POTENTIAL DIFFUSION OF RENEWABLE-BASED 3GDH AND 4GDH ASSESSMENT THROUGH ENERGY MAPPING: A CASE STUDY IN MILANO

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FRAMEWORK
Assessing excess heat-based district heating potential through energy mapping. Focus on 4GDH. Case study: Metropolitan city of Milan
Assessing the potential diffusion of district heating from a technical, environmental and economic point of view

Specific problem
Estimating infrastructural network cost in areas in which there’s no DH

HEAT DEMAND
Estimation and spatial distribution in the residential and tertiary sector

MATCHING SOURCES AND DEMAND
Spatial allocation of heat sources and spatial distribution of DH in comparison with individual solutions

HEAT SOURCES
Estimation and spatial distribution of heat sources and current individual solutions

STRUCTURE OF THE WORK
METHODOLOGY

REFERENCE APPROACH (HRE)

Heat demand estimation → Heat distribution cost estimation → Potential DH heat market share

Matching

Heat supply potential estimation

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METHODOLOGY

REFERENCE APPROACH (HRE)

Heat demand estimation → Heat distribution cost estimation → Potential DH heat market share

Matching

Heat supply potential estimation → Cost of heat sources connection → Connection cost between areas

Geographical consideration of DH market share

DH economic potential

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PROPOSED APPROACH

Heat demand estimation → Heat distribution cost estimation → Potential DH heat market share

Clustering

Heat supply potential estimation

Cost of heat sources connection

Geographical consideration of DH market share

Connection cost between areas

DH economic potential

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HEAT DEMAND ESTIMATION

Demographic survey of 2011

Tipology
Period of construction

Centralized heating system

3GDH

4GDH

Energy performance certificates

Refurbished dwelling (Energy class A)

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6th International Conference on Smart Energy Systems
6-7 October 2020
#SESAAU2020
Excess heat sources potential estimation

- Industrial sites and power production plants (AIA)
  - HT and LT
- Datacenters (Data Center Map)
  - $T_{\text{average}} = 30°C$
- Wastewater treatment plants (Hotmaps)
  - $T_{\text{average}} = 18°C$
- Metro stations (HRE)
  - $T_{\text{average}} = 13°C$
HEAT MAPS OF MILAN AND CLUSTERING
HEAT MAPS OF MILAN AND CLUSTERING

DBSCAN algorithm

MinPts = 4

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HEAT MAPS OF MILAN AND CLUSTERING

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RESULTS – CASE STUDY

RECOVERABLE ENERGY [GWh/year]

- Total heat demand
- DH-connectable heat demand
- Total recoverable excess heat

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RESULTS – 4GDH

REFERENCE APPROACH

Distribution capital cost per census section

Distribution capital cost per cluster

PROPOSED APPROACH

1 TWh/year

0.3 TWh/year

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RESULTS – 3GDH

REFERENCE APPROACH

Distribution capital cost per census section

Distribution capital cost (€/MWh)

Census sections

25 TWh/year

PROPOSED APPROACH

Distribution capital cost per cluster

Distribution capital cost (€/MWh)

Clusters

5 TWh/year

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RESULTS – COMPARISON BETWEEN TOTAL COST OF DH AND THE INDIVIDUAL HEATING SOLUTIONS

4GDH

3GDH

Clusters

Total cost (€/MWh)

Clusters

Total cost (€/MWh)

DH_WWTP

DH_HT industries

DH_LT industries, Metro, DC

NG Boiler

Heat pump

DH_WWTP

DH_HT industries

DH_LT industries, Metro, DC

NG boiler

OIL boiler

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CONCLUSIONS

Development of a new methodology
• High level of detail
• Georeferenced results
• High replicability

Viable potential of 3GDH and 4GDH in the province of Milan
Thank you for your attention

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