Minewater 2.0

Development of a Hybrid Sustainable Energy Infrastructure in the Municipality Heerlen, the Netherlands

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Content

1. Goals Minewater 2.0
2. Minewater 1.0
3. Minewater 2.0
4. How it works (2.0)
5. Minewater 3.0 (near future)
Minewater 2.0

Goals

1. Long term maximum use of geothermal underground for sustainable heating and cooling of buildings
2. Becoming an essential part of the Sustainable Energy Structure Plan 2040 municipality Heerlen (carbon neutral city)
3. Minewater Corporation (Modern Utility Company) with a sound business case based on a long-term ROI (± 25 years)
4. Promotion of local employment
5. Involving local educational and research institutions
6. High social involvement and sustainability awareness inhabitants
Minewater 1.0

History

1999 First ideas to use Minewater as an energy source
2000 – 2003 Lobby and fund raising: Interreg IIIB (European) and EOS Energy Research Subsidy (National)
2004 Decision City Council start Minewater project
2004 – 2006 Research, design, drilling two hot wells (700 m), pump tests. Water quality, temperatures and capacity OK.
2006 – 2008 Drilling two cold wells (250 m) and one intermediate injection well (450 m), design and construction conduct network between wells and potential customers
2007 Calculations indicate that mine water is indeed a long term viable resource
2008- 2012 European funding by 6th Framework Program project EC REMINING-lowex (Redevelopment of European Mining Areas into Sustainable Communities by Integrating Supply and Demand Side based on Low Exergy Principles) and national funding by UKR Unique Opportunity Regulation
Minewater 1.0

History

2008 - 2009 City Council agrees with intention to found a Minewater Company and with start business activity
2008 Realisation and connection first mine water power station Heerlerheide Centrum (HHC: 30.000 m2)
2009 Realisation and connection second mine water power station Central Bureau of Statistics (CBS: 22.000 m2)
2009 – 2011 Investigation on behalf of city council if Minewater can be developed into an economically viable activity based on a business case and risk analysis
2011 Final decision City Council to establish an independent Minewater Company, initially with 100% shareholder ship municipality.
2012 – 2013 Concept design, engineering, construction Minewater 2.0 hybrid sustainable energy infrastructure with two new connection Arcus (30.000 m2) and APG (32.000 m2)
November 2013 Final Establishment Minewater Company
2014 – Future Minewater 3.0.........
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Funding

European funding:
• Interreg IIIB (6,4)
• 6th Framework Program project EC REMINING-lowex (3,5)

National funding:
• EOS Energy Research Subsidy (0,3)
• UKR Unique Opportunity Regulation (0,6)
• ISV Investment budget City Renovation (1,3)
• Province of Limburg (0,4)

Investment Municipality Heerlen (2)
Shares Municipality Heerlen (5,1)

Total investment Minewater project ± 19,6 MEUR
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Drivers Municipality Heerlen

1. Rehabilitation of the Limburg mining past
2. Use former mines as source for sustainable energy
3. Stimulating energy-transition and savings

- First reason most important to start the project.
- After closing mines economy went down, connection to new labour market was bad and people lost there identity and pride.
- Old mineworkers where closely involved in the project by searching for the best locations for the wells. Also existing mining areas in Poland where visited.
- The Minewater project was used as a vehicle to tell stories of old mineworkers and capture these stories for future generations.
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Drivers Municipality Heerlen

1. Rehabilitation of the Limburg mining past
2. Use former mines as source for sustainable energy
3. Stimulating energy-transition and savings

The second and third reason follow out of the first one: the ambition to use the past in a positive way for the future (black to green):

• Significant CO2 emission reduction
• High social historical context
• First project in The Netherlands where former mines are used as heat/cold source
• High innovative character and stimulation for other innovative sustainable energy projects in Europe.
• Strengthen image municipality Heerlen en Parkstad Region as a sustainable and innovative region
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End and new beginning

May 2014
Minewater 1.0
2008 – May 2013

3D model of the underground mine water network (VITO)
Temperature evolution of the hot (HH1) and cold (HLN1) production wells for different conduction factors (VITO).
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Flow pattern reservoir

Mijnwater 1.0, municipality Heerlen

Customers

Depth compared to surface

NAP

Coal seam

Mined coal seam

Carboniferous

Triassic

Infiltration

Summer

Winter

 Shaft

225 m

318 m

420 m

545 m

700 m

700 m

31°C

100 m

166 m

250 m

340 m

420 m

825 m

May 2014
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Other restrictions

- Limited hydraulic and thermal capacity
- Not demand driven and single acting:
  - Summer April until September only cold supply
  - Winter October until March only heat supply
- No heat and cold exchange between buildings possible
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New Concept

- Energy exchange instead of energy supply:
  - Between buildings through cluster grids
  - Between clusters through mine water grid
- Energy storage and regeneration of mine water reservoir instead of depletion
- Enlargement hydraulic and thermal capacity
- Fully automatic control and demand driven
- Addition of poly generation (Bio CHP, reuse waste heat, cooling towers)
- Addition of energy storage in buildings and cluster grids
- System suitable for demand and supply side management in near future (Minewater 3.0)
Minewater 2.0
Final situation

Return well HLN3 out of order
Hot to Hot (HH2)
Cold to Cold (HLN2)

T_hot supply 28°C
T_cold supply 16°C
T_hot return 28°C
T_cold return 16°C

CLUSTER A
Arcus-APG

CLUSTER B
CBS-Maankwartier

CLUSTER C
Weller HHC

CLUSTER D
Componenta-Otterveurdt
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Enhanced flow pattern reservoir
Minewater 2.0
Situation 2013

Sophisticated injection valves in hot and cold injection wells
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How it works

3 Levels of control:
- Building: Temperature
- Cluster: Flow
- Minewater: Pressure

Demand

Supply
Minewater 2.0

How it works

Artist impression Minewater 2.0 with geographically dispersed mine water installations
Minewater 2.0
How it works: CMS
Minewater 3.0
Demand and supply side management

Learning

Optimal use of assets

Predicting

Cell/cluster-balancing

Minewater B.V.
Minewater
Feedback operation 1.0 and 2.0

Minewater 1.0:
• Simple system: hardly to nil operational problems
• Little flexibility: change over system => only heat or cold supply => failure heat pumps during mid season

Minewater 2.0:
• Complex automatic demand driven system: intensive fine tuning was necessary
• Some leaking incidents because conduct network was never operated with high pressures, reverse flow and pressure fluctuations => old weak points occurred.
• After more than one year of experiences the (process control) system works very successfully as intended
Minewater
Possible difficulties and challenges

• Creative, inventive and pragmatic thinking solves all difficulties. Choose the right team and partners in the development chain.
• Own know-how and capability to manage know-how are essential. Be master of your own concept.
• Politics: a cooperating government (municipality and county) and representatives who believe and support the project and team from the beginning are essential.
• Create support by explaining what you're doing.
• Know the cost price, purchase main components yourself, conservation for 30 years included.
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Focus points and challenges

• Choose the right drilling locations: technically and strategically (energy storage)
• Law aspects e.g. mining law, construction permits
• Recruiting new customers = seducing (win/win)
• Reliability of supply (back-up)
• Funding and financing (for the long-term)
• Think integral and back-wards: demand side is leading not the supply side.
• Think in re-use / exchange instead of supply => new possibilities and solutions appear.
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Mine water
Our water
Our future

Thank you for your attention