

#### **Classification of District Heat Heat Exchange Stations Using Smart Meter Data**

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<u>www.4dh.eu</u>

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#### Classification of District Heat Heat Exchange Stations Using Smart Meter Data

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#### The Concept





#### **Smart Meters**



 Recording frequency down to seconds, usually 15 min – 60 min interval





#### **Smart Meter Data Application**



Limited research on DH smart meters analytics!



Source: Tureczek. Alexander M, Nielsen. Per S. Structured Literature Review of Electricity Consumption Classification Using Smart Meter Data. Energies 2017;10:584. doi:10.3390/en10050584.

### Electricity Smart Meters Clustering





Source: Viegas JL, Vieira SM, Melício R, Mendes VMF, Sousa JMC. Classification of new electricity customers based on surveys and smart metering data Commission for Energy Regulation. Energy 2016;107:804–17. doi:10.1016/j.energy.2016.04.065.



#### The Data





#### District Heat Data From AVA

District Heat data from Aarhus

49 Heat Exchange stations (HX)

January 2017 (744) hourly observations per HX











Large differences in consumption volume



## The Preprocessing and Cleaning of Data



#### Data Preprocessing of the AVA Data – 🚆 Dealing with Missing Data





# Normalizing Data to Remove Volume







# The Clustering of the Original Data Using K-Means



#### Selecting Optimum Number of Cluster (4) for K-Means Normalized Data





4 clusters selected

#### Cluster Means (4) on Normalized Data





4 clusters selected

# Cluster Members (49) Superimposed





4 clusters selected



#### The Preprocessing Revisited: Feature Extraction





#### Autocorrelation as Feature for Clustering







#### The Clustering Revisited: Features as Input to K-Means



#### Selecting Optimum Number of Cluster (7) for K-Means on New Feature Data





7 Clusters selected

### Cluster Means (7) on Feature Input



Only 6 clusters are shown as last cluster only had 1 member.



## Cluster Members (49) Superimposed



Only 6 clusters are shown as last cluster only had 1 member.





#### The Findings





#### **Clustering Comparisson**

Normalized Data, 4 Clusters

Feature ACF Data, 7 Clusters



For Feature ACF Only 6 clusters are shown as last cluster only had 1 member.





#### Conclusions

- Classification of Heat Exchangers using Smart Metering data and K-Means can be achieved.
- Preprocessing data for K-Means can improve Clustering performance.
- Classification indicates same underlying model for most Heat Exchangers.
- Outlook
  - Cluster stability Analysis
  - Including jump probabilities
  - Weather / Temperature

