Tools and concepts for sustainable management of the subsurface in the Netherlands: A technical investigation

Jasper Griffioen, Joke van Wensem, Justine Oomes, Frans Barends (all TCB), Jaap Breunese, Hans Bruining, Theo Olsthoorn, Fons Stams, Almer van der Stoel
**Environmental management ain’t easy**

Conflicts among stakeholders are more common than exceptional

The quarrelsome relation in environmental management

<table>
<thead>
<tr>
<th>authorities</th>
<th>citizens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Law Power</td>
<td>Knowledge Power</td>
</tr>
<tr>
<td>Compulsion Power</td>
<td>Media Power</td>
</tr>
</tbody>
</table>

(Ph.D Winnubst)
TCB working group Sustainable Management of Subsurface

What are technical tools for sustainable management of the subsurface?

What goes wrong – What goes right
Why do things go wrong – go right

Approach made:
Cases and lessons learned → an analysis
Theoretical concepts → an investigation
Cases investigated

1. Underground constructions
2. Moving earth and making lakes shallower
3. Soil remediation
4. Aquifer thermal energy storage
5. CO₂ storage survey
6. Salt mining and land subsidence
7. Geothermics
## Core elements related to use of the subsurface

<table>
<thead>
<tr>
<th>Technological/scientific</th>
<th>Administrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary research</td>
<td>Assessment</td>
</tr>
<tr>
<td>Suitability of the subsurface</td>
<td>Planning</td>
</tr>
<tr>
<td>Application of theory in practice</td>
<td>Precautions</td>
</tr>
<tr>
<td>Risk estimate</td>
<td>Agreements and responsibilities</td>
</tr>
<tr>
<td>Monitoring WITH threshold values</td>
<td>Liability</td>
</tr>
<tr>
<td>Measures in the event of failure</td>
<td>Direction and guidance</td>
</tr>
<tr>
<td>Transparency of democratic procedures</td>
<td>Transparent democratic procedures</td>
</tr>
</tbody>
</table>
## The sustainability issue - 1

<table>
<thead>
<tr>
<th>Properties of the use itself</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Duration</td>
</tr>
<tr>
<td></td>
<td>Optimisation</td>
</tr>
<tr>
<td></td>
<td>Scarcity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social issues</th>
<th>Political aims</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Usefulness and need</td>
</tr>
<tr>
<td></td>
<td>Effect and consequence</td>
</tr>
</tbody>
</table>

Continuous communication !!!!!
Awareness raising on, in particular, usefulness and need

Maintenance of good and usable subsurface is a public interest
The sustainability issue – Legal principles

1. Precautionary principle
2. Obligation of care
   - Prevention
   - Rectifying pollution at the source
   - ALARA - As Low As Reasonably Achievable
3. Polluter pays/stand-still

The precautionary principle asks for
- Risk-limiting measures
- Application of risk management strategies
Hand-on-the-tap risk management

See De Waal et al. (2012). Neth. J. Geosci. (91/3), 385-399
**Assessment methodologies on sustainability**

They exist but are not often applied to subsurface activities

- Social cost-benefit analysis
- Life cycle assessment
- Sustainability profile of a location
- Environmental impact assessment

Specifically for energy

- Concept of useful energy
Recommendations made

- Management by scarcity instead of by demand
  - sustainable resource-driven management
    - legal instruments
    - economic
    - communicative
- Implement closed-loop monitoring for riskful activities
- For heterogeneity and unknown features, apply precautionary principle
  - Learning by doing
- Responsibility and liability must be set out
- Consider reversibility of impacts
- Consider abandonment, too
Thank you for your attention

www.tcbodem.nl
Soil Protection Technical Committee

Jasper Griffioen: also at
Deltaries