m²/m²ha/year</td>
</tr>
<tr>
<td>121</td>
<td>266</td>
<td>82</td>
<td>454</td>
<td>2508,00</td>
<td>9,43</td>
<td>64,00</td>
</tr>
</tbody>
</table>

*Note: The table above represents data related to the building's energy consumption and operational energy usage. (*)
What we now include in the tool is:

The (Embodied) land to regrow the trees (for compensating wood use)

And the energy to collect iron ions from seawater, to re-establish concentrated iron due to dispersion. (to fill the hole)

A recycled part can be distracted from the load.
Steel and wood beam adapted for comparable load (carry floor section)

<table>
<thead>
<tr>
<th>m² (-year)</th>
<th>Emb Land, Ren. Energy based</th>
<th>without return</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EL-dir</td>
<td>EL-ee</td>
</tr>
<tr>
<td>steel beam</td>
<td>0,002</td>
<td>1,4</td>
</tr>
<tr>
<td>wood beam</td>
<td>23,8</td>
<td>0,3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>m² (-year)</th>
<th>Emb Land, Fossil energy based</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EL-dir</td>
<td>EL-ee-fossil</td>
</tr>
<tr>
<td>steel beam</td>
<td>0,002</td>
<td>462140992</td>
</tr>
<tr>
<td>wood beam</td>
<td>23,8</td>
<td>84856396</td>
</tr>
</tbody>
</table>
RECYCLING: GELDT ALS NIEUW TENZIJ VORIG GEBRUIK IS GEREGERISTREERD
O-exergy building
Electricity via Oil

Time relation:
Oil used and stocks: (2005): 336,000 miljard ltr.;
Earth: 510,066,000 km²; > 65 million year

Per day: ~14,000 ltr (globally)

Space time relation:
0,0106 ltr oil per km²-year or
~0,0006 kWh(e)/ha-year

Efficiency?
Efficiency: in % from solar to electricity:
~0,00000000006 % (6 x 10⁻⁹ %)

PV

Time relation:
Per day globally: sheer endless

Space time relation:
1 million kWh / ha-year

Efficiency?
Efficiency: in % van zon naar electriciteit:
~14 %
0-impact is about m2's

Our ability to convert M2 of solar radiation access to provide human demands
Blanc system

No demand, no production

High potential/quality increase over time

Existing system situation

High demand No production: strong decrease of quality

Process: maximize production, reduce functions and demand to become neutral: Urban Harvest Plus (pilot KW)

System to be used:

Process: max production of quality guiding for functions to be allowed in system

Function/demand:

Optimise space time need, for functions, to balance quality potential growth and decrease by functions.

Highest quality/Exergy: ecosystem
Tools Characteristics: differences

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cause</td>
<td>effect/impact</td>
<td></td>
</tr>
<tr>
<td>Absolute</td>
<td>relative</td>
<td></td>
</tr>
<tr>
<td>Historic benchmark</td>
<td>future target</td>
<td></td>
</tr>
<tr>
<td>Weighted results</td>
<td>un-weighted results</td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>process evaluation</td>
<td></td>
</tr>
<tr>
<td>Unit-less</td>
<td>Mass/ CO2/ physical/money unit</td>
<td></td>
</tr>
<tr>
<td>Climate adapted</td>
<td>non-adapted</td>
<td></td>
</tr>
<tr>
<td>Socioculturally adapt.</td>
<td>non-adapted</td>
<td></td>
</tr>
<tr>
<td>Whole chain ass.</td>
<td>construction assessment</td>
<td></td>
</tr>
</tbody>
</table>

R.Rovers, SBScentre www.sustainablebuilding.info
### B 4.10 Design for disassembly, re-use or recycling

<table>
<thead>
<tr>
<th>Bench-mark building</th>
<th>Benchm.</th>
<th>B 4.10</th>
<th>B4</th>
<th>tot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score compare d to BB</td>
<td>1,0,3,5</td>
<td>12,1 %</td>
<td>56 %</td>
<td>22 %</td>
</tr>
<tr>
<td>score</td>
<td>3</td>
<td>0,36</td>
<td>0,20</td>
<td>0,044</td>
</tr>
</tbody>
</table>

**Total Score**

![Graph showing performance issues](image)

- **Resources**: 1.6
- **Loadings**: 2.2
- **IEG**: 1.2
- **Service Quality**: 1.3
- **Economics**: 1.2
- **Management**: 1.4
- **Transport**: 0.0

- **Total** Score: 1.8

- **Performance issues**
**Kg/m² la**

- Total materials: 924
- Renewable/rec.: 81
- Percentage: 8.7%

---

**Kg/m² la**

- Total materials: 1122
- Renewable/rec.: 192
- Percentage: 17%
Laten zien hoeveel nodig voro oe en ee
## Project Indicators Planning

<table>
<thead>
<tr>
<th>Project</th>
<th>Status</th>
<th>Energy Demand</th>
<th>Energy Supply</th>
<th>Materials Demand</th>
<th>Materials Supply</th>
<th>Water Demand</th>
<th>Water Supply</th>
<th>Landuse Demand</th>
<th>Landuse Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knik</td>
<td>Under construction</td>
<td>vraag</td>
<td>leervering</td>
<td>&lt; 750 kg/m²</td>
<td>25% renewable</td>
<td>min &quot;watergie&quot;</td>
<td>0% renewable</td>
<td>plus 1</td>
<td>Landuse</td>
</tr>
<tr>
<td>Eco/nect</td>
<td>In detail phase</td>
<td>passive</td>
<td>EPC = 0.3</td>
<td>50% renewable</td>
<td>50% renewable</td>
<td>100% renewable</td>
<td>100% renewable</td>
<td>100% renewable</td>
<td>100% renewable</td>
</tr>
<tr>
<td>Exergie House</td>
<td>In design</td>
<td>EnergyPlus</td>
<td>EnergiePlus</td>
<td>&lt; 750 kg/m²</td>
<td>75% renewable</td>
<td>Exergie 2.0</td>
<td>Exergie 2.0</td>
<td>Exergie 2.0</td>
<td>Exergie 2.0</td>
</tr>
<tr>
<td>0-materials</td>
<td>Planned</td>
<td>E-Plus</td>
<td>E-plus</td>
<td>Exergie 2.0</td>
<td>~100% renewable</td>
<td>Exergie 2.0</td>
<td>Exergie 2.0</td>
<td>Exergie 2.0</td>
<td>Exergie 2.0</td>
</tr>
</tbody>
</table>

*Note: The table above provides a snapshot of various project indicators including energy demand and supply, material usage, and water requirements.*
Regeneration of renewable fraction:

**space-time occupancy**

**EMBODIED LAND**

- 125 years: 7.3 m²/year
- 100 years: 9.2 m²/year
- 75 years: 12.2 m²/year
- 50 years lifetime: 18.3 m²/year
- 25 years: 36.6 m²/year
- 10 years: 91.6 m²/year
- 1 year: 916 m²/year

*Ijburg*
- 1 m² living area
- 550 kg/m² total mass
- 38 kg/m² renewables
- 43% renewables
5-step approach

1. Production  
   maximise production in system

2. (Re-)organisation  
   fullfill demand in most effective functional way

3. Reduction  
   Direct reduction of function demand

4. Optimisation  
   Cascading and combining demand and production

5. Maximisation  
   Fullefill needs maximised for all sources together
closed Building resource Cycle
A: total mass per m²,
B: renewable mass /m²
C: distance to 0; non-renewable fraction