



# IBPSA Project 1

**IBPSA Project 1**  
**BIM/GIS and Modelica Framework for building and**  
**community energy system design and operation**  
**TASK 3: Application and Dissemination**  
**WP 3.1 District Energy DESTEST**

Dirk Saelens

Aachen expert meeting – Status presentation – 2019.04.03

## WP 3.1 Application and DESTEST for district energy models

### Changes in WP3

- WP3.1: Development of DESTEST
- WP3.2: Application → Alessandro Maccarini

# Development of DESTEST

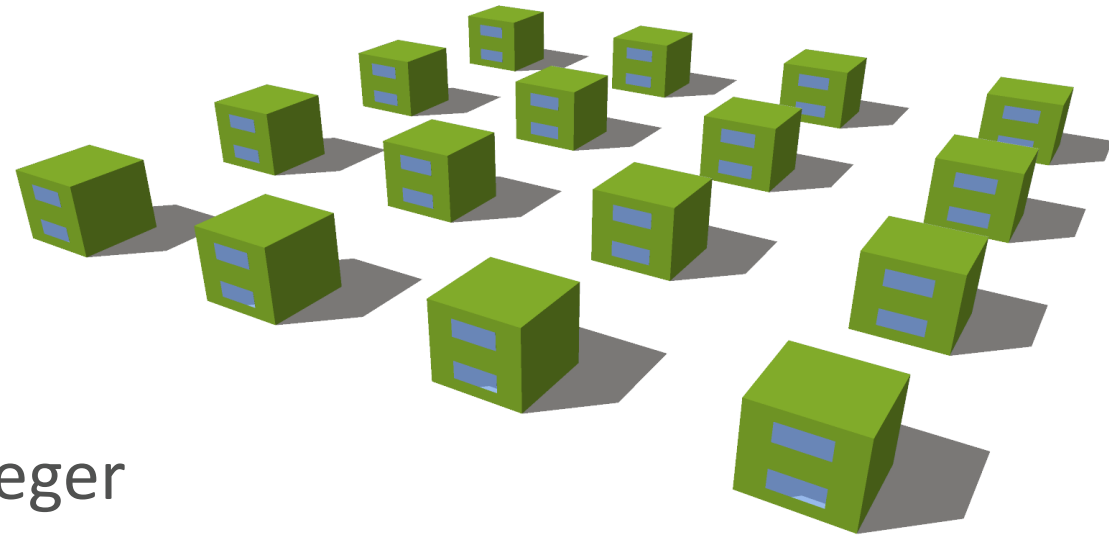
Aim is to:

1. Develop typical or representative DES configurations
  - that can be used for testing different DES models (intermodel comparison, validation?)
  - that can be used for testing different DES implementations and approaches (f.i. central vs decentral storage)
2. Develop a test framework for testing individual DES models (f.i. substations, pipes, heatpumps ...)

# Activities

- Main activities
  - 3 Coordination meetings
  - Many subgroup meetings
  - Finalization of common exercise 1
- Papers for BS2019
  - The influence of input data uncertainty on the district energy demand, Ina De Jaeger et al
  - Towards a DESTEST: a District Energy Simulation Test Developed in IBPSA Project 1, Dirk Saelens et al

# Development of DESTEST



- Two tracks are working in parallel
  - Focus on **building** models: Ina De Jaeger
  - Focus on **energy system** models: Felix Bunning
- Common Exercises
  - Start with description of (very) simple neighborhood of buildings
  - Use this information to design thermal network(s)

# Start simple: 16 identical buildings



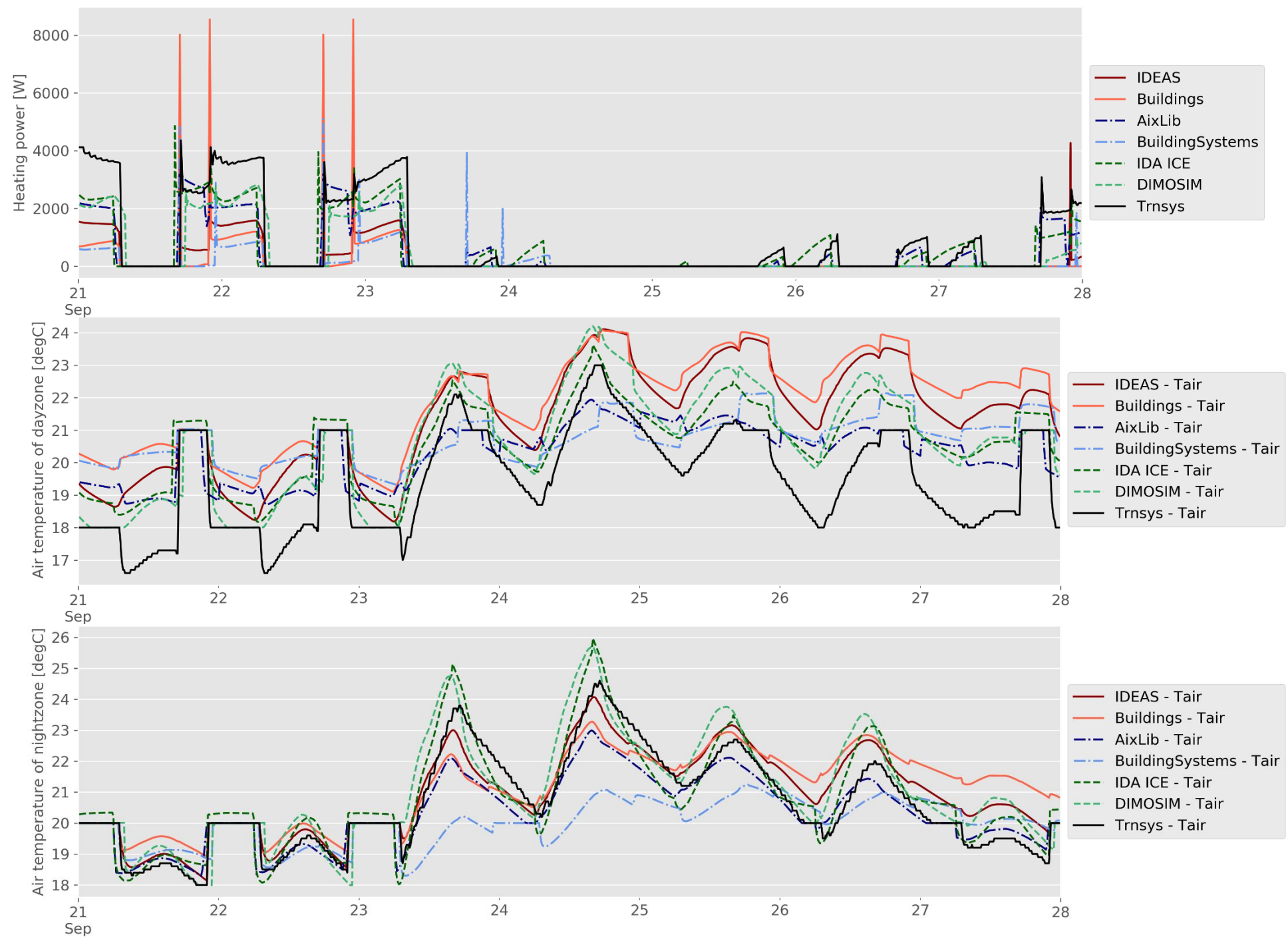
- Single-family dwelling of 1980
- Thermal performance based on TABULA project for Belgium
- Two-zone model (day zone and night zone)
- Standard occupant (ISO 13790)
- Only heat demand for space heating

# Participants

Modelling environment	Modeler	Affiliation of participant
Modelica IDEAS	Ina De Jaeger	KU Leuven / VITO / EnergyVille
Modelica Buildings	Alessandro Maccarini	Aalborg University
Modelica AixLib	Michael Mans	RWTH Aachen
Modelica BuildingSystems	Haris Shamsi	UCD Dublin
IDA ICE	Øystein Rønneseth, Igor Sartori	Sintef Norway
DIMOSIM	Enora Garreau	CSTB
Trnsys	Enora Garreau	CSTB

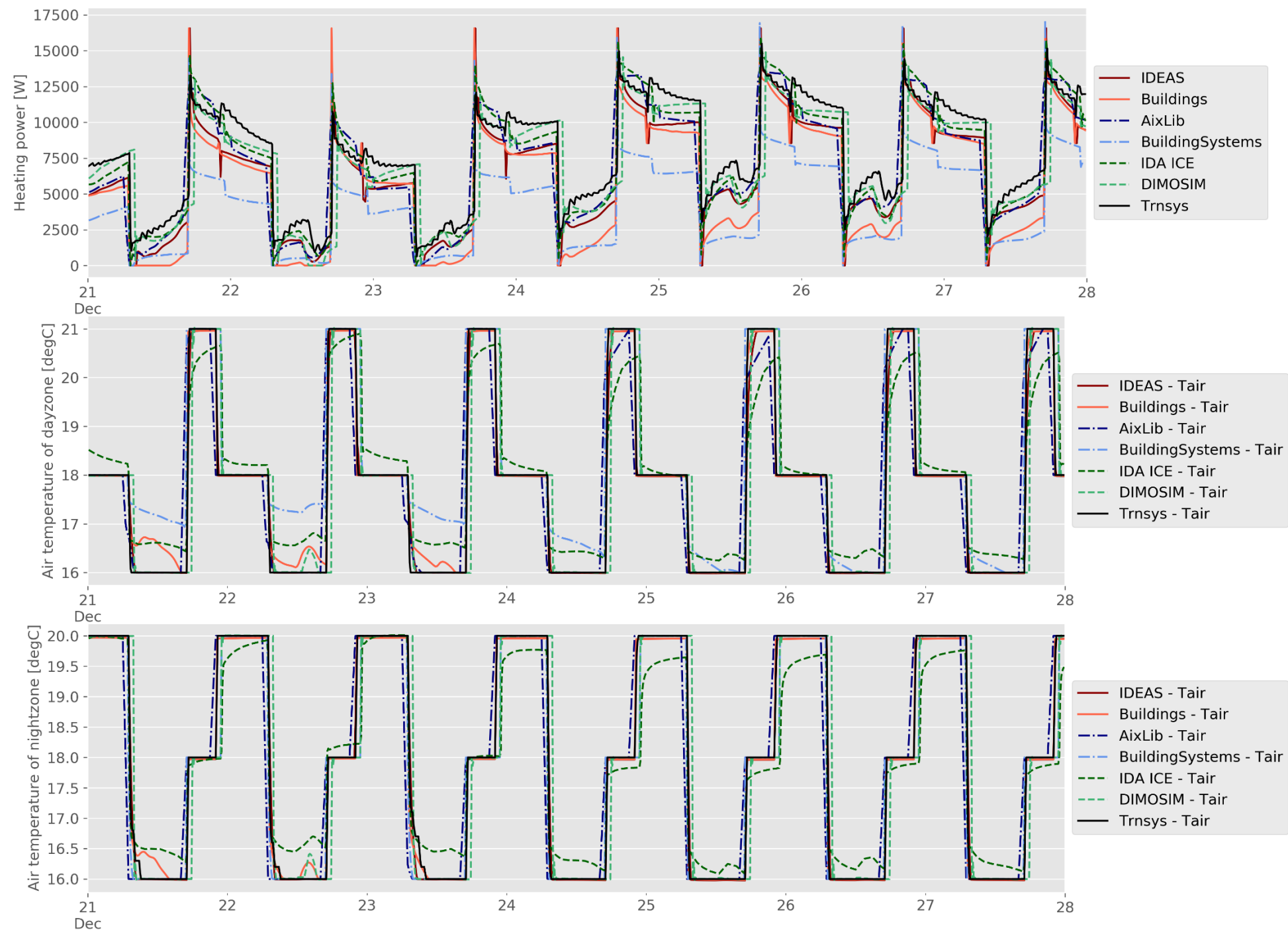


# Profiles: September

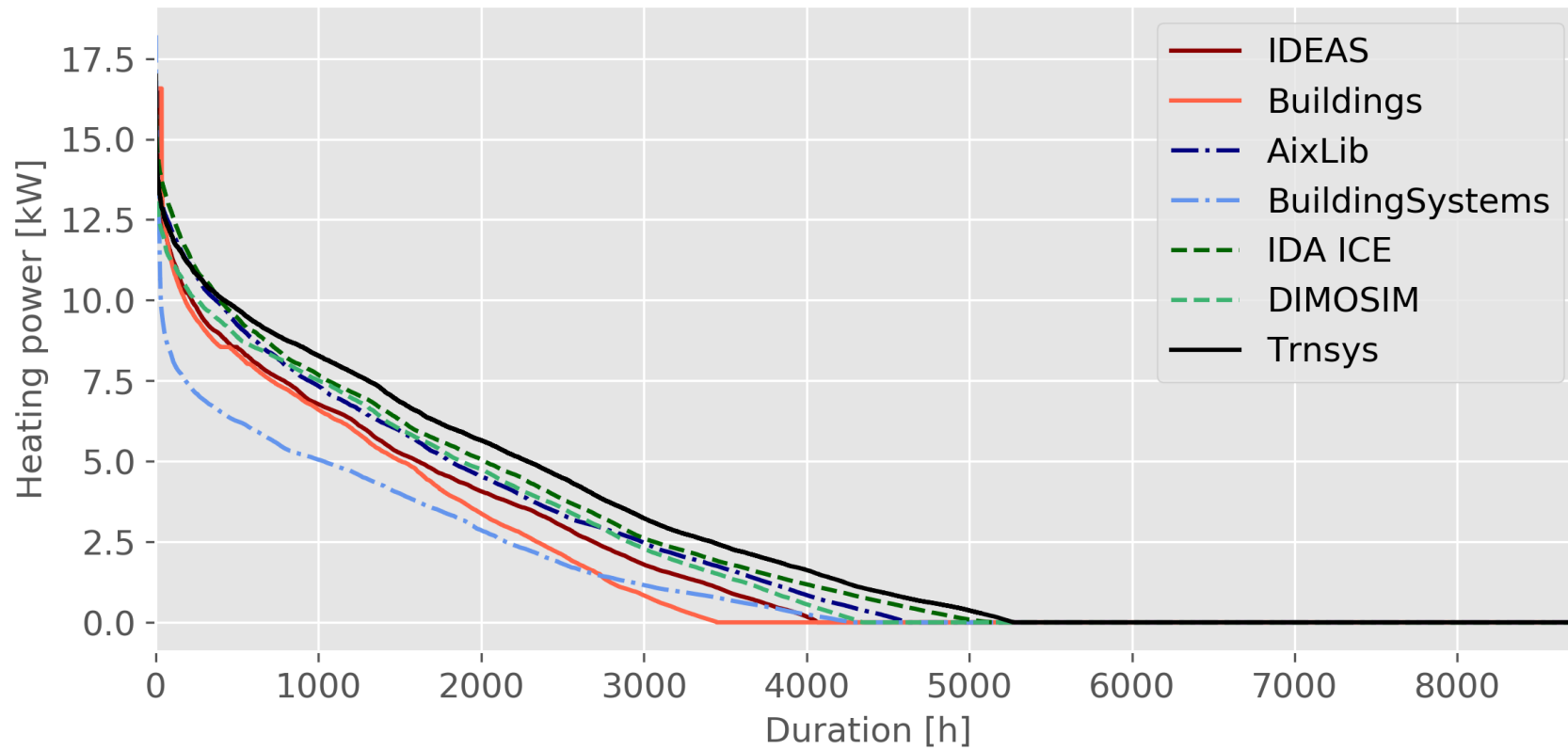




# Profiles: December

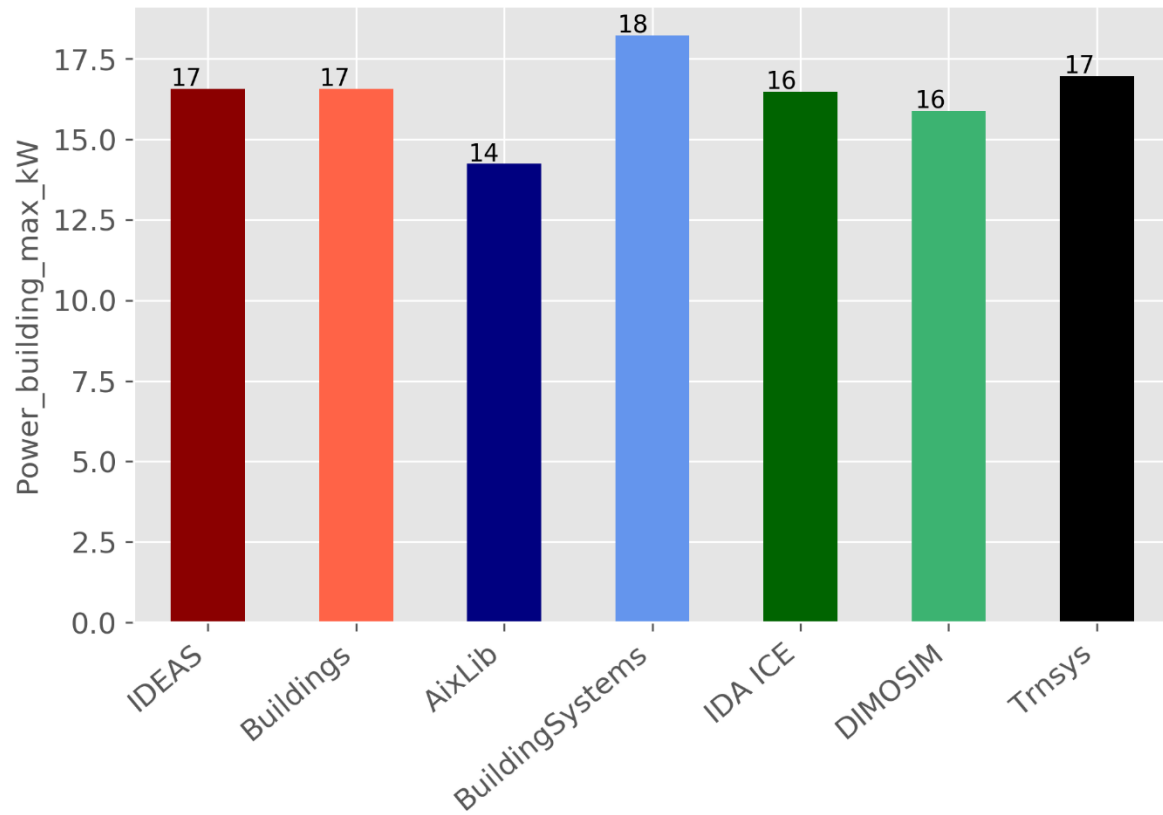


# Load duration curve

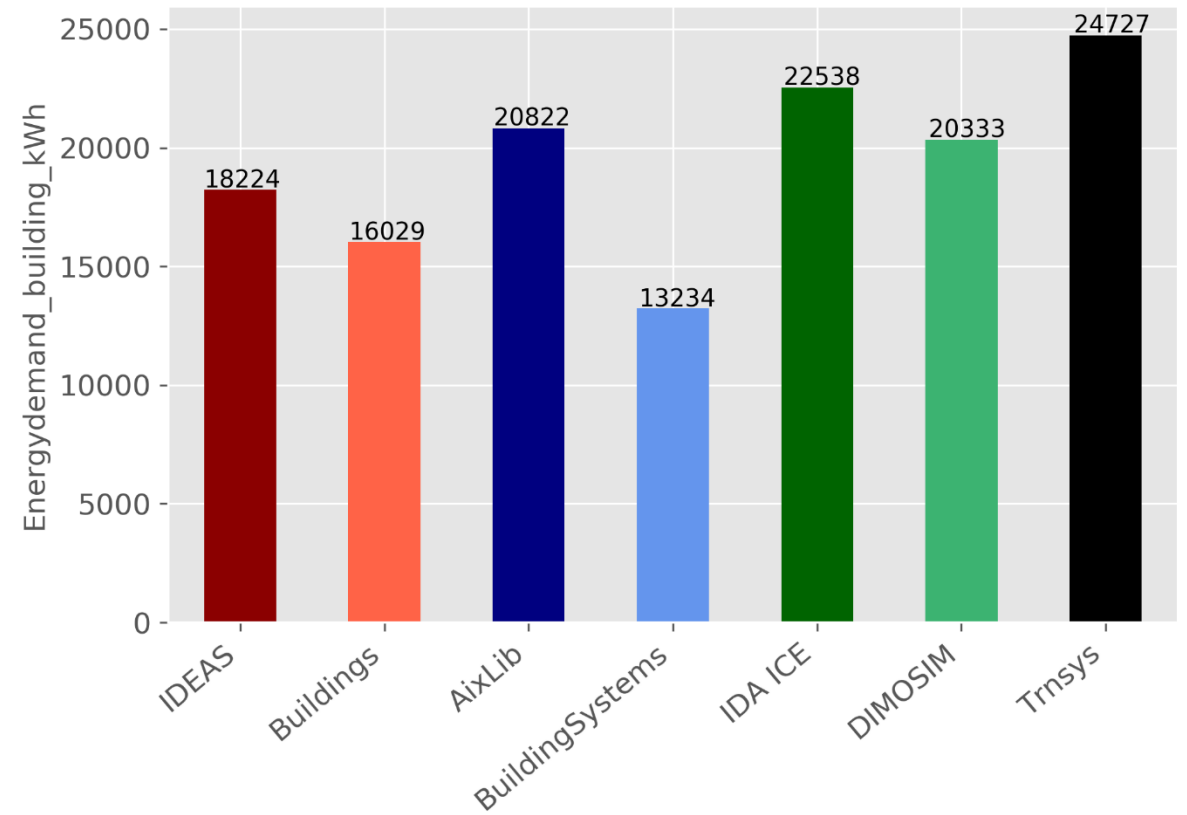


# Peak power & energy demand

## Peak power



## Annual energy demand

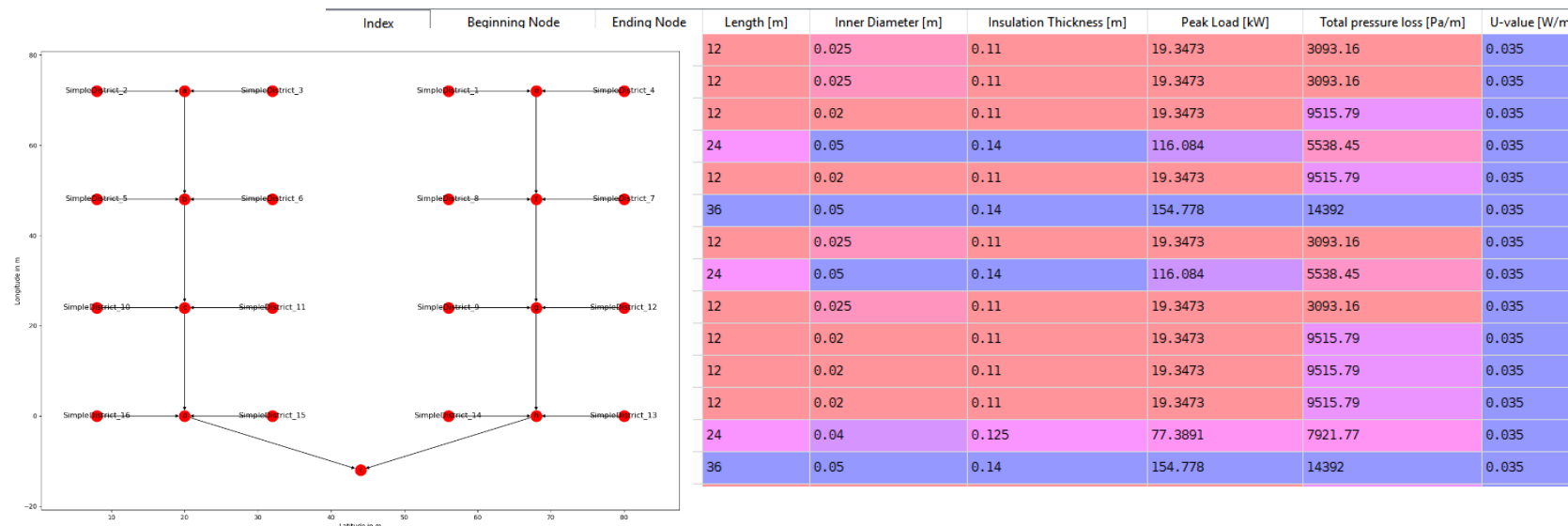
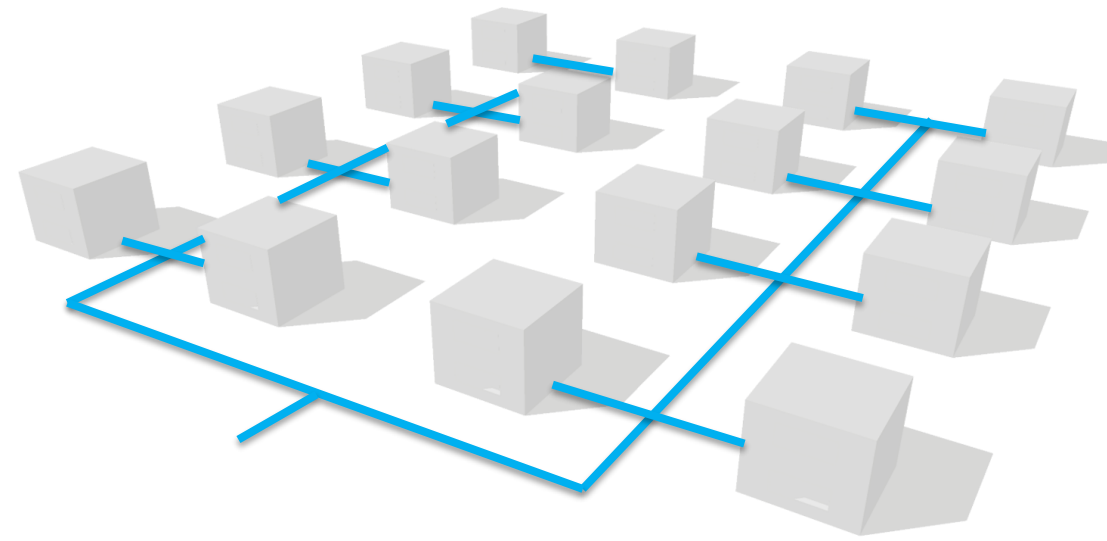


# Next steps

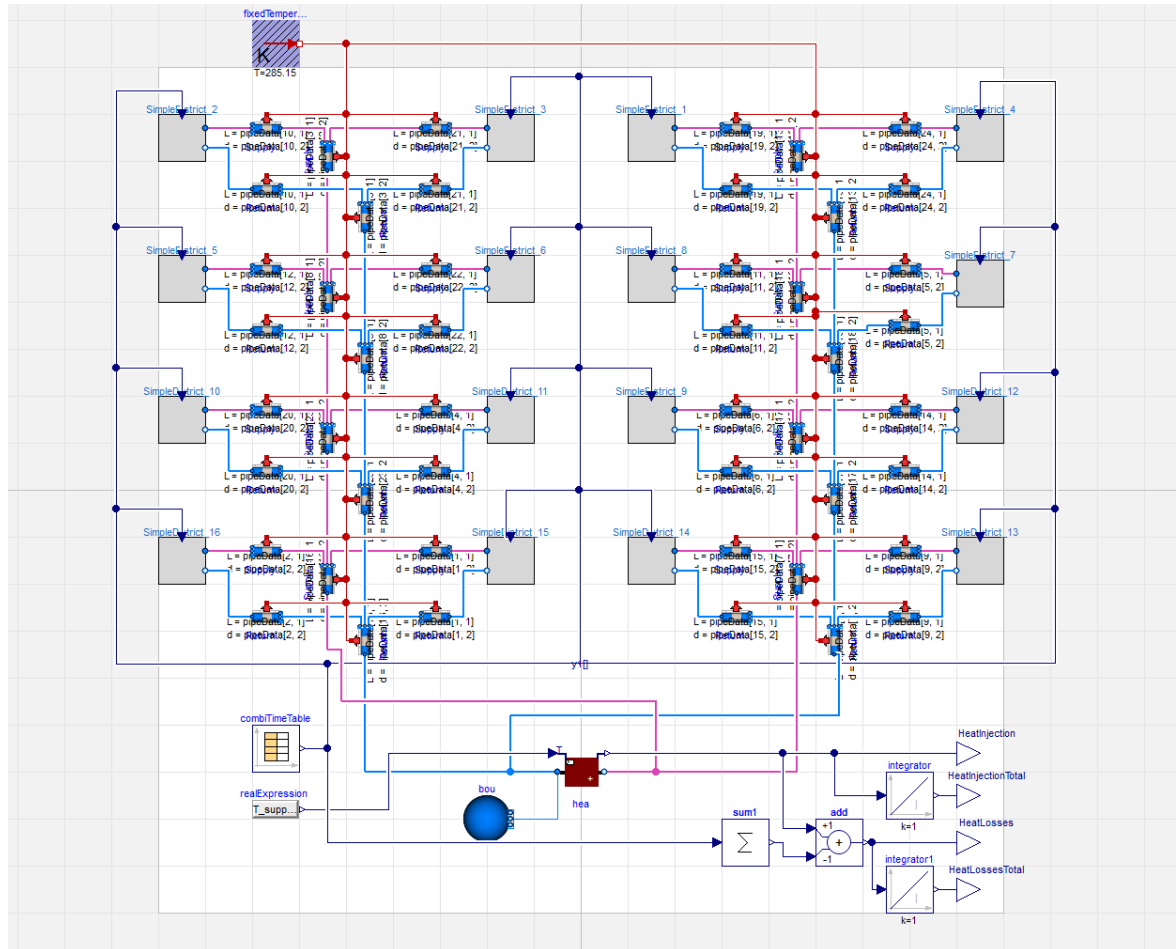
- Replace nodes with other loads
  - Automated model generation with TEASER
    - Other types of single-family dwellings
    - Apartment blocks
    - Office buildings
  - Usage of different building standards and countries
  - ...
- Change network layout, increase of complexity

# NETWORKS: From building load to district heating system

- Building loads stored on github
- Derive network from loads:
  - Fix topology
  - Python: Automatically generate pipe dimensions, write to csv file



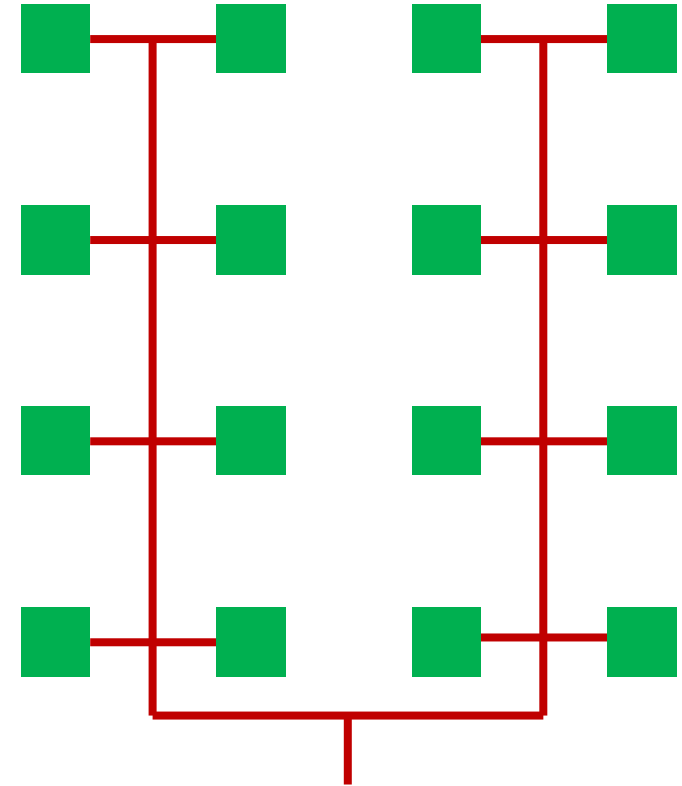
# Modelica model generation



- Modelica: automatic parametrization from csv file
- → automated process from building energy loads to simulation-ready Modelica model

# Base for common exercise

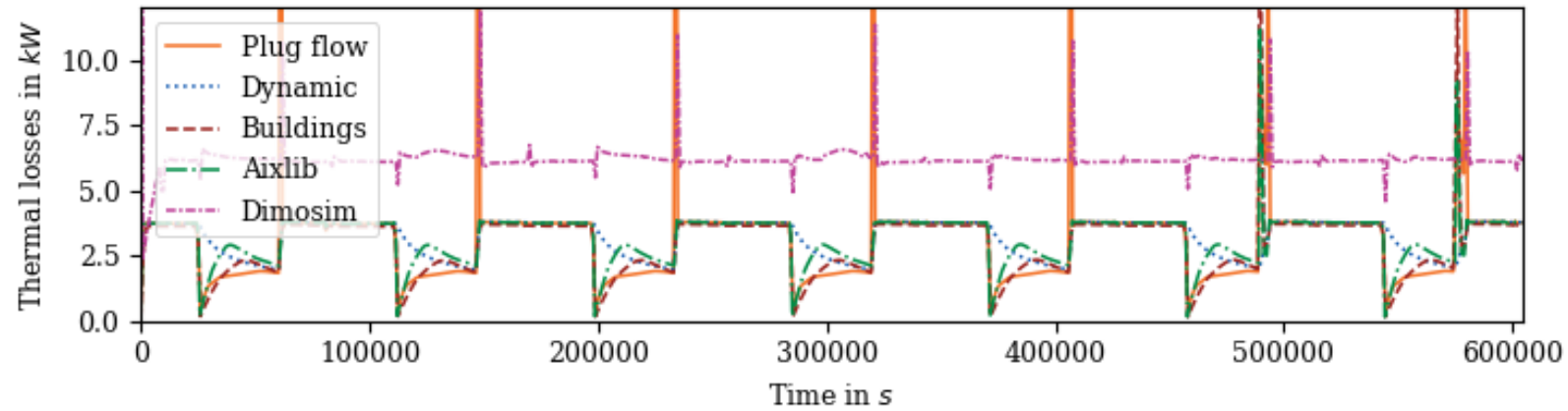
- Defined building layout and radial network layout
- Comparison of heat losses for different models
- Used models:
  - Plug-flow pipe (IBPSA library)
  - Dynamic pipe (Buildings library)
  - Dimosim (CSTB)



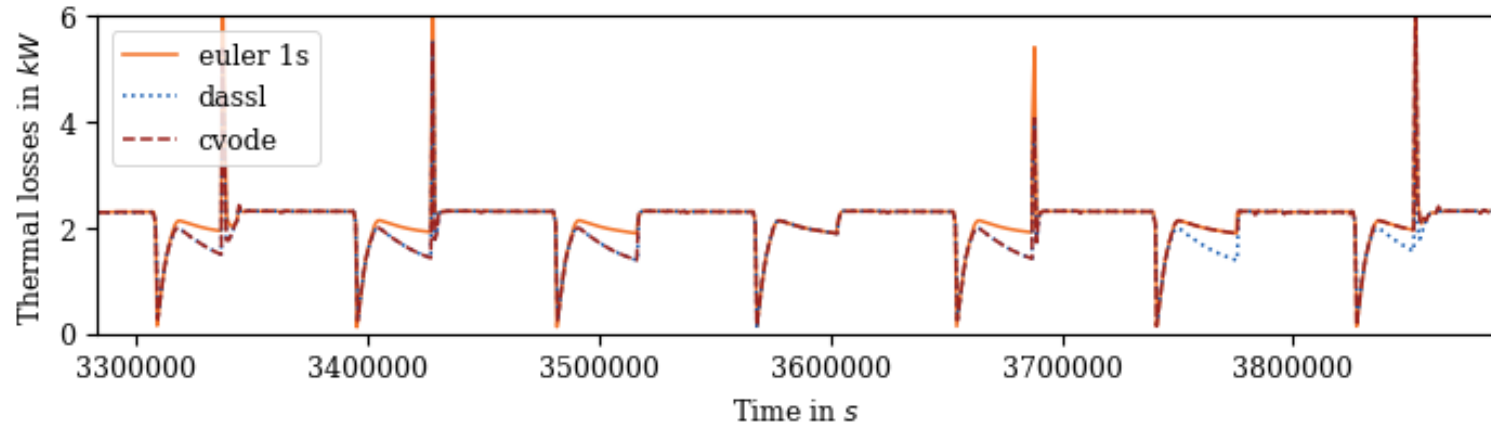


# Results

- Heating losses



- Numerical issues



# Ongoing work

- Preparation of template to define new cases in a structured and coherent way
- Definition of new cases:
  - Different network typologies
  - Combined heating and cooling
  - Use of different central plant models and substation models
- Investigation of numerical issues

# Plan for breakout sessions

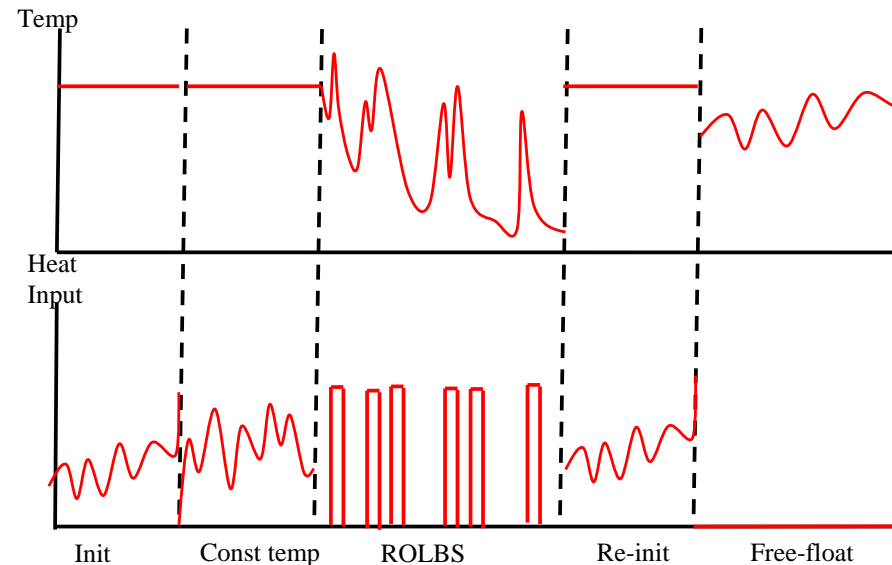
BS 1-1	Topic 1.1
Chair: Felix / Ina	Feedback on Network Modeling
	Feedback on Building Demand Modeling
BS 1-2	Topic 1.2
Chair: Ina	Feedback on Building Demand Modeling
	Quantifying Uncertainty Propagation For District Energy Demand Using Realistic Variations On Input Data
BS 2-1	Topic 2.1
Chair: Alessandro	Joint 1.1 and 3: DHC substation and central plant models
	Development of template for the collection of application case studies
	Automated model generation and simplification for district heating and cooling grids
	Update on Modesto
BS 2-2	Topic 2.2
Chair: Dirk	Definition of Next common exercise: pitches
	Summary of ideas in BS2019 paper
BS 2-3	Topic 2.3
Chair: joint session	DESTEST parallel session with 1.1 [Numerics w. Felix, Michael Mans, 10 minutes]
	Felix & Michael Mans: opportunity to discuss solver issues
	Optimal control (explore collaboration with 1.2)
	Development of simplified model for central plant in district heating models (WP 1.1)
	models for substations (WP 1.1)
BS 2-4	Topic 2.4
Chair : Dirk	Definition of Next common exercise: continued + conclusion
	planning of CE
	definition of CE
	commitments
	planning of joint publications

# IEA Annex 71: Whole model empirical validation of a full-scale building including building service equipment and synthetic users

## → VALIDATION EXERCISE

Detailed specifications and the measured climate data will be released to modelling teams soon (spring 2019)

Participate? Contact Paul Strachan (or me): <paul@esru.strath.ac.uk>





# IBPSA Project 1

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Dirk Saelens

Aachen expert meeting – Wrap-up breakout sessions – 2019.04.04

## WP3.1 wrap up

- Finalization and Communication of CE1 results:
  - Reporting existing work
  - What format to communicate results? CityGML, Energy ADE, geoJSON
- Discussion on substation models (with WP1.1)
- Free presentations
  - Automated model generation and simplification for district heating and cooling grids (Michael M.)
  - Update on Modesto (Annelies)
  - Application study cases (Konstantin)



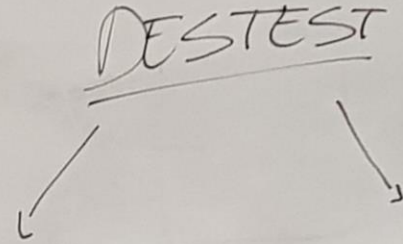
## WP3.1 wrap up

- Discussion on DESTEST future steps
  - Future steps in the demand calculations
  - Future steps in the distribution network modelling
  - Combination of buildings and distribution + system approach
  - Application of DESTEST description,  
also useful for benchmark testing of existing DES simulation tools  
as an emulator for BOPTEST



# WP3.1 next steps

~ 5 months to Rome



## ① Dissemination

- Report / template } 1<sup>st</sup> coord. meet.
- Results (online)
- Description "CityGML" → Michael has a look

## ② Modelling

→ 3 typical buildings (maybe later 5)

↳ single-family dwelling OK

↳ office - small → Michael sends 1<sup>st</sup> proposal

(L) supermarket ? (cooling-dominated) ??? → Wishlist

↳ office - large

→ Variations : \* Occupant : 16 profiles (Ina)

\* old/new :

RURAL

16/16

URBAN

10/16

4/16

2/16

(Enora)

## WP3.1 next steps

~ 5 months until Rome

goals: ① → finish common ex 1 (10% deviation?)

KPIs → T at substation, pressure diff critical  
description (github md file) (1<sup>st</sup> substation  
coordination  
meeting)

② → online comparison for results

③ → pitch individual ideas based on first common ex (2<sup>nd</sup> coordination  
meeting)

↳ agree on 1-2 new common exercises  
→ first results for Rome

## WP3.1 wrap up

- Publication plan
  - Extension of BS2019 paper to full journal paper