



Development and application of *data-driven* methodologies for the *district heating sector*

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Contact info

- Research topics:
 - Data acquisition and analysis
 - Clustering and pattern recognition
 - Energy performance assessments
 - Determination of building characteristics
- Projects
 - "E-DYCE" (<https://edyce.eu/>)
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Content

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Current research status

Publications (Open access)

- *Treatment and analysis of smart energy meter data from a cluster of buildings connected to district heating: A Danish case*
 - Johra et al. (<https://doi.org/10.1051/e3sconf/202017212004>)
- *Using data from smart energy meters to gain knowledge about households connected to the district heating network: A Danish case*
 - Leiria et al. (<https://doi.org/10.1016/j.segy.2021.100035>)
- A methodology to estimate space heating and domestic hot water energy demand profile in residential buildings from low-resolution heat meter data
 - Leiria et al. ([Submitted – Under review](#))
- Validation of a new method to estimate energy use for space heating and hot water production from low-resolution heat meter data
 - Leiria et al. ([Submitted – Under review](#))

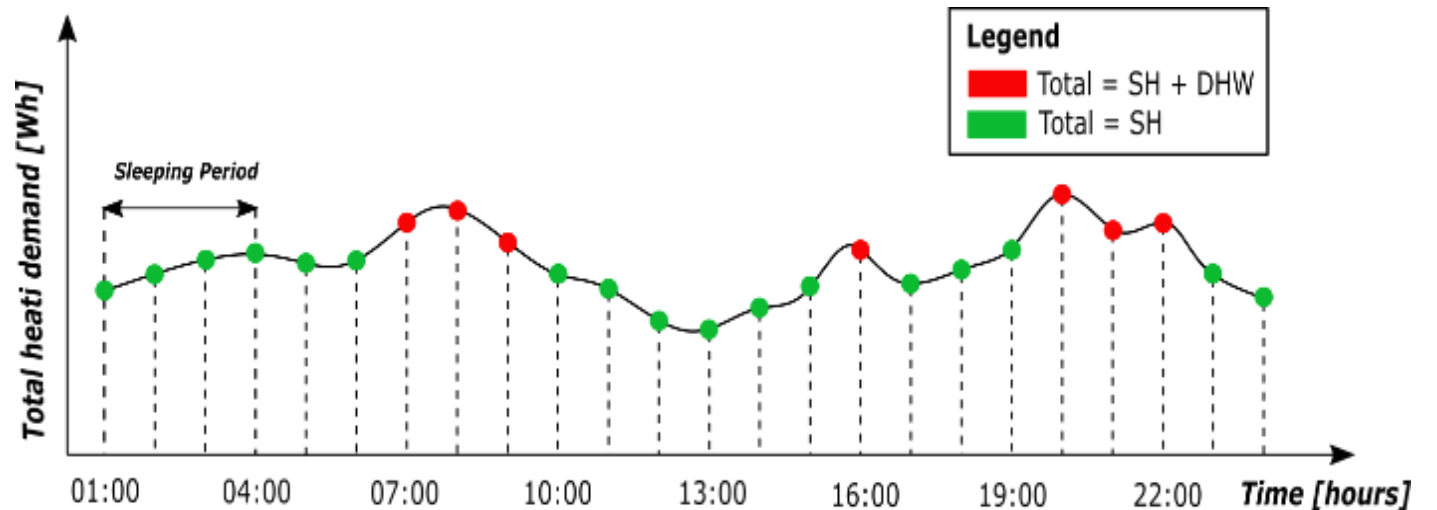
Disaggregation and estimation of SH and DHW in smart heat data

- Problem formulation:
 - The smart energy meters only measure the total energy usage (space heating and DHW)
 - By having only minimum information, is it possible to separate the energy demanded for the space heating and the DHW in buildings?
- Objectives:
 - Separate both energy components – Space heating and DHW
 - Hourly measurements
 - Minimum information (Total energy and weather data)

Disaggregation and estimation of SH and DHW in smart heat data

Methodology

- **2 stages** method:
 - SH+DHW points identification
 - SH estimation



Disaggregation and estimation of SH and DHW in smart heat data

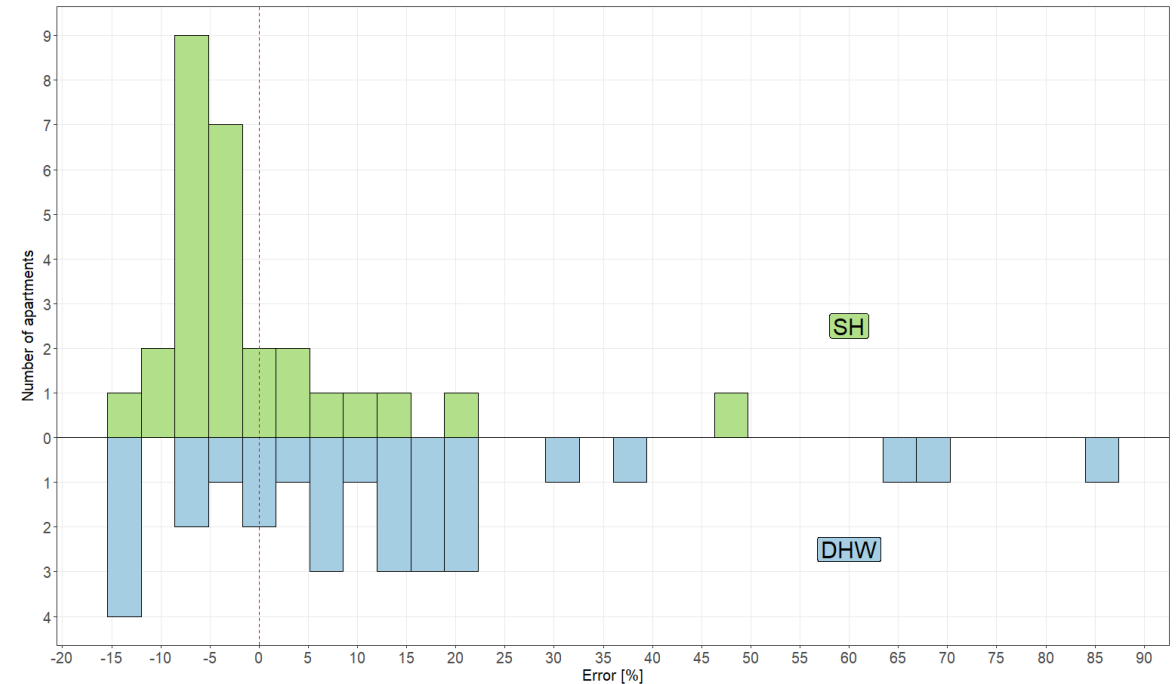
Validation

- 28 apartments in **Denmark** (Decimal and rounded data)
- 1 apartment block in **Switzerland** (Aggregated users data)
- 1 Theater in **Italy**
- 1 Rehabilitation institution in **Italy**
- **Comparison** with DHW compliances

Disaggregation and estimation of SH and DHW in smart heat data

Validation - Decimal measurements

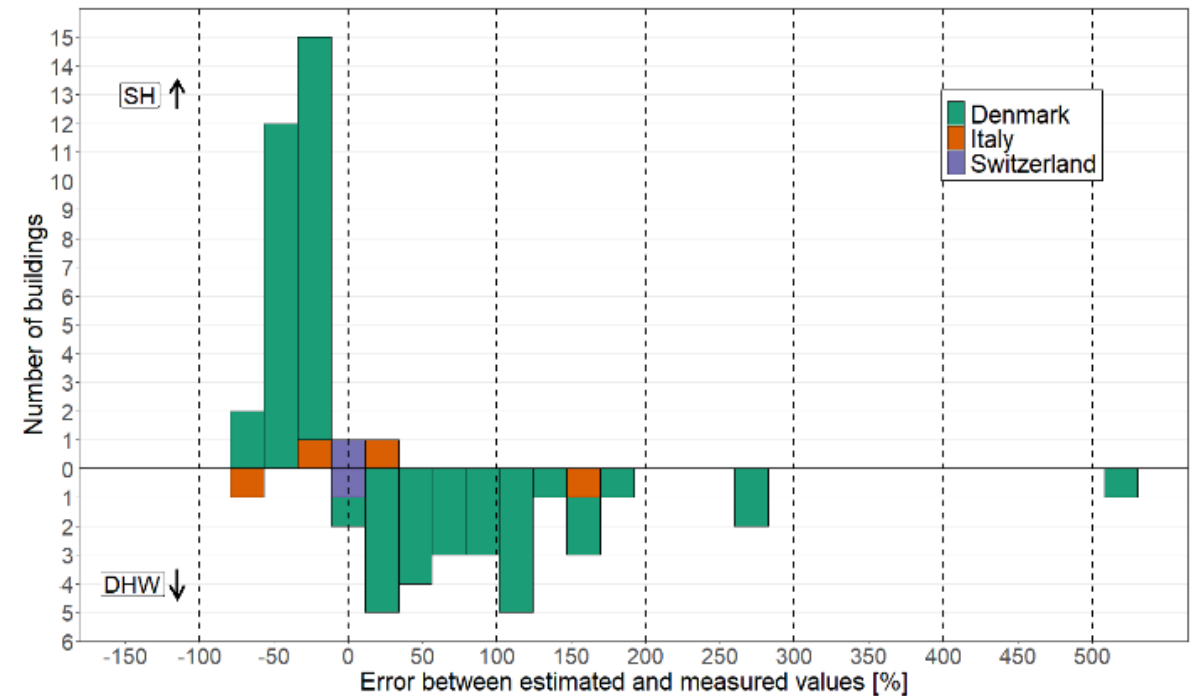
Apartment ID	Area [m ²]	E_{DHW} [kWh/h]	$E_{DHW,compl}$ [kWh/h]	$E_{DHW,estim}$ [kWh/h]	Error between E_{DHW} and $E_{DHW,compl}$	Error between E_{DHW} and $E_{DHW,estim}$
666	112	0.314	0.167	0.315	-47%	0%
668	111	0.286	0.165	0.346	-42%	21%
669	110	0.184	0.164	0.224	-11%	22%
670	111	0.588	0.165	0.555	-72%	-6%
671	110	0.247	0.164	0.295	-34%	20%
697	111	0.692	0.165	0.606	-76%	-12%
698	111	0.674	0.165	0.627	-75%	-7%
699	110	0.678	0.164	0.588	-76%	-13%
700	111	0.074	0.165	0.137	123%	85%
701	111	0.167	0.165	0.196	-1%	18%
702	110	0.088	0.164	0.115	87%	32%
724	110	0.229	0.164	0.255	-28%	11%
726	111	0.116	0.165	0.132	43%	14%
727	111	0.103	0.165	0.121	61%	18%
728	110	0.148	0.164	0.203	11%	37%
729	110	0.144	0.164	0.161	14%	12%
730	111	0.388	0.165	0.406	-57%	5%
731	111	0.087	0.165	0.142	90%	63%
732	110	0.406	0.164	0.347	-60%	-15%
734	97	0.091	0.145	0.106	59%	17%
735	111	0.328	0.165	0.347	-50%	6%
736	111	0.336	0.165	0.34	-51%	1%
739	111	0.524	0.165	0.561	-68%	7%
740	111	0.164	0.165	0.159	1%	-3%
741	111	0.237	0.165	0.253	-30%	7%
742	97	0.145	0.145	0.167	-1%	15%
743	111	0.461	0.165	0.403	-64%	-13%
745	111	0.093	0.165	0.157	78%	69%



Disaggregation and estimation of SH and DHW in smart heat data

Validation - Rounded measurements

Dataset	Case building	Error between E_{DHW} and $E_{DHW,compl}$	Error between E_{DHW} and $E_{DHW,estim}$
Denmark	Apart. 666	-47%	97%
Denmark	Apart. 668	-42%	103%
Denmark	Apart. 669	-11%	102%
Denmark	Apart. 670	-72%	21%
Denmark	Apart. 671	-34%	108%
Denmark	Apart. 697	-76%	12%
Denmark	Apart. 698	-75%	21%
Denmark	Apart. 699	-76%	10%
Denmark	Apart. 700	123%	510%
Denmark	Apart. 701	-1%	93%
Denmark	Apart. 702	87%	182%
Denmark	Apart. 724	-28%	89%
Denmark	Apart. 726	43%	70%
Denmark	Apart. 727	61%	149%
Denmark	Apart. 728	11%	152%
Denmark	Apart. 729	14%	119%
Denmark	Apart. 730	-57%	43%
Denmark	Apart. 731	90%	273%
Denmark	Apart. 732	-60%	24%
Denmark	Apart. 734	59%	144%
Denmark	Apart. 735	-50%	44%
Denmark	Apart. 736	-51%	40%
Denmark	Apart. 739	-68%	34%
Denmark	Apart. 740	1%	75%
Denmark	Apart. 741	-30%	59%
Denmark	Apart. 742	0%	121%
Denmark	Apart. 743	-64%	29%
Denmark	Apart. 745	78%	265%
Switzerland	Apart. Block	4%	-9%
Italy	Rehab inst.	-59%	-79%
Italy	Theater	-35%	154%



Next stage (and collaboration)

Overview of KPIs and tariffs in DH sector

- A review publication – We are still discussing what we want to address, however the subjects on the table are:
 - Key performance indicators (KPIs) – A revision of the existing ones
 - Building level
 - Grid (main system) level
 - Key performance indicators (KPIs) – Development of new ones
 - DH tariffs – A revision of the existing ones
 - DH tariffs – Development of new ones
- The development of a “guidebook” publication that can be used to assess the DH system

Next stage (and collaboration)

More information about the buildings

- The necessity of labelled data
 - Detected faults
 - Building characteristics
 - Heating systems
- KPI suggestions used by Aalborg Forsyning



Thank you