



A strategic area-approach to energy transition in the built environment

Saleh Mohammadi, Witteveen+Bos International Projects B.V.

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Content

- 1. Witteveen+Bos facts and figures
- 2. Trias Territoria: W+B approach to energy tarnation in the built environment
- 3. ERDH Case study







Witteveen - Bos





Mission & Vision

- 1. We provide consultancy services and designs in the fields of water, infrastructure, environment and construction.
- 2. Independent consultancy
- 3. Cooperation is key
- 4. Corporate social responsibility is important in all our activities



Clients

- Public authorities
- Private sector companies
- Industries
- Joint ventures





International offices Latvia United Kingdom 🔳 Kazakhstan United Arab Emirates Vietnam Panama Ghana Singapore Indonesia



Areas of expertise (business lines and units)

- Area Development
 - Buildings
- Environmental Law and Permits
- Planning Studies and Process Management
 - Urban Development Energy Transition





Ecology

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- Coasts, Rivers and Land Reclamation
- Flood Protection and Land Development
- Hydraulic and Geotechnical Engineering
- Ports and Waterways
- Water Management

- Asset Management
- Digital Technologies
 - Drinking Water
- Industry and Energy

 International Technical Assistance
Soil Remediation and Sustainable Land Management





- Civil Structures for Railways
- Construction Management
- Infrastructural Engineering
- Smart Infra Systems
- Traffic and Roads
- Underground Infrastructure





Built Environment

Main measures

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- Efficient energy use
 - Individual and collective fossil-free heat options



Regional Level

Bos

Witteveen



Regional heating structure

- Overview regional heat demand
- Allocation large heat sources (geothermal, residual heat)
- Inform level of participation

Municipal Level



Heat transition vision

- Roadmap to 2050 with preferable sustainable heating option(s) for each district in the municipality
- Inform, consult levels of participation

Neighborhood Level



Neighborhood implementation plan

- Implementation plan
- Detailed technical and financial analyses
- Inform, consult, involve collaborate level of participation

Iterative, participatory, more and more detailed



Trias Territoria, W+B sustainable design principle





Trias Territoria - first step: building



- facade improvements: insulation and structural improvements at 'best buy' level
- 2. Installation improvements: save energy through hardware improvements, for example: heat recovery, lighting and lighting controls, etc.
- **3.** Good housekeeping: saving energy by optimizing operation of installations
- 4. Smart buildings: reducing user-related energy demand by influencing behavior
- 5. Building-integrated sustainable energy generation, such as PV, PVT and GSHP



Trias Territoria - second step: neighborhood

- Optimal use of local sources of renewable energy such as Aquifers Thermal Energy System (ATES)
- Exchange and distribution of energy flows, for example using a Smart Thermal grid





Trias Territoria – third step: region

 Procurement of HT geothermal heat or renewable electricity from WT





Trias Territoria - steps order

TT is not intended to be a rigid system that cannot be deviated from. It describes a philosophy that can be deviated on the basis

of good arguments





Principle of Aquifer Thermal Energy Storage (ATES) operation

Example configuration of an ATES system demonstrates the principle of operation







ATES well infrastructure

ATES-well installation, hidden under the street



ATES-well on the surface, with open covering structure





Aquifers Thermal Energy System

- Aquifers are present in most subsoil areas in built environment, in general at 40 to 250 m depth
- We started with ATES for single building use, now we scale aquifers over complete city area
- The water in the aquifers is not used itself, there are strict physical borders in heat exchangers between the building systems and the circular used water from the aquifers
- It's not the temperature difference, but the vast amounts of water and sand used in the aquifers to store the heat and cold, that makes this systems extremely efficient



Potential benefits of ATES

- Energy savings: COP of systems vary between 4-40, depending on sources & seasons
 - In cooling mode up to 90 % energy savings, in heating mode up to 50% energy savings
 - Overall CO2-savings from 40% up to 90 %
 - ROI up to 7 years, depending on location, sub-soil complexity and energy prices
- Suitable for all built environment: housing, offices, hospitals, schools etc.
 - No smell, no noise, no visual impact, no smog, no heat islands and limited electricity usage

MOTION2040 Een samenwerking tussen Witteveen+Bos, DWA en Rebel

ERDH (EnergieRijk Den Haag)

STATISTICS IN THE



EnergieRijk Den Haag (The Netherlands)

2018 – running The Hague, The Netherlands

Clients > Government to set example for sustainability:

- · Rijksvastgoedbedrijf, State Company for Government Real Estate
- Municipality of The Hague
- Province of South-Holland

Consortium: Motion2040 consisting of DWA, Rebel, and Witteveen+Bos **Scope**: Area-oriented strategy to make 16 (semi-)government buildings sustainable (since 2020: over 30 buildings).

Coverage: over 1 million m² of (semi-) public building area in the city center of The Hague.

Goal: The goal was devising measures based on the TT approach to make the buildings climate neutral by 2040. The consortium aim to working out a repeatable and scalable area approach that client can also roll out in other cities.

Trias Territoria, Smart Thermal Grid and Geothermal Energy



The Hague, governmental capital of The Netherlands



the Hague city Center

Map of clusters of buildings, with buildings age



Trias Territories - building level

Three energy saving packages at the building level has been distinguished:

- 1. Minimal savings
- 2. Common sense
- 3. Maximum savings

Measures	Packages	
Good Housekeeping	Minimal savings	
Monitoring	Minimal savings	
Energy coach	Minimal savings	
Frequency control of ventilation system	Common sense	
Heat recovery	Common sense	
Energy-efficient lighting	Common sense	
building conditioning	Maximum savings	
Facade improvements/ post- insulation	Maximum savings	
Demand-driven lighting	Maximum savings	



Trias Territories – area and regional levels concepts

For the heat systems, the following systems have been mapped:

- HT Heat network
- LT ATES network
- Combined ATES Heat network



HT Heat Network

Sources for the HT heat network:

- Geothermal energy
- · Industrial residual heat
- Biomass / biogas





ATES Network

- Existing individual ATES installations will be preserved and connected to the ATES network
- Heat pumps are necessary to upgrade the heat from the grid
- Regeneration might be necessary to recharge the heat or cold unbalances





ATES Network

- Linking ATES to unlock sustainable potential
- Added value:
 - Better utilization through coupling
 - Energy exchange at building level
 - Clustering leads to connecting more buildings
 - Residual heat and cold will be available for surrounding real estate





Combined ATES and Heat network

- Providing synergy by linking ATES and heat network
- In this concept, heat network will be used as a peak load in situations that the ATES encounters limits
- The advantage of this combined approach is that it becomes easier to choose an optimal approach per building





Evaluation of Concepts

Minimal savings

+ Cheapest

- Maintain high energy demand and thus demand for sustainable energy sources
- Not always suitable for low temperature heat

Heat network

+ Cheapest

- + Low project and process risks
- + Limited use of space in the building and surroundings
- Scarcity of high temperature heat
- Dependent on third parties for objectives and planning

Common Sense

- + Balanced in investment with respect to energy savings
- + N-ZEB-ready
- Not always suitable for low temperature heat

Heat network and ATES

- + Limited high temperature demand
- + ERDH is launching customer for ATES linkage + heating network
- + Technically robust because the network and ATES are each other's back-up
- Linking ATES technical/organizational complex
- Dependence on third parties

Maximum savings

- + N-ZEB: very energy efficient
- + Commitment to low temperature heat
- + Solved heat demand in the environment
- Expensive in relation to investment

ATES

- + Unlocking the potential of the substrate
- + ERDH is the launching customer for ATES linkage and coordination
- + Minimal dependence on policy and third parties
- Need expensive peel insulation
- Existing contracts problematic



Variants

Systems of heat supply	Packages of Energy Saving Measures		
	Cost-effective measures	Common Sense measures	Maximum savings measures
HT Heat network	A, C	F	E
ATES and Heat network		В	
LT ATES			D



Variants assessment





THERE

Next stage EnergieRijk Den Haag 2.0



Lessons Learned

- Trias Territoria orders a sustainability assignment into a step-by-step approach that can provide direction and can diminish the complexity of heat transition
- Sustainability at building level is not possible; energy from the environment is necessary
- The optimum solution lies in a combination of measures at the building, area and regional level
- Focusing on energy label steps can lead to sub-optimal solutions and high costs
- Implementing energy measures at area level offers significant economies of scale.



