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**HUYGEN**

TNO

Cauberg-Huygen

Deerns

Applied research  
built environment

TKI and EU-H2020 funding

# WHISPERING WITH SMART METERS



**HUYGEN**

Give Brains To buildings, TUD 2020-02-07



## THE VALUE OF SMART METER DATA

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- Predict energy use/costs
  - Detect mal function or anomalies
  - Interact with energy grid/district
  - Identify user behaviour
- .....

“DeltaT, predictor for heating”

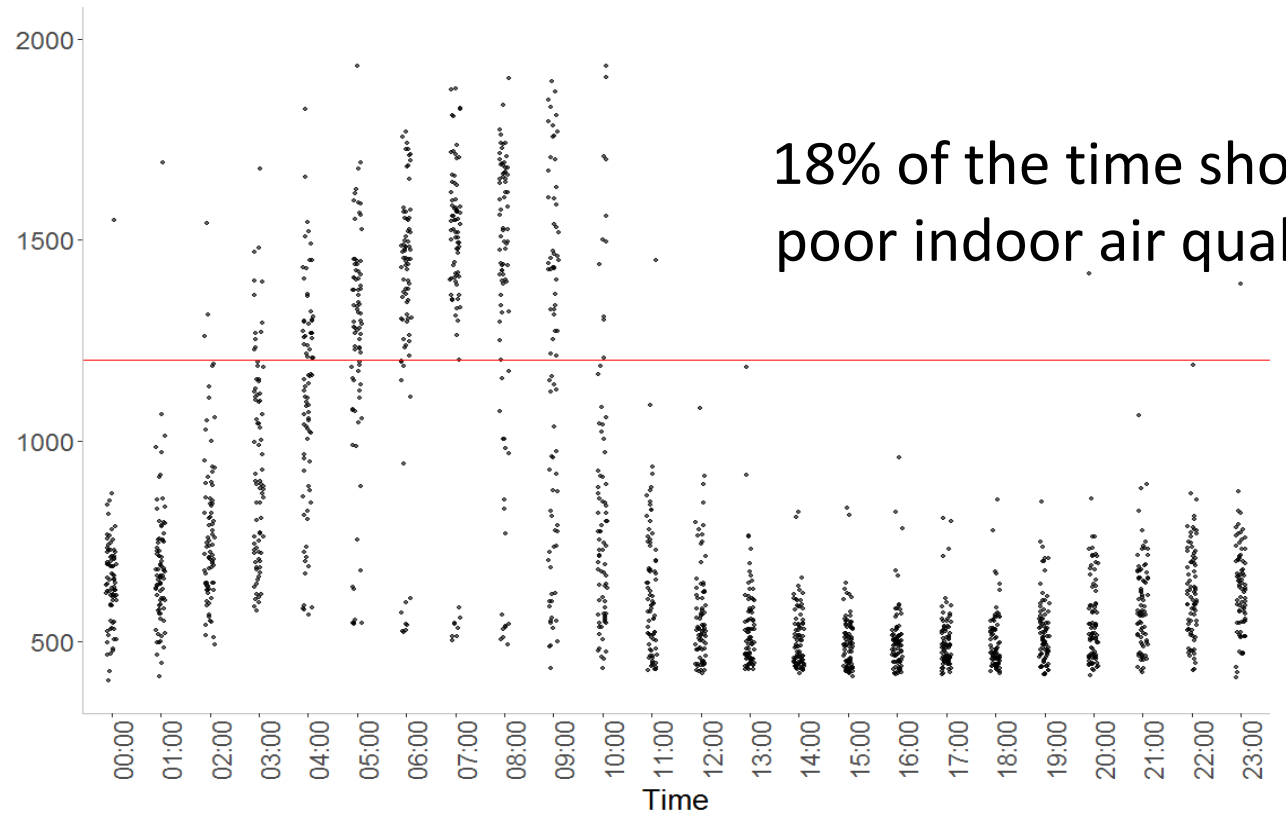
“Date-time, predictor for  
occupant behavior”

“Other influential factors  
are minor”

# OCCUPANT BEHAVIOUR AND INDOOR AIR QUALITY

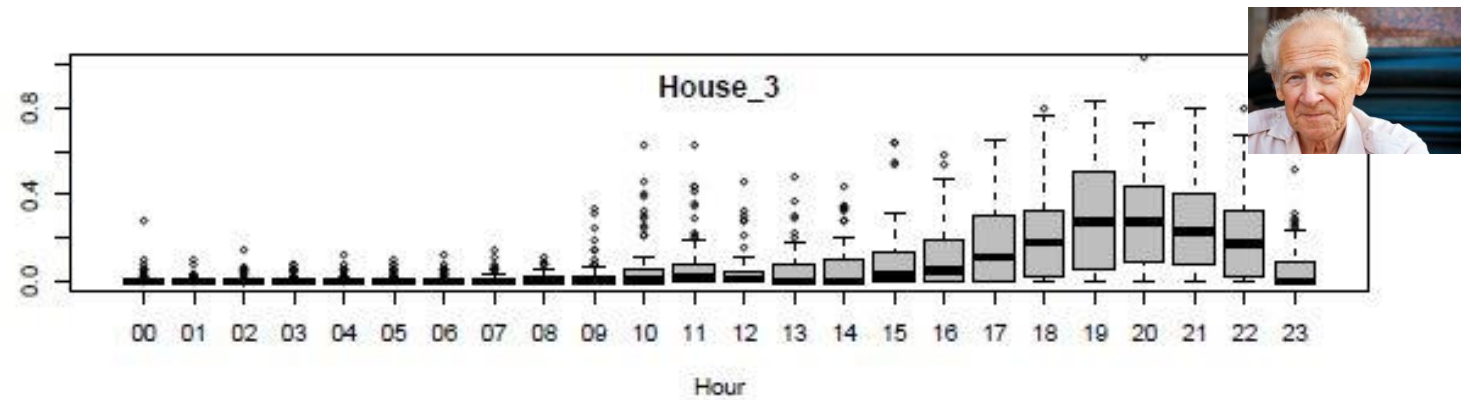


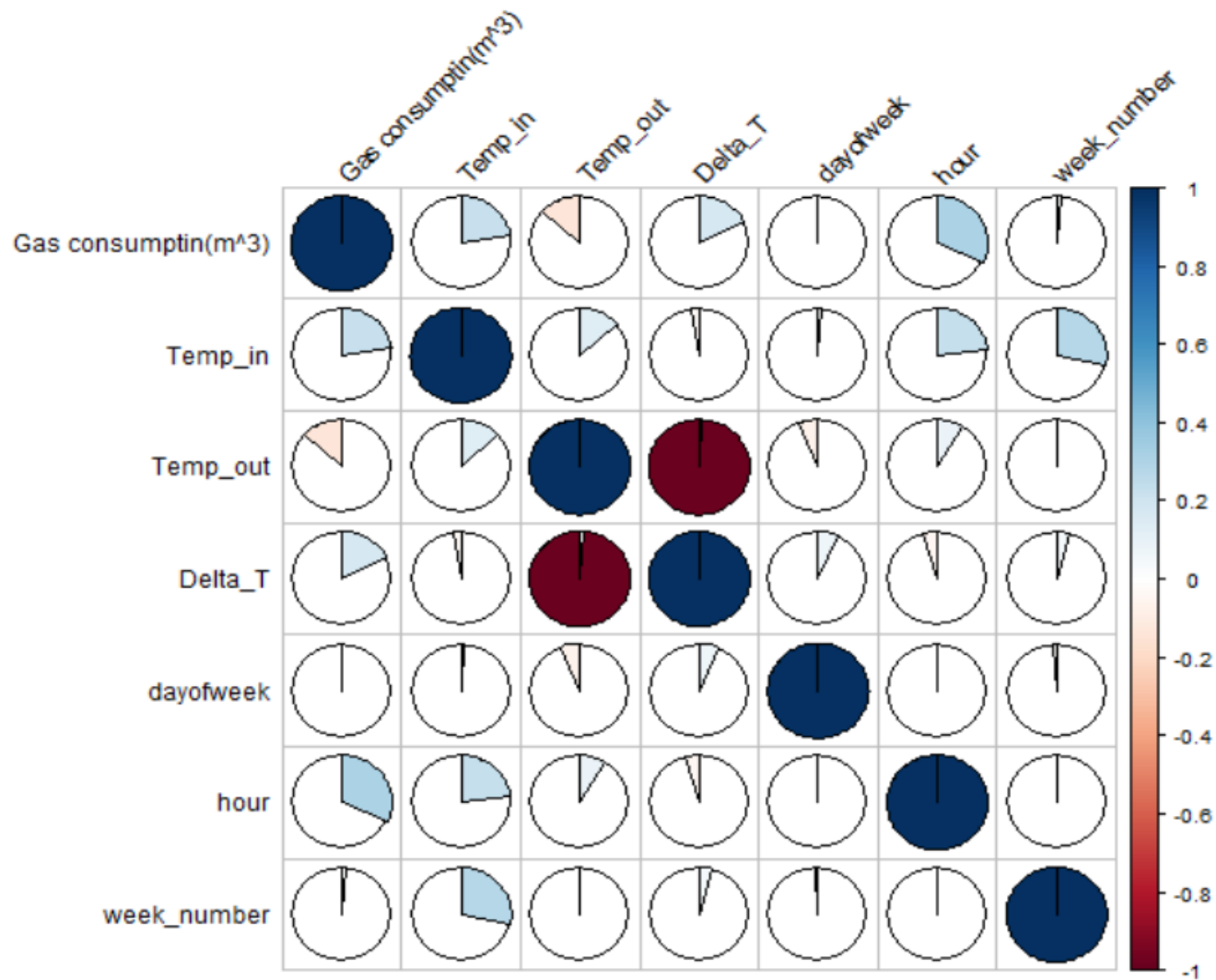
## Decision tree in search for hot water



18% of the time shows poor indoor air quality

difference in gas meter in hour (m<sup>3</sup>·h)

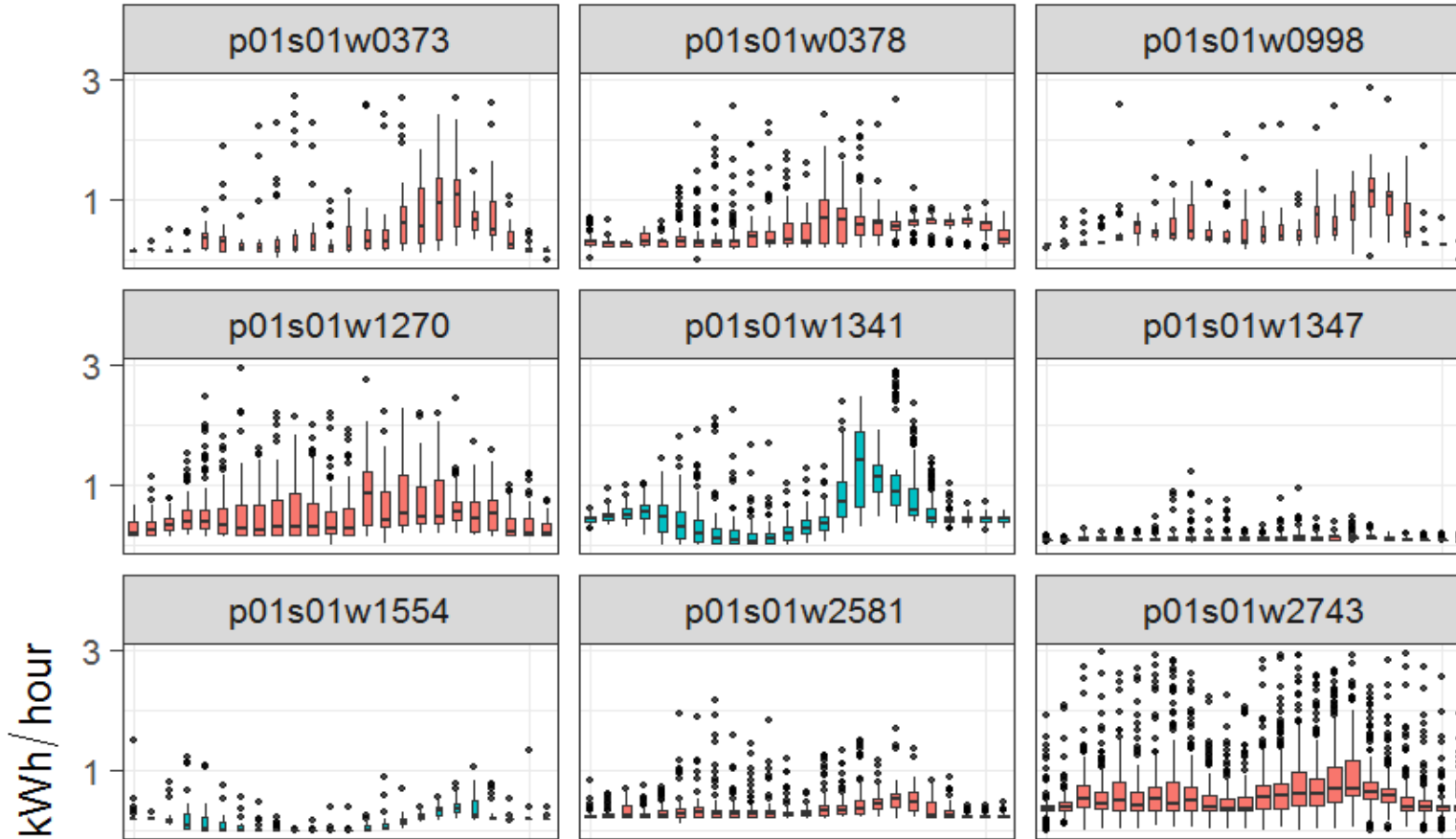




## ENERGY PERFORMANCE AND OCCUPANT BEHAVIOUR

- Indoor minus Outdoor temperature (DeltaT) is key
- Date-time also indicator

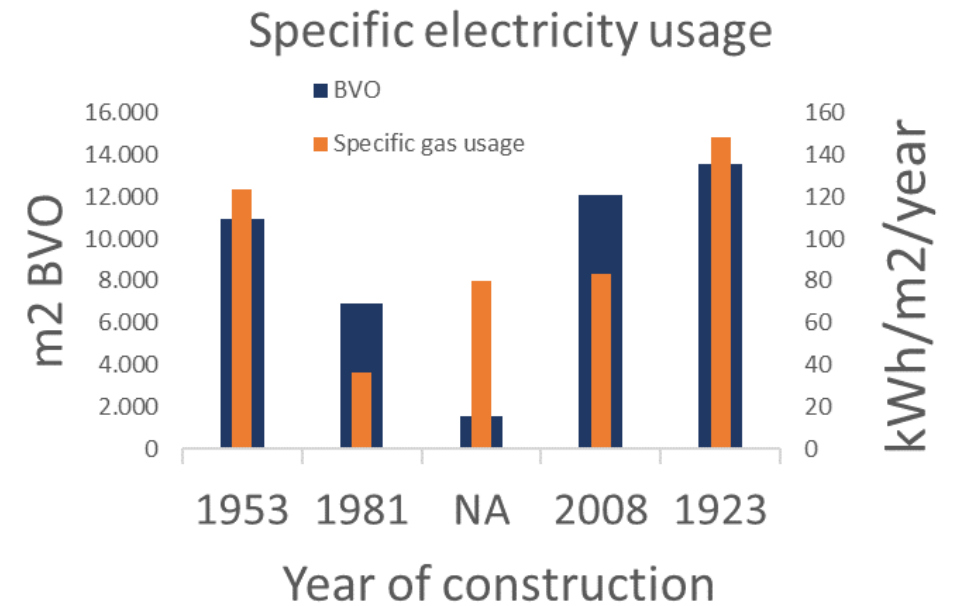
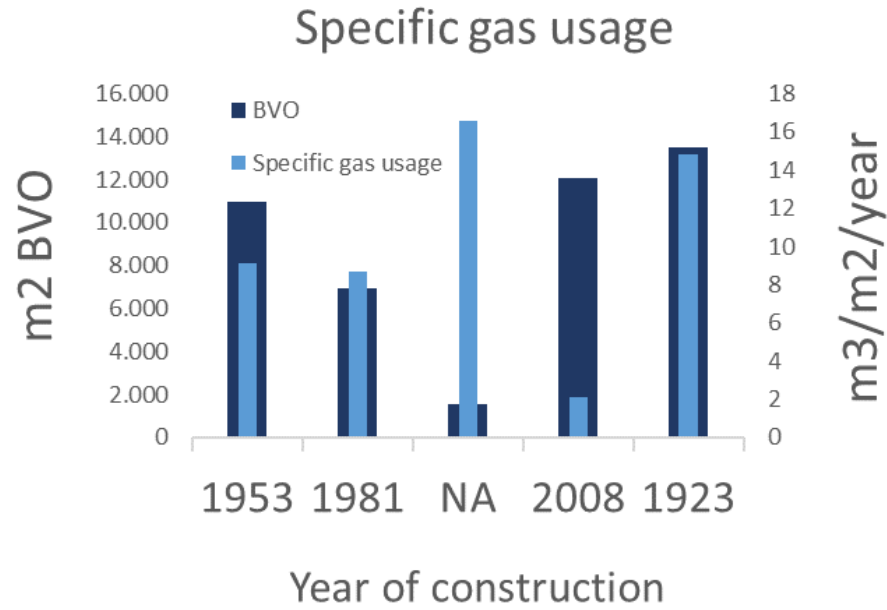
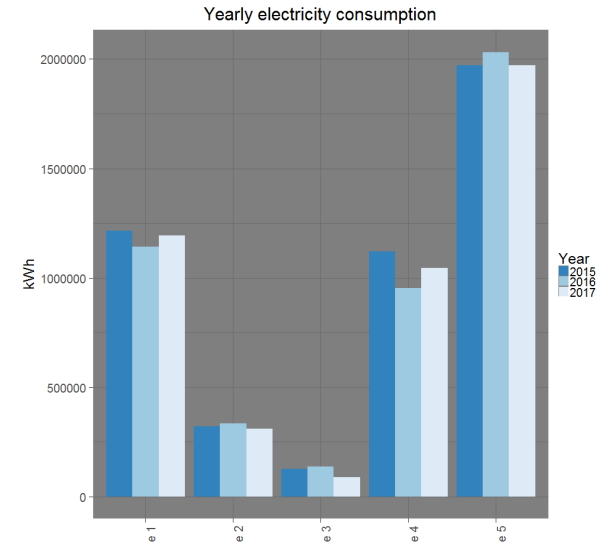
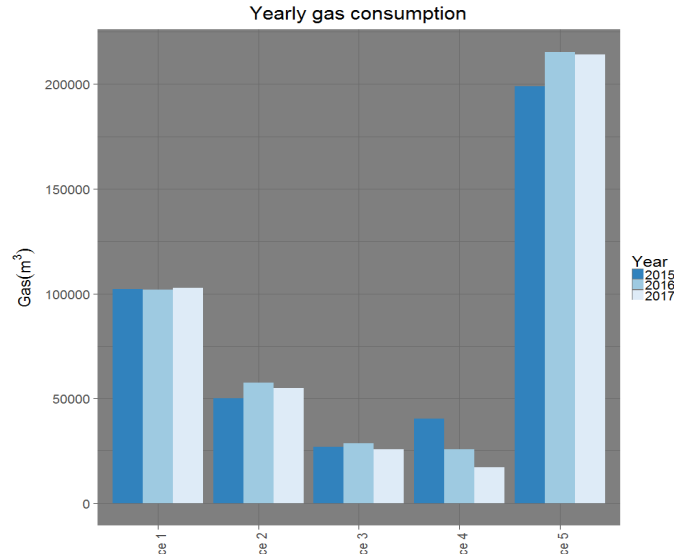
## Box-plot of hourly electricity use



## OCCUPANT BEHAVIOUR FROM ELECTRICITY USE

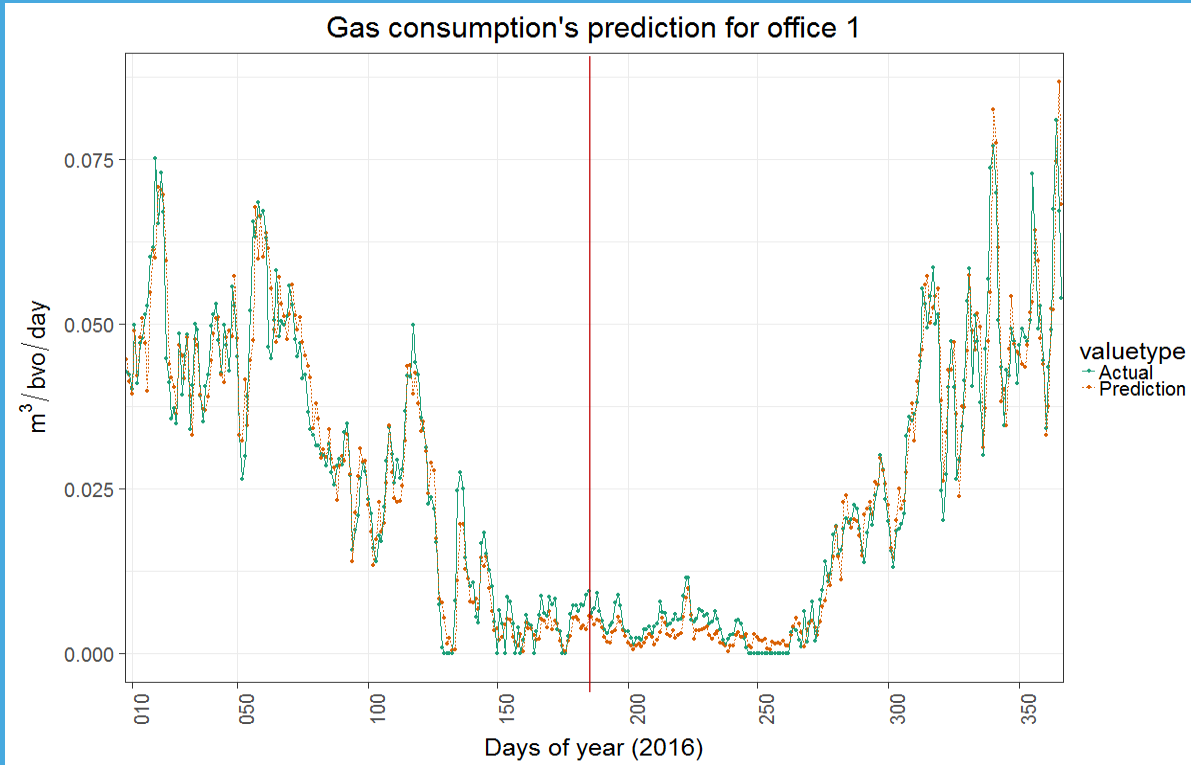


# OFFICE BUILDINGS

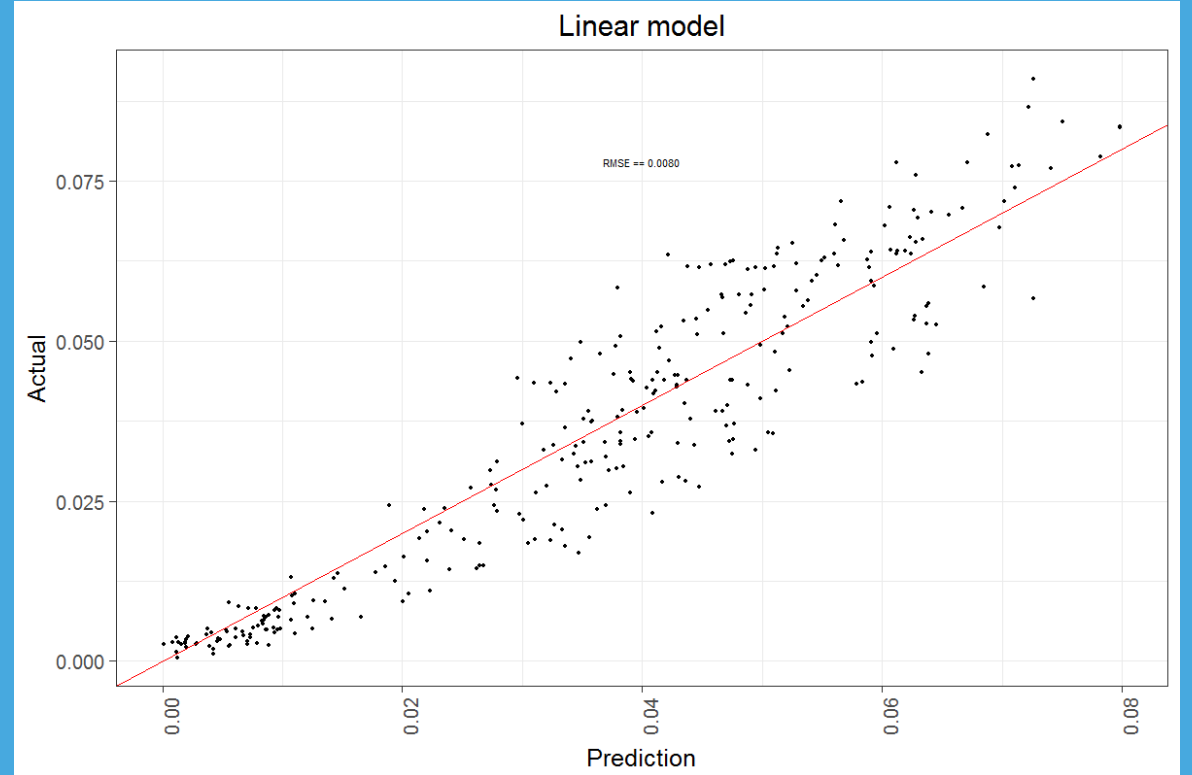


# Prediction energy use by ML

## Supervised learning, XGBoost



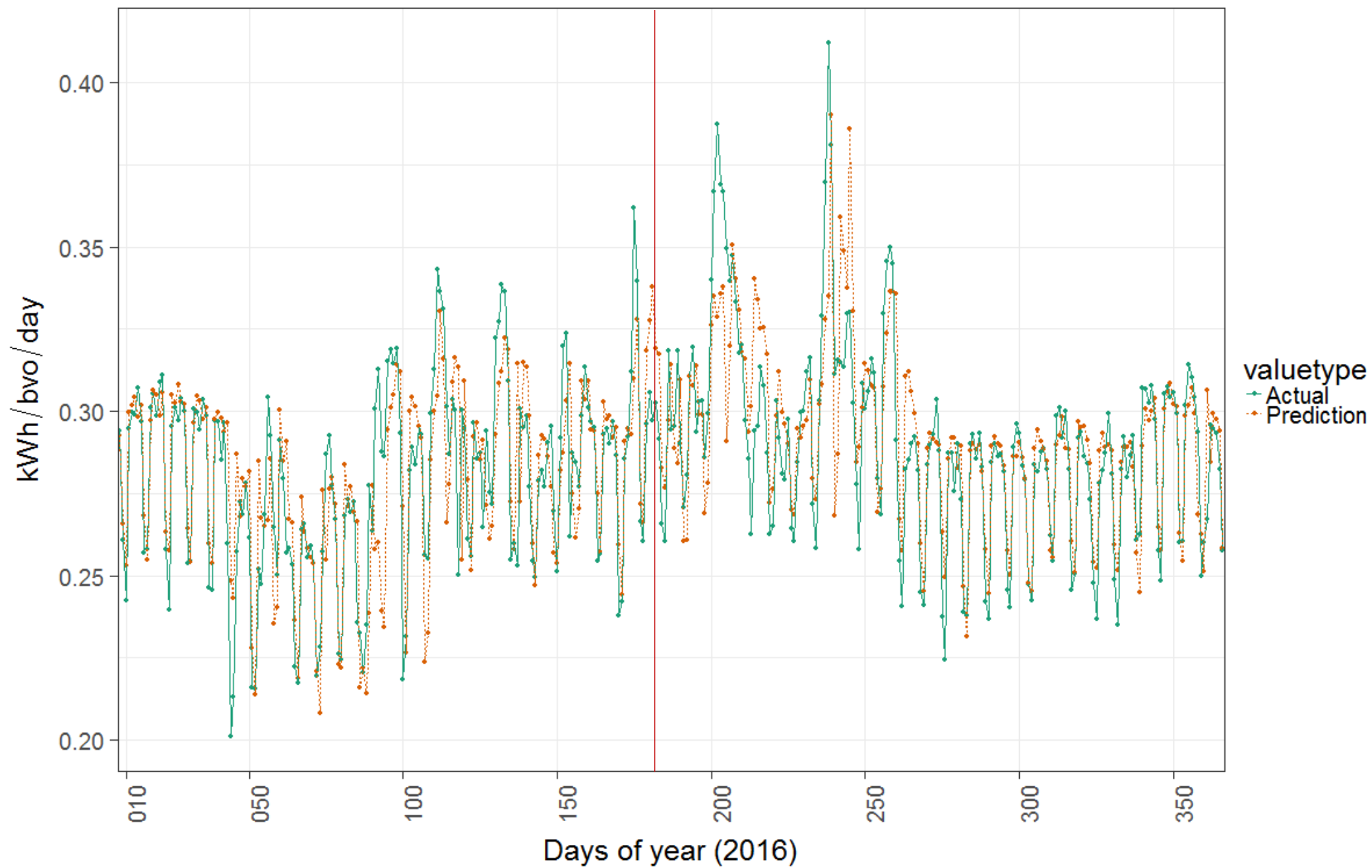
With actual - not predicted - climate data

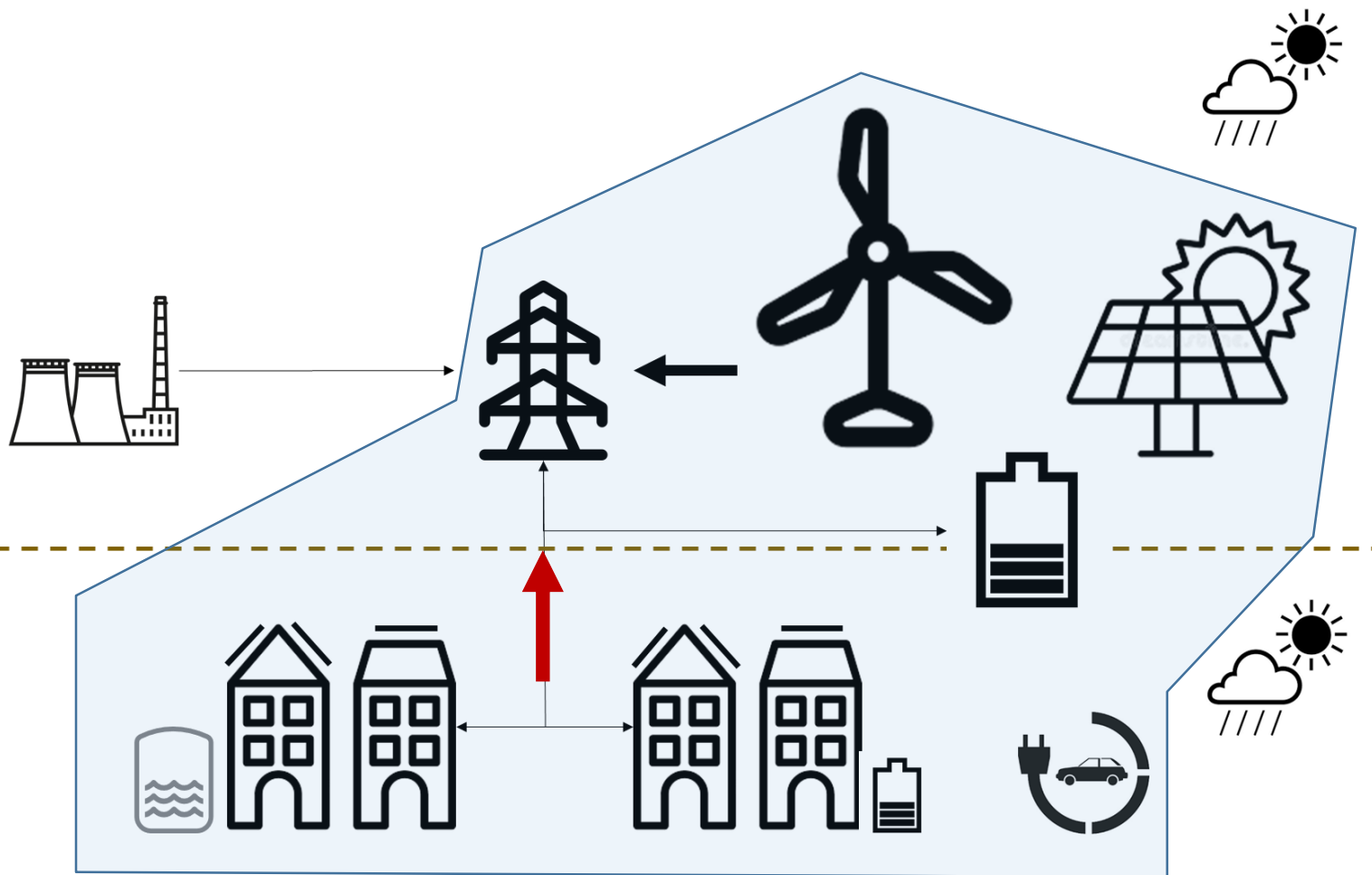


Train and Test data



# Electricity consumption's prediction for office 1





## BUILDINGS BEHAVE ENERGETICALLY LINEAIR

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**DeltaT**, predictor for  
heating

**Date-time**, predictor for  
occupant behavior

**Other influential factors**  
are minor



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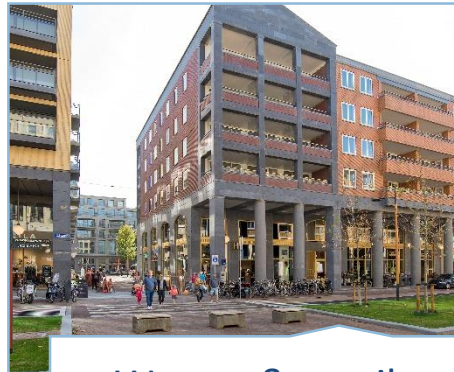
[www.sensi-sensoren.nl](http://www.sensi-sensoren.nl)



Gezondheidszorg



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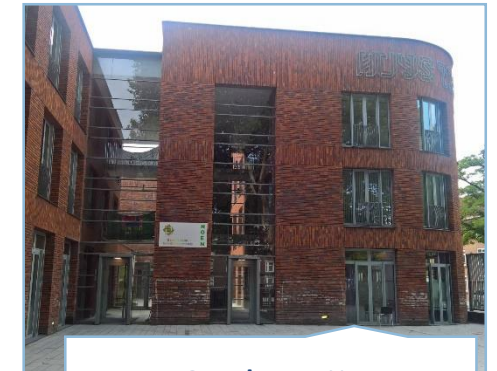
Wonen & retail



Renovatie & transformatie



Bedrijfsgebouwen



Onderwijs

