Digital tools for refurbishment planning based on facts and choice of pipe system based on Total Cost of Ownership and CO2 emission
**Peter Jorsal**  
Product & Academy Manager  

**Presenting**  

**Total Cost of Ownership (TCO) tool**  
A tool that will find the best choice of pipe system based on Total Cost of Ownership  

**Martin Lindgaard Pedersen**  
Senior Director - Digitalization  

**Presenting**  

**Pipe Invest**  
A ONE-CLICK solution that brings you aggregated overview of utility networks. It shows current status, but can also predict future refurbishment in utility assets (grids) and allows Utilities to optimize OPEX and CAPEX levels.
Global presence

LOGSTOR Group
• Headquarters in Denmark
• 1,260 employees
• Annual turnover > 240 MEUR

Facts:
• 7 plants and 2 mobile production units
• 13 Sales Units
• Serving more than 40 countries
• More than 5,000 km pre-insulated pipes every year
• More than 300,000 km LOGSTOR pipes supplied to data
LOGSTOR Pipe Invest
Disclaimer!

The Pipe Invest tool is currently under development. We are looking for utilities, who are willing to test the system. Expected launch late 2021.
Asset management and network optimization tool

A ONE-CLICK solution that brings you aggregated overview of utility networks. It shows current status, but can also predict future refurbishment in utility assets (grids) and allows Utilities to optimize OPEX and CAPEX levels. Utilities can reach new levels of confidence in surveillance and investments based on specific network predictions.

Pipe Invest can tell Utilities where, when and how much to invest
Different users with different roles and needs

"Typical" Utility organisation

Board of Directors

CEO

Operation

Planning

Monitoring and future digital services

Economic overview

Network overview
How it works:

The DH network is imported (via Shape files) in the software. The Shape files contains information on the District Heating pipes. In the “Network” view, the utility “adjusts” individual parameters on sliders:
- Quality of Pipes
- Energy Loss
- Joints
- Physical condition

After this an economic view is calculated, using algorithms from the TCO tool (presented later by Peter)
Economy View:

The Economy Overview will provide information to your reinvestment planning. With a given maintenance budget, the bar chart with the budget curve (blue) will provide an overview of the financial effects and the map will show the location of the pipes in question.
TCO tool

The right choice of pipe system
The challenge – complexity in amount of possibilities

- Available pipe systems

- **Single pipe**
  - Series 1
  - Series 2
  - Series 3

- **TwinPipe**
  - Series 1
  - Series 2
  - Series 3

- All these variants can be delivered with or without a diffusion barrier
  - The diffusion barrier secures that heat loss properties will remain the same during life time

- → 12 different choices for the same project
Markets for pair of pipe

Single pipe series 1

Single pipe series 2

Single pipe series 3

Series 1 single pipe is 60% of the total market of pair of pipe

Series 1 dingle pipe is the pipe system with the worst insulation properties
Why is situation like that?

We see many energy companies that make their choice of pipe system based on

“We do what we do because this is what we always have done”
Total Cost of Ownership includes:

- **Investment (CAPEX)**
  - Pre-insulated pipes
  - Excavation and asphalt
  - Pipe handling, welding and jointing
  - Consulting, design
  - Supervision

- **Operation (OPEX)**
  - Heat loss cost
  - Pumping cost
  - Repairs
  - Maintenance
  - Surveillance
TCO tool, 12 different pipe scenarios for the same project

<table>
<thead>
<tr>
<th>DN</th>
<th>80</th>
<th>96</th>
<th>60 m DN 40</th>
</tr>
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<td></td>
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<td>780</td>
<td>60 m DN 40</td>
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</table>
TCO tool, Input of data

Design data
- T flow [°C]: Winter 80, Summer 70
- T return [°C]: Winter 35, Summer 40
- T soil [°C]: Winter 4, Summer 14
- Days in operation: Winter 215, Summer 114
- Pressure [bar]: Winter 6, Summer 150
- Soil Cover [m]: Winter 0.6, Summer 3
- Lambda Soil [W/mK]: Winter 1.6, Summer 1.1

TCO Calculation data
- Currency: EUR
- Exchange rate: 1
- Interest [%]: 3
- Period TCO calc [years]: 3
- Energy unit: MWh
- Energy price [price/unit]: 40

CO2 Emission data
- Fuel type: Natural Gas
- Ton CO2/TJ: 55.52
- Include CO2 in TCO: Yes
- CO2 quote price (currency/ton): 35
- Number of years in TCO: 9

Enter metre trench pipe by dimension

Bonded pipe system
- 120: DN32 / Ø42.4
- 276: DN40 / Ø48.3
- 96: DN50 / Ø60.3

FlexPipe system
- Select type
- Add

Calculate TCO
TCO tool, Calculation of TCO

Results of calculation

Dimensions DN20-DN200

TwinPipe Conti, s. 2 with diffusion barrier $\lambda = 0.023 \text{ W/mK}$**

Note regarding lambda values:
* Pair of pipes, Conti DN200 series 2 and series 3 have lambda values at 0.025 W/mK.
** Twinpipes, DN 100 series 2 and DN 125-200 series 1/3 have lambda value 0.027 W/mK.

Graph showing TCO cost in EUR for different pipe configurations.
Calibration of the model and sensitivity analysis

Calibrate the system in relation to share of the different parts of the investment cost

Make sensitivity analysis on price of energy and period for the calculation

Use the sliders
Calibrate the share of investment costs

Results of calculation

Dimensions DN20-DN200

TwinPipe Conti, s.2 with diffusionbarrier λ = 0.023 W/mK **

DN20-DN200 note regarding lambda values:
* Pair of pipes, Conti in DN200 series 2 and series 3 have lambda value at 0.023 W/mK.
** Twin pipes, DH100 series 2/3 and DH125-DN200 series 1/2/3 have lambda value 0.027 W/mK.
TCO tool, Sensitivity analysis energy cost and period

Results of calculation

Dimensions DN20-DN200

TwinPipe Conti, s=3 with diffusion barrier λ = 0.023 W/mK

Note regarding lambda values:
* Pair of pipes, Conti DN200 series 2 and series 3 have lambda value of 0.023 W/mK
** Twinpipes, DN200 series 2/3 and DN150-DN200 series 1/2/3 have lambda value of 0.027 W/mK
TCO tool, Calculation of CO₂ emission

Values are summarized across all years and compared to the pipe solution with the highest CO₂ emission.

Dimensions DN20-DN200

<table>
<thead>
<tr>
<th></th>
<th>Savings (%)</th>
<th>0%</th>
<th>17%</th>
<th>28%</th>
<th>37%</th>
<th>44%</th>
<th>50%</th>
<th>58%</th>
<th>52%</th>
<th>60%</th>
<th>65%</th>
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</thead>
<tbody>
<tr>
<td>Pair of pipes</td>
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<tr>
<td>without diffusion barrier</td>
<td>1,572</td>
<td>1,523</td>
<td>1,386</td>
<td>1,270</td>
<td>1,121</td>
<td>1,030</td>
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Pair of pipes

TwinPipe

Traditional
without diffusion barrier
λ = 0.027 W/mK

Conti.
with diffusion barrier
λ = 0.025 W/mK

TwinPipe
cont.
with diffusion barrier
λ = 0.023 W/mK
TCO tool, Calculation of ROI

Dimensions DN20-DN200

ROI

- TwinPipe Traditional, s.1 without diffusion barrier
  - λ = 0.027 W/mK

- TwinPipe Conti s.2 with diffusion barrier
  - λ = 0.023 W/mK

Years

EUR

12.8 years
The TCO tool is being tested in this period

Launch October 2021
Questions