LowTEMP

Economic efficiency and funding gaps in (LT)DH systems

Introduction and application of a calculation method

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Interreg Baltic Sea Region
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

LowTEMP training package - OVERVIEW

Introduction

- Intro Climate Protection Policy and Goals
- Intro Energy Supply Systems and LTDH
- Energy Supply Systems in Baltic Sea Region

Energy Strategies and Pilot Projects

- Methodology of Development of Energy Strategies
- Pilot Energy Strategies – Aims and Conditions
- Pilot Energy Strategy – Examples
- Pilot Testing Measures
- CO_2 emission calculation
- LCA calculation

Financial Aspects

- Life cycle costs of LTDH projects
- Economic efficiency and funding gaps
- Contracting and payment models
- Business models and innovative funding structures

Technical Aspects

- Pipe Systems
- Combined heat and power (CHP)
- Large Scale Solar Thermal
- Waste & Surplus Heat
- Large Scale Heat Pumps
- Power-2-Heat and Power-2-X
- Thermal, Solar Ice and PCM Storages
- Heat Pump Systems
- LT and Floor heating
- Tap water production
- Ventilation Systems

Best Practice

- Best Practice I
- Best Practice II

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1. Introduction

Problem, aim and definitions of terms

Problem and aim

- Economical problems of LTDH projects:
  - large upfront capital
  - lack of profitability
- Possible solution: funding
- Obstacles:
  - Amount of funding to cover "funding gap"?
  - Proof of "funding gap" to authorities or investors

- Tool for determining economic efficiency and calculating funding gaps of LTDH projects
- Stakeholders:
  - LowTEMP's project partners
  - municipal actors
  - DH suppliers
  - energy agencies
  - planners
  - Engineers
  - Funding authorities

Definition of terms

Economic efficiency

- Simply said and absolutely speaking, when the sum of all benefits is higher than the sum of all costs (over a certain period of time)
- many different calculation methods
- dynamic calculations shall be preferred as they consider time value of money

Discount rate

- interest rate used in dynamic techniques to calculate the present value of future cash flows

Funding

- money given by a government or organization for an event or activity [1]
- usually free of charge [2]
- no requirements to pay back it back [2]

Definition of terms

Funding gap

- part of an investment that cannot be covered by revenues within the usual amortization period [3]
- basis for applying for funding [3]
- "difference between the positive and negative cash flows over the lifetime of the investment, discounted to their current value (typically using the cost of capital)" [4]

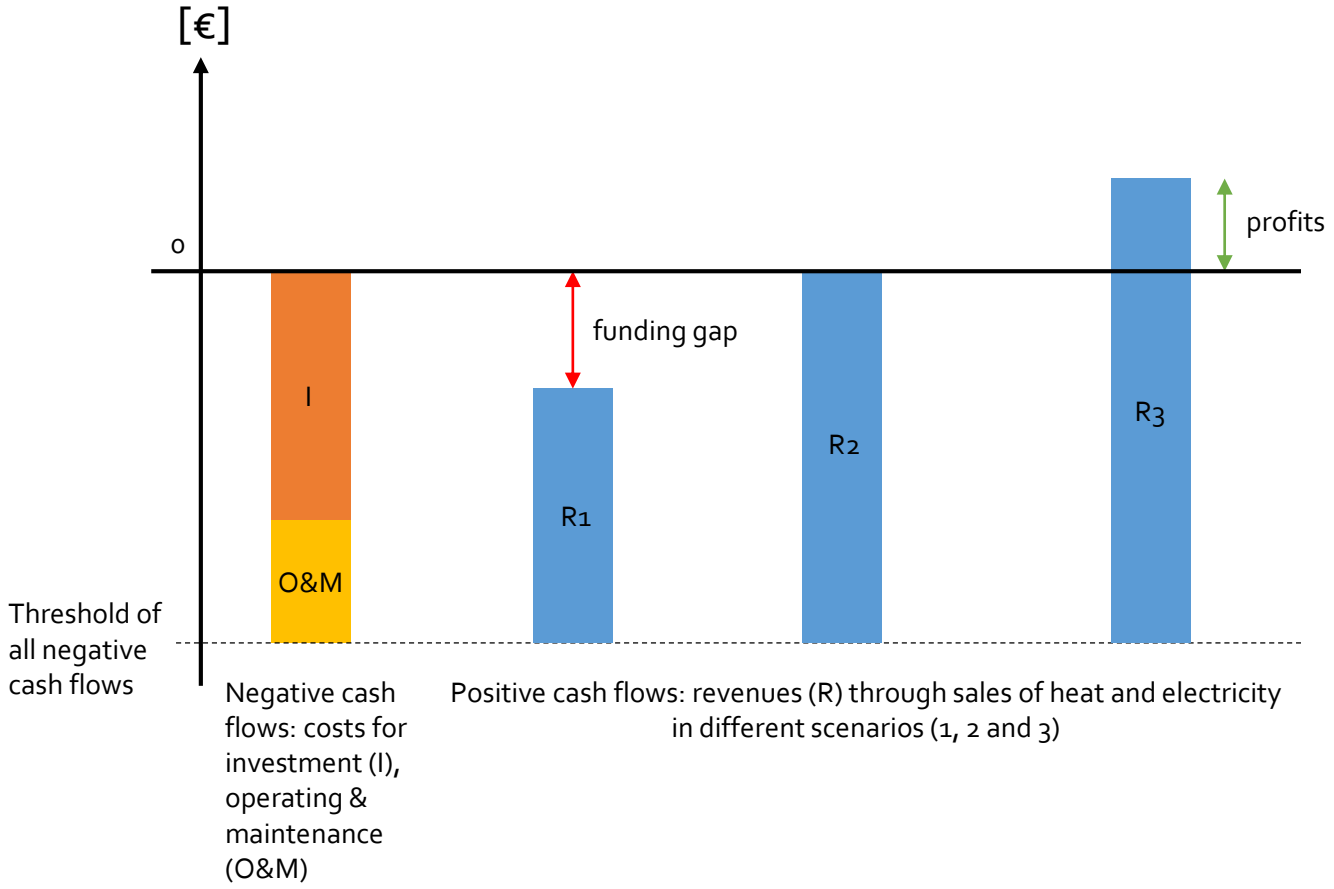

Fig. 1: Principle of funding gaps, positive and negative cash flows, own graphic based on [3]

2. Implementation

Output, structure of the tool, calculation method, example of application, needed information and results

Output

- Analysis of financial framework and funding gaps (pdf, for further information on topic)
- Calculation tool for determining economic efficiency and calculating funding gaps (excel tool)
- Manual on determining economic efficiency & funding gaps (pdf, in use with excel tool)

Fig. 2: Output analysis and tools economic efficiency & funding gaps [5]

Structure of the tool

- Excel based tool
- Several spreadsheets:
  - Input data: information on project is needed in 4 input sections
  - Add. Calc.: additional calculations, works automatically. No input required
  - Results: statement on economic efficiency and, if present, funding gap.
  - Background data: contains drop down menues, references, and text blocks. Input possible.
  - Version: informative, no input required.

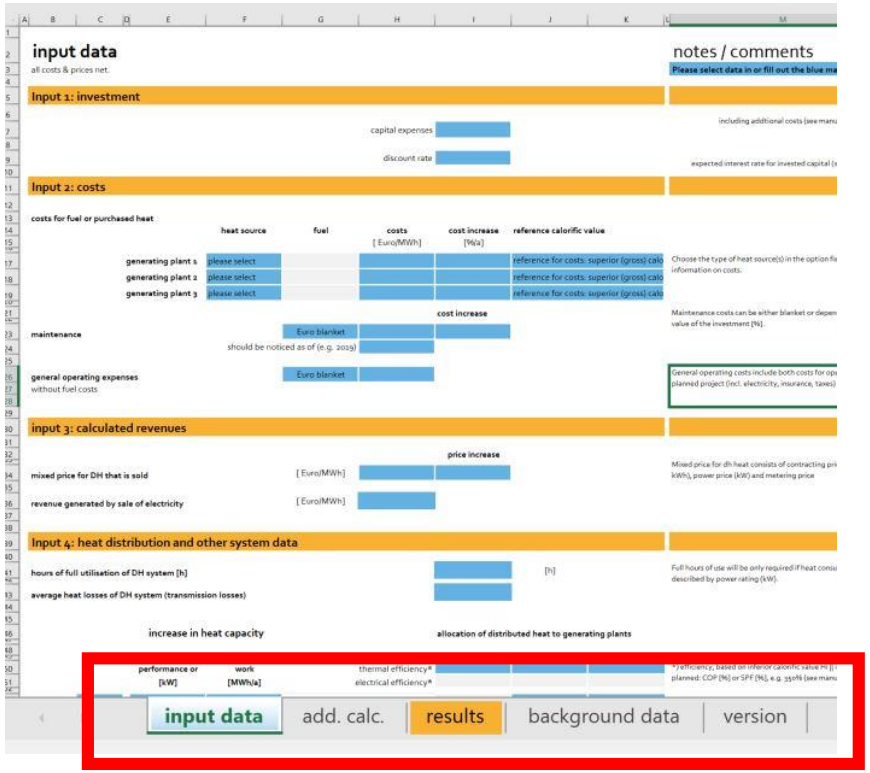

Fig. 3: Structure of the Exceltool [5]

Calculation method

Economic efficiency

- Method: Internal Rate of Return (IRR)
- "the value of the discount rate at which the net present value is zero" [6]
- Calculation: $$0 = \sum_{t=0}^{n} \frac{CF_t}{(1+IRR)^t}$$
  - n = lifespan of the investment of the measure [years]
  - t = time index number, a certain year of the investment [w.d.]
  - CFt = cash flow in year t or in other words the difference between costs and revenues in year t [€]
  - IRR = internal rate of return [%]

Funding gap

- Method: Net Present Value (NPV)
- funding gap = NPV of whole investment over 20 years
- Calculation: $$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+k)^t}$$
  - NPV = net present value [€]
  - n = lifespan of the investment of the measure [years]
  - t = time index number, a certain year of the investment [w.d.]
  - CFt = cash flow in year t or in other words the difference between costs and incomes in year t [€]
  - k = discount rate [%]

Prerequesites

What information do users need?

- Object of consideration and investment costs
- Costs for operating and maintaining
- Revenues generated by selling heat and electricity
- Technology data
- Funding opportunities (optional)

(all costs and revenues without VAT)

Prerequisites – object of consideration

- In general: investments in either
  - Grid
  - Generating plant
  - Or both
- Accounting boundaries: including everything that is needed to fulfill project objective
- Considering largest accounting boundaries possible (see figure)

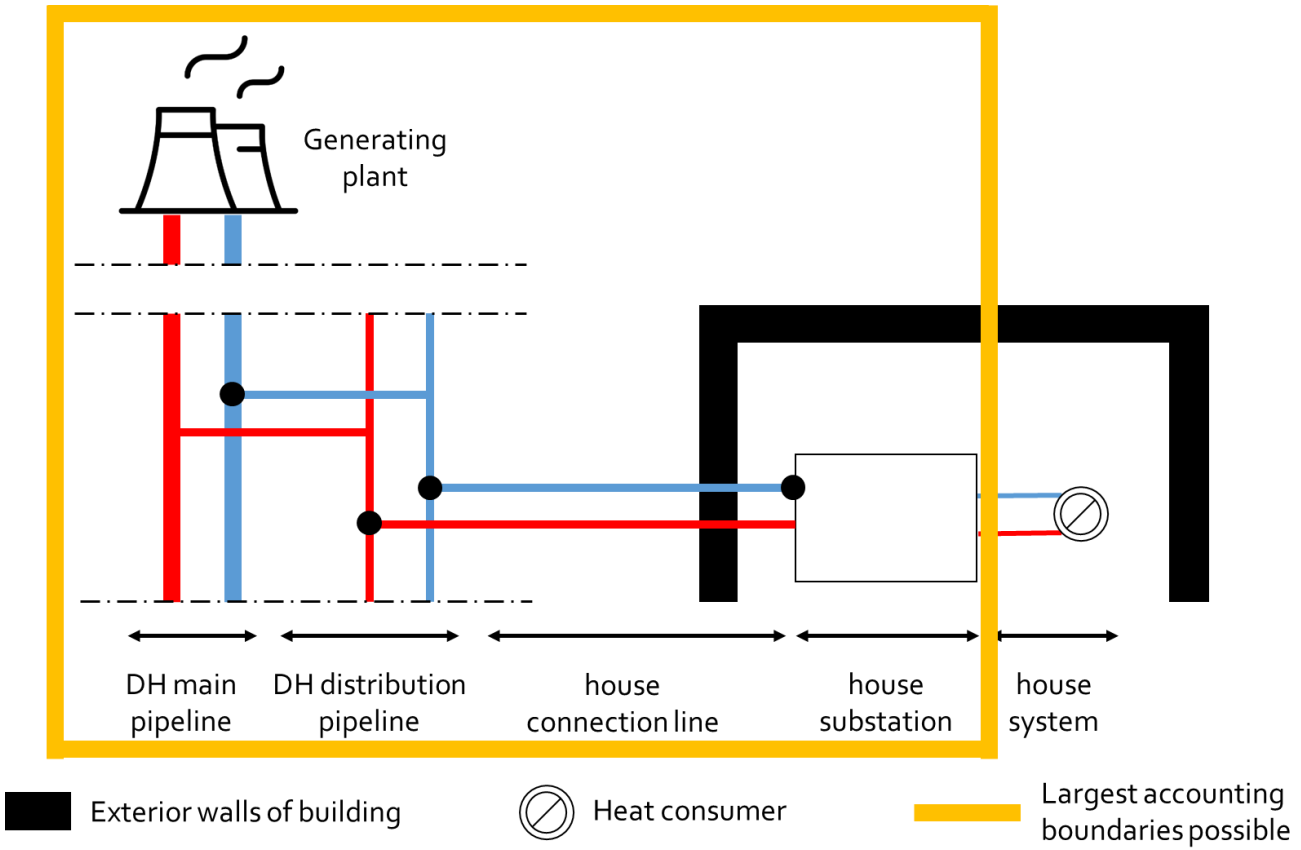

Fig. 4: Largest accounting boundaries possible [7]

(10)

Prerequisites – costs & revenues, discount rate

Investment costs

- Costs that are necessary to build the project objective
- Manual with detailed list of possible investment costs parameters

Discount rate

- Manual gives recommendation for choosing discount rate according to EU regulations and recommendations

Costs for operating and maintaining

- Operating costs
  - Fuel costs
  - General operating costs as x % of expected revenues or lump sum in €/a
- Costs for maintaining
  - X % of investment or lump sum in €/a
  - Expected cost increase in %/a
- Revenues by selling…
  - Heat: mixed price for DH in €/MWh and expected price increase in x %
  - electricity in €/MWh (only applicable with CHP)

Prerequisites – costs, revenues & technology data

Technology data

- Heat distribution
  - Hours of full utilization in h/a
  - Average heat losses of the DH system in %
- Heat capacity
  - Year of installation or deinstallation of generating plant
  - Performance in kW or amount of generated heat in MWh/a
- Allocation of distributed heat to generating plants
  - Thermal efficiency in %, if heat pumps are used then COP or SPF
  - If CHP is used: electrical efficiency
  - If more than one generating plant is used: share in work

Funding opportunities (optional)

- Only if already known to the user
- Amount of funding in € and
- year of receiving funding

Example of calculation: Gulbene pilot measure

- Installation of local heating system in 2019
- Providing heat for 3 municipal building, generated by biomass boiler (199 kW_{th})
- Distribution via small local heat grid
- Smart metering system within all buildings that are provided with heat from small local heating system

Fig. 5: Utility room LT local heating system, Photo: Sandis Kalniņš [8]

Example of calculation: Gulbene pilot measure

Accounting boundaries

- Project objective: installation of a local heating system
- Accounting boundaries including:
  - Biomass boiler
  - Small local heat grid
- Not considered: smart metering system because:
  - not necessary for project objective (installation of a local heating system) → System would run without smart metering system
  - component falls outside the accounting boundaries

Live-Demonstration of inputs via the tool

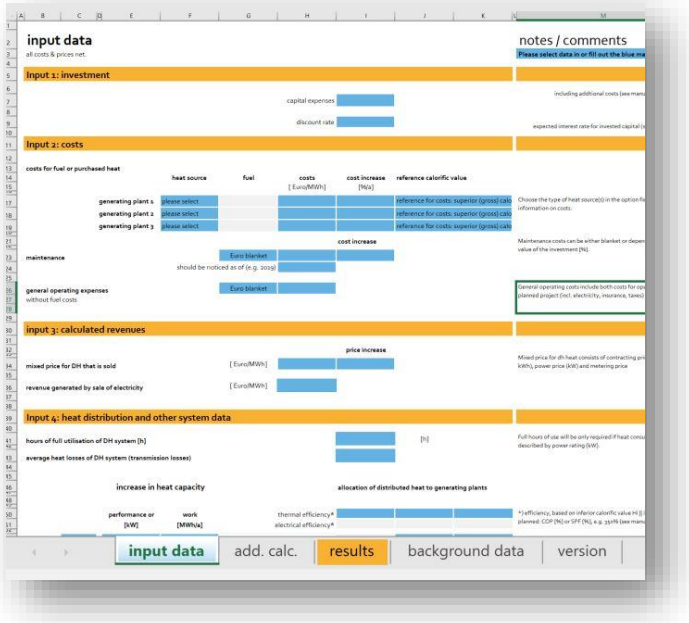

Fig. 6 Screenshout tool, own graphic [5]

3. Conclusion

Conclusion

Possibilities

- Users are enabled to calculate both economic efficiency and funding gap
- Transparent calculation methods following state of technology and knowledge, e.g. EU regulations
- Considering time value of money
- Own adjustments are possible

Limitations

- So far…
  - No economically consideration of energy savings due to investments in already existing systems
  - Period of consideration is fixed to 20 years

Results do not imply approval of funding!
Review by funding authority is still necessary!

Sources

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