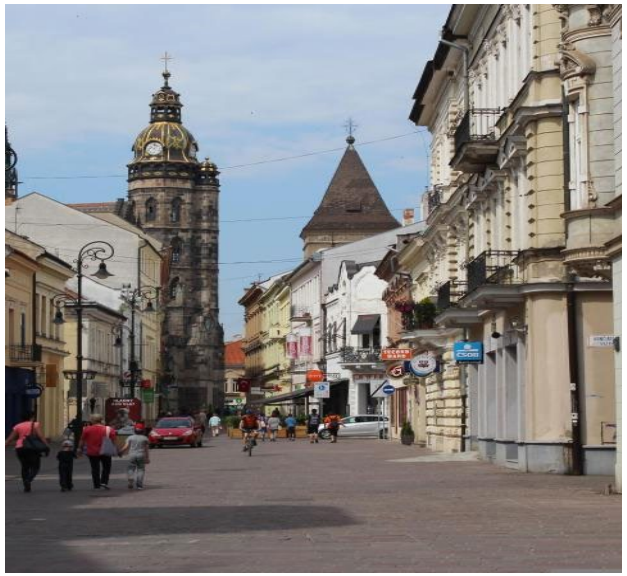
EIB Advisory - JASPERS Energy

District Heating decarbonisation

Economic appraisal with levelized cost indicators

Francesco Angelini, 17th December 2024



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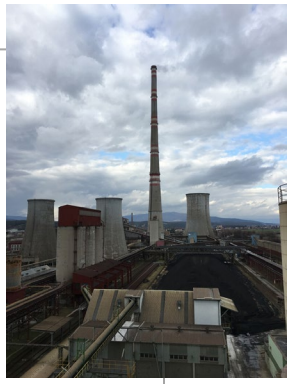
District heating decarbonisation



Contribution to strategic options analysis

Market

Policy & strategies

Simplified CBA

Techno-economic performance

Analysis of existing situation

Objectives

Option Analysis

Measures

Investment projects

Institutional set-up

"SWOT"

Multi-criteria Analysis

"Levelised" cost of heat

Local environmental impact

Social acceptance

Security of supply

GHG emissions

Risks

European Investment Bank

The levelized cost indicator

- The "**levelized cost"** is a commonly used concept in energy economics, particularly when comparing alternative technologies
- This is calculated as the ratio between:
  - (i) the *present value* of the project costs over its life cycle and
  - (ii) the *present value* of the supplied power/heat over the same reference period
- By adding to the project costs the **shadow cost of 'externalities'**, the levelized cost can also be estimated in socioeconomic terms
- The use of levelized costs can be particularly useful at the stage of **option analysis**, e.g., to compare different energy decarbonisation options
- It can be used for **simplified cost-benefit analysis**, e.g., comparing the project levelized costs against the next-best alternative (levelized cost of counterfactual)

The levelized cost of heat

The levelized cost of heat (LCOH) can be estimated in:

- **Financial** terms (at market prices): to check affordability and competitiveness (*promoter*'s point of view)
- **(Socio-)economic** terms: to identify most economically viable solutions (*society*'s point of view)

Financial LCOH	Economic LCOH
+ CAPEX	+ CAPEX
+ O&M costs	+ O&M costs
+ Fuel costs (if relevant)	+ Fuel costs (if relevant)
+ CO_2 Emission Trading System (ETS) allowance costs (if relevant)	+ Social cost of CO_2 emissions
	+ Social cost of SO_2, NO_x and PM
	+ Security-of-supply cost
– Revenue from power sales (if relevant)	– Economic value of power sales (if relevant)
= Net LCOH (financial)	= Net LCOH (economic)

A worked example

Estimate the LCOH for a new 20 MW_{th} biomass heat-only boiler for a DH system

- **Economic life**: 15 years of operations
- **Investment cost**: EUR 9m; (social) opportunity **cost of capital**: 5%
- **O&M costs**: 3% of investment cost p.a.; **fuel cost**: 20 EUR/MWh_f
- **Load factor**: 66%; **efficiency**: 85%
- Environmental **externalities** (airborne pollutants): 4.30 EUR/MWh_{th}

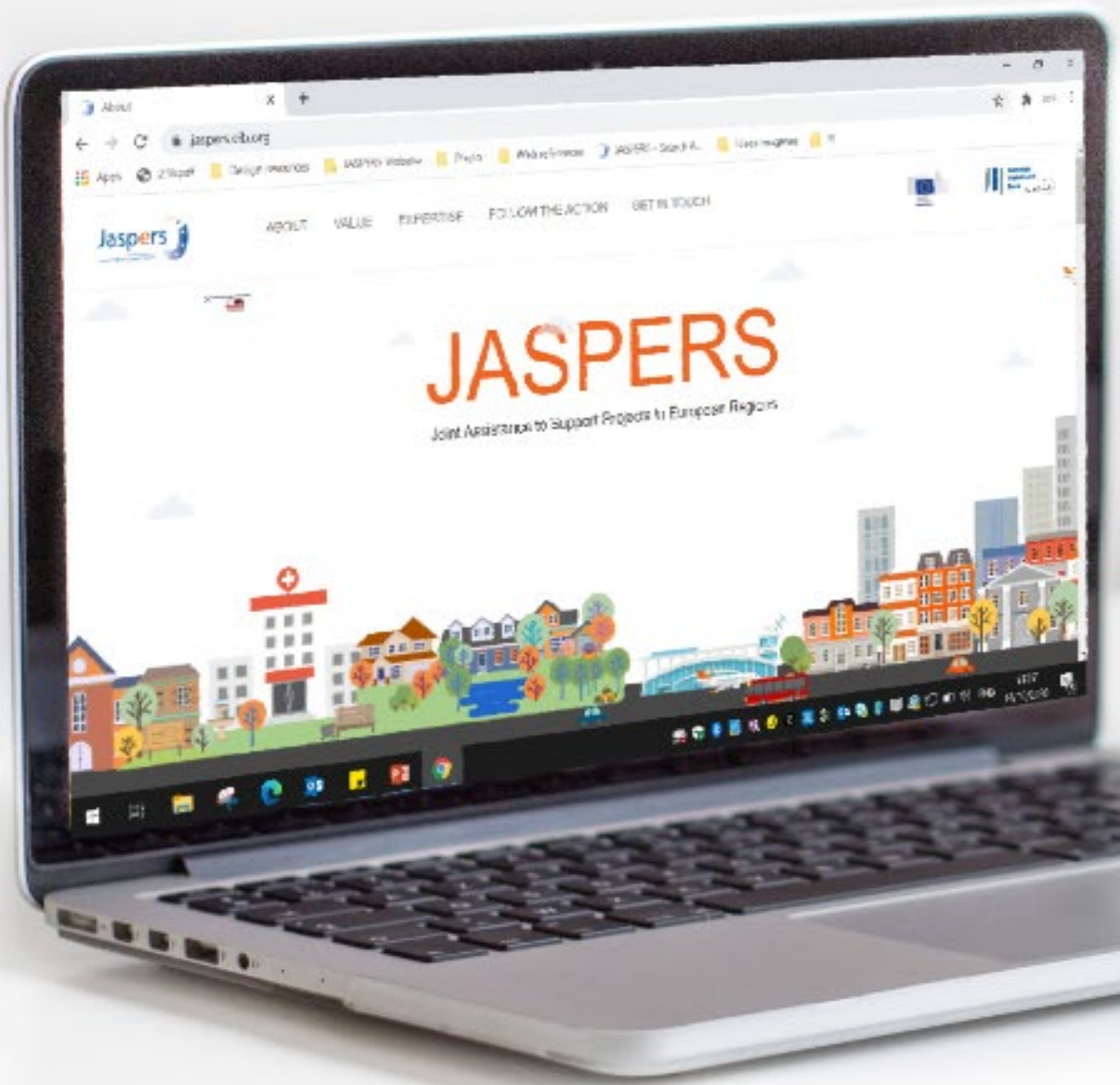
EUR	NPV@ 5%	2021	2022	2023	2024	2025	…	2030	…	2037
Investment cost	8,367,347	4,500,000	4,500,000							
Fuel costs	25,614,953	-	-	2,720,753	2,720,753	2,720,753		2,720,753		2,720,753
Other O&M costs	2,541,957	-	-	270,000	270,000	270,000		270,000		270,000
Total costs (excl. "externalities")	**36,524,257**	**4,500,000**	**4,500,000**	**2,990,753**	**2,990,753**	**2,990,753**		**2,990,753**		**2,990,753**
Shadow cost of CO2 emissions	-	-	-	-	-	-		-		-
Shadow cost of airborne pollutants	4,646,360	-	-	493,524	493,524	493,524		493,524		493,524
Total socio-economic cost	**41,170,616**	**4,500,000**	**4,500,000**	**3,484,277**	**3,484,277**	**3,484,277**		**3,484,277**		**3,484,277**
Heat Produced (MWh)	1,088,635	-	-	115,632	115,632	115,632		115,632		115,632

A worked example

- **Financial LCOH** = EUR 36,524,257 / 1,088,635 MWh = 34 EUR/MWh
- **Economic LCOH** = EUR 41,170,616 / 1,088,635 MWh = 38 EUR/MWh
- By dividing the net present value (NPV) of the single cost components by the NPV of the energy generated, the levelized cost subcomponents can also be estimated
- By adding the DH distribution cost (network – take losses into account too) one can compare the competitiveness against individual heating solutions (e.g. Vs. LCOH of an individual heat pump)

LCOH example – Biomass boiler (EUR/MWh)	
Capital cost	8
Fuel cost	24
Other operating and maintenance costs	2
LCOH – financial	**34**
Shadow cost of CO_2 emissions	-
Shadow cost of airborne pollutants	4
LCOH – economic	**38**

Disclaimer: the costs do not reflect current market conditions!
The example is taken from the European Commission' Economic Appraisal Vademecum (see Annex II on Renewable Energy).



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JASPERS support for the clean energy transition

JASPERS guide to decarbonisation of district heating systems

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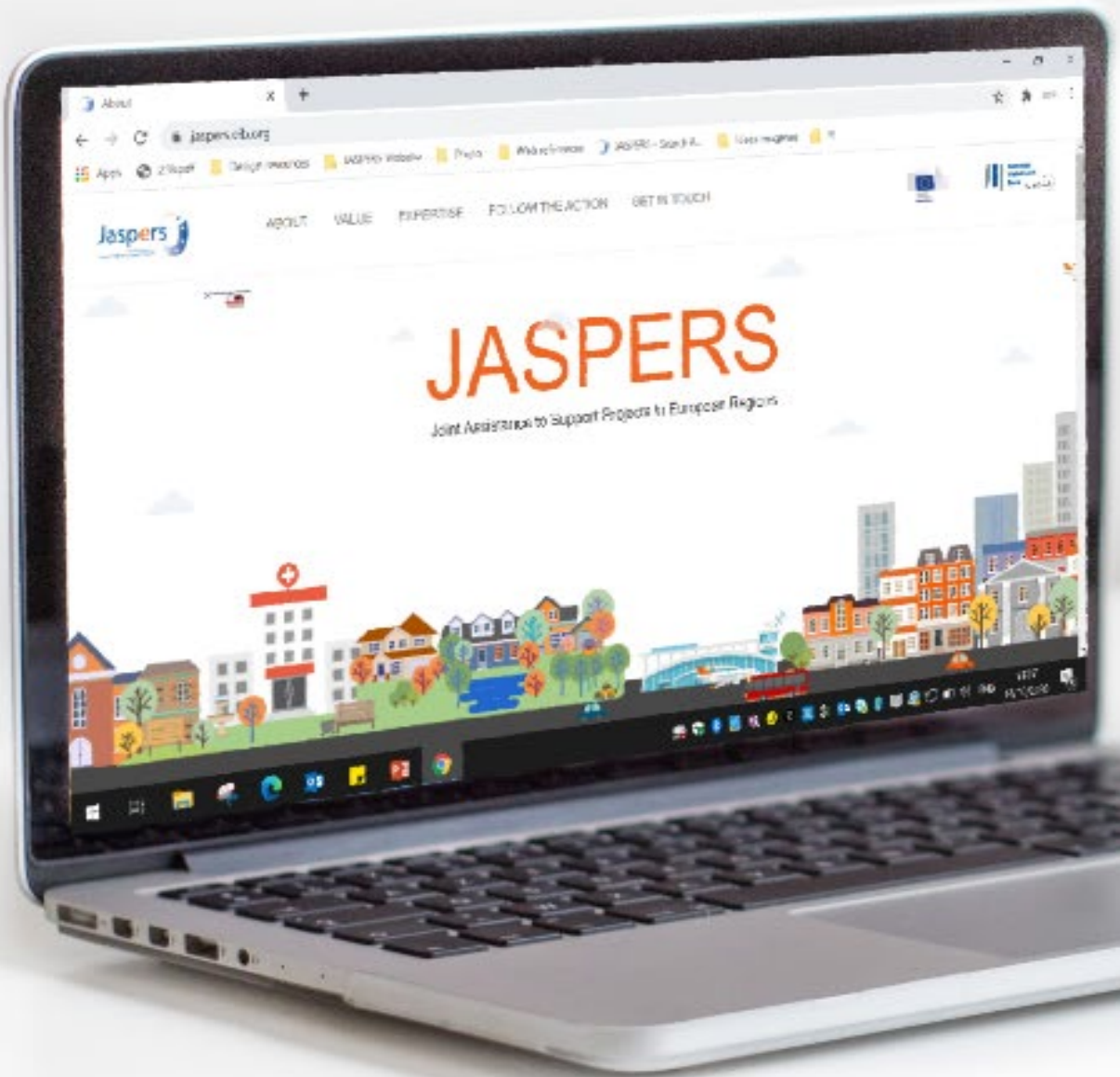

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